



Vancouver National Historic Reserve Amphibian Inventory 2002-2003

Natural Resource Technical Report NPS/NCCN/NRTR—2013/732



ON THE COVER

Examples of aquatic habitats sampled for amphibians at Fort Vancouver National Historic Reserve
Photograph by: NPS

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Executive Summary

This document details amphibian inventories conducted in Fort Vancouver National Historic Site and the greater Vancouver National Historic Reserve. The Vancouver National Historic Reserve was established by Congress in 1996 in recognition of its national historic and cultural significance. The Reserve includes 366 acres of lands in federal, State, and the City of Vancouver ownership. The Reserve was established as a partnership between the National Park Service through Fort Vancouver National Historic Site (FOVA), the City of Vancouver, the US Army Reserve, and the Washington State Department of Archeology and Historic Preservation for the management, preservation, and protection of the Historic Reserve. Fort Vancouver National Historic Site includes 209 acres. Amphibian inventories were conducted in FOVA and on other lands within the Reserve, at the request of the FOVA Superintendent.

These inventories were part of a larger effort to document species presence at five North Coast and Cascades Network (NCCN) parks: Mount Rainier National Park (MORA), Ebey's Landing National Historical Reserve (EBLA), Lewis and Clark National Historical Site (LEWI), Fort Vancouver National Historic Site (FOVA), and San Juan Island National Historical Park (SAJH). Four of the parks (EBLA, LEWI, FOVA, and SAJH) had incomplete amphibian lists based on limited or undocumented data. Our primary goal was to meet the National Park Service Inventory and Monitoring program goal to better assess the status of amphibian species listed as "expected" in the parks and to verify the occurrence of 90% of these species. Species occurrences were documented or verified by written records and photographs; no specimens were collected in this inventory. Prior to this inventory, FOVA had no verified list of amphibians and reptiles occurring in the park. Additional searches of museum specimens and state records have not been completed.

Our primary goal for FOVA was to search for the presence of expected species: *Ensatina* (*Ensatina eschscholtzii*), western red-backed salamander (*Plethodon vehiculum*), northern red-legged frog (*Rana aurora*), Oregon spotted frog (*Rana pretiosa*), American bullfrog (*Lithobates catesbeianus*), Pacific treefrog (*Pseudacris regilla*), and western toad (*Anaxyrus boreas*). At the request of the FOVA Superintendent, the inventory was expanded to include the Reserve and three additional species expected to occur within the Reserve were added: northwestern salamander (*Ambystoma gracile*), long-toed salamander (*Ambystoma macrodactylum*), and rough-skinned newt (*Taricha granulosa*).

Inventories of reptiles were not targeted during this project; however they were documented when encountered.

This report provides an updated list of amphibian species present within the Reserve, describes the survey methods and results, and a discussion on each species detected. The results include a summary of species documented at each survey site, information on species life stage and habitat, and maps showing the spatial distributions of amphibians in the park. The appendices include detailed information from the surveys. Microsoft EXCEL spreadsheets that provide records documenting sampling events, ArcMap GIS themes depicting locations, slide photographs of sites surveyed, and digital (and slide) voucher photos for species documented have been submitted to the NCCN Data Manager.

Voucher specimens were not collected for this project, but photographs were taken to document species occurrence.

Thirteen surveys were conducted within the Reserve. Amphibian detections were made on the east side of the Reserve near the City of Vancouver Water Resources Education Center Building. However, no amphibians or reptiles were found within the 209 ac of FOVA. Three out of ten species (Ensatina, Pacific treefrog, and the long-toed salamander) expected to inhabit the Reserve were observed. Two species reported as potentially occurring in the area of FOVA by Benvenuti (1993), (western toad and western red-backed salamander), were not detected. The common garter snake (*Thamnophis sirtalis*) was also documented in the Reserve.

The area between the Fort and the City of Vancouver Water Resources Education Center Building is a highly developed industrial area. Most of the river front along the Columbia River is paved and diked. The river front along the Water Resources Education Center complex has suitable habitat for amphibians, but is subject to extreme water level fluctuations from the management of upstream dams on the Columbia River.

Species absence is extremely difficult to determine; thus, some species recorded historically or occasionally but not detected during our survey efforts may still be present in the park. Additional surveys of targeted habitats and species should be conducted.

In addition to this inventory, a separate project was funded, as part of the North Coast and Cascades Network (NCCN) Inventory and Monitoring (I&M) Program amphibian inventories, to provide a network wide amphibian database (Galvan et al. 2005), including North Cascades and Olympic National Parks. We developed this database by consolidating existing network databases containing information relevant to amphibian distributions into one functional relational database, including data resulting from this inventory. The consolidated database describes the locations of amphibians in various life stages identified in pond, stream, and terrestrial surveys conducted within the NCCN. The database includes fields relevant to the study years, park names, survey types, coordinates, elevations, scientific and common names, and life stages. The park staff and the NCCN data managers will assume maintenance responsibilities for the database, including updating it to ensure compliance with NPS data management mandates. Metadata for the database was also included.

Acknowledgments

Funding for this inventory was provided by the NPS's Inventory and Monitoring Program and Mount Rainier National Park.

We thank Matt Grove and Brian Hasebe for their field assistance. We thank Cory Samia, City of Vancouver, for her assistance in locating field sites. We thank Robert Hoffman and Mark Huff for their review of this document and comments made to improve it. We thank Mike Adams for his technical assistance in developing the amphibian protocols for the NCCN inventories. We also thank Natalya Antonova for assistance with maps and Lise Grace for assistance with formatting and editing

Introduction

The status of amphibian populations has long been a concern in the Pacific Northwest (USDA Forest Service and DOI Bureau of Land Management 1994, Bury et al. 1980, Bury 1999). Habitat requirements of amphibians in late-successional forests of the Pacific Northwest have received some attention from the U.S. Forest Service over the past 15 years but further work is needed to better understand how habitat variation affects population viability. Because amphibian species are associated with riparian systems, understanding the relationships between riparian management and amphibian population dynamics is a high priority. In addition, further work is needed to better understand the population dynamics of rare and locally endemic species.

