WESTERN POND TURTLE HABITAT SURVEY IN THE CANOE CANAL, ALTON BAKER PARK AND EASTGATE WOODLANDS, EUGENE AND SPRINGFIELD, OREGON

By

ASHLEY ELIZABETH PHEIL

A THESIS

Presented to the Honors College and the
Environmental Studies Program
At the University of Oregon
In partial fulfillment of the requirements
For the degree of
Bachelor of Science

June 2009

An Abstract of the Thesis of

Ashley Elizabeth Pheil for the degree of Bachelor of Science

In Environmental Science to be taken May 8, 2009

Title: WESTERN POND TURTLE HABITAT SURVEY IN THE CANOE CANAL, ALTON BAKER PARK AND EASTGATE WOODLANDS, EUGENE AND SPRINGFIELD, OREGON

Approved: [redacted]
Professor Nicholas Kohler

The western pond turtle (*Actinemys marmorata*) is native to the west coast of the United States and has experienced a serious decline in population size since Euro-American settlement of the region. This paper describes a survey performed in the Canoe Canal of Alton Baker Park and Eastgate Woodlands in Eugene and Springfield, Oregon that described potential aquatic and nesting habitat for western pond turtles. Sites were ranked based on their current suitability as western pond turtle habitat, and three aquatic sites and three nesting sites were found to be suitable without human alteration. Numerous other sites were recommended for habitat restoration projects including addition of basking structures and removal of vegetation. General recommendations for public education and cooperation between local landowners and city agencies are also presented.

ACKNOWLEDGEMENTS

I would like to thank Professors Nicholas Kohler, Cristin Hulslander, and Roxann Prazniak for their input and assistance on this project. Thanks also go to Pat French of Willamalane Park and Recreation District and Lauri Mullen of Eugene Parks and Open Space for providing suggestions for the project and information about Alton Baker Park and Eastgate Woodlands. Also, thank you to the 2008 Environmental Leadership Program Turtle Team, for the humor and camaraderie during the project that inspired this one. Finally, thanks to my family and friends for their constant support throughout the thesis process. Thank you so much for being there and providing the right mixture of encouragement and prodding to see this through to the end.

TABLE OF CONTENTS

SECTION	PAGE
Introduction	1
Background	2
Ecology	2
Conservation Status	5
Eugene Parks and Open Space	6
Willamalane Park and Recreation District	7
Study Site	8
Methods	9
Aquatic Habitat	10
Nesting Habitat	11
Results	12
Aquatic Sites	13
Nesting Sites	17
Recommendations	21
Aquatic Sites	22
Nesting Sites	25
Other Recommendations	27
Suggestions for Further Study	30
Appendix	32
Survey Site Aerial Photos	32
Habitat Survey Forms	34
Spreadsheets with Survey Data	35
Highest and Good Quality Potential Aquatic and Nesting Sites Marked on Aerial Photos	38
Site Photos	41
References	42

LIST OF FIGURES

PAGE

Figure 1 Historical Western Pond Turtle Range..... 2

Figure 2 Historical Range in Oregon..... 2

Figure 3 Canoe Canal in Alton Baker Park and Eastgate Woodlands... 8

LIST OF TABLES

PAGE

Table 1 Highest Potential Aquatic Sites..... 13

Table 2 Good Potential Aquatic Sites..... 14

Table 3 Moderate Potential Aquatic Sites..... 15

Table 4 Low Potential Aquatic Sites..... 16

Table 5 Highest Potential Nesting Sites..... 17

Table 6 Good Potential Nesting Sites..... 18

Table 7 Moderate Potential Nesting Sites..... 19

Table 8 Low Potential Nesting Sites..... 20

Introduction

The western pond turtle (*Actinemys marmorata*) is native to the Willamette Valley and has experienced a decline in population size and reduction in distribution from its historical range. Considered a species of concern by the United States Fish and Wildlife Service, the western pond turtle requires conservation efforts to prevent it from becoming endangered or extinct. This paper discusses a survey at the Canoe Canal in Alton Baker Park and Eastgate Woodlands of Eugene and Springfield, Oregon for potential aquatic and nesting habitat for the western pond turtle.

The inspiration for this project came from my work with the 2008 Environmental Leadership Program Western Pond Turtle project in conjunction with the Eugene Bureau of Land Management. For that project, students performed habitat surveys for western pond turtles on BLM forested lands in the mid-Willamette Valley. Habitat surveys are a good starting point for western pond turtle conservation because it is unlikely that the species of interest will exist if suitable habitat is not available. The presence/absence of western pond turtles in the Canoe Canal of Eugene/Springfield is not the focus of this study. Instead, the survey seeks to determine if habitat characteristics of the area are capable of supporting the species. Actions are also recommended for preserving and restoring habitat in the area.

The results of this study are reported, via copies of my thesis, to the agencies managing the site, Willamalane Park and Recreation District and Eugene Parks and Open Space, as well as to the Oregon Department of Fish and Wildlife. Recommendations are made regarding future management actions with the goal of maintaining or augmenting western pond turtle habitat in the park. It is hoped that this

project will pave the way for future projects that develop viable habitat and ultimately promote the introduction of a western pond turtle population to the Canoe Canal.

Background

Ecology

The western pond turtle (*Actinemys marmorata*) was once divided into two subspecies, the northwestern pond turtle (*A. marmorata marmorata*) and the southwestern pond turtle (*A. marmorata pallida*). More recent molecular analysis however, has shown that there is no genetic evidence for splitting the western pond turtle into these two subspecies (Spinks and Shaffer 2005). Nonetheless, there is some morphological and behavioral variation in the species throughout its range. The species' historical range is along the west coast of North America from Baja California to southern British Columbia and from the Pacific Ocean to the Cascade and Sierra Nevada mountain ranges (see Figures 1 and 2). The turtle primarily inhabits lakes and slow moving rivers and streams, and it is rarely found above 5000 feet in elevation (Holland 1994).

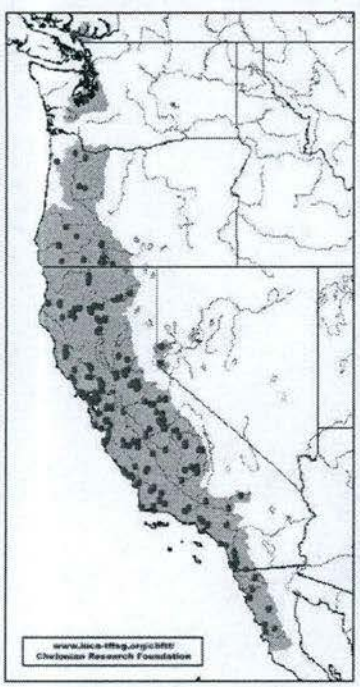


Figure 1 Historical Western Pond Turtle Range (Bury and Germano

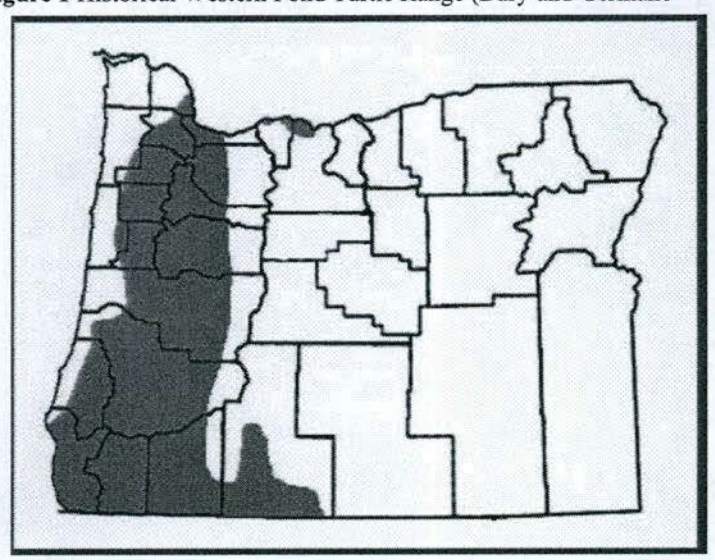


Figure 2 Historical Range in Oregon (Tom Titus, Univ. of Oregon)

The carapace (upper shell) of the western pond turtle ranges in color from brown to olive green with dark marbled markings, from which the Latin species name meaning marbled is derived. The skin is variably yellow, gray, or brown with some amount of dark mottling, with the ventral side paler than the dorsal. The plastron (lower shell) is usually pale yellow with little to no markings. The western pond turtle looks very similar to its invasive competitor, the red-eared slider (*Trachemys scripta elegans*), except it lacks the latter's distinctive red markings and yellow stripes on the sides of the head. Adult western pond turtles usually have a carapace length between 130 and 170 mm, though individuals have been observed with carapace length up to 210 mm. Western pond turtles become sexually mature at a carapace length between 110 and 120 mm, usually between eight and ten years of age (Holte 1998). Western pond turtles from the southern portion of their range tend to be somewhat smaller and have paler coloring than their northern counterparts (Buskirk 2002). Holland (1994) estimates the average lifespan of a western pond turtle at around 40 years, though the maximum lifespan is likely much longer (Hays et al. 1999).

Western pond turtles occupy a wide variety of aquatic habitat including streams, ponds, drainage areas, side channels, seasonal pools, and more. The water body must be of intermediate and variable depth: deeper in some areas than a turtle is tall, but with warm, shallow edges for juveniles to inhabit. As ectotherms, the turtles must utilize environmental conditions to regulate their body temperature. For this reason they require basking structures in their aquatic habitat in the form of logs, rocks, or any other partially submerged offshore object large enough for the turtle to perch on out of the water. Young western pond turtles need aquatic refugia such as undercut banks or

underwater vegetation to conceal them from predators. Another key use of aquatic habitat is for obtaining food. Western pond turtles are dietary generalists consuming aquatic invertebrates, algae, small fish, insects, and larvae. In addition to obtaining most of their food in or near water, western pond turtles almost exclusively consume their food in water, with a few exceptions (Buskirk 2002).

