FINAL REPORT
of the
MAMMAL SURVEY
on
WILLOW CREEK PRESERVE
Eugene, Oregon

Conducted January, 2006 through January, 2010

by

Judith K. Berg

Presented 31 March 2010
to
The Nature Conservancy
Eugene, Oregon

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All photos by the author

INTRODUCTION

The Willamette Valley is a north-south depression in western Oregon that lies between the Coast and Cascade Ranges and is drained by the Willamette River (Verts and Carraway 1998). Bailey (1936) referred to the Willamette Valley as the Humid Division of the Transition Zone with an average precipitation of 40 inches.

Historically, the lower Willamette Valley was grassy prairies (Bailey 1936); in fact, most of this Valley comprised grassland communities that were maintained through annual burning by the Native Americans who inhabited them (Verts and Carraway 1998). However, when European settlers moved into Oregon, they turned this land into fields for farming (Bailey 1936).

According to Verts and Carraway (1998), sixty-two species of mammals have been recorded throughout the Willamette Valley; however, five species characterize this area: Townsend's mole (*Scapanus townsendii*), brush rabbit (*Sylvilagus bachmani*), Camas pocket gopher (*Thomomys bulbivorus*), gray-tailed vole (*Microtus canicaudus*), and red fox (*Vulpes vulpes*). Each of these five species occurs in the Willow Creek Preserve.

CURRENT PROJECT

The purpose of this project was to conduct a mammal survey in the Willow Creek Preserve. Its results will provide baseline data for future mammalian research.

I conducted this project throughout all seasons of a four year period to determine if there were any variations in speciation or the addition of new

species during this period of time. This was particularly important following periods of burning and mowing sections of the prairie, as well as removal of brush and other vegetation, which, in turn, removed habitat and cover for some species.

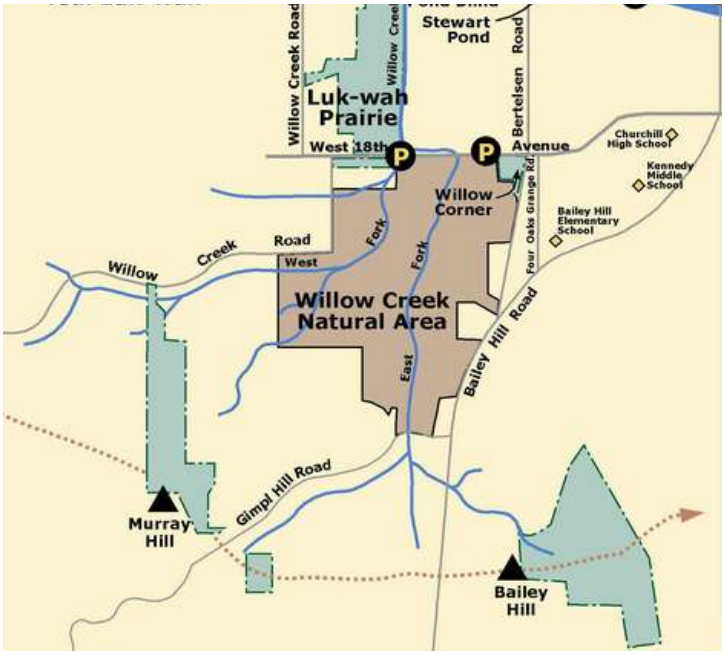
This project was not intended to give population estimates of mammals in the Preserve.

The goal of this project was to determine which *Mammalian Species* in our 508 acre segment of the southern portion of the Willamette Valley are currently using Willow Creek Preserve or have used it in the recent past.

MATERIALS AND METHODS

STUDY AREA

Willow Creek Preserve is a 508 acre site owned by The Nature Conservancy. It is situated in the southern extent of the 2500 acre watershed of the West Eugene Wetlands partnership. This partnership includes local, state and federal agencies, the local community, and The Nature Conservancy.



Key features of Willow Creek Preserve are the East and West forks of Willow Creek, which drain Bailey Hill and Murray Hill, respectively, eventually converge, and form a valuable component of the Amazon Creek watershed in the West Eugene Wetlands.

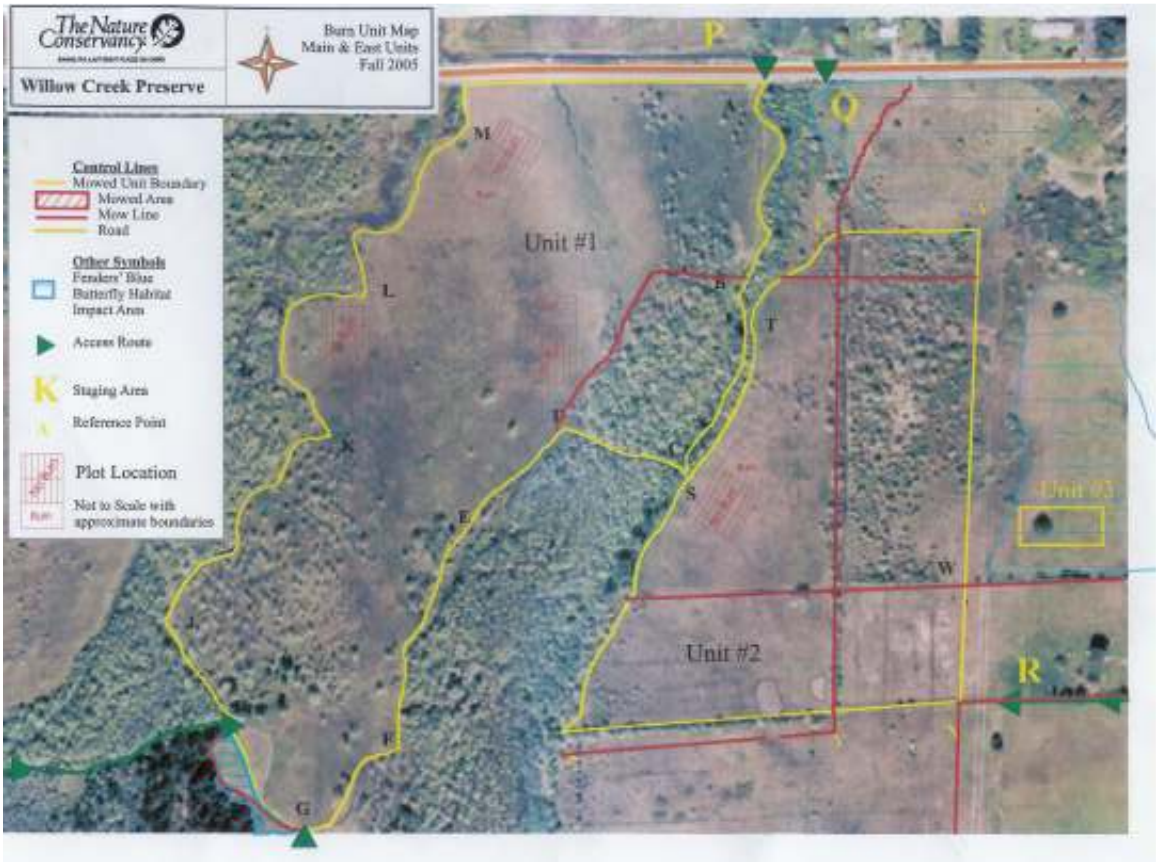
Willow Creek Preserve is considered to be the richest remnant of native wet prairie in the southern Willamette Valley. This Preserve includes wet prairie, upland prairie, Oregon white oak-California black oak woodland, Oregon ash forested wetland, riparian wetland, and forest communities. Thus it provides a diverse array of habitats for *Mammalian Species*. There are over 200 native plants plus several different species of fauna. For details on the flora and non-mammalian fauna, please contact The Nature Conservancy at Willow Creek Preserve.