Amphibians are important members of terrestrial and aquatic ecosystems because they occupy key trophic positions in food webs. As adults they can be top carnivores, and as eggs, larvae or juveniles, they may be the major food source of many other species including birds, mammals, fish, and invertebrates. In some forest ecosystems, amphibians may comprise the major component of the vertebrate biomass (Burton and Likens 1975, Bury 1988). Moreover, amphibians are good “bioindicators” of environmental stress because of their complex life histories. Amphibian declines may be an early warning signal that other organisms also may be in danger of decline or extinction (Bury et al. 1980, Blaustein and Wake 1995, Phillips 1990, Wyman 1990, Wake 1991).

In 1994, Mount Rainier National Park (MORA), North Cascades National Park (NOCA), and Olympic National Park (OLYM) identified the lack of information on amphibian species distributions and abundances as the highest priority issue to address cooperatively with the newly created U.S. Geological Survey Biological Resources Division (BRD). The National Park Service (NPS) and BRD began inventories of aquatic breeding amphibians in these parks in 1996. The inventories continued through 1999, and resulted in the first published parkwide survey of amphibians for MORA (Tyler et al. 2003), NOCA (Holmes and Glesne 1997, Holmes and Glesne 1998, Holmes and Glesne 1999, and Rawhouser et al. 2009), and for OLYM (Bury and Adams 2000). Vital Signs workshops for several of the NCCN parks identified amphibians as a high priority taxonomic group for long-term ecological monitoring for assessing the health of park ecosystems.

Assessments of the status of amphibian populations in the Pacific Northwest have been difficult to complete because the number of long-term inventory and monitoring efforts has been limited and few if any comparable data sets are available (Olson and Leonard 1997). Yet, human-related activities have disturbed many amphibian habitats (Fellers and Drost 1993, Blaustein and Wake 1995, Bury 1999); for example, fish stocking, logging practices, and alteration of streams, wetlands, and riparian areas have potentially had widespread effects on amphibian communities.

The primary objective of this inventory was to document species presence in FOVA because information on amphibian and reptile species presence and distribution in the park is limited. Our overarching goal set by the I&M Program was to document the presence of certain vertebrate species groups in national parks, including amphibians to the 90% verification level.¹ State and federal species documentation lists, published references and local expertise were used to

¹ 90% of the species expected to be present in the park have been documented.

determine which species are expected to occur in the park. Prior to this inventory, FOVA had no documentation of amphibians or reptiles in the park. We expanded our surveys to include the entire Reserve, at the request of the FOVA Superintendent.

Study Area

Fort Vancouver National Historic Site (FOVA) is located on the Columbia River, near Vancouver, Washington and across the river from Portland, Oregon. Its 209 ac were protected in 1948, as well as in subsequent legislation, to preserve and interpret the Hudson's Bay Company fort, the settlement of Oregon Country, and the establishment of Fort Vancouver, the first US military post in the Pacific Northwest (Figure 1). Historically, the natural landscape of the Columbia River's north shore was a mosaic of plains, coniferous forests, streams and lakes, with the Cascade Range visible in the distance (NPS 2008). The natural environment of the site has been heavily impacted over time by the Hudson's Bay Company beginning in 1824, US Army development beginning in 1849, and by urbanization of the Portland–Vancouver metropolitan area. As a result, only vestiges of the pre-contact prairie and Columbia River habitat remain. Today the site is comprised of: 62.9 ac of maintained historic landscapes with ornamental plantings and orchards, 83.3 ac of developed land (airport and railroads), and 23.8 ac of disturbed uplands and riparian areas. The north shore of the Columbia River forms the south boundary of FOVA, approximately 3600 ft. in length, at the mean high waterline. No other surface watercourses exist within the park. The vegetation along the river historically consisted of native riparian trees and shrubs. Today, the majority of the Fort Vancouver waterfront consists of native riparian vegetation, masses of Black Cottonwoods, willows, and alders. The uplands contain several aggressive exotic plant species and 9.3 ac of disturbed area in the Columbia River riparian corridor. The Fort, the heart of the Hudson's Bay Company operations, was located on a low-lying river plain called Fort Plain that was six miles upriver from the confluence of the Columbia and Willamette Rivers.

The Vancouver National Historic Reserve was established by Congress in 1996 in recognition of its national historic and cultural significance. The 366 ac site established a partnership between the National Park Service through Fort Vancouver National Historic Site, the City of Vancouver, the US Army Reserve, and the Washington State Department of Archeology and Historic Preservation for the management, preservation, and protection of the Historic Reserve (Figure 1). In 1998, the Vancouver National Historic Reserve Trust was established as the official nonprofit organization for the Historic Reserve. The City of Vancouver's Water Resources Education Center, also a partner in the Reserve, has a mission to teach people of all ages how to better care for and make wise decisions about water. The Water Resources Education Center's role in the Reserve is to interpret its natural history.

In order to properly preserve and interpret FOVA's full story, park management desires to re-establish a portion of the site's natural area to show the landscape as it was upon arrival of Euro-Americans in the early 19th century. The natural environment played a key role in the culture of native people and in this site being the place where the Fort was originally established.