Western pond turtles overwinter roughly between October and May, though this is often shorter in southern regions and longer in northern regions. Most turtles overwinter by moving to terrestrial sites up to 500 m from their aquatic habitat (Holland 1994). The turtles seek out pre-existing holes in the ground or piles of organic debris in which to bury themselves for the winter. Some individuals overwinter in the muddy bottom of lakes or streams, though this is generally restricted to lacustrine populations (Holland 1994).

Another use of upland habitat by western pond turtles is for nesting. Females usually seek out nesting sites in June and July, though the precise timing varies with latitude. A female will often use the same nest site in subsequent years and will travel a maximum of 500 m to a nesting site (Bettelheim 2004). Most females will lay one clutch per year, but in the southern portion of the range some nest twice during a single summer. Optimal nesting sites in the species' northern range have south or west-facing slopes for maximum sun exposure, sparse ground cover, and dry silt or clay soil (Holland 1994, Holte 1998). The optimal orientation is different farther south in the range where solar exposure is higher (Holte 1998). When a suitable site is found, the female urinates onto the soil and digs into the side of the slope forming a pear shape about one meter in depth from the ground surface to the back of the nest chamber (Holte

1998). Between 1 and 13 eggs are then deposited in the nest and the hole is filled with a plug of soil and plant material. Females will abandon a nest site if it proves to be unsuitable upon attempted excavation, if disturbed while at work, or for other unknown reasons (Holland 1994). The eggs hatch after 80 to 100 days and the juveniles overwinter in the nest site before emerging in the spring (Holte 1998). Nests are vulnerable to predation, as are juveniles as they emerge and make their way to the water.

Native and non-native predators pose threats to western pond turtles, especially in the egg, hatchling, and juvenile stages. Introduced largemouth bass and bullfrogs are believed to eat western pond turtle young, though in the case of bass this is unconfirmed. Raccoons, coyotes, domestic dogs, and large birds also eat hatchlings and sometimes act as nest predators (Holland 1994). Another turtle species, the non-native red-eared slider, competes with western pond turtles for food and resources in addition to spreading diseases previously undocumented in the species. Red-eared sliders are introduced to western pond turtle habitat either as escapees or intentional releases from homes where they were kept as pets.

Conservation Status

Besides predation and competition from other turtles, western pond turtles face serious threats due to habitat loss and degradation. Human activities including land development, agriculture, wetland destruction, and the channelization of rivers due to damming have reduced habitat for the turtles with a grave impact on their population size (Moll and Moll 2004). Holland (1994) estimates that western pond turtle numbers in the Willamette drainage have decreased from a historical high of between 60,000 to

90,000 in the early 1800s, to a current size between 1500 and 2400 individuals. This represents a 96 – 98% decrease from historic levels. This staggering figure is repeated in the San Joaquin Valley of California (Holland 1994). The species is believed to be extirpated in Canada, if indeed it ever lived there, and survives in only very limited populations in the state of Washington (Buskirk 2002, Hays et al. 1999).

The International Union for Conservation of Nature and Natural Resources (IUCN) has included the western pond turtle on their Red List as "vulnerable" (IUCN 2008). A "vulnerable" classification means that a species is "considered to be facing a high risk of extinction in the wild" (IUCN 2008). Federally, the western pond turtle is not listed by the United States Endangered Species Act, but it is listed by the United States Fish and Wildlife Service as a "Species of Concern", and by the Bureau of Land Management as "Sensitive" (Bettelheim 2004). In the state of Oregon, the Oregon Department of Fish and Wildlife lists the western pond turtle as a "Critical Species" on their Sensitive Species List (ODFW 2008). The goal of the Sensitive Species List is to "provide a positive, proactive approach to species conservation" and to "prevent species from declining to the point of qualifying as threatened or endangered" (ODFW 2008). A "Critical" sensitive species is defined as one that is "imperiled with extirpation from a specific geographic area of the state because of small population sizes, habitat loss or degradation, and/or immediate threats" (ODFW 2008).

Eugene Parks and Open Space

Eugene Parks and Open Space is the agency that manages publicly owned land in Eugene, Oregon. Alton Baker Park, including the Whilamut Natural Area, is one of the parks administered by Eugene Parks. The park planning goals include providing areas

for the public to "play, relax, meet their neighbors, and enjoy the natural environment" by creating "neighborhood and community parks, natural areas, wetlands and open waterways, and ridgeline open space" (Eugene Parks and Open Space (EPOS) 2009). Creation and maintenance of western pond turtle habitat in the Canoe Canal in Alton Baker Park would go a long way toward meeting these goals and supporting new populations of vulnerable western pond turtles. Additionally, western pond turtle sightings have occurred in the Patterson Slough stretch of the Canoe Canal (pers. obs.). If confirmed, this would provide additional incentive for Eugene Parks to aid in habitat recovery for the species.

Willamalane Park and Recreation District

Willamalane Park and Recreation District was formed in 1944 and serves the Springfield, Oregon community. Their mission is to "provide exceptional park and recreation services that enhance the livability of our community and the lives of the people we serve" (Willamalane Park and Recreation District (WPRD) 2009). Willamalane manages the Eastgate Woodlands in Springfield. The district is currently working on native plant restoration and an invasive English ivy removal project in the park. The vision for the park is to provide the public with access to examples of native plant and animal species and communities (WPRD 2009). In this spirit, enhancing park habitat for western pond turtle livability would increase the native biodiversity in the park and potentially increase the number of visitors who come because they are interested in viewing native wildlife. In addition, and in compliance with the goals of the Oregon Sensitive Species List, the district would be creating habitat for a sensitive

species and could lessen the chances of the western pond turtle becoming more seriously endangered.

Study Site

Alton Baker Park and Eastgate Woodlands lie adjacent to each other and are located in Eugene, Oregon and Springfield, Oregon respectively. The parks are located along the north bank of the Willamette River from the Ferry Street Bridge on the west to just beyond Aspen Street on the east. They comprise nearly 450 acres, 40 of which are in Eastgate Woodlands, and 237 of which form the Whilamut Natural Area, previously called East Alton Baker Park (WPRD 2009, EPOS 2009). The Canoe Canal runs the length of the parks beginning in Eastgate Woodlands, where it is pumped from the Willamette River, to where it spills back into the river just west of the Duck Pond in West Alton Baker Park. An offshoot of the canal, Patterson Slough, begins east of the central pond and continues roughly north past the Autzen Stadium parking lot. Figure 3 shows the Canoe Canal situated within Alton Baker Park and Eastgate Woodlands.

Figure 3. Canoe Canal in Alton Baker Park and Eastgate Woodlands

The Canoe Canal and section of Patterson Slough were chosen for this study because they are in the historical range of the western pond turtle and initial observations showed a potential to contain appropriate habitat types for the western pond turtle. In addition, Pat French from Willamalane had expressed curiosity as to whether western pond turtles could be living in the Canoe Canal.

Methods

Aerial photographs of the Canoe Canal were provided by Lauri Mullen, Natural Resources Coordinator for Eugene Parks and Open Space. These can be found in the Appendix. The photos were used for marking spots of interest while in the field. The Canoe Canal was split into nine segments by aerial photos and these segments were referenced during data collection. The methodology for this survey was adapted from the Western Pond Turtle Habitat Survey performed in the spring of 2008 by the Environmental Leadership Program at the University of Oregon in conjunction with the Eugene Bureau of Land Management. Surveying for this project took place in October and November 2008 and began at the eastern end of the Canoe Canal where it emerges in the Eastgate Woodlands in Springfield, Oregon, and continued west to where the canal spills back into the Willamette River. The part of Patterson Slough, from where it branches off of the canal east of the central pond until it goes underground south of Martin Luther King Jr. Boulevard, was also surveyed.

On each day of data collection, the date, weather conditions, and surveyed canal segment were recorded in the headings of the aquatic and nesting habitat survey forms.

Aquatic Habitat

Beginning at the eastern end, the Canoe Canal was visually assessed for areas of potential current or future habitation by western pond turtles. The primary considerations included relatively slow moving water, some accessible banks, and varying water depths. Areas that appeared suitable for western pond turtle habitation, or could be made suitable by human intervention, were recorded as sites and further data were recorded for each such site. Each site was given a site ID with the format AQSegment.Site representing an aquatic site in a given segment (based on the aerial photo on which it appears) and the site number for that segment (i.e. AQ1.1). Where entire stretches of the Canoe Canal were found suitable to be recorded, sites were distinguished by reasonable line of sight. In these instances, sites were discrete areas between bends in the canal. If a suitable stretch between bends was too long to see features at one end from the other end, it was divided into multiple sites.

At each recorded site, a GPS reading was taken using a Garmin Etrex GPS unit in the degrees-minutes-seconds recording system. The site was also marked on the corresponding aerial photo. The maximum length, width, and depth for the feature were estimated by eye to the nearest foot. These numbers did not need to be exactly accurate, as they were meant to get a feel for relative size. The presence or absence of basking structures was noted with a Y or N meaning yes or no, respectively, and the presence or absence of a path within an estimated 300 feet of the aquatic feature was similarly recorded. Path presence was recorded in order to get a sense of the human presence near potential habitat sites. Further descriptions of these features were included in the comments section. The percentage canopy closure over the aquatic feature was

recorded, as was the number of turtles seen. The presence or absence of nesting habitat features within an estimated 300 feet of the aquatic feature was recorded with the same Y or N system as used previously. This distance was used because while some turtles travel up to 1500 feet to nest, that is exceptional and most turtles nest within 100 meters of water, or around 300 feet (Hays et al. 1999). One or more photographs were taken of each feature and their number recorded matching the site number. If more than one photo was taken at any given site, lowercase letters a, b, etc. were added at the end of the site number to distinguish them. Finally, any further comments about the site were recorded in a comments section. The aquatic habitat survey form can be found in the Appendix.