METHODOLOGY

This mammal survey was conducted employing a naturalistic approach of walking the study site throughout the seasons. Neither telemetry nor live trapping was used. However, two other individuals had conducted live trapping of small mammals (vole-sized species). Gilbert Voss live trapped over an extensive period prior to my project and Kyle Pritchard live trapped throughout a five day period during my project.

A systematic approach to cover all areas of particularly Unit 2 was conducted. Two years into the project Unit l was added to this project, but not precluding Unit 2. Locations near and areas above The Nature

Conservancy office were not covered by me since other people were there on a daily basis and able to report mammals seen.



My project began in January 2006 and extended through January 2010. Two months prior to beginning this project, a preliminary period was spent to become familiar with the study site (and get my feet wet, literally). Ninety-eight days were spent in the field with an average of four hours per day.

When walking the study site, all pertinent information was documented into a daily log. Measurements and photographs were taken of all encountered signs of mammals, and when found, live and dead animals. The date, time, weather conditions, area covered, habitat, time spent in the field, and any known extraneous variables were recorded. Specific signs documented and photographed included tracks, scat, scrapes, slides into and up from waterways, river otter rolling area, beaver dams, den sites, mounds of fossorial species (and related information), trails through grasses of voles and deer mice, debarking activities, and anything else indicating mammal activity.

PROCEDURE

Most carnivore scat (except raccoon because of potential parasitic roundworm (*Baylisascaris procyonis*) that can live in their intestine) was collected. Each scat was individually bagged in pint-sized baggies and labeled with information including date, location, scat condition, and substrate where found. Information recorded in my daily log included measurements and photograph identification so all input could be coordinated.

Scats were taken home and air-dried for future analysis. These dried carnivore scats were broken apart and hard portions (bones, teeth, mandibles, etc.) removed. The removed portions were placed in individual containers and cleaned in a solution of water and denture cleaner (Polident: GlaxSmithKlein). After two to four days, the hard remains were washed through a fine-wired sieve, then placed in individual containers for analysis. (The denture cleaner and water method was learned when visiting an otter researcher in 1996, Paul Yoxon, on the Isle of Skye, Scotland. I used this procedure for the scat analysis portion of my river otter project in the Rockies (1999) and it was later used by Crait and Ben-David (2006) for cleaning otter scat.)

Skeletal material from the cleaned scats, which covered the first 2 years of my project, was examined by Dave Bontrager (Mammalogist and Ornithologist). Bontrager (2008) stated that since the specimens came from scat, the skulls were largely disintegrated which made identification difficult. However, using his dissecting microscope along with information on voles in Verts and Carraway (1998), he was able to compare jaw and molar size along with distinguishable characteristics of the crowns of molars to determine genera, *Microtus*, and down to species for most.

Each of the hundreds of photographs was evaluated for each date taken. Pertinent information from field notes was added to photo information to be used in verification of all mammal signs, particularly tracks and scat. These verifications were made using primarily the field guides of Elbroch (2003); Murie (1974); and Rezendes (1992).

EDUCATIONAL PROCEDURE

Representatives from mammals at the Preserve in the form of scat, cleaned skulls and skeletal parts, obtained skulls and photos for posters were used for educational purposes.

RESULTS

SIGNS OF MAMMALIAN SPECIES

SCAT

Fifty-four carnivore scats were collected and identified to species during the four year period (January 2006 – January 2010). Seventy-six percent were determined to be from the following species:

Coyote (*Canis latrans*) 37%
Red Fox (*Vulpes vulpes*).... 12%
Bobcat (*Lynx rufus*) 27%

The remaining 24% of collected carnivore scats were from river otter (*Lontra Canadensis*), mink (*Mustela vison*), feral cat (*Felis domestica*), and, inadvertently collected, raccoon (*Procyon lotor*).

Coyote scat was evenly distributed over each of the four years. Bobcat scat increased during 2007 then decreased during the next two years. River otter and mink scats were found only during March 2007.

Obviously, not all scats of all species were found in my study site. However, when discovered, they were collected. Canine scat containing hair and bones lasts the longest in the wild (Elboch 2008). The main purpose for collecting and breaking down carnivore scat was to determine what carnivores were feeding upon.

CARNIVORE DIET

Twenty of the three major canine scat breakdowns (coyote, red fox and bobcat) were analyzed by Dave Bontrager. These were scats from the first two years of the project. All of these scats were determined to contain the genus, *Microtus*. Nine contained *Microtus canicaudus* (gray-tailed vole), six contained *Microtus Townsendsii* (Townsend's vole) and five were from unknown *Microtus*. Also, larger bone fragments were found in some of these scats. Bones from a young bird turned up in one scat and toe tips from a mole were found in another. I also found some hard parts of fruits (seeds, pits, and stems) in carnivore scat during the fruit season.

Even though I did not analyze the remaining twenty-one canine and feline scats from those I collected and broke down to a species level, bones and hair from small rodent species continued to be prevalent.

The river otter and mink scats contained crayfish parts. This is corroborated by evidence of crayfish I found (parts of specimens and typical burrows with two entrances in under-water banks during wet seasons) in sections of the

West Fork of Willow Creek. I compared scat I had retained from my otter project – which also contains crayfish parts – with the current scat as to size, shape, and overall appearance for further corroboration.

TRACKS OF MAMMALS

Eighty-seven tracks were documented and photographed. Species whose tracks were identified are coyote, red fox, bobcat, raccoon, black-tailed deer, and small rodents. Empirical measurement was used in the identification of tracks, except for the small rodents. Deer tracks were not always recorded, as they were so prevalent in my study site. I found one likely mountain lion track on the side of a ditch that could not be verified. I also discovered beaver tracks in the bed of a waterway after the waters dried up and I was able to climb around in the area.

Determining the difference between coyote and domestic dog tracks is often difficult unless one sees a trail of the animal walking (Rezendes 1992). These tracks were measured and studied in the field and again from my photographs, where I could compare them with several good mammal track guides. Actually, most of the domestic dog tracks I found were larger than those of the coyote and closer to the size of a gray wolf, thus possibly from an Alaskan malamute (Murie 1974).

Prior to my project, tracks of black bear (*Ursus americanus*), mountain lion (*Felis concolor*), and elk (*Cervus elaphus*) were verified by qualified individuals.

OTHER MAMMAL SIGNS

Mole (*Scapanus*) and gopher (*Thomomys*) mounds were seen, measured, and photographed throughout the years of my project. Please refer to my photos and discussion of species for details of these genera.

Early in this project I discovered and measured several volcano-shaped and chimney-shaped mounds of soil in the preserve. Holes leading into the mounds at ground level measured two to three inches in diameter. Because vegetation was growing from most of these mounds, they were considered to not have been recently constructed. The heights of these mounds varied from 10 to 15 inches. The Camas gopher (*Thomomys bulbivorus*) constructs chimney mounds of mud during the wet season in Oregon (Verts and Carraway 1998). They range in height to ten inches above ground level. They are constructed to remove mud from their main tunnels to admit air for drying out their tunnel system; therefore, they have an unplugged hole in the top (Verts and

Carraway 1998). The Townsend's mole (*Scapanus townsendii*) also constructs volcano-shaped mounds when excavating their underground tunnels that can reach up to twelve inches in height (Bailey 1936). One or both of these species – or another unknown species – may have originally constructed these mounds. According to Vaughan (1972), abandoned mounds are used by various *Mammalian Species* and as critical retreats for certain reptiles and amphibians. Unfortunately, work crews destroyed these large mounds in October 2006.

Normal sized mole mounds – with an average height of 7 inches and average width of 17 inches – that were measured throughout this project were definitely those of the Townsend's mole (*Scapanus townsendii*) (Sheehan and Galindo-Leal 1997). This species was also verified through two specimens.