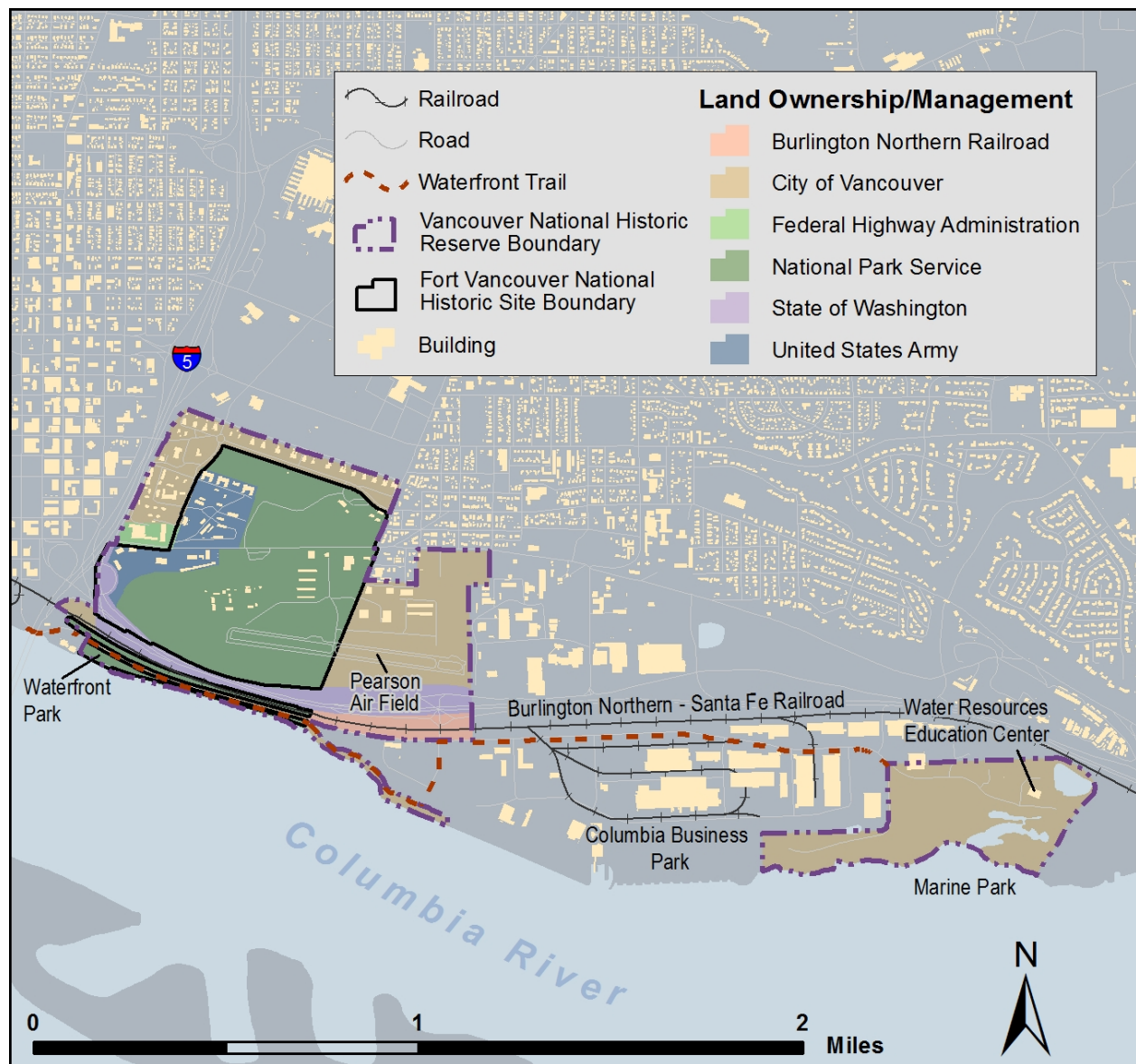


Figure 1. Map of Fort Vancouver National Historic Site and the Vancouver National Historic Reserve (NPS 2008).

Methods

The primary objective of the surveys at FOVA was to inventory and confirm the presence of amphibian species, and to document reptiles incidental to amphibian surveys. Aquatic and terrestrial surveys were conducted during a narrow period of time, and incidental observations were recorded. In 2002, surveys were attempted in early spring, but no amphibians were detected and no suitable amphibian habitat was found within the park boundaries. At the request of the FOVA Superintendent, the inventory was expanded to lands within the Vancouver National Historic Reserve (Figure 1). Two surveys were conducted within the Reserve in June 2002, and additional targeted wetlands were searched within the Reserve in spring 2003. Cory Samia, with the City of Vancouver, assisted us in locating suitable habitat to survey within the 40 ac of riparian wetlands and 7 ac of depressional wetlands owned by the City.

See Figure 2 for a map of samples sites from 2002-2003, and Table 1 for a list of sample sites.

Table 1. Survey sites in Vancouver National Historic Reserve.

Site ID	Location Description	Date	UTM E	UTM N	Elevation (ft)
FV1	Wetland E of Vancouver Aquatic Ed. Center	19-Jun-02	529366	5051167	35
FV2	Columbia River Front	19-Jun-02	525939	5051677	20
FV3	South of main visitor trail, South of Vancouver Aquatic Ed Building	20-Jun-02	529682	5051080	20
FV4	300m nw of historic fort - maintenance boneyard	07-Apr-03	526089	5052070	
FV5	Depressional wetland ne of h2o education center	08-Apr-03	529881	5051186	15
FV6	Near water treatment plant	08-Apr-03	529853	5051149	15
FV7	West of FV10, deciduous forest	08-Apr-03	529851	5050994	0
FV8	Depressional pond 200 se of pond Water Resources Education Center	08-Apr-03	529827	5051059	15
FV9	200m e of Water Resources Education Center building along sidewalk near stream bridge	09-Apr-03	529877	5051099	
FV10	Small stream draining depressional wetland flowing s of h2o ed. Center	09-Apr-03	529874	5051001	10
FV11	Slough immediately s. Water Resources Education Center	09-Apr-03	529696	5050982	15
FV12	Pond on west side of Water Resources Education Center reserve	09-Apr-03	529406	5051015	12
FV13	water treatment plant	09-Apr-03	529928	5051012	20