Sites were recorded in this way for the entire length of the Canoe Canal and Patterson Slough.

Nesting Habitat

For each aquatic habitat site identified, a visual survey of the surrounding upland area was conducted to determine if any potentially suitable nesting habitat was within 300 feet of the aquatic feature. Sun exposure, slight to moderate slope, and limited ground cover were the main considerations for determining potentially suitable nesting habitat. Areas that were determined to be currently suitable for western pond turtle nesting, or could be made into suitable nesting sites with some human alteration, were recorded. Nesting sites were given site ID numbers in the same way as aquatic sites, but with NE for nesting, instead of AQ.

GPS coordinates were recorded at each potential nesting site and the site was marked on the corresponding aerial photograph. The use status of the site was recorded:

unknown, or nesting, if used for that purpose. The length, width, and distance from the nesting habitat to the nearest aquatic site were estimated by eye in feet. The slope of the ground was estimated in degrees and the aspect of the slope was recorded in cardinal directions determined by a compass. The surface composition was recorded giving major types of ground cover (i.e. grass, soil, shrubs, etc.) and their respective percentages of the site's area. One or more photos were taken for each site and recorded with their matching site number as were the aquatic features. All further comments were recorded in the comments section. The nesting habitat survey form can be found in the Appendix.

All of the collected data were compiled into Excel spreadsheets for neatness and ease of review. These spreadsheets can be found in the Appendix. The sites were categorized as described in the Results section.

GPS coordinates for most sites in Segment 1 could not be recorded due to the dense canopy blocking the satellite signals to the GPS unit. The southern two-thirds of Segment Patterson 1 could not be surveyed due to impenetrable vegetation on one bank and private property on the other.

Results

The habitat survey at the Canoe Canal and southern stretch of Patterson Slough resulted in 39 potential aquatic habitat sites with an approximate total area of 600,000 square feet and 28 potential nesting habitat sites comprising approximately 336,000 square feet in total. Below, the specifics of the aquatic and nesting sites are described separately and sites are categorized by degree of alteration required to become optimal habitat.

Sites designated as "highest potential" are suitable for western pond turtle occupation without any alteration by humans required. "Good potential" sites require minimal human alteration to become suitable for habitation by western pond turtles. "Moderate potential" sites require moderate human alteration to become suitable for western pond turtles. "Low potential" sites require extensive human alteration to become suitable for western pond turtle habitation. Within each category the sites are not ordered by quality. The highest and good potential sites for both aquatic and nesting habitat are marked on aerial photos of the Canoe Canal in the Appendix.

Aquatic Sites

In general, the Canoe Canal has slow-moving water of moderate depth and receives moderate to high sun exposure. A significant portion of the surveyed area was recorded as potential western pond turtle aquatic habitat. Slightly more than half of the recorded sites have basking structures and most are near potential nesting habitat. All of the aquatic features are within 300 feet of a path.

Three aquatic sites received a ranking of highest potential based on their current suitability as western pond turtle habitat. These sites and some of their characteristics are listed in Table 1.

Table 1. Highest Potential Aquatic Sites

Site ID	Area (ft^2)	Basking (Y/N)	Canopy Closure (%)	Nearby Nesting (Y/N)	Comments
AQP2.1	16000	Y	25	Y	next to road, profuse log basking, nesting site access
AQP2.2	16000	Y	30	Y	lots of log basking, access to NEP2.1, turtles seen here in past

AQ6.3	10000	Y	10	Y	minimal basking (emergent branches), decent bank access

AQP2.1 and AQP2.2 are in Patterson Slough near the Autzen Stadium parking lot. Though trees cause a moderate amount of shade at these sites they are still among the best sites encountered in this habitat survey. Their large size, profuse basking, seclusion, still water, and access to potential nesting habitat make them ideal western pond turtle habitat. Furthermore, specimens believed to be western pond turtles have been seen at AQP2.2 (shown in Appendix). Site AQ6.3 has high sun exposure, some basking access, nearby potential nesting habitat, and slow moving water. These characteristics make it suitable for habitation by western pond turtles in its current state.

Table 2 lists the nine good potential aquatic sites and their distinguishing characteristics.

Table 2. Good Potential Aquatic Sites

Site ID	**Area (ft^2)**	**Basking(Y/N)**	**Canopy Closure (%)**	**Nearby Nesting (Y/N)**	**Comments**
AQ1.4	3750	Y	30	Y	clear bank on S side, center of channel swift, nesting habitat on S bank
AQ1.5	3000	Y	25	Y	slow, S bank access with nesting
AQP2.3	12000	Y	15	Y	banks thickly overgrown, log basking structures
AQ4.1	250000	Y	5	Y	"Turtle Pond", minimal basking, edges okay, human activity prevalent
AQ4.2	8000	N	20	Y	fairly secluded, banks not too overgrown
AQ4.4	5000	N	30	Y	some blackberries on S bank, nesting on N bank
AQ5.2	12500	Y	20	Y	minimal basking, small trees overhanging banks

AQ6.1	3750	Y	10	Y	by amphitheater, minimal branch basking, fences on one side, nesting in Seg. 5
AQ6.2	10000	N	5	Y	no basking, easy bank access, by bridge and amphitheater

These good potential aquatic sites all have potential nesting habitat nearby, and most of them have at least minimal basking structures. The sun exposure at all of these sites is moderate to high.

Table 3 lists the sixteen aquatic sites classified as moderate potential and gives some of their distinguishing characteristics.

Table 3. Moderate Potential Aquatic Sites

Site ID	**Area (ft^2)**	**Basking (Y/N)**	**Canopy Closure (%)**	**Nearby Nesting (Y/N)**	**Comments**
AQ1.3	4000	Y	30	N	little bank access, low-mid basking logs and branches, next to bridge
AQ2.1	9000	N	5	Y	near good potential nesting habitat, bank access limited
AQ2.3	10500	Y	10	Y	bank access difficult, basking poor
AQ2.4	12000	N	10	Y	bank access difficult, no basking
AQ3.1	6000	N	5	Y	limited bank access, houses abut water
AQ3.2	12000	N	15	Y	very limited bank access, calm water
AQ3.3	20000	N	15	Y	very limited bank access, calm water
AQ3.4	6000	Y	20	Y	minimal basking, blackberries on N bank, limited bank access
AQ3.5	6000	Y	15	Y	minimal basking, very limited bank access
AQP1.1	15000	Y	10	Y	thick brush W, private property E, minimal basking
AQ4.3	9000	N	40	Y	banks fairly accessible, some blackberries

AQ5.1	12500	Y	15	Y	minimal basking, blackberries on N bank
AQ5.3	12000	N	5	Y	dogs swim here, good bank access
AQ5.5	9000	Y	40	Y	minimal basking, paths on both sides
AQ5.6	7500	Y	20	Y	minimal basking, fence at W end, S bank overgrown with blackberries
AQ6.4	15000	N	10	Y	no basking, little refugia, tunnel and little fall at end

Half of these moderate potential aquatic sites lack basking structures and most of the sites with basking structures have very few. Most of the sites are near potential nesting habitat, but many have thickly overgrown banks with poor accessibility.

The eleven low potential aquatic sites and some of their distinguishing features are listed in Table 4.

Table 4. Low Potential Aquatic Sites

Site ID	**Area (ft^2)**	**Basking (Y/N)**	**Canopy Closure (%)**	**Nearby Nesting (Y/N)**	**Comments**
AQ1.1	8000	Y	20	N	steep, vegetated banks, little basking, lots of blackberries
AQ1.2	2800	Y	60	N	minimal basking, overgrown banks (esp. N)
AQ1.6	625	N	40	Y	close enough to NE1.2, overgrown banks
AQ1.7	400	N	10	Y	banks barely accessible, right next to I-5, no basking
AQ2.2	20000	N	5	Y	hard to access banks, no basking
AQ2.5	15000	N	10	Y	N bank has private homes, no basking, very undercut banks, difficult access
AQP3.1	720	Y	40	Y	overgrown banks, right next to road
AQ5.4	12000	Y	20	Y	concrete run/dam, fast water on other side, herons
AQ6.5	5000	N	5	Y	no basking, little refugia, steep W bank

AQ6.6	10000	Y	5	N	minimal basking, some refugia on W bank, significant human activity
AQ6.7	10000	N	10	Y	ledge E bank, overgrown W bank, no basking

Most of the low potential sites contain few or no basking structures. Approximately half are within 300 feet of potential nesting habitat. Some of them are heavily shaded, have overgrown and/or inaccessible banks, or have other non-ideal characteristics.

Nesting Sites

Most of the upland habitat around the Canoe Canal is either thick with grass or overgrown by blackberries. Pedestrian and bike paths run adjacent to or bisect many of the potential nesting sites recorded in this survey.

Three potential nesting sites were of high enough quality to be suitable for western pond turtle habitation without human alteration. Their distinguishing characteristics are listed in Table 5.

Table 5. Highest Potential Nesting Sites

Site ID	**Area (ft^2)**	**Dist. To AQ (ft)**	**Slope (°)/ Aspect**	**Comp-osition**	**Comments**
NE2.1	2000	1	20/N	80% grass, 20% soil	right next to path, grass somewhat thick, high sun exposure
NE4.5	800	0	15/SW	20% soil, 60% short grass, 20% tall grass	near biking race track, moderate sun exposure
NE5.2	1600	0	15/SW	5% trees, 80% grass, 15% rocky soil	N bank, moderate sun exposure

These sites are all directly adjacent to potential aquatic sites, some of which are categorized as good potential, others moderate and low. They also have moderate to

high sun exposure, slight slopes, and are of mixed composition with some exposed soil. They provide good digging substrates for female western pond turtles and incubating sites for western pond turtle eggs. Though NE2.1 faces north, aspect is not the most crucial criterion of a nesting site and the other characteristics are favorable. A photograph of site NE4.5 is shown in the Appendix.