Winding down my project at the end of 2009, I concentrated on recent activity of the proposed Camas pocket gopher in one segment of the Preserve near the beginning of the East Fork trail. This concentration, which began at the beginning of the wet season (October 2009), was motivated by the listing of this species on the IUCN Red List of Threatened Species (Linsey and Hammerson 2008). The holes I measured in these gopher mounds ranged from 2½ to 3½ inches in diameter and from 3 to 4 inches in height, with the earth plugged 7 to 10 inches deep into the holes. One particularly large mound I followed since January 2010 reached a length of 66 inches and a width of 44 inches at its widest point.

Beaver activity was documented on the West Fork of Willow Creek during the wet seasons throughout the project. Then, two years into the project, beaver activity was also observed on the East Fork of Willow Creek during the wet season. This was the period I incorporated Unit 1 into my study site. In addition to teeth marks on the ends of branches, I watched as the lower portion of a tree was "chipped away" over time, discovered wood chips with teeth marks, and documented their bank dens and dams. As with the Camas gopher, I discovered recent activity of the beaver in the East Fork of Willow Creek and near 18th Street early in 2010. Please see my photos of beaver influence during these seasons in the discussion.

Other mammal signs I discovered include vole trails, potential mink bank dens, and bank dens of nutria. There were other potential den sites in the forested areas, but without seeing the animals or finding other signs, they could not be determined as to species.

I documented river otter slides (based on size) into and up from waterways and a rolling/grooming area at the same time as their scat was discovered. Other slides were possibly from beaver and/or nutria. Deer, among other species, also walk (or may slide) into the water when drinking and traveling. Verification could be determined only through other signs, particularly tracks. Infrequent scrapes were found near scat.

LIVE MAMMALS

I saw very few live species. Those I did see include black-tailed deer (*Odocoileus hemionus*), brush rabbit (*Sylvilagus bachmani*), and feral cats (*Felis domestica*). TNC staff observed a long-tailed weasel (*Mustela frenata*) near the TNC office and Gilbert Voss reported the western gray squirrel (*Sciurus griseus*), California ground squirrel (*Spermophilus beecheyi*) and a chipmunk (*Tamias*). A black bear (*Ursus americanus*) was observed in Fall 2009 near portions of the Preserve. One other species without other verification was determined through live trapping (*Peromyscus maniculatus*).

MAMMAL SPECIMENS

I either found or was given specimens from the preserve which I verified to the species level. These animals include opossum (*Didelphis virginiana*), Townsend's mole (*Scapanus Townsendsii*), wandering shrew (*Sorex vagrans*) gray-tailed vole (*Microtus canicaudus*), Townsend's vole (*Microtus Townsendsii*), and nutria (*Myocastor coypus*).

MAMMAL SPECIES OF WILLOW CREEK PRESERVE

Twenty-five species were verified as occurring in the Willow Creek Preserve. This information is based on the results from my survey and observations from the Eugene staff of The Nature Conservancy.

Order Didelphimorphia (Marsupialia)
- Family Didelphidae
  - *Didelphis virginiana* – Opossum

Order Insectivora
- Family Talpidae
  - *Scapanus townsendii* – Townsend's Mole
- Family Soricidae
  - *Sorex vagrans* – Wandering Shrew

Order Lagomorpha
- Family Leporidae
  - *Sylvilagus bachmani* – Brush Rabbit

Order Rodentia
- Family Sciuridae
  - *Sciurus griseus* – Western Gray Squirrel
  - *Spermophilus beecheyi* – California Ground Squirrel
  - *Tamias* sp. – Chipmunk
- Family Muridae
  - *Microtus canicaudus* – Gray-tailed vole
  - *Microtus townsendii* – Townsend's vole
  - *Peromyscus maniculatus* – Deer mouse
- Family Geomyidae
  - *Thomomys bulbivorus* – Camas Pocket Gopher
- Family Castoridae
  - *Castor canadensis* – Beaver
- Family Myocastoridae
  - *Myocastor coypus* – Nutria (coypu)

Order Carnivora
- Family Canidae
  - *Canis latrans* – Coyote

Vulpes vulpes – Red Fox

Family Felidae

Felis concolor – Cougar (Mountain Lion)

Lynx rufus – Bobcat

Felis domestica – Domestic (feral) Cat

Family Ursidae

Ursus americanus – Black Bear

Family Mustelidae

Lontra canadensis – River Otter

Mustela vison – Mink

Mustela frenata – Long–tailed Weasel

Family Procyonidae

Procyon lotor – Raccoon

Order Artiodactyla

Family Cervidae

Odocoileus hemionus columbianus – Black-tailed Deer (Mule deer)

Cervus elaphus – Elk

DISCUSSION

Twenty-five *Mammalian Species* were determined to occur within Willow Creek Preserve. This determination was based on direct observation of a species, specimens found in the Preserve, signs left by the animal, or evidence recovered during breakdown of collected carnivore scat (which also included specimens and live-trapping of same species). Some species reside there all months of the year; other species move through during the wet season; and still others have large home ranges which include the Preserve. Whatever the case may be, these twenty-five species are documented as having occurred in this Preserve.

LIVE MAMMALS

I observed black-tailed deer (*Odocoileus hemionus*), brush rabbit (*Sylvilagus bachmani*), and feral cats (*Felis domestica*). TNC staff saw a long-tailed weasel (*Mustela frenata*) near their office. Gilbert Voss, a former member of the staff, reported observing western gray squirrel (*Sciurus griseus*), California ground squirrel (*Spermophilus beecheyi)*, and chipmunk (*Tamias sp*.) near the office.

Live-trapping by Gilbert Voss verified Townsend's vole (*Microtus townsendi*), gray-tailed vole (*Microtus canicaudus*), and deer mouse (*Peromyscus maniculatus*). Kyle Pritchard later did some live-trapping and verified the last two species.

MAMMAL SPECIMENS

Specimens I discovered in Unit 2 of the Preserve were the remains of opossum (*Didelphis virginiana*), nutria (*Myocastor coypus*), wandering shrew (*Sorex vagrans*), and gray-tailed vole (*Microtus canicaudus*). Two specimens found by TNC staff and verified by me were Townsend's mole (*Scapanus townsendii*) and Townsend's vole (*Microtus townsendii*).

MAMMAL SIGNS

TRACKS

Tracks left by mammals were not always easy to find through the vegetation. I increased my time in the field during the rainy season to try to find muddy locations to look for tracks. Sometimes human tracks wiped out all or portions of a track, adding to the difficulty in determining species. During summer, when sections of the West Fork of Willow Creek were dry, I was able to find some tracks embedded in the bottom of the stream bed. Other signs such as bank dens, dens under rooted trees, and beaver signs were also discovered during the dry season when I could climb in and around the stream beds.

Tracks I found in the Preserve were from black-tailed deer (*Odocoileus hemionus*), raccoon (*Procyon lotor*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), bobcat (*Lynx rufus*), beaver (*Castor canadensis*), and small rodents (species determined by other means). Prior to the beginning of my project, TNC and WREN staff members verified tracks of elk (*Cervus elaphus*), mountain lion (*Felis concolor*), and black bear (*Ursus americanus*). I also found a potential mountain lion track during my project and was given information about a black bear moving around in the Preserve area. These three species, although rare, are still included in the mammal species of Willow Creek Preserve.

SCAT

Canine scat containing hair and bones lasts the longest in the wild. The hair contained in these scats helps protect the innards of the animal from bones with sharp edges (Elbroch 2008). I can attest to the fact they were also very hard to break apart. Canine scats were usually found at trail junctions where a deer trail crossed a human trail and/or in the middle of a trail. This is typical wild canine behavior (Rezendes 1993).

The breakdown of canine and of bobcat scat showed that these carnivores were feeding primarily on voles (*Microtus sp*.). The importance of this diet in keeping down the small rodent population is explained in the major species section of this discussion.

River otter (*Lontra canadensis*) and mink (*Mustela vison*) scat were discovered in early 2007. These scats were determined to be from a diet of crayfish, which are known to occur in the west fork of Willow Creek.