Aquatic Surveys

Aquatic habitats included ponds, lakes, and wetland complexes. Aquatic habitats were described and surveyed with visual searches conducted according to modified protocols developed by Dr. Michael J. Adams, USGS-BRD (see Appendix A), under the Amphibian Research and Monitoring Initiative (ARMI). Visual surveys were conducted by a minimum of two people. Surveyors walked the perimeter of the wetland, stopping every 10 m or at 20 evenly spaced stations to scan for embryos and larvae. One person waded and the other person walked on shore. Dip net sweeps were made to capture individuals to ensure definitive species identification. Identified animals were released at the point of capture. Cover items were moved to check for larvae. Vegetated areas and other habitats likely to harbor embryos and larvae were also

searched. Aquatic habitat survey site characteristics and water quality descriptions for aquatic breeding sites are presented in Appendix C-1 and C-2.

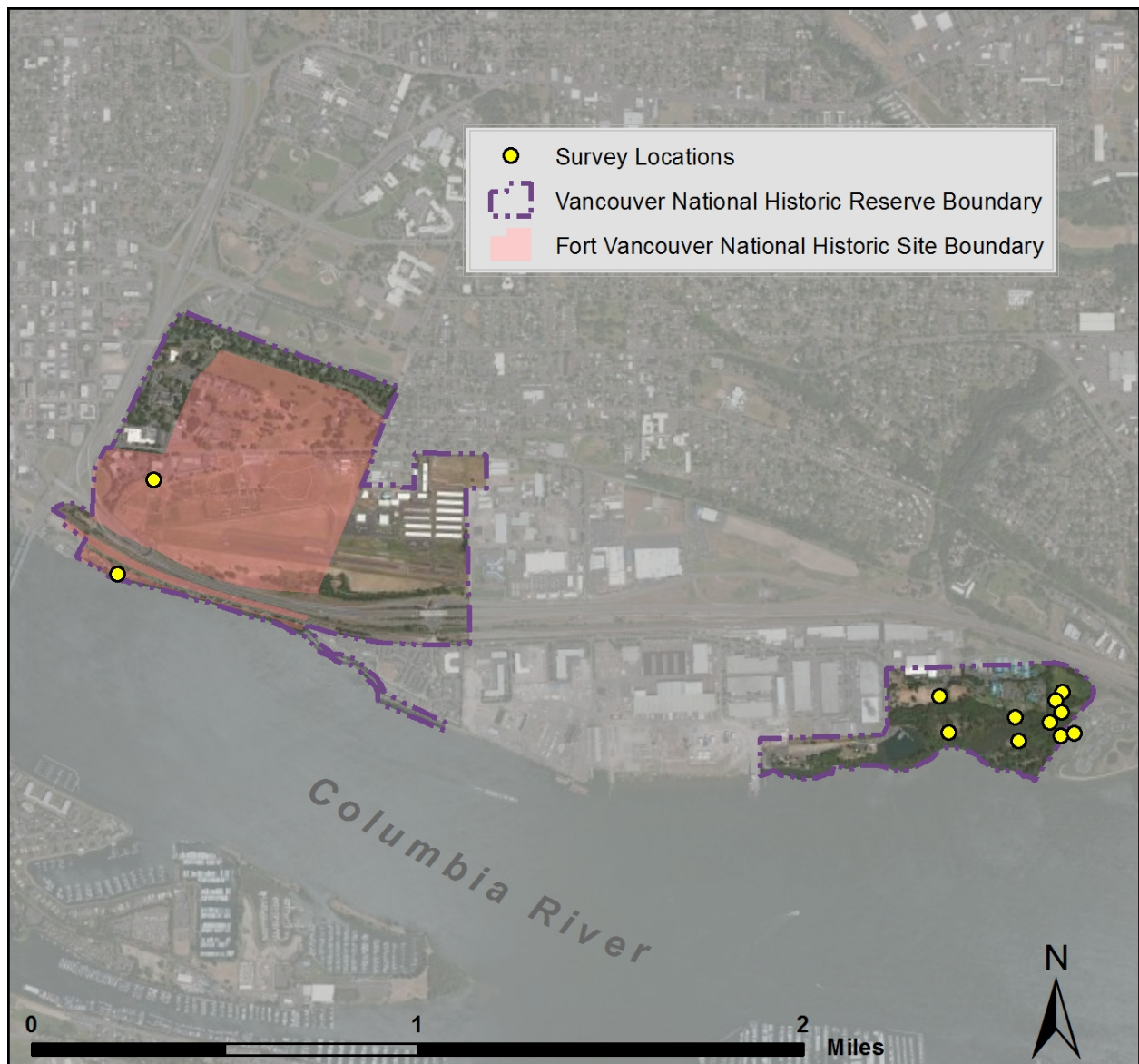


Figure 2. Vancouver National Historic Reserve amphibian survey sites.

Water quality

Water temperature and conductivity at aquatic breeding sites were documented at five and four sites, respectively (Appendix C-2). Air temperature was also measured. A self-calibrating Hach™ 44600 portable meter was used to measure conductivity. Electrodes were triple-rinsed with de-ionized water between uses. Air and water temperatures were measured with a National Institute of Standards and Technology (NIST) stem thermometer. Air temperature was measured in the shade and one m above ground. Water temperature was measured in the sun and ten cm below the surface of the water.