Table 6 lists the six good potential nesting sites and some of their distinguishing characteristics.

Table 6. Good Potential Nesting Sites

Site ID	Area (ft^2)	Dist. To AQ (ft)	Slope (°)/ Aspect	Comp-osition	Comments
NE2.3	2000	1	10/E	95% grass, 5% soil	grassy, right next to path
NE2.4	2250	1	5/NE	90% grass, 10% soil	grassy, right next to path
NEP2.1	1600	0	30/NW	80% grasses, 20% shrubs	right next to road, too thick grass, good sun exposure
NE4.2	500	0	25/SSW	50% grass, 40% blackberries/ shrubs, 10% soil	too many blackberries, decent sun exposure, fairly secluded N bank
NE4.3	600	0	25/SSW	70% grass, 25% shrubs/black-berries, 5% soil	too many shrubs, good sun exposure, fairly secluded N bank
NE6.4	7500	0	15/SW	10% soil, 90% grass/herbs	right next to path, grassy, between two AQ sites

These sites receive high sun exposure and are near potential aquatic habitat sites. The common problem with these sites and the majority of the potential nesting sites surveyed is the presence of excessive grass, shrubs, or other vegetation on the ground that may inhibit excavation by nesting females.

The seven moderate potential nesting sites and their distinguishing characteristics are listed in Table 7.

Table 7. Moderate Potential Nesting Sites

Site ID	Area (ft^2)	Dist. To AQ (ft)	Slope (°)/ Aspect	Comp-osition	Comments
NE1.1	800	1	30/NE	45% soft soil, 30% shrubs, 25% grass/herbs	site of invasives removal?, webbing on ground, minimal sunlight, near AQ1.4
NE1.2	500	1	30/NE	40% soil, 40% small shrubs, 20% grass/herbs	like NE1.1, removal site
NE1.3	400	1	35/NNW	60% shrubs/blackberries, 10% soil, 30% grasses	lots of blackberries, but right next to path
NE2.2	37500	4	15/S	90% grass/herbs, 10% soil	separated from water by band of tall, thick vegetation, too grassy, next to path
NE3.1	6000	30	0/NA	90% grass, 3% soil, 7% shrubs	thick grass, right next to path
NE3.2	37500	25	0/NA	95% grass, 5% shrubs	soil inaccessible, right next to path
NE5.4	750	0	10/S	95% grass, 5% blackberries/shrubs	moderate sun exposure, easy bank access, thick grass

The main problems at these moderate potential nesting sites are some combination of excessive vegetative ground cover, inadequate solar exposure, too much human activity in the area, and/or barriers to potential aquatic habitat sites. Multiple projects would be required to improve these sites for nesting by western pond turtles, thus their assignment to the moderate potential category.

Table 8 lists the 12 low potential nesting sites and their distinguishing characteristics.

Table 8. Low Potential Nesting Sites

Site ID	Area (ft^2)	Dist. To AQ (ft)	Slope (°)/ Aspect	Comp-osition	Comments
NE2.5	6000	15	10/NNE	100% grass	too grassy, between paved and chip paths
NEP1.1	400	10	60/W	95% soil, 5% leaves	private property, steep cut below lawn, geese nearby, across gravel road
NEP2.2	6000	15	0/NA	80% grasses, 10% leaves, 10% soil	hard to access, right next to road, grassy, not ideal sun exposure
NEP3.1	750	20	0/NA	90% grass, 10% soil	grassy area in tailgating parking lot, likely gravel just under grass
NE4.1	20000	2	5/N	90% grass, 2% trees, 8% rocky soil	path bisects site, path between water and most of site, on south bank
NE4.4	20000	20	0/NA	80% grass, 20% trees/bushes	on opposite side of path from water, moderate sun exposure
NE5.1	100000	30	0/NA	90% grass, 10% trees/bushes	right next to path, path separates nesting from water
NE5.3	800	0	20/SSW	95% grass, 5% soil	busy place, next to road/dog park, thick grass
NE6.1	4500	0	30/E	90% grass, 5% blackberries, 5% tall grass	too lawn-like, moderate sun exposure, shade from some trees
NE6.2	10000	0	0/NA	5% trees, 10% rocky dirt, 85% grass/shrubs	too grassy, very exposed to people, geese
NE6.3	45000	20	0/NA	5% shrubs, 5% rocky dirt, 90% grass	exposed to people, grass too thick
NE6.5	20000	100	5/W	10% trees/bushes, 90% grass	too grassy, across two paths, too many people

These low potential nesting sites exhibit the same problems as the moderate potential sites, including excessive vegetative ground cover, inadequate solar exposure, high human activity, and barriers to potential aquatic habitat sites, but to a greater degree.

Overall, the Whilamut Natural Area of Alton Baker Park and the Eastgate Woodlands provide better western pond turtle habitat and greater potential for habitat improvement than West Alton Baker Park. The more manicured state of the latter and its heavier human use, make it less suitable for utilization by western pond turtles.

Recommendations

Now that the habitat in the Canoe Canal has been assessed for its potential to support western pond turtles, visual field surveys for western pond turtles themselves should be conducted, especially in the Patterson Slough area where suspected sightings have occurred. The general protocol used by Paul Adamus in his 2002 surveys for western pond turtles could be applied in the Canoe Canal. His goal was to add to the known turtle locations in the Willamette River Basin and for this reason he emphasized rapid appraisal of each site (Adamus 2003a), but more time could be spent surveying in the Canoe Canal because it covers less area. Adamus (2003a) conducted his surveys on sunny days between March and August to increase the likelihood that turtles would be out in the open. Observers should visit all aquatic sites within the Canoe Canal and use binoculars or spotting scope to scan the water from a short distance. It is important to remain quiet so as not to frighten any turtles away (Adamus 2003a). In a visual survey, the observer must look for basking and swimming turtles, as well as those with just their snout poking out of the water. Greatest attention should be paid to sites with slow

moving water and high solar exposure (Adamus 2003a). Surveys should be repeated multiple times at each site, as time allows, in order to maximize the chances that turtles are spotted. As in the model survey, surveys of this type in the Canoe Canal should not attempt to estimate turtle population size or demographics, but only the locations, if any, where western pond turtles are present (Adamus 2003a).

If turtles are found in the Canoe Canal during visual field surveys, the next effort should focus on improving and maintaining the habitat surveyed in this project. Recommendations for improvement of the Canoe Canal habitat should encourage the establishment of western pond turtle populations. Habitat restoration efforts should be focused on aquatic and nesting sites designated as highest potential and good potential in the interest of efficient use of time and resources. As it is unlikely that funding or labor allotment will permit the restoration of all sites discussed in this report, priority should be given to those requiring the least alteration to become suitable habitat. Recommendations for highest and good potential habitat sites are as follows.

Aquatic Sites

Sites AQP2.1 and AQP2.2 are adjacent aquatic sites within the Patterson Slough offshoot of the Canoe Canal. Designated as highest potential habitat, they are suitable for western pond turtle habitation as they are, but could still use some small-scale improvements to optimize their quality. Manual removal of vegetation along the banks in this area would ease turtle movement around these sites. A few people with gloves, clippers, and shovels could spend a few days clearing the blackberries and other brush from the first few feet of shoreline, especially near the adjacent nesting site NEP2.1. Mowing or herbicide application are other possibilities for removal of especially

tenacious blackberry bushes, though the possibility for water contamination by chemicals should be taken into consideration when selecting a course of action. Periodic maintenance of this type a few times a year would likely be sufficient to keep the vegetation in check. This type of intensive human labor should be avoided in July and August when female turtles are most likely to be nesting and are thus most prone to disruption by human activity.

Site AQ6.3 is also suitable habitat in its current state, but to maximize its potential it is recommended that a few large basking structures be added as basking access is currently limited at this site. Large rocks or logs that emerge from the water and provide a semi-level surface for turtles to rest on make ideal basking structures. They should be anchored offshore to prevent easy access to basking turtles by terrestrial predators and humans. Any tree removed from a Eugene or Springfield park could be sectioned and anchored in the Canoe Canal to serve as western pond turtle basking structures. Large root balls from removed trees make good basking structures and also provide underwater refugia in the form of intricately twined root systems, allowing western pond turtles to hide from predators. If natural basking structures are unavailable, artificial basking structures can be constructed and placed in aquatic sites. In a study beginning in 1999, Jeff Alvarez (2006) constructed basking platforms of wooden planks, foam panels, and large capped PVC tubes for flotation and anchored them in aquatic sites with nylon cords and concrete blocks. The construction of these platforms cost between $9.00 and $19.00 each and they proved durable, having lasted for 6 years at the time of the article's writing (Alvarez 2006). Out of nine ponds in the central California study site, western pond turtles were seen at two ponds prior to the

platform placement and in eight ponds following the placement (Alvarez 2006). A similar basking platform project could be employed in the Canoe Canal at relatively low cost and even reveal previously unknown populations of western pond turtles.

Aquatic sites AQ1.4 and AQ1.5 were designated as good potential sites and are in the Eastgate Woodlands. They receive more shade than many of the other aquatic sites. Removal of some of the medium-height shrubs at the water's edge would slightly increase solar exposure and would facilitate turtle movement onto land. It would also be beneficial to add one or more basking structures to each site. These sites should not be among the highest priority however, because none of the nesting habitat identified in the Eastgate Woodlands was designated as highest or good potential. This is because the quantity of trees in the area results in significant shading on any potential nesting habitat and there is concern that the ground would not be warm enough to incubate western pond turtle eggs.