I also found scat that I verified to be nutria (Myocastor coypus), raccoon (*Procyon lotor*), black-tailed deer (Odocoileus hemionus), feral cat (*Felis domestica*), and small rodents.

OTHER SIGNS

Signs of mammals not mentioned above included mounds of moles (*Scapanus sp.*), mounds of gophers (*Thomomys sp.*), and trails of voles (*Microtus sp.*).

DETAILED INFORMATION ON SPECIES MOST PREVALENT AND/OR OF GREATEST IMPACT FOUND IN WILLOW CREEK PRESERVE

Order Insectivora
Family Talpidae
***Scapanus townsendii* – Townsend's Mole**

The Townsend's mole is found in locations west of the cascades, including areas of the Willamette Valley (Maser 1998), which was also the case historically (Bailey 1936). They most often occur in moist meadows, lowlands, prairies, and shrub habitats. Two dead moles found in the preserve during this project were identified by the researcher as being of the above species.

The Townsend's mole is a solitary fossorial species, spending most of its time underground. Researchers in Oregon discovered that above-ground activity occurred primarily at night during juvenile dispersals (4 to 6 months of age) and was considered the primary annual surface activity of this species (Giger 1973; Kuhn 1966). Mating of Townsend's occurs in February with a litter of 1-4 young born in March.

Mounds of moles have been observed throughout this project. When I was fortunate enough to see recently excavated tunnels, the two toned surface soil of the exposed mound is a clue to the depth at which they are digging. Moles use their front paws when excavating, then push soil back with their rear feet. Their method of digging is called humeral-rotation that involves a powerful rotation of the humerus (Hopkins and Davis 2009). Their strong foreclaws, plus humerus and other skeletal features, were detected during the examination of my dissected specimens.

During their excavation behavior, moles construct extensive tunnel systems from 6 inches to 10 feet deep, depending on soil conditions (Carraway, et al 1993). Deeper tunnels are used most frequently, with surface tunnels used primarily during foraging (Yates and Pedersen 1982). Nursery nests are often found in slightly elevated land areas in

Oregon due to rainfall during the mole's nesting period. These nursery nests occur beneath, or within three feet of, a large mound of earth, sometimes called a fortress (Gorman and Stone 1990), with other smaller mounds nearby (Maser 1998). These moles are good swimmers and may dig shallow burrows following an upward slope of land ahead of rising waters rather than traveling above the surface of the ground (Maser 1998).

The diet of Townsend's mole is primarily earthworms, insect larvae, and insects, but they will also feed on other invertebrates. An examination of the stomachs of 308 individuals of this species in the Willamette Valley discovered that about 70% of their food remains were from earthworms and their cocoons, with the remainder being insects, insect larvae, centipedes, and slugs (Verts and Carraway (1998).

BENEFICIAL – This species is beneficial because they aerate and mix soil layers during their tunneling behaviors. They also eat a significant number of insects and other invertebrate pests (Carraway, et al 1993).

Order Lagomorpha

Family Leporidae

***Sylvilagus bachmani* – Brush Rabbit**

Two individuals were observed on two different occasions while conducting this project. As their common name implies, they use brushy habitats in western Oregon. According to Maser (1998), their breeding season in Oregon runs from mid-February through August, with a litter of from one to six. The gestation period is about 27 days and up to five litters can occur in one year. They feed on various species of vegetation. Although they are known to be a favorite prey of bobcat, which does occur on the preserve, no identifiable rabbit bones were observed in the bobcat scat I found and broke down into its parts. However, there were some pieces of unidentifiable mammal bones. Research conducted near Corvallis found this species to have a

strong homing instinct, with their home ranges extending from 35 to 306 feet for males and 30 to 233 feet for females (Chapman 1971).

Order Rodentia

Family Muridae

***Microtus canicaudus* – Gray-tailed Vole**

This researcher found a fresh specimen, portions of sculls and mandibles (teeth) during carnivore scat analysis, and signs of this species on the preserve. Two other individuals also discovered them through live-trapping (Voss; Pritchard).

Historically, this species ranged through the Willamette Valley and areas east of the Cascades. They inhabit fields, pastures and grassy areas, making their tunnels through the grass (Bailey 1936). Their range and habitat continues to be the same today (Maser 1998), with a preference for grassy meadows and prairie habitat (Verts and Carraway 1984; Getz 1985). They feed on the green vegetation where they reside, which is primarily grasses and clover, but also wild onion and false dandelion (Maser 1998). They construct runways (tunnels) through the vegetation and may also use subterranean tunnels of other species (Verts and Carraway 1987). Runways through grasses have been observed on the preserve.

This species breeds throughout the year with four to five young born after a gestation period of 21 to 23 days. They have been known to breed at less than one month of age; however, there is a high mortality rate during their first month of life (Verts and Carraway 1987).

CONCERNS – One major concern at the preserve is the vole cycles and their affect upon the vegetation. Boyd and Blaustein (1985) suggest that familiarity, kin recognition, and inbreeding avoidance may play important roles in the population cycles of this species. When there is a low dispersal rate of the young, reproduction decreases. There must be immigration of non-familiar individuals in the area for population growth (Boyd and Blaustein 1985). Predation by carnivores can help prevent this successful immigration . With the help of Dave Bontrager and his dissecting microscope, microtine teeth (from their mandibles), along with many bones from their limbs and bodies, were found in my carnivore scat breakdowns. According to Pearson (1985), carnivore

predation was found to be an essential component of the multi-annual microtine cycle. Whereas raptors, which also feed upon voles, leave when their prey numbers become scarce, carnivores remain. Therefore, they play their important role both during and following the decline by depressing the population to extremely low levels and delaying its recovery. During each year of my project, the major prey items found in carnivore scat were the remains of voles.

***Microtus townsendii* – Townsend's Vole**

Evidence of Townsend's vole was also found in my carnivore scat breakdown, thanks also to Dave Bontrager. In December 2009, I was given a fresh specimen from the Preserve, which I identified as a Townsend's vole. Gilbert Voss also discovered this species in the preserve through live-trapping. They are known to occur in our area, as well as other locations west of the Cascades (Verts and Carraway 1984; Maser 1998), which corroborates the historical distribution (Bailey 1936). This species prefers a wetter habitat compared to the gray-tailed vole. They reside in moist meadows along streams, pond banks, and ditches (Verts and Carraway 1984), and in habitat which is seasonally arid (Getz 1985). In the Willamette Valley, Goertz (1964) considered them to be primarily a riparian species but found they also reside in areas of dense grass and sedges.

This species feeds on a variety of vegetation, especially tender grassland and marsh flora (Cornely and Verts 1988). Voles have molars which grow throughout their lifetime; therefore, they can feed on more abrasive vegetation.

Nests of this species are balls of dry grass that occur on the ground surface, under protective plant cover, or in underground chambers (Bailey 1936). They can breed throughout the year; age of first pregnancy was determined to be 35 to 80 days, dependent more on body mass than age, however. The mean litter size is four after a

gestation of 21 to 24 days (Cornely and Verts 1988). Males have a home range of about 1000 square yards; females have 400 square yards less. More males than females disperse from their nesting area. Interesting to note is that runways created by these voles may be used by successive generations and can be worn two or more inches deep (Maser 1998).

CONCERNS – The cyclic population of Townsend's vole is also a concern in Willow Creek Preserve. Many factors involving their population cycles have been studied. Taitt and Krebs (1983) suggest that interactions of spacing behavior, predation, food availability, and temporary suitable habitat are factored into the population's multiannual cycles. One experimental study conducted in a cattle field found that when increasing cover for the Townsend's vole by adding straw, their populations increased. Then, when reducing cover by mowing, their populations declined (Taitt and Krebs 1983). Also, predators play their part on this species of vole; I have found them to occur in carnivore scat breakdowns. Recently I found fur remains of two Townsend's voles assumed to be from owl predation. I had seen an owl flying in that particular area on two separate occasions.