Terrestrial Surveys

Land ownership maps and wetland maps were searched for all suitable habitats for which a safe and legal access route could be found. Personnel at the Water Resources Education Center assisted in determining the final sites to survey. Terrestrial surveys were conducted for three survey sites with suitable habitat for terrestrial breeding species. A plot with a 30m radius was non-randomly established in the most suitable habitat. Where possible, the center of each plot was at least 75 m from any forest edge. Searches for amphibians were made within these plots for a minimum of 30 min. Search time was doubled or tripled in some cases if amphibian habitat was spatially complex. Additional details on terrestrial survey protocols are provided in Appendix B.

Field habitat measurements were taken to aid in future amphibian studies but detailed analysis of these data was beyond the scope of this inventory. Field habitat measurements were recorded from the center of each plot and included: the primary forest association series canopy cover to the nearest 20%; slope and aspect; presence of streams, seeps, or talus; the relative percent cover of each overstory species present and any deciduous trees present; size class categories for the percent of stems from each tree species; and the absolute cover of understory components for the three most dominant species in each category using six cover categories and the percent cover of grasses, mosses, and large organic debris (Appendix D, Table 1). Course woody debris was recorded in four transects for three of the survey sites (FV6, FV7, FV13). The distance (cm) that a line was in contact with down wood was recorded along with the decay class for each object.

Each plot was searched for a minimum of 30 worker-minutes during daylight (> one hour after sunrise and before sunset). A search consisted of workers methodically visually searching for amphibians over the entire area of the plot and looking under as much loose wood, bark, or rock that could be lifted and restored to a condition relatively similar to its original state.

Night time surveys, using a spotlight, were conducted to verify non-detection of expected species that were not observed during daytime searches of sites.

Incidental surveys

When unmapped amphibian habitat was encountered, workers surveyed these areas and recorded: the area and amount of time the area was searched; general habitat description; location coordinates; general weather conditions; species detected, life stage, and snout-vent length (Appendix D, Table 1). Incidental surveys were also used in areas of thick brush such as Himalayan Blackberry and Wild Rose.

Voucher Specimens

All amphibians encountered were recorded on data sheets. Photographs depicting key identification characteristics were taken for previously unconfirmed species. No voucher specimens were collected but voucher photographs were taken for species observed.

Results

A total of 87,231 m² in 1,100 search-minutes were surveyed within the Vancouver National Historic Reserve. We detected three amphibian species and one reptile species within the Reserve. However, no amphibian or reptile species were detected within FOVA. Specific habitat types for species detected within the Reserve are presented in Table 2. A summary of species occurrence, location, search area and time, and type of survey conducted is presented in Table 3. Spatial distributions of amphibians and reptiles detected in the Reserve are presented in Figures 3 to 5.

Table 2. Summary of habitat types searched and species detected in the Vancouver National Historic Reserve.

Site ID	Species Code ¹	Habitat Type
FV 1	PSRE	Depressional wetland, reed canary grass, cattails
FV 2	NONE	Concrete river front
FV 3	NONE	Deciduous forest, flooded by river
FV 4	NONE	Wood piles/ maintenance yard
FV 5	AMMA	Meadow/ wetland/ seasonal/ altered
FV 5	PSRE	Meadow/ wetland/ seasonal/ altered
FV 5	THSI	Meadow/ wetland/ seasonal/ altered
FV 6	ENES	Deciduous/ riparian/ class 4 log
FV 7	AMMA	Deciduous /bark slab
FV 8	FROG	Lake/ pond/ permanent/ natural
FV 9	AMMA	Small stream/ class 3 ² log
FV 10	PSRE	Small stream/ permanent/ natural
FV 11	NONE	Oxbow/ backwater/ permanent/ natural
FV 12	PSRE	Lake/ pond/ permanent/ natural
FV 13	NONE	Deciduous/ riparian

¹ PSRE = Pacific treefrog, AMMA= long-toed salamander, THSI = common garter snake, ENES = Ensatina, FROG = unknown frog species

²Decay classes, Appendix D, Table 2

Table 3. Amphibian search area and time, survey type and species detected for surveys conducted in Vancouver National Historic Reserve.

Field Site ID	Date	Location Description	UTM-N	UTM-E	Area Searched (m2)	Search time (min.)	Survey Type	Species	Stage	Count
FV1	19-Jun-02	Wetland E of Vancouver Aquatic Ed Center	529366	5051167	100	120	Incidental Terrestrial	PSRE	A	1
FV2	19-Jun-02	Columbia River Front	525939	5051677	50	60	Incidental Terrestrial	None		
FV3	20-Jun-02	South of main visitor trail, South of Vancouver Aquatic Ed Building	529682	5051080	1000	240	Incidental Terrestrial	None		
FV4	7-Apr-03	300m NW of historic Fort - maintenance bone yard	526089	5052070	25	45	Incidental	None		
FV5	8-Apr-03	Depressional wetland NE of Water Resources Education Center	529881	5051186	30000	180	Aquatic	PSRE AMMA THSI	A L A	1 10 1
FV6	8-Apr-03	Near water treatment plant	529853	5051149	2827	35	Terrestrial	ENES	A	1
FV7	8-Apr-03	Deciduous forest west of FV10	529851	5050994	2827	30	Terrestrial	AMMA	A	2
FV8	8-Apr-03	Depressional pond 200 SE of pond Water Resources Education Center	529827	5051059	1500	50	Aquatic	Frog spp. (adult)		
FV9	9-Apr-03	Along sidewalk near stream bridge	529877	5051099			Incidental	AMMA	A	1
FV10	9-Apr-03	Small stream draining depressional wetland flowing south of Water Resources Education Center	529874	5051001	450	120	Aquatic	PSRE	A	5
FV11	9-Apr-03	Small stream draining depressional wetland flowing S of Water Resources Education Center	529696	5050982	40000	80	Aquatic	None		
FV12	9-Apr-03	Pond on west side of Water Resources Education Center reserve	529406	5051015	5625	100	Aquatic	PSRE	A	1
FV13	9-Apr-03	Water Treatment Plant	529928	5051012	2827	40	Terrestrial	None		