Site AQP2.3 is very similar to the previously discussed sites AQP2.1 and AQP2.2 except it does not have access to decent nesting habitat. Blackberry removal along the banks could make this site suitable for habitation by western pond turtles. If a relatively large contiguous area were cleared of blackberries and other tall vegetation it could serve as nesting habitat. The northeast section is especially promising for this as it has few trees and thus greater solar exposure.

In segment 4, three sites were designated as good potential aquatic habitat: AQ4.1, AQ4.2, and AQ4.4. Site AQ4.1 is the large pond near the center of the Canoe Canal. This site would benefit from the addition of more basking structures. As the site is a popular place for human recreation, it would be important to educate the public

about responsible behavior around western pond turtles and possibly restrict access to a few more secluded segments of the bank during peak nesting times. Possibilities for public education will be discussed in more detail later. Site AQ4.2 lacks basking structures altogether and requires the placement of a couple of them to make it into suitable habitat. Similarly, AQ4.4 needs the addition of basking structures, but it would also benefit from blackberry removal on the south bank.

Aquatic site AQ5.2 near Autzen Stadium currently has minimal available basking sites and would be improved by the addition of a few basking structures. Its banks are somewhat overgrown, so projects should involve removal of taller vegetation from segments of the banks, especially the southeast section near the potential nesting site NE5.2. Sites AQ6.1 and AQ6.2 are near the Cuthbert Amphitheater and might face problems from human use nearby. This is another place where public education could aid the success of western pond turtles. These two sites both need basking structures to be installed, as AQ6.1 has minimal basking availability and AQ6.2 has none. Both could also use some removal of blackberries and other shrubs.

Nesting Sites

The highest potential nesting sites, NE2.1, NE4.5, and NE5.2 are suitable for western pond turtles as they are. The only recommendation regarding these sites is to check on them periodically to ensure that no invasive vegetation is encroaching and preventing nest excavation. The earlier such vegetation is spotted, the easier the removal process will be.

Good potential sites NE2.3 and NE2.4 are rather grassy, but otherwise decent habitat. However, a thick band of tall grass and other vegetation lies between them and

the aquatic features nearby. Mowing or removal of this vegetation would facilitate turtles' overland travel to nesting and other terrestrial sites. These sites are right next to the bark chip running path and a little farther away is the paved bike path. It would be important to post signs and educate the public about the potential for encountering turtles in the area, so that turtles are not either run over or harassed by people.

Site NEP2.1 is in Patterson Slough and is right next to the highest potential aquatic site AQP2.1. It would benefit from the removal of blackberry bushes and some patches of tall grass to expose the soil in some areas. Mowing might also work to achieve this result. A fence or other barrier should be installed on the south end of this site to prevent western pond turtles from entering the road (Leo Harris Parkway) and being run over by cars or bikes.

Nesting sites NE4.2 and NE4.3 are downstream of the large pond (AQ4.1) and are adjacent to other good potential aquatic habitat sites (AQ4.2 and AQ4.4). They receive significant solar exposure and are relatively secluded, which makes them very promising western pond turtle nesting habitat. Both are somewhat overgrown however, with blackberries and some clumps of tall grasses. These need to be removed to optimize the site for future turtle nesting. Site NE6.4 is positioned between aquatic habitat sites, though neither of the directly adjacent ones is recommended for improvement, as they are ranked below good potential. Nonetheless, the nesting site is accessible from a highest potential aquatic habitat site (AQ6.3). It could use removal of some of the taller vegetation near the water's edge, in order to ease turtle movement from the water to the nesting site.

Other Recommendations

If the visual field surveys reveal that no western pond turtles inhabit the Canoe Canal, Eugene Parks and Open Space and Willamalane Park and Recreation District might consider exploring the option of implementing a western pond turtle introduction program. The Woodland Park Zoo in Seattle, Washington and the Oregon Zoo in Portland, Oregon have been working since the early 1990s on western pond turtle reintroduction projects (Oregon Zoo, Woodland Park Zoo et al. 2007). Both employ headstarting programs, in which eggs are removed from nests in the wild and hatched in captivity. Then, the hatchlings are cared for until they reach eight to ten months of age and are no longer as vulnerable to predators (OZ, WPZ et al. 2007). At this point, the juveniles are returned to where their eggs were collected or they are released at sites in Puget Sound or the Columbia Gorge where reintroduction projects are underway (OZ, WPZ et al. 2007, Hays et al. 1999). The Woodland Park Zoo also has a captive breeding program to provide western pond turtles for reintroduction programs (WPZ et al. 2007). The headstarting methods used at these zoos could be employed for an introduction program at the Canoe Canal, but juvenile turtles must be obtained elsewhere. Juvenile or adult turtles could potentially be obtained from either the West Eugene Wetlands' western pond turtle population or from the newly established population at Buford Park, with consideration for population size and stability at these locales. Population viability at these other locations should not be jeopardized to establish a new population in the Canoe Canal. These Willamette Valley individuals face little risk of deleterious genetic impacts in the Canoe Canal, as compared to individuals from more distant populations. The previously discussed habitat improvements should be made before any

introductions take place because any introduced individuals will be more likely to survive and establish populations if the habitat is more suitable.

Funding is likely to be a barrier to many of the recommended habitat improvements for the Canoe Canal. For this reason, it is advisable to consider the use of volunteer labor to perform much of the vegetation removal and basking structure installation. Support could likely be drummed up in the Eugene/Springfield community by publicizing the plight of the western pond turtle and enlisting the public's help to create habitat for them in our public parks. Regular weekend volunteer work parties could potentially accomplish many of the restoration goals discussed earlier. The Friends of Buford Park and Mt. Pisgah organizes numerous work parties and other volunteer opportunities to maintain trails, remove invasive plants, and collect native seeds throughout the year at Buford Park in Lane County (Friends of Buford Park and Mt. Pisgah). In 2008, over 500 volunteers spent time performing these duties and others at the park (FBPMP). This is a tactic that Eugene Parks and Willamalane should consider when planning western pond turtle habitat restoration for the Canoe Canal.

A western pond turtle education campaign would be useful to garner local volunteer support and protect future western pond turtle populations. Turtle crossing signs should be installed along bike paths that pass near habitat used by western pond turtles. Additionally, culverts could be constructed to allow turtles to travel under paths. Creating information kiosks detailing the basic biological information, threats, and conservation efforts surrounding the western pond turtle would also be useful to help the public understand why they should be careful around turtles and their habitat. People should be reminded to keep their dogs and themselves away from turtles and

turtle nests and that it is illegal to capture or otherwise harm a western pond turtle. Additionally, recreational boaters should be advised to keep their distance from basking turtles and remain quiet so as not to frighten them off their basking structures. A short lesson plan about western pond turtles should be developed to teach in local elementary and middle school classrooms. Often the best way to educate the public is through school children that will take home what they learned and tell their parents. If we can instill conservation attitudes and concerns in children then the future for western pond turtles and all other threatened species will be a little brighter.

Habitat restoration efforts by Eugene Parks and Willamalane would also benefit from communication and cooperation with private landowners. Canoe Canal segments 2 and 3, as well as part of Patterson Slough, are bounded on the north/east bank by private property consisting of homes and lawns. Landowner actions in and around the Canoe Canal could impact western pond turtles either positively or negatively. Turtles could try to nest in private yards in which case the nests might be dug up in a garden or preyed upon by a pet dog. Some local property owners might be amenable to working on habitat restoration projects with recommendations from the city. A good starting place would be to pass out informative brochures to landowners with property abutting the Canoe Canal. Like the lesson plan, they could include basics on western pond turtle biology, threats, and local habitat restoration projects. At the least these could advise people to look out for western pond turtles, and the brochures could provide a phone number for landowners to call if they are interested in getting more information about turning their yard into a haven for turtles. The public, and especially property owners, would be a good resource for reporting turtle sightings in the Canoe Canal. The

brochure mentioned above could also encourage landowners to call and report turtle sightings on and around their property.

Suggestions for Further Study

Further research should be undertaken in the Canoe Canal area with the goal of increasing potential for western pond turtle habitation. Whether western pond turtles are already present or are introduced in the future, there are other factors influencing their potential for surviving and establishing long term populations. The habitat restoration projects recommended earlier are important steps, but not the only ones to consider when attempting to assist in the recovery of a sensitive species.

Monitoring of invasive plant species such as Himalayan blackberry and English ivy should occur in upland areas to determine their extent and potential for encroachment upon western pond turtle nesting sites. Where funding and labor allow, these invasive species should be removed from the park, for the sake of all native wildlife, including western pond turtles. Surveys for western pond turtle predators and competitors including bullfrogs, largemouth bass, raccoons, skunks, and red-eared sliders would increase the knowledge base about local threats to western pond turtle survival. Visual surveys for these animals could be conducted similarly to those for western pond turtles described above, but must take into account the differences in behavior and habitat.

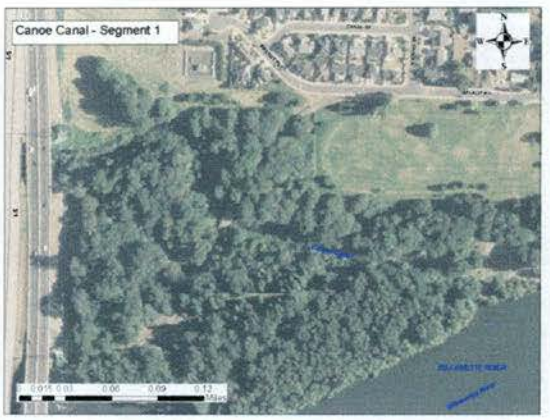
Sites identified as potential nesting habitat should be monitored for nesting activity by western pond turtles. Where nests are found, enclosures can be placed over nests to prevent access by predators. These enclosures consist of wire boxes anchored to the ground that allow small hatchling turtles out, but prevent predators from getting in.