VOLE CYCLIC SUMMARY – Based on years of research conducted by various mammalogists as to why there are vole cycles, Krebs (1996) concludes that population fluctuations are based on intrinsic processes involving spacing behavior and extrinsic processes involving predation and food. He states that there are many details of cyclic fluctuations that apply to a specific species and cannot be generalized across all species of a family. I have tried to bring forth some of the research conducted on our two species of voles; needless to say, research continues on why voles have population cycles!

***Peromyscus maniculatus* – Deer Mouse**

This species occurs in our area and throughout North America (Kays and Wilson 2002). They were discovered on the preserve via live-trapping, previously by Gilbert Voss and more recently by Kyle Pritchard (2008). They occupy every terrestrial habitat in the wild (Maser 1998). Unlike our vegetarian voles, deer mice are omnivores, feeding on vegetative material plus insects and other invertebrates. They use olfaction rather than vision to find their food (Maser 1998). Reid and Brooks (1994) showed that deer mice broaden their diet to include insects and vegetation to meet water requirements when reduced water is available. An interesting note from an experimental study by Grant (1971) reveals this species suffers from competition with Townsend's vole where they both occur in grasslands.

Deer mice breed throughout the year in the Willamette Valley with litters of three to five (Maser 1998). The average age of first estrus is 48 days with a gestation of 21 to 27 days (Novak 1999). According to Maser (1998), they are a social species with overlapping home ranges that average 4¾ acres for males and 3½ acres for females.

This species uses burrows and runways of other species (such as gophers); they do not excavate their own. They particularly use underground burrows during adverse surface conditions where they can go into a state of torpor. Torpor only lasts from four to nine hours on a daily basis (Hill 1983).

An interesting study by Slade and Crown (2006) showed that deer mice residing in grassland habitats were unaffected by mowing and moved freely through areas which had sparse areas of low vegetative cover. Kaufman et al (1988) found that this species' abundance was greater in burned areas of low vegetative cover than in unburned areas of more cover in tall grass prairies. Even during fire, mortality of this species was low because they moved to underground burrows and their nest temperatures were unaffected. At least during the first year following a burn, the population responded positively to amounts of soil and grasses (food) and negatively to amounts of litter (Kaufman et al 1988).

Family Geomyidae

Thomomys bulbivorus – Camas Pocket Gopher

At this point in time, I am 99% convinced that we have the camas pocket gopher (*Thomomys bulbivorus*) in the Willow Creek Preserve. This species' occurrence is restricted to the Willamette Valley (Verts and Carraway 1987; Maser 1998; Kays and Wilson 2002). According to Maser (1998), the camas gopher resides from the Columbia River south to Eugene in Lane County. From research begun in 1888 (Bailey 1936), the Camas gopher was the only species of gopher found in our area of the Willamette Valley.

This species is IUCN Red Listed as a Threatened Species for 2009; at the present time it is of least concern because its range "probably" includes a few protected areas (Linzey and Hammerson 2008). Its chief threat is habitat altered via urbanization and conversion to intensive agriculture. Locally, in orchards and fields, this species is regarded as an agricultural pest and is subject to attempted eradication through poisoning and trapping. Based on the recovery of populations subject to trapping, Verts and Carraway (1998) concluded that this species can recover rapidly from periods of high mortality.

Mazama pocket gophers (*Thomomys mazama*) may occur in our area (Maser 1998) as well, and, may also occur on the preserve. At least in one section of the range of both Camas and Mazama, they have been found within one hundred yards of each other (Verts and Carraway 1987). The Mazama is a much smaller species, weighing only 2 to 4 oz., compared to 13 to 19 oz. for the Camas. Mazama is closer in size to the Townsend's vole.

Through a lot of detective work trying to determine the possible size of the Camas Gopher's entrances or exits to their burrows, I believe that a 2½ to 3½ inch diameter would be about right for an animal of its size. Elbroch (2003) includes burrow entrance measurements for some species. Comparing sizes of animals (Kays and Wilson 2002) and the sizes of their entrances, a species similar to the Camas Gopher, the Uinta ground squirrel, is close to the body length and weight of the Camas. Their burrow entrances are 2½ to 3 inches in diameter.

There has been recent activity of fan shaped mounds with the typical Camas gopher entrance at the pointy end from which the dirt radiates. Most of the measured entrances have 2½ to 3½ inch diameters. According to Verts and Carraway (1998), tunnels of the Camas pocket gopher have been measured from 2 to 5 inches in diameter. When soils are wet, this species' large mounds have an opening on top of their constructed burrow (Verts and Carraway 1987). I have also observed and photographed this phenomenon. The purpose for constructing these openings is thought to be to increase ventilation and promote drying of their tunnels (Verts and Carraway 1987).

The increase in mound building inland from the East Fork Trail began when the soils became moist after a series of rains in October and November 2009; this is typical Camas gopher behavior. There was also increased activity in a section off the trail that had better drainage compared to the area which I had been following. This occurred during mid December through January 2010 and is reflected in my photos.

The Camas pocket gopher is primarily a solitary fossorial species. They inhabit land disturbed by clearing; they often prefer deep, heavy clay soils, but avoid poorly drained grassy fields (Verts and Carraway 1998). They are associated with early seral plant communities. They occur in unwooded lowlands and are common in agricultural and pastoral lands (Linzey and Hammerson 2008).

Mating occurs primarily in the spring, but can extend through August, with only one litter per year. They have a gestation period of about 28 days with an average litter size of 4.2 (Verts and Carraway 1998).

The Camas gopher (and Mazama) is vegetarian; it feeds on the roots of various plants, bulbs, tubers, and above ground vegetation. Although this species may have a taste for the sweet tasting bulbs of the camas lily, this plant is not considered to constitute much of their diet (Verts and Carraway 1987). They may come out at night or on overcast days to obtain vegetation, but remain close to their burrows. They transport acquired plant material inside their cheek pouches to their underground burrows on which to feed or store in their chambers (Maser 1998; Nowak 1999).

The gopher makes two kinds of tunnels: shallow for gathering food; and deep for shelter, storing food, toilets, and nesting chambers (Nowak 1999).There are many factors influencing all pocket gopher species' burrowing activity and the geometry of their foraging tunnels such as sex, age, and habitat (Romanach et al 2005). These burrows represent their home range and may be extended to forage for vegetation and seek mates, but within a fixed area (Reichman et al 1982). The mounds found in the Preserve have both been clumpy and smooth, depending on the soil in which the animal is excavating. The shape of the gopher mound is fan-shaped with a hole at one end. When the animal is not actively excavating the earth, they plug their burrows with soil (Verts and Carraway 1984). These plugs provide a form of air-conditioning inside their system and protection against unwanted visitors entering their homes.

The Camas gopher excavates several main tunnels with inclined tunnels that lead to the surface. Their tunnels can be over 800 feet long, and, in moist soil, at least three feet deep (Verts and Carraway 1987).

The Camas gopher has weak claws for digging their underground tunnels; instead, they use their protruding incisors to loosen hard soil. Often their mounds contain lumps of well-baked soil (Bailey 1936). According to Verts and Carraway (1998), who have studied this species in the Willamette Valley, fragments of soil that appear above

the surface of the ground bear distinct curves formed as the earth is peeled from the tunnel surface with the animal's incisors. Their photo (p. 231: Fig.11-49) of the mounds of this species looks exactly like the photos I have included with this report. (Also see photos in Results.)

I would not try to live-trap this animal for reasons discussed by Verts and Carraway (1998), who experimented with different traps. One type of trap they used killed the animal; the other badly injured it. Emerging from those experiences, they designed their own live-trap which is used for their scientific purposes.