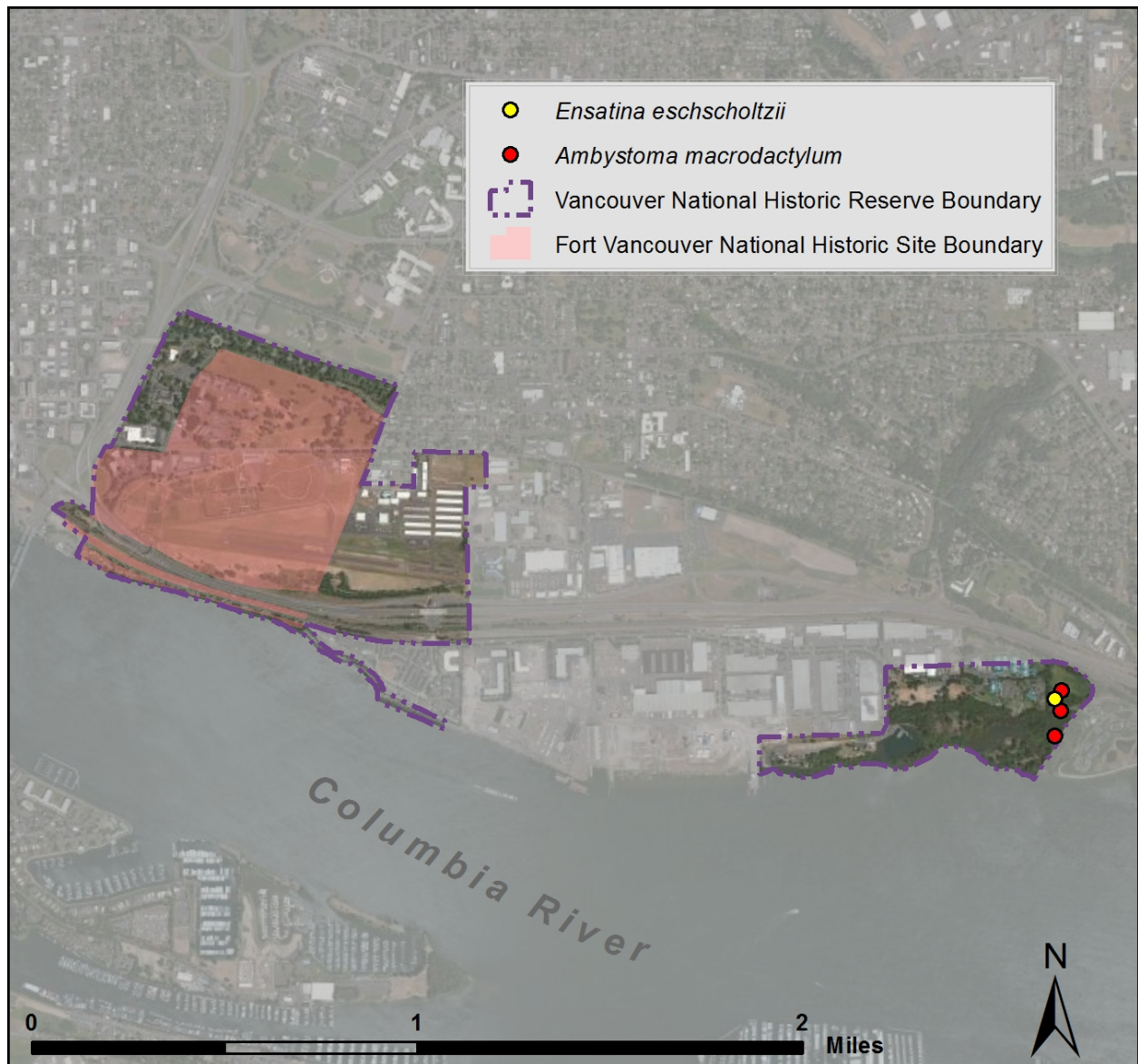


Figure 3. Observations of *Ensatina* (*Ensatina eschscholtzii*) and long-toed salamanders (*Ambystoma macrodactylum*) based on amphibian surveys conducted at Vancouver National Historic Reserve in 2002 and 2003.