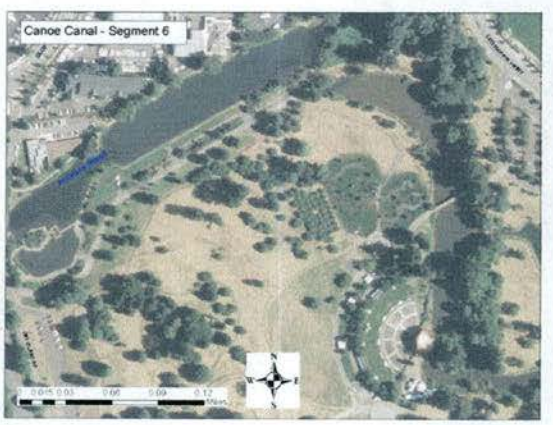
Fencing could also be useful around confirmed nesting areas with signs warning people to stay out. It might be better not to advertise turtle nesting in these areas, as curious people would likely disturb or harm nesting females, eggs, or emerging hatchlings.

Finally, if a western pond turtle introduction program is ever implemented in the Canoe Canal, it might be advisable to monitor populations via radio telemetry tracking devices. Monitoring the size and age structure of the population is crucial for providing a warning in case of population decline and gives conservationists a chance to identify and remedy any problems before it is too late. It could also be interesting, though expensive, to track the movements of any introduced pond turtles to see if they colonize outward from their introduction site.

Appendix

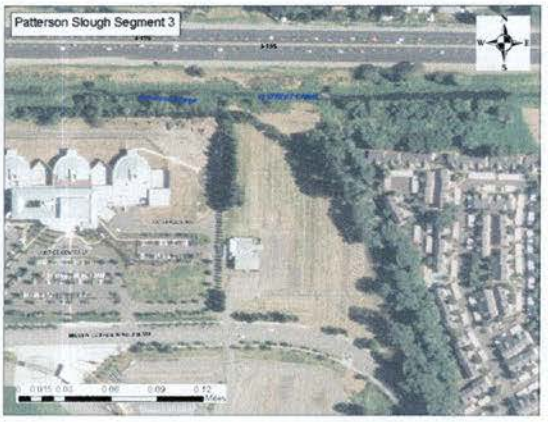
Survey Site Aerial Photos (Provided by Lauri Mullen, Eugene Parks and Open Space)






Patterson Slough Segment 1


Patterson Slough Segment 2


Patterson Slough Segment 3

Aquatic Habitat Survey Form

Canoe Canal Western Pond Turtle Habitat Survey – Aquatic Habitat Form

Date _____ Weather _____ Canal Segment_____

Site ID	GPS coord.	Length (ft)	Width (ft)	Depth (ft)	Basking structures?	Nearby path?	Canopy closure (%)	# turtles	Nearby nest hab.?	Photo #	Comments

Nesting Habitat Survey Form

Canoe Canal Western Pond Turtle Habitat Survey – Nesting Habitat Form

Date _____ Weather _____ Canal Segment_____

Site ID	GPS coord.	Use	Length (ft)	Width (ft)	Distance to aq. (ft)	Slope (°)	Aspect	Composition	Photo #	Comments

Spreadsheets with Survey Data

Aquatic Habitat Survey Form													
Site ID	Date	Weather	Canal Sgmt	GPS coord.	L (ft)	W (ft)	D (ft)	Bsk ?	Path ?	c.c.	nest ?	photo #	comments
AQ1.1	10/20/08	partly cloudy	1	NA	200	40	5	Y	Y	20%	N	AQ1.1	mostly steep, vegetated banks, little basking access, lots of blackberries
AQ1.2	10/20/08	partly cloudy	1	NA	80	35	3	Y	Y	60%	N	AQ1.2	minimal basking, overgrown banks (esp. N)
AQ1.3	10/20/08	partly cloudy	1	NA	100	40	3	Y	Y	30%	N	AQ1.3	one bank access spot, low-mid basking logs and branches, next to bridge
AQ1.4	10/20/08	partly cloudy	1	NA	150	25	3	Y	Y	30%	Y	AQ1.4	clear bank on part of SW side, center of channel swift, nesting habitat on SW bank
AQ1.5	10/20/08	partly cloudy	1	NA	100	30	3	Y	Y	25%	Y	AQ1.5	slow, ducks present, SW bank access with nesting
AQ1.6	10/20/08	partly cloudy	1	NA	25	25	2	N	Y	40%	Y	AQ1.6	not great, close enough to NE 1.2, overgrown banks
AQ1.7	10/20/08	partly cloudy	1	44 02 54.5, 123 02 57.7	20	20	2	N	Y	10%	Y	AQ1.7	banks barely accessible, right next to I-5, needs basking structures
AQ2.1	10/20/08	partly cloudy	2	44 02 55.1, 123 03 03.7	300	30	4	N	Y	5%	Y	AQ2.1	near good potential nesting habitat, bank access limited
AQ2.2	10/20/08	partly cloudy	2	44 02 57.3, 123 03 07.5	500	40	3	N	Y	5%	Y	AQ2.2	hard to access banks, need basking structures, ducks
AQ2.3	10/20/08	partly cloudy	2	44 03 00.9, 123 03 09.0	300	35	3	Y	Y	10%	Y	AQ2.3	bank access difficult, basking poor
AQ2.4	10/20/08	partly cloudy	2	44 03 02.7, 123 03 10.9	400	30	3	N	Y	10%	Y	AQ2.4	bank access difficult, needs basking structures
AQ2.5	10/20/08	partly cloudy	2	44 03 05.3, 123 03 17.3	500	30	2	N	Y	10%	Y	AQ2.5	N bank private homes, needs basking structures, very undercut banks, hard to get out of water
AQ3.1	10/26/08	sunny, clear	3	44 03 06.2, 123 03 22.6	200	30	2	N	Y	5%	Y	AQ3.1	limited bank access, houses abut water
AQ3.2	10/26/08	sunny, clear	3	44 03 06.2, 123 03 25.8	400	30	3	N	Y	15%	Y	AQ3.2	very limited bank access, calm water

Aquatic Habitat Survey Form													
Site ID	Date	Weather	Canal Sgmt	GPS coord.	L (ft)	W (ft)	D (ft)	Bsk ?	Path ?	c.c.	nest ?	photo #	comments
AQ3.3	10/26/08	sunny, clear	3	44 03 06.1, 123 03 31.6	500	40	3	N	Y	15%	Y	AQ3.3	same as AQ3.2
AQ3.4	10/26/08	sunny, clear	3	44 03 08.0, 123 03 40.9	200	30	3	Y	Y	20%	Y	AQ3.4	minimal basking, blackberries on N bank, limited bank access
AQ3.5	10/26/08	sunny, clear	3	44 03 08.3, 123 03 41.4	200	30	3	Y	Y	15%	Y	AQ3.5	minimal basking, very limited bank access
AQP1.1	11/7/08	overcast	Patterson 1	44 03 21.7, 123 03 45.3	300	50	4	Y	Y	10%	Y	AQP1.1	ducks present, thick brush W, private property E, minimal basking
AQP2.1	11/7/08	overcast	Patterson 2	44 03 22.6, 123 03 45.5	400	40	3	Y	Y	25%	Y	AQP2.1	next to road, profuse log basking, banks severely overgrown, blackberries
AQP2.2	11/7/08	overcast	Patterson 2	44 03 29.1, 123 03 48.5	400	40	3	Y	Y	30%	Y	AQP2.2	garbage, oil slick, lots of log basking, access to NEP2.1, turtles seen here in past, thickly overgrown banks, blackberries
AQP2.3	11/7/08	overcast	Patterson 2	44 03 34.7, 123 03 48.5	400	30	3	Y	Y	15%	Y	AQP2.3	banks thickly overgrown, turtles might not be able to reach nesting habitat
AQP3.1	11/7/08	overcast	Patterson 3	44 03 35.3, 123 03 47.9	60	12	2	Y	Y	40%	Y	AQP3.1	overgrown banks, right next to road
AQ4.1	11/10/08	partly cloudy	4	44 03 05.4, 123 03 51.4	500	500	UNK	Y	Y	5%	Y	AQ4.1	"Turtle Pond", minimal basking, edges okay, popular with people
AQ4.2	11/10/08	partly cloudy	4	44 03 09.2, 123 03 53.5	400	20	3	N	Y	20%	Y	AQ4.2	fairly secluded, banks not too overgrown
AQ4.3	11/10/08	partly cloudy	4	44 03 11.4, 123 03 59.2	300	30	3	N	Y	40%	Y	AQ4.3	banks fairly accessible, some blackbernes
AQ4.4	11/10/08	partly cloudy	4	44 03 14.1, 123 04 01.8	200	25	3	N	Y	30%	Y	AQ4.4	some blackberries on S bank, nesting on N bank
AQ5.1	11/10/08	partly cloudy	5	44 03 15.9, 123 04 03.6	500	25	3	Y	Y	15%	Y	AQ5.1	minimal basking, blackberries on N bank