BENEFICIAL – Pocket gophers are valuable to the natural world. Their tunneling behavior helps keep the earth porous. They bury vegetation, which enriches the soil by forming humus (Nowak 1999). Also, according to Maser (1998), particularly after they have moved on, their porous mounds and tunnels hold rain water, precluding excessive surface runoff. Additionally, seedlings from gophers' food storage work their way to the surface to become new vegetation.

There is so much complexity within the natural world, with each species playing Nature's intended role. The seldom-seen fossorial and semi-fossorial species mentioned above are each a complex part of our little-known world.

Family Castoridae

***Castor canadensis* – Beaver**

Beavers, as of 1824, were scarce in the Willamette River due to over-trapping. This continued to be the case until the early 1900's, when their numbers began to increase due to rigid legal protection (Bailey 1936). Now beavers are found throughout suitable waterways of Western Oregon (Maser 1998).

Signs of beaver have been seen and photographed throughout this project. The pictorial page of this report reflects their dams and surrounding vegetation throughout the year, both when the waters are flowing during the winter and when dry during the warmer months. When the waters begin to dry up, the beavers move on. What they leave behind is an enriched flora system – created through their behaviors that may increase or decrease the local water table (Berg 2005). It is thought that beavers,

which appear for a few wet months on the preserve, are dispersed young. This means they are about two years of age, which is the age when they reach sexual maturity and dispersal can begin. If this is the case, they would be seeking their own territories (Novak 1999; Patemaude 1984).

There is a single breeding season, with mating occurring during mid-winter and two to four young born between April and June after a gestation period of about three to four months (Maser 1998; Novak 1999).

Basically, this species feeds on the bark, cambium, twigs, leaves and roots of deciduous trees and shrubs, plus aquatic vegetation (Novak 1999).

The beaver is a semi-aquatic species whose claim to fame is that of the engineer of the animal world. "They are the designers, the contractors, and the builders of their own natural environment" (Berg 2005, pg.38). Their construction tool set is their strong, continually growing, front incisor teeth. In fact, if they don't keep using their incisors, they would eventually grow back into their skulls. These teeth allow them to fell trees, chew off branches, and strip their bark. These branches are then used for feeding and in construction of their dams and lodges (Berg 2005). Although I have not found lodges in our area, I have found bank dens and other dens near the waterways located under large rooted trees. Their dams are constructed with a foundation of mud and stones; brush, branches, and trees are then added, along with soggy vegetation which acts as plaster (Observations in the Rockies during my otter project).

BENEFICIAL – Still waters behind beavers' dams create habitat for a variety of wildlife species, such as amphibians, reptiles, mink, river otters, and waterfowl, to name a few that occur on the preserve. Also, their dams slow and trap runoff, then release it gradually (Rezendes 1992). I refer you, in particular, to Maser (1998) for information on the many benefits of beaver engineering from his research in Oregon, and historically to Bailey (1936, pg. 222), for beavers' conservation of water and the resulting benefits to humans.








Family Myocastoridae

***Myocastor coypus* – Nutria (coypu)**

This species is indigenous to the southern half of South America; it was introduced into Oregon and other areas of our country by dispersal from fur ranches. This semi-aquatic species prefers the same fresh water systems as the beaver, with which it competes. I discovered nutria scat up from the West Fork of Willow Creek and found a partially decomposed specimen near the East Fork of Willow Creek.

Breeding can occur year around with two or three litters annually (Brown 1975). Gestation is about four months, with an average litter size of five (Novak 1999). They are vegetarian, feeding on aquatic and semi-aquatic plants plus other vegetation near water. They also were found to prefer monocots and avoided dicots (Borgena et al 2000).

Order Carnivora

Family Canidae

***Canis latrans* – Coyote**

I found, identified, photographed, and broke down coyote scat throughout this project. I also found some tracks that could be identified as coyote and not domestic dog, which has also been seen

on the preserve (accompanied by human tracks). There is a separate section on the breakdown of carnivore scat in the results. Briefly, I found their scat primarily where the main trail crosses a deer trail or in the middle of a trail. This is a behavior correlated to most wild canines (Rezendes 1992). If bone shards are consumed by the coyote, they are accompanied by the hide and hair that surround them, thus

protecting the animals innards from being punctured (Elbroch 2003). This is corroborated by my research also.

Historically, coyote were scarce west of the cascades (Bailey 1936). But today, they are found throughout Oregon (Maser 1998). They are one of the most adaptable *Mammalian Species* in North America, occupying almost every suitable habitat (Maser 1998). Coyotes are most active at night in areas of close proximity to humans, but in more natural areas, they can be active any time during a 24 hour period, particularly the hours around sunrise and sunset (Grinder and Krausman 2001). Their home range size is variable, but the average size across studies was found to be eight square miles (Bekoff 1982). Bowen (1982) also discovered that their home ranges were shared by both males and females.

Mating occurs from January to March, with an average litter of six pups born after a two month gestation. The pups are cared for by both parents, along with helpers from prior litters (Nowak 1999).

Coyotes are opportunistic feeders. About 90% of their diet is mammalian flesh, especially rabbits and rodents (Novak 2005). Deer is usually eaten as carrion, but coyotes working together can bring down larger prey, particularly those that are immature, aged, or sick (Bekoff 1977). They hunt primarily by smell, especially when seeking rodents, and use surprise rather than speed to capture their prey. However, in open areas they can chase larger prey, since coyotes can reach speeds up to 40 mph. Research showed that adults and juveniles hunt voles, but only adults were found to hunt gophers and ground squirrels (Wells and Bekoff 1982).

BENEFICIAL – Recent research by Randa et al (2009) has shown that canine predators (coyote and fox) consumed juvenile voles before these voles dispersed. Therefore, they stated, these young voles were consumed before reaching reproductive age, thus leading to a low-density vole population. In addition, these researchers found that when these predators were unable to find voles, they supplemented

their diet with mice. In a coniferous forest in Oregon, Toweill and Anthony (1988) discovered that, particularly during spring (60%) and summer (39%), rodents were a major portion of coyotes' diet, especially deer mice and voles. These species were supplemented with other small rodents and rabbits during all seasons; during the summer, fruit was also a high priority. I also found seeds from fruits in summer coyote and fox scat. As Rezendes (1992) states, during the season of ripe fruits, coyote and fox (and raccoons as well) reduce their hunting and become "fruitarians".

***Vulpes vulpes* – Red Fox**

Historically, the red fox did not occur in our area (Bailey 1936), but that is no longer the case (Maser 1998). In fact they are now considered to be one of the five species that characterize the Willamette Valley (Verts and Carraway 1998). They occupy about every terrestrial habitat except deep forest. Their preferred habitat is meadows interspersed with patches of brush and timber (Maser 1998). I have found their scat, and early in this project, a set of tracks. The fox, like the coyote, often defecates on trails, and particularly where two trails cross (Rezendes 1992). My observations corroborate this citation; most of the wild canine scat I found occurred where a deer trail crosses the main trails on the Preserve.

One day I walked off the trail and headed into a forested area to sit on a stump. After a few quiet moments, I returned to the nearby trail to continue my trek. There on the trail, almost on an even line with where I had been sitting, was some nice fresh fox scat. When I had checked the area before moving into the forest, it was not there. The animal may have seen me, but I was not fortunate to see it. Rezendes (1992) calls the red fox a "ghost of the forest" and states that they may see you but you don't see them. That was certainly the case with my experience.

This species can have a home range from ½ to 6 square miles under natural conditions, or 24 acres in suburban areas. Their home range

usually includes one male and one or two adult females with their young (Nowak 2005). Breeding season occurs in January and February with an average of five pups born after a 53 day gestation. Both parents help raise the young (Maser 1998).

Like the coyote, they are an opportunistic feeder. Their main diet consists of rodents, lagomorphs, insects, and fruits (Nowak 1999). They are most active at night when their prey is active. I discussed their impact on voles and mice under the coyote section above. When hunting these small rodents, they stand motionless while using their visual and auditory senses. Once prey is detected, they leap bringing down their forelegs to pin the animal (Nowak 2005).