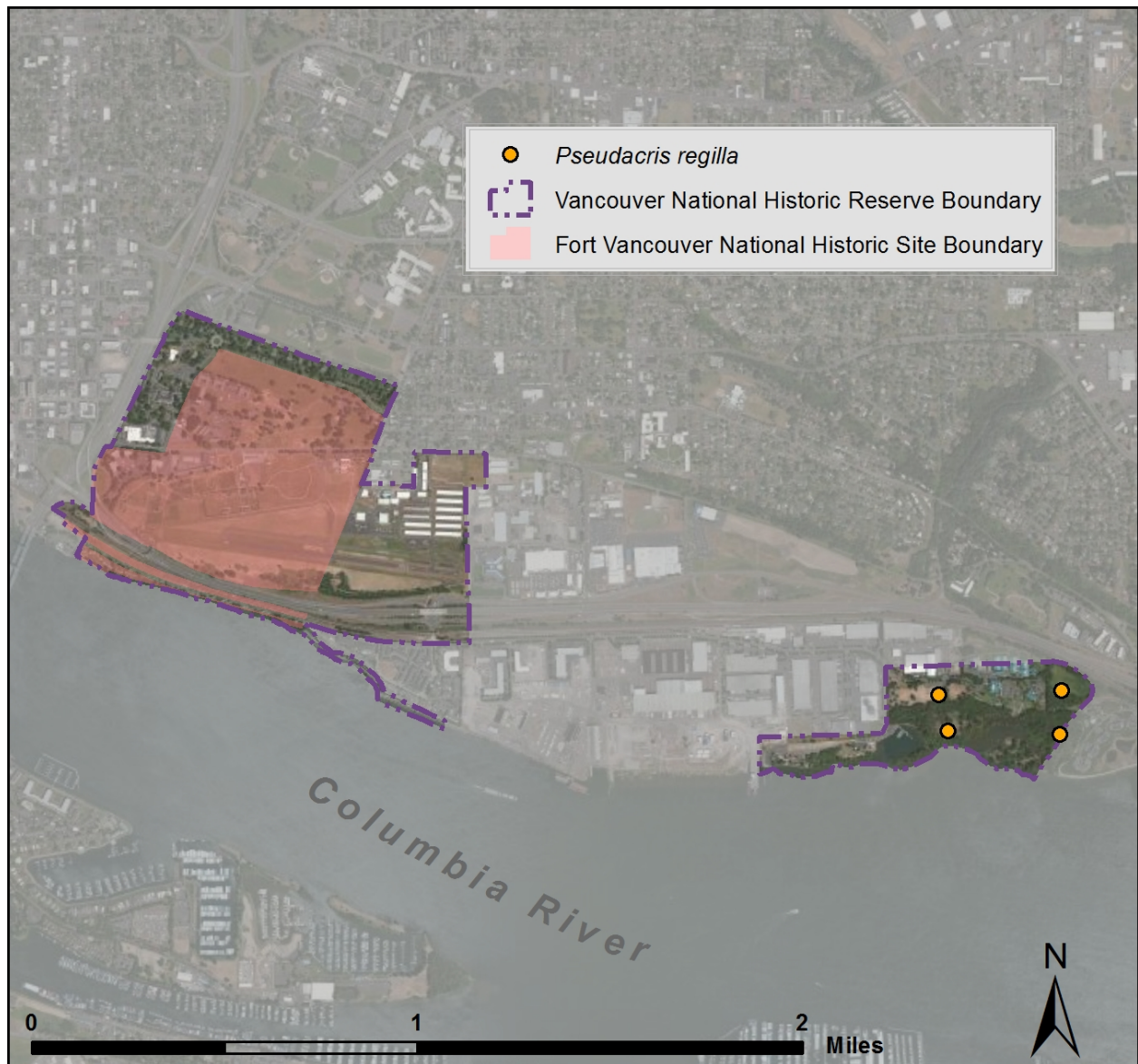


Figure 4. Observations of Pacific treefrogs (*Pseudacris regilla*) based on amphibian surveys conducted at Vancouver National Historic Reserve in 2002 and 2003.