Aquatic Habitat Survey Form													
Site ID	Date	Weather	Canal Sgmt	GPS coord.	L (ft)	W (ft)	D (ft)	Bsk ?	Path ?	c.c.	nest ?	photo #	comments
AQ5.2	11/10/08	partly cloudy	5	44 03 18.5, 123 04 07.4	500	25	3	Y	Y	20%	Y	AQ5.2	minimal basking, small trees overhanging banks
AQ5.3	11/10/08	partly cloudy	5	44 03 23.2, 123 04 09.9	400	30	3	N	Y	5%	Y	AQ5.3	dogs swim here, good bank access
AQ5.4	11/10/08	partly cloudy	5	44 03 22.5, 123 04 15.0	400	30	3	Y	Y	20%	Y	AQ5.4	concrete run/dam, fast water on other side, herons
AQ5.5	11/10/08	partly cloudy	5	44 03 21.6, 123 04 20.2	300	30	3	Y	Y	40%	Y	AQ5.5	minimal basking, paths on both sides
AQ5.6	11/10/08	partly cloudy	5	44 03 20.6, 123 04 27.8	300	25	2	Y	Y	20%	Y	AQ5.6	minimal basking, fence at W end, S bank overgrown with blackberries
AQ6.1	11/16/08	cloudy	6	44 03 22.4, 123 04 29.7	150	25	2	Y	Y	10%	Y	AQ6.1a, AQ6.1b	by amphitheater, minimal basking, nesting at seg 5
AQ6.2	11/16/08	cloudy	6	44 03 23.8, 123 04 29.9	250	40	2	N	Y	5%	Y	AQ6.2	needs basking, easy bank access, by bridge and amphitheater
AQ6.3	11/16/08	cloudy	6	44 03 26.7, 123 04 31.7	250	40	2	Y	Y	10%	Y	AQ6.3	minimal basking (emergent branches), decent bank access, next to bridge and garden
AQ6.4	11/16/08	cloudy	6	44 03 29.0, 123 04 33.6	300	50	2	N	Y	10%	Y	AQ6.4	no basking, little refugia, tunnel and little fall at end
AQ6.5	11/16/08	cloudy	6	44 03 30.5, 123 04 38.0	100	50	3	N	Y	5%	Y	AQ6.5	no basking, little refugia, steep W bank
AQ6.6	11/16/08	cloudy	6	44 03 30.4, 123 04 38.8	200	50	3	Y	Y	5%	N	AQ6.6	minimal basking, some refugia on W bank, popular place with people
AQ6.7	11/16/08	cloudy	6	44 03 29.2, 123 04 41.2	200	50	3	N	Y	10%	Y	AQ6.7	ledge east bank, overgrown west bank, no basking, ducks

Nesting Habitat Survey Form													
Site ID	Date	Wea-ther	Canal Sgmt	GPS coord.	Use	L (ft)	W (ft)	D to Aq. (ft)	Slope (deg)	Asp	Composition	Photo #	Comments
NE1.1	10/20/08	partly cloudy	1	NA	UNK	40	20	1	30	NE	45% soft soil, 30% small shrubs (incl. blackberries), 25% grass/herbs	NE1.1	site of invasives removal?, webbing on ground, not a lot of sunlight, near AQ1.4
NE1.2	10/20/08	partly cloudy	1	NA	UNK	25	20	1	30	NE	40% soil, 40% small shrubs, 20% grass/herbs	NE1.2	like NE1.1, removal site
NE1.3	10/20/08	partly cloudy	1	44 02 54.2, 123 02 57.0	UNK	20	20	1	35	NNW	60% shrubs, blackberries, 10% soil, 30% grasses	NE1.3	needs blackberries removed, right next to path
NE2.1	10/20/08	partly cloudy	2	44 02 54.4, 123 03 04.0	UNK	100	20	1	20	N	80% grass, 20% soil	NE2.1	good, but right next to path, grass thick
NE2.2	10/20/08	partly cloudy	2	44 02 56.0, 123 03 03.9	UNK	500	75	4	15	S	90% grass/herbs, 10% soil	NE2.2	separated from water by band of tall, thick vegetation, too grassy, next to path
NE2.3	10/20/08	partly cloudy	2	44 02 57.1, 123 03 07.3	UNK	100	20	1	10	E	95% grass, 5% soil	NE2.3	grassy, right next to path
NE2.4	10/20/08	partly cloudy	2	44 03 02.7, 123 03 10.5	UNK	150	15	1	5	NE	90% grass, 10% soil	NE2.4	grassy, right by path
NE2.5	10/20/08	partly cloudy	2	44 03 05.0, 123 03 17.3	UNK	300	20	15	10	NNE	100% grass	NE2.5	too grassy, between paved and chip paths
NE3.1	10/26/08	sunny, clear	3	44 03 05.7, 123 03 33.6	UNK	100	60	30	0	N/A	90% grass, 3% soil, 7% shrubs	NE3.1	could be good with some grass removal, right next to path
NE3.2	10/26/08	sunny, clear	3	44 03 06.9, 123 03 39.0	UNK	250	150	25	0	N/A	95% grass, 5% shrubs	NE3.2	make soil more accessible, right next to path

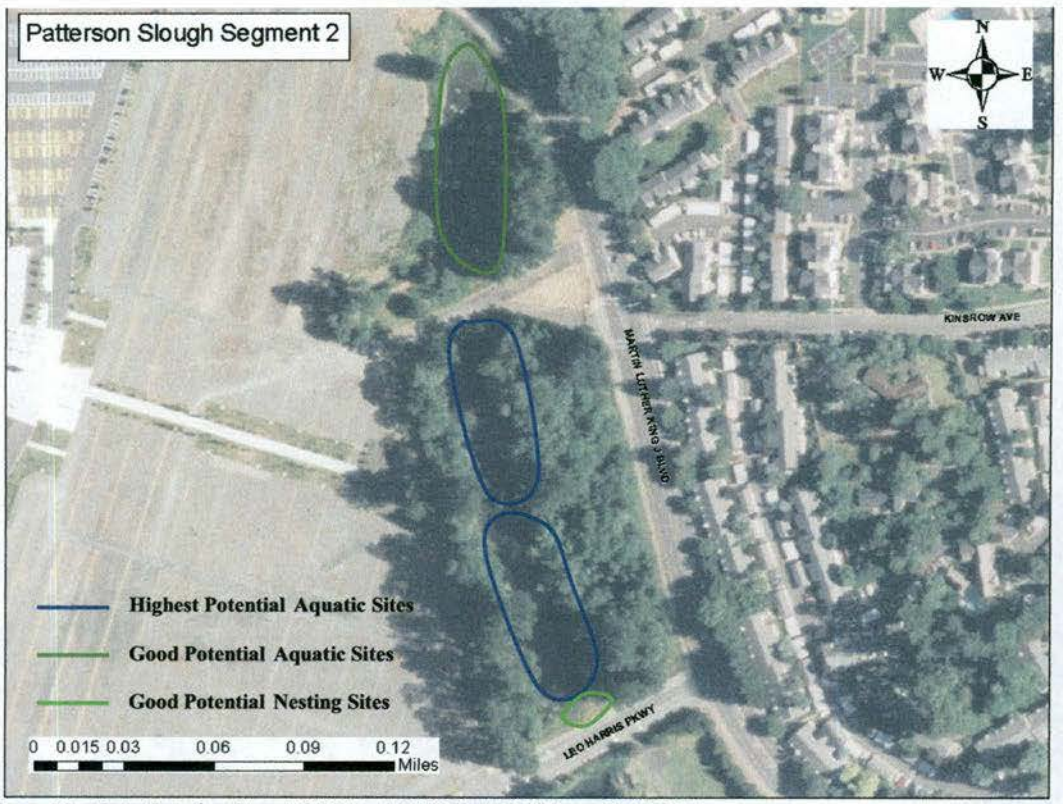
Nesting Habitat Survey Form													
Site ID	Date	Wea-ther	Canal Sgmt	GPS coord.	Use	L (ft)	W (ft)	D to Aq. (ft)	Slope (deg)	Asp	Composition	Photo #	Comments
NEP1.1	11/7/08	over-cast	Patter-son 1	44 03 21.8, 123 03 44.7	UNK	40	10	10	60	W	95% soil, 5% leaves	NEP1.1	private property, steep cut below lawn, geese nearby
NEP2.1	11/7/08	over-cast	Patter-son 2	44 03 22.4, 123 03 45.9	UNK	80	20	0	30	NW	80% grasses, 20% shrubs	NEP2.1	right next to road, thick grass, good sun exposure
NEP2.2	11/7/08	over-cast	Patter-son 2	44 03 33.7, 123 03 47.1	UNK	300	20	15	0	N/A	80% grasses, 10% leaves, 10% soil	NEP2.2	hard to access, right next to road, grassy, not ideal sun exposure
NEP3.1	11/7/08	over-cast	Patter-son 3	44 03 35.7, 123 03 48.3	UNK	30	25	20	0	N/A	90% grass, 10% soil	NEP3.1	grassy area in tailgating parking lot, not very good, gravel under grass
NE4.1	11/10/08	partly cloudy	4	44 03 04.9, 123 03 51.2	UNK	400	50	2	5	N	90% grass, 2% trees, 8% rocky soil	NE4.1	path bisects site, path between water and most of site, on S bank
NE4.2	11/10/08	partly cloudy	4	44 03 09.6, 123 03 55.7	UNK	25	20	0	25	SSW	50% grass, 40% blackberries/shrubs, 10% soil	NE4.2	needs blackberry removal, decent sun exposure, fairly secluded N bank
NE4.3	11/10/08	partly cloudy	4	44 03 10.3, 123 03 57.0	UNK	30	20	0	25	SSW	70% grass, 25% shrubs, blackberries, 5% soil	NE4.3	needs shrub removal, good sun exposure, fairly secluded N bank
NE4.4	11/10/08	partly cloudy	4	44 03 11.4, 123 03 59.6	UNK	400	50	20	0	N/A	80% grass, 20% trees/bushes	NE4.4	on opposite side of path from water, moderate sun exposure
NE4.5	11/10/08	partly cloudy	4	44 03 14.2, 123 04 01.9	UNK	40	20	0	15	SW	20% soil, 60% short grass, 20% tall grass	NE4.5	good site, but near biking race track, moderate sun exposure