Coyote and red foxes co-exist over much of their range in North America, even though they feed on many of the same small prey (Randa et al 2009). Some studies have also shown there is a high degree of interspecific tolerance between these two species; however, coyotes can be antagonistic towards red foxes when hunting in pairs (Sargent and Allen 1989).

BENEFICIAL – The predatory behavior of both the coyote and red fox contribute to keeping voles and deer mice in balance throughout Willow Creek Preserve.

Family Felidae

***Lynx rufus* – Bobcat**

I have found bobcat scat and tracks on the Preserve. According to Maser (1998), this species is found in most habitats of western Oregon, particularly brushy areas, but historically they preferred the moist, heavily forested areas west of the Cascades (Bailey 1936). They are primarily active at night, but can also be seen during the day.

According to Maser (1998), the breeding season of bobcats in Oregon extends from January to July. They have a 63 day gestation with three to four young born mainly during April and May.

As with all cat species, bobcats lead a highly predatory life style. This can be appreciated when viewing their dentition, which emphasizes teeth used for seizing and cutting (Nowak 1999). They are a generalist

feeder; brush rabbits are their preferred species, but they also feed on almost any other species they can catch. This includes voles (which I have found in their scat) and deer mice (Maser 1998).

This species and other family members have highly specialized eyes that assist their hunting very effectively at night. They also have a good sense of hearing and possess very sensitive whiskers that help them feel their surroundings (Maser 1998). According to Rezendes (1993:p.220), "Bobcats hunt by stealth, by ambush, and by slow, careful stalking." An interesting study conducted by Koehler and Hornocker (1991) over a five year period in Idaho found a high incidence of voles being consumed by bobcat (from scat analysis) throughout the year, and particularly during winter. Even during winter bobcat used snow-free areas to seek their prey.

BENEFICIAL – As with the coyote and red fox, the bobcat's predatory behavior also assists keeping the vole and rabbit populations in balance.

Family Mustelidae

***Lontra canadensis* – River Otter**

Having spent in excess of six years studying river otters on the Colorado River in the Rocky Mountains of Colorado, how exciting it was to find river otter scat and other signs on the West Fork of Willow Creek in the Preserve. Their scat contained crayfish parts, which were corroborated by the crayfish I also found in this area.

River otters are a semi-aquatic species that have been observed with moderate frequency in Amazon Creek, including its confluence with Willow Creek. I documented incidental sightings of otters in sections of Amazon Creek during the four year period 2005-2008. (My 2008 report in support of the City of Eugene's grant application to OWEB to preserve the Amazon Creek Headwaters, attached at the end of this report, contains additional pertinent information on river otters, with specific references.) At least one otter was seen in Willow Creek before I started my mammal survey. Although they are most active at night or during the crepuscular hours, they have been seen in sections of Amazon Creek at various times during the day.

Historically, the otter population was sparse in Oregon due to 100 years of trapping (Bailey 1936). Today they can be found in suitable fresh water habitat throughout much of Oregon. There is, however, a concern for this species due to habitat destruction and pollution of their waterways (Maser 1998; Berg 2008, attachment).

In western Oregon, otters usually breed in late winter or early spring (Tabor and Wight 1977). Because of the process called "delayed implantation," the young are not born until 10 to 12 months after a successful mating. An average litter is two or three young.

Otters feed primarily on fish, and to a lesser extent other aquatic vertebrates and invertebrates (Berg 2000). Across North America, when and where crayfish are abundant, otters may consume them to a greater degree than there primarily fish diet (Berg 1999). I assume crayfish were the primary reason the otter came into the Preserve for

a "brief" visit. In addition to crayfish, signs were found in a beaver-enhanced area. According to Melquist and Dronkert (1987:631), "… several states have correlated good river otter habitat with the activities of beaver." There are also such beaver-enhanced areas along Amazon Creek. Berg (2005:107) states "Since otters' home ranges can include land and waterways encompassing 8 to 38 linear miles" (or more), the animal whose signs were observed was likely just moving through. There are many variables related to the size of the otter's home range which are not pertinent to this report.

BENEFICIAL – River otters are near the top of the food chain in aquatic ecosystems. They are susceptible to pollution (Duffy et al. 1996), and are thus a bio-indicator for the environmental health of fresh water habitats (Melquist & Dronkert 1987; Larivier & Walton 1998). Research is also showing that when this semi-aquatic species travels on land, their aquatically derived nutrients that are left behind in their feces influence the prevalence and growth of specific plants important to the health of riparian systems (Ben-David et al. 1998).

***Mustela vison* – Mink**

Mink is a semi-aquatic species that is known to occur in Amazon Creek. They have been reported in some of the same sections as the river otter, specifically between Beltline and Terry Streets. They are an opportunistic carnivore that feeds on a variety of prey, especially aquatic and semi-aquatic species. Mink were also shown to feed on voles from grassy areas surrounding locations of fresh water systems (Loukmas and Halbrook 2001). During the same time period that I found river otter scat, I also found scat which appeared to be that of mink. It was found near the water on the West Fork. This identification was determined from my prior research in the Colorado Rockies.

Historically, mink were fairly common along fresh waters and coasts of Oregon, and although heavily trapped, they returned slowly and increased their numbers (Bailey 1936). Today they occur throughout western Oregon and other locations of our country (Maser 1998; Nowak 1999).

Mink are most active at night, but have been seen during the day. According to Maser (1998), they concentrate most of their activity in the one segment of their home range that appears to be regulated by food and den sites. Eventually, they move to another segment. Their home ranges vary from .08 sq. mi. for females to 2.4 sq. mi. for males (Nowak 1999). During the dry season of the West Fork, I have found a few bank dens that are too small for nutria and beaver, but are possibly (but not certainly) those of the mink. According to Rezendes (1993), mink dens are usually along riverbanks, with openings along

the water four to six inches across. Those I found would be the correct size for this species. However, as with the other semi-aquatic species, because we have seasonal streams on Willow Creek Preserve, they too would move on during the dry season.

This species normally breeds during February and March with an average litter of 4 kits born during April or May (Maser 1998). Since the kits are not weaned until five or six weeks and this species is primarily aquatic in its habits, they would have moved out before the West Fork dried up, assuming they were there during the winter months. Also, since the young disperse during autumn, as do beaver, the potential mink may have been a dispersing young.

***Mustela frenata* – Long-tailed Weasel**

This species was observed near the TNC office. Although they occur throughout western Oregon, their population is not abundant (Maser 1998). They are frequently active during the day and can be found in areas devoid of cover (Maser 1998). Their preferred habitat is open, brushy or grassy areas near water (Nowak 2005). The diet of this species consists primarily of rodents and other small mammals, but they have been known to take prey larger than themselves (Maser 1998). Because of their long slender body, they can follow a mouse into its burrow (Nowak 2005). Then, they may take over the burrow. This weasel has been observed enlarging voles' nests, then lining the nests with the fur of their prey (Maser 1998). In an interesting observation, this species used its body to capture its prey. Once the rodent was captured, the weasel threw its body in a loose, snake-like coil over the rodent's body, subduing it before gripping the back of the head for the killing bite (Miller 1931).

Long-tailed weasels mate in July and August, but due to delayed implantation of the fertilized eggs, the young are not born until the following April or May. The mean number of young born is six. This species has a home range from .016 to .5 sq. mi. They have overlapping home ranges but, since they are primarily solitary, they usually only meet during the reproductive season (Nowak 1999).

BENEFICIAL – As with most of the other carnivores inhabiting the preserve, they, too, prey on – and control the populations of – voles and other rodents.

Family Procyonidae

***Procyon lotor* – Raccoon**

Raccoons occur in all habitats and their tracks and scat have been found throughout this project. They are most active at night, but can be seen during the day depending on the season and the habitat (Maser 1998). Historically, our raccoons were referred to as the Northwestern Raccoon; their range occurred west of the Cascades in Oregon, particularly near waterways, except when they searched for fruits (Bailey 1936).

In an interesting study conducted on a grassland reserve concerning raccoons as a potential predator of ground nesting birds, Newbury and Nelson (2007) showed that raccoons avoided nest-searching behavior in grasslands during the nesting seasons of spring and summer. Instead, they moved across grasslands to areas of richer food sources found in forested riparian and wetland habitats. During fall and winter, sparser food supplies led to more searching for food in all habitats.

Raccoons have a well-developed sense of touch in their forepaws; they can use their forepaws almost as skillfully as primates use theirs. Therefore, they pick up their food with their hands (Nowak 1999). This species has a large number of nerves associated with touch in their forepaws and a high degree of developed areas of the brain associated with touch, so moving food between their paws may give them pleasure. It was discovered that raccoons with no access to water still "washed" their food between their paws (Van Gelder 1982).

This species is an opportunistic omnivore and will feed on anything it can find or catch, both on the ground and in trees. In addition to preying on various animal species, they feed on different plants, and, particularly in our area, seasonal nuts, acorns, berries, and apples. Even through I have found their scat on the Preserve, I avoided collecting it because it potentially contains the eggs of a parasitic roundworm (*Baylisascaris procyonis*) harmful to animals and humans. (Rezendes 1992).

The size of this species' home range is variable, depending on the habitat where they reside. Breeding in Western Oregon usually begins in April, with an average of two to three young born about two months after a successful mating (Maser 1998).

Order Artiodactyla

Family Cervidae

***Odocoileus hemionus* – Mule Deer**

***Odocoileus hemionus columbianus* – Black-tailed Deer**

Black-tailed deer have been observed throughout my project. I have seen primarily females, and, on rare occasion, young fawns. They are a versatile species in their habitat choice as long as there is enough cover to protect them from summer heat and from predators. This species occurs in all areas of western Oregon (Maser 1998). Historically in western Oregon they were considered their own species (Odocoileus columbianus); they inhabited forests which protected them from predators and overhunting (Bailey 1936).

In our area, breeding season (rut) occurs in November and December (Maser 1998). Fawns are born about seven months later. Female deer (does) usually give birth to one or two fawns. This genus has the presence of metatarsal glands (Nowak 1999), which are used by the female and her young for recognition purposes (Maser 1998). Since they are not a herd animal, their social grouping usually includes a doe, one or two fawns, and two yearlings. Males (bucks) are either solitary or form small feeding groups. According to Maser (1999), during spring, families and male groups may come together for feeding purposes.

Odocoileus does not possess upper canine teeth so, instead of the upper and lower canines working together, they use their highly

mobile lips and prehensile tongue to draw vegetation across their lower teeth (Nowak 1999). Then, they cut off the vegetation much like a tape dispenser cuts off tape. Black-tailed deer predominantly graze in summer, but are usually a browser during other times of the year (Nowak 1999).Historically, grasses were not found in the stomachs of many examined individuals in Oregon, but Bailey (1936) states this doesn't prove that they won't sometimes feed on green grass. There was, during that time period, a vast array of vegetation available for them to feed upon (Bailey 1936).

When browsing, according to Rezendes (1992), deer begin feeding at the preferred height of about a man's knee to hip level, and continue until that range has been stripped. Then they proceed to ground level, and finally finish by standing on their hind legs to reach their food source.

There have been many studies in nutritional ecology that associate nutritional linkages with habitats in this genus. An interesting study in an Alaska forest environment discovered that skunk cabbage, devils club leaves, and arboreal lichens were a major source of energy and protein when and where they occurred (Parker et al 1999). I did not document exactly what deer in our Preserve feed on.

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I am forever grateful to The Nature Conservancy for having the foresight to preserve the Willow Creek Natural Area for its varied and specialized plant communities that comprise the habitat for a biodiverse array of fauna. Finally, I thank the mammal species that inhabit the Preserve for leading me on a journey of discovery.

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APPENDIX

RIVER OTTERS IN AMAZON CREEK

The North American River Otter is a high level indicator species of environmental health in fresh water ecosystems, and is even a contributor to that health. Increasingly frequent sightings of river otters by reliable sources have occurred in sections of Amazon Creek, particularly during the past three years. I document this information as I receive it. There have been from one to six otters in each sighting. (These sightings are not necessarily all inclusive; other sightings may have occurred that were not reported to me.)

That an otter showed up during October, 2006 at the Headwaters of Amazon Creek is indicative of the water quality at this location, coupled with the long home range required by this species. According to the September 2006 IUCN Otter Specialist Group Report, degradation of aquatic and wetland habitats pose long term threats for the North American river otter if water quality standards are not maintained and enforced. According to Maser (1998), the quality of much of the river otter's habitat is decreasing in the Pacific Northwest because of clear-cut logging, urban sprawl, and pollution of the waterways. Preserving Amazon Creek Headwaters through the proposed acquisition will protect the quality of not only that segment of Amazon Creek, but also this entire fresh water ecosystem, its river otters, and far beyond.

RIVER OTTERS ARE A "FLAGSHIP" SPECIES

River otters are near the top of the food chain in aquatic ecosystems. They are primarily piscivorous predators, and, to a lesser extent feed on other aquatic vertebrates and invertebrates (Berg 2000). Because otters are susceptible to pollution (Duffy et al.1996), they are considered a bio-indicator for the environmental health of fresh water habitats (Melquist & Dronkert 1987; Lariviere & Walton 1998). Wetlands which occur at the Amazon Creek Headwaters enhance the water quality of this fresh water system. If this land is not protected in its natural state, development will most likely occur resulting in removal of vegetative species and thus erosion of soils into the waters. Naturally treated pollutants in the current pristine habitats will no longer occur and the resultant introduction of human toxins will affect the waters, its aquatic species, and ultimately the river otters.

RIVER OTTER HABITAT

Favorable river otter habitat is non-polluted river systems that are interconnected with meandering streams, and the tributaries and lakes which feed them (Toweill and Tabor 1982; Melquist and Dronkert 1987; Reid et al. 1994). Because river otters are a semi-aquatic species, they rely on appropriate terrestrial cover that insures suitable passage between the waters across land bridges. Riparian vegetation adjacent to these fresh

waters is a key component of good river otter habitat (Melquist and Hornocker 1983). This habitat also attracts beavers that in turn create foraging and denning sites for otters (Melquist and Dronkert 1987; Berg 1999).

Beginning at the Amazon Creek Headwaters are stretches of important land cover for otters in the form of riparian, wetlands and mixed forest. Beaver enhancements also occur in sections of the Creek. Therefore, this freshwater habitat is good not only for river otters, but for many other fauna and flora species which are a part of this complex web of life and rely on it for their survival.

RIVER OTTERS' IMPORTANCE TO HEALTHY FRESH WATER HABITAT

Destruction of riparian forests can alter stream ecosystems, and vice versa, by disrupting the flow of resources that link these two ecosystems (Baxter et al. 2004). Most of the energy in headwater streams, such as Amazon Creek, is derived from the surrounding riparian forests. River otters have recently been documented as a resource to the health of this complex ecosystem (Ben-David et al. 1998a). While traveling on land, river otters deposit their aquatically derived nutrients through their scent marking behaviors (feces and urine). These nutrients have been found to influence the prevalence and growth of specific plants important to the health of these riparian systems (Ben-David et al. 1998b). This nutrient transference onto land, in turn, eventually works its way back into the fresh waters through reverse flow patterns (Wilson et al. 2004).

Streams and forests are vulnerable to habitat degradation when the fluxes of resources across the boundary between them is severed (Polis et al. 2004). Impact of these feeder streams, beginning at their headwaters – such as Amazon Creek- has a far reaching affect as these waters flow through their systems, ultimately reaching the ocean (Wilson et al. 2004).

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