Nesting Habitat Survey Form													
Site ID	Date	Wea-ther	Canal Sgmt	GPS coord.	Use	L (ft)	W (ft)	D to Aq. (ft)	Slope (deg)	Asp	Composition	Photo #	Comments
NE5.1	11/10/08	partly cloudy	5	44 03 16.0, 123 04 04.3	UNK	500	200	30	0	N/A	90% grass, 10% trees/bushes	NE5.1	right next to path, path separates nesting from water
NE5.2	11/10/08	partly cloudy	5	44 03 18.1, 123 04 08.0	UNK	80	20	0	15	SW	5% trees, 80% grass, 15% rocky soil	NE5.2	north bank, moderate sun exposure, maybe too many trees
NE5.3	11/10/08	partly cloudy	5	44 03 23.2, 123 04 10.3	UNK	40	20	0	20	SSW	95% grass, 5% soil	NE5.3	busy place, next to road/dog park, thick grass
NE5.4	11/10/08	partly cloudy	5	44 03 20.9, 123 04 26.5	UNK	80	15	0	10	S	95% grass, 5% blackberries/shrubs	NE5.4	moderate sun exposure, easy bank access, thick grass
NE6.1	11/16/08	cloudy	6	44 03 25.7, 123 04 32.1	UNK	150	30	0	30	E	90% grass, 5% blackberries, 5% tall grass	NE6.1	too lawn-like, moderate sun exposure, shade from some trees
NE6.2	11/16/08	cloudy	6	44 03 27.4, 123 04 31.9	UNK	200	50	0	0	N/A	5% trees, 10% rocky dirt, 85% grass/shrubs	NE6.2	too grassy, very exposed to people, geese
NE6.3	11/16/08	cloudy	6	44 03 28.7, 123 04 33.9	UNK	300	150	20	0	N/A	5% shrubs, 5% rocky dirt, 90% grass	NE6.3	exposed to people, grass too thick
NE6.4	11/16/08	cloudy	6	44 03 20.3, 123 04 36.7	UNK	100	75	0	15	SW	10% soil, 90% grass/herbs	NE6.4	right next to path, grassy, between two aquatic sites
NE6.5	11/16/08	cloudy	6	44 03 25.5, 123 04 45.2	UNK	200	100	100	5	W	10% trees/bushes, 90% grass	NE6.5	too grassy, across two paths, too many people

Highest and Good Potential Aquatic and Nesting Sites

Sites AQ1.4 (South) and AQ1.5 (North).

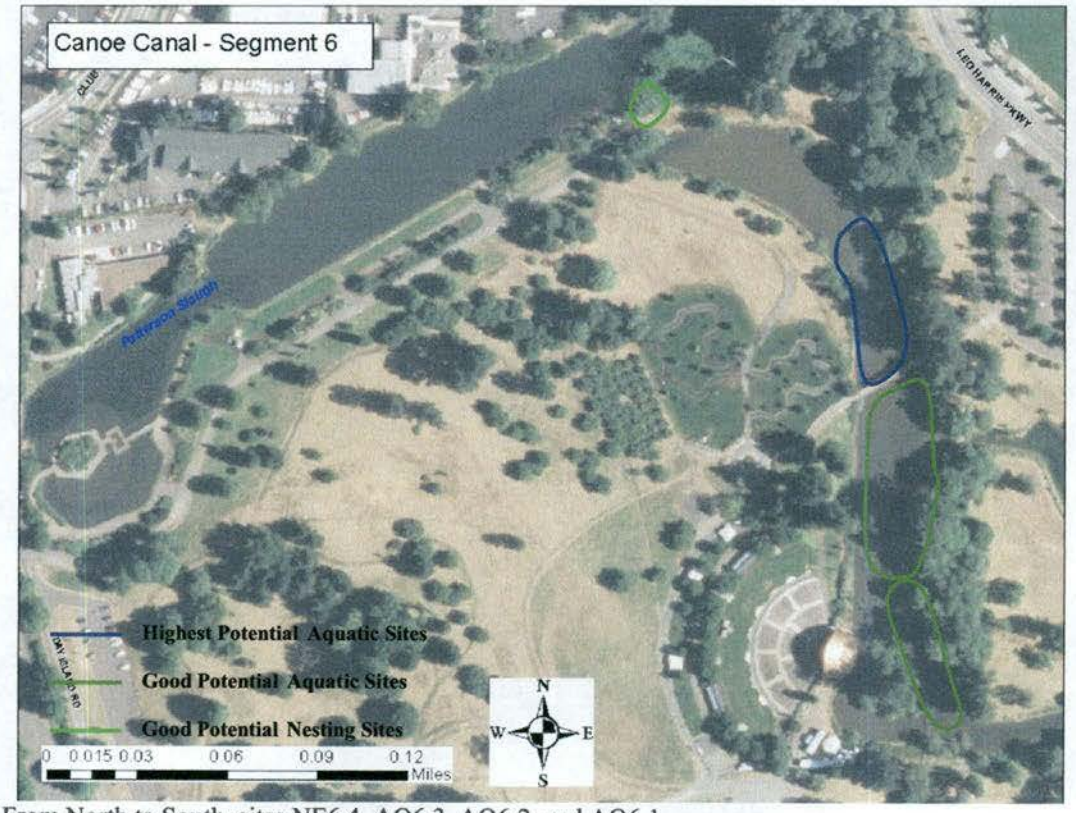
Sites NE2.1 (South), NE2.3 (center), and NE2.4 (North).



From North to South, sites AQP2.3, AQP2.2, AQP2.1, and NEP2.1.

From left to right, sites AQ4.4, NE4.5, AQ4.2, NE4.3, NE4.2, and AQ4.1.

Sites AQ5.2 (West) and NE5.2 (East).



From North to South, sites NE6.4, AQ6.3, AQ6.2, and AQ6.1.

Site Photos

Highest potential aquatic site AQP2.2 (Pheil, 2008).

Highest potential nesting site NE4.5 (Pheil, 2008).

References

Adamus, PR. 2003a. "Distribution of western pond turtle populations in the Willamette River Basin, Oregon". Adamus Resource Assessment, Inc. Corvallis, Oregon.

Adamus, PR. 2003b. "Potential for conservation and restoration of western pond turtle habitat in the Willamette River Basin, Oregon". Adamus Resource Assessment, Inc. Corvallis, Oregon.

Alvarez, JA. 2006. "Use of artificial basking substrate to detect and monitor Pacific pond turtles (*Emys marmorata*)". *Western North American Naturalist* 66(1): 129 – 131.

Bettelheim, MP. 2004. "The western pond turtle, *Clemmys marmorata*… a natural history of the species". Walnut Creek, California 94596.

Buskirk, J. 2002. "The western pond turtle, *Emys marmorata*". *Radiata*, 11 (3): 3 –30.

Ernst, CH., Lovich, JE., and Barbour, RW. Turtles of the United States and Canada. Washington: Smithsonian Institution Press, 1994.

Eugene Parks and Open Space. http://www.eugeneor.gov/portal/server.pt?space =CommunityPage&control=SetCommunity&CommunityID=678&PageID=156 7. Accessed 1 February 2009.

Friends of Buford Park and Mt. Pisgah. http://www.bufordpark.org/. Accessed 25 March 2009.

Hays, DW., McAllister, KR., Richardson, SA., and Stinson, DW. 1999. "Washington state recovery plan for the western pond turtle". Washington Department of Fish and Wildlife. Olympia, Washington. August 1999.

Holland, DC. 1994. "The western pond turtle: habitat and history: final report." Portland, OR (P.O. Box 3621, Portland 97208-3621): The Bonneville Power Administration.

Holte, DL. 1998. "Nest site characteristics of the western pond turtle, *Clemmys marmorata*, at Fern Ridge Reservoir, in west central Oregon". M.A. Thesis, Oregon State University.

Jones, C. 2007. "South meadow phase two completed." *The Rookery: Newsletter of the Friends of Buford Park and Mt. Pisgah*. Fall 2007. Eugene, OR (P.O. Box 5266, Eugene 97405).

Leatham, TM. 1994. "1993 Study of the western pond turtle *Clemmys marmorata* at Kirk Park, Fern Ridge Reservoir, Oregon". Report to U.S. Army Corps of Engineers.

Moll, D. and Moll, E. The Ecology, Exploitation, and Conservation of River Turtles. New York: Oxford University Press, 2004.

Oregon Department of Fish and Wildlife. 2008. "Oregon Department of Fish and Wildlife sensitive species: frequently asked questions and sensitive species list, *organized by taxon*". http://www.dfw.state.or.us/wildlife/diversity/species/docs/SSL_by_taxon.pdf. Accessed 21 March 2009.

Oregon Zoo. "Western pond turtles – *Clemmys marmorata*". Oregon Zoo, Portland, OR. http://www.oregonzoo.org/Conservation/westernpondturtle.htm. Accessed 25 March 2009.

Spinks, PQ. and Shaffer, HB. 2005. "Range-wide molecular analysis of the western pond turtle (*Emys marmorata*): cryptic variation, isolation by distance, and their conservation implications". *Molecular Ecology* 14: 2047 – 2064.

Todd, LL. 1998. "The ecology and habitat use of the northwestern pond turtle (Clemmys marmorata marmorata) in a lake in southwestern Oregon". M.S. Thesis, Portland State University.

Willamalane Park and Recreation District, Springfield, OR. http://www.willamalane.org/. Accessed 1 February 2009.

Woodland Park Zoo, Partners for Wildlife, and Pacific Northwest Alliance. 2007. "Western pond turtle recovery project". Woodland Park Zoo Conservation Report. Seattle, Washington.