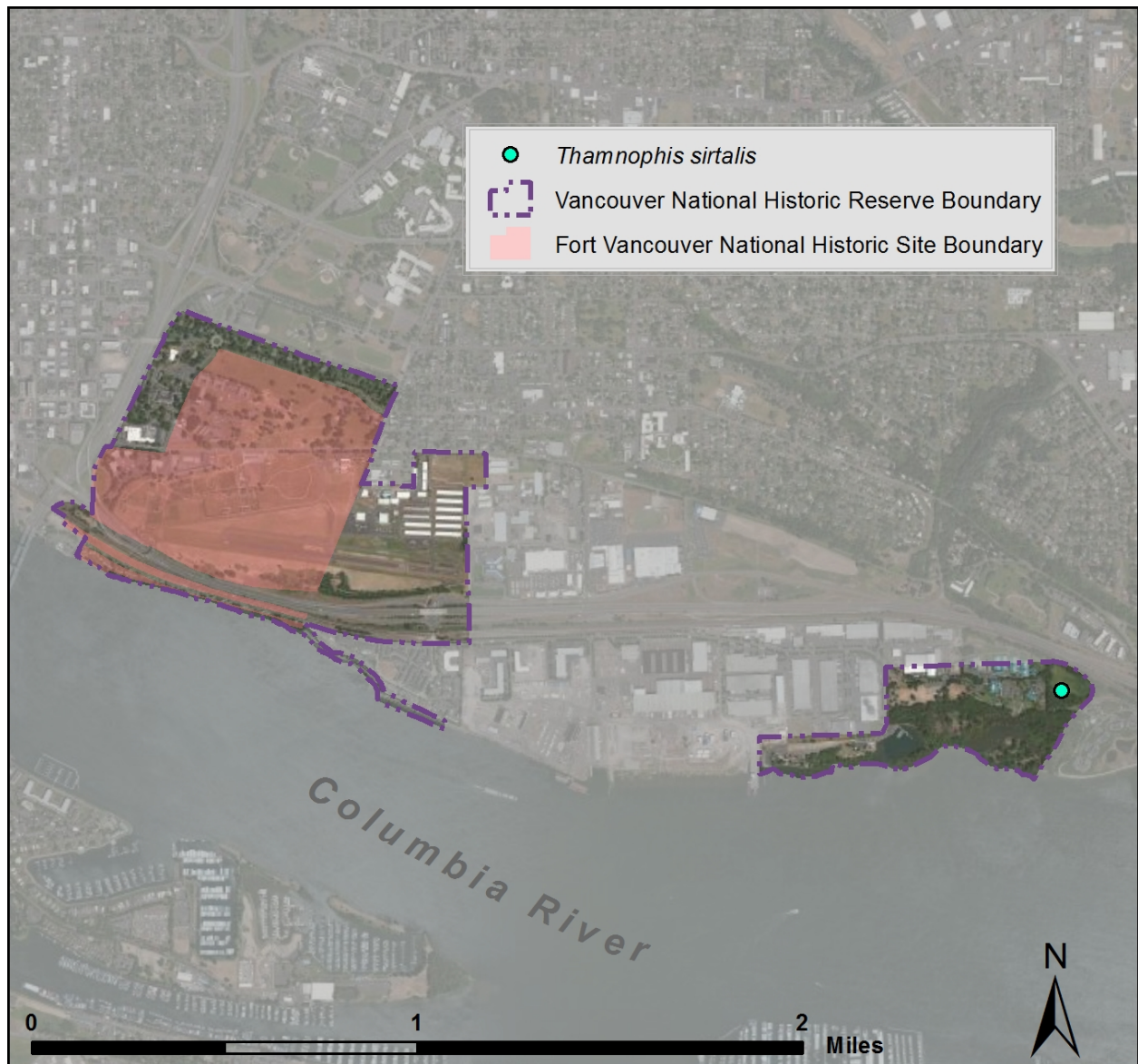


Figure 5. Observations of common garter snakes (*Thamnophis sirtalis*) based on amphibian surveys conducted at Vancouver National Historic Reserve in 2002 and 2003.

Discussion

The Reserve encompasses an area where the natural environment has been heavily impacted over time and little of the area's historic natural environment remains. The Reserve includes restored wetlands adjacent to the Columbia River and portions of the Columbia River waterfront. The area between the Fort and the City of Vancouver Water Resources Education Center building is a highly developed industrial area. Most of the river front along the Columbia River is paved and diked. The river front along the Water Resource complex provides some habitat but is subject to extreme water level fluctuations from the management of upstream dams on the Columbia River. However, suitable amphibian habitat exists within the Reserve for at least three amphibian species: Long-toed salamander, Pacific tree frog and Ensatina.

Long-toed Salamander (*Ambystoma macrodactylum*)

Larval stages of long-toed salamanders were found at a depressional wetland northeast of the Water Resources Education Center (FV5). Adult salamanders were found under decaying bark in a deciduous forest (FV7) (Figure 6), and one was observed along a side walk near a stream bridge by the Water Resources Education Center (FV9). Surface water depth at FV5 was less than 1 m, and 75% of the wetland was covered in emergent vegetation. Long-toed salamanders at FV5 were found in association with Pacific treefrogs and a common garter snake.

Long-toed salamanders occur in wet coastal forests in lower elevations and often breed in newly formed, temporary or recently disturbed pools of water, shallow lake edges or very slow flowing streams (Corkran and Thoms 2006). This is the earliest breeding salamander, breeding as early as January through April. Eggs hatch in two to three weeks and the length of the larval period is variable, depending on site conditions such as food and temperature (Hallock and McAllister 2005a). Adults spend most of their lives underground, except when migrating to and from breeding sites, and often seek refuge under decaying logs, loose bark, and rocks.

Long-toed salamanders are affected by loss of breeding habitat and by the introduction of fish (Hallock and McAllister 2005a, Liss et al. 1995). Loss of habitat such as small isolated wetlands may also pose a threat to this species.

Slater (1955) reported this species in Clark County in the 1950's. Surveys of known breeding sites should be repeated to verify the continued presence of this species within the Reserve.



Figure 6. Long-toed salamander (*Ambystoma macrodactylum*) at site FV7 within the Vancouver National Historic Reserve.

Pacific Treefrog (*Pseudacris regilla*)

Adult or recent hatchling Pacific treefrogs were found in the depression wetland northeast of the Water Resources Education Center (FV5, pond description provided above), in a backwater pond located on the west side of the Water Resources Education Center (FV12), and in a small, shallow, stream-ditch that drains a wetland flowing south of the Water Resources Education Center (FV10).

Pacific treefrogs were found in association with, long-toed salamanders, and a common garter snake. Slater (1955) reported this species as occurring in Clark County, specifically at Fort Vancouver.

The Pacific treefrog is the smallest and most common of the frogs in Washington, and is found in a variety of habitats including wetlands, woodlands, brush, and disturbed areas (Corkran and Thoms 2006). They breed in shallow, quiet waters with submerged vegetation and will lay their eggs in almost any small body of water, including ephemeral ponds that may dry up before metamorphosis occurs (Nussbaum et al. 1983).

Breeding occurs associated with warm winter or early spring rains, with most egg laying occurring in mid-February at lower elevations (Hallock and McAllister 2005b). Breeding may occur over a period of months, eggs hatch in three to five weeks, and larval development typically takes 1 ½ to 2 ½ months to complete (Hallock and McAllister 2005b).

Threats to Pacific treefrogs include the introduction of fish to breeding areas, pollutants, and chemical contaminants. Hallock and McAllister (2005b) reported that frogs that breed in ponds with high levels of nutrients from fertilizers, cattle or other sources may be at higher risk for developing malformations. We recommend a public education program be developed to help address the effects of land use practices on amphibians within the Reserve.

Ensatina (*Ensatina eschscholtzii*)

One adult Ensatina was found near the water treatment plant within the Reserve (FV6), in a deciduous forest comprised of black cottonwood (*Populus trichocarpa*), ash (*Fraxinus* sp.),

common snowberry (*Symphoricarpos albus*), dogwood (*Cornus sp.*), Himalayan blackberry (*Rubus armeniacus*). Ensatina are mainly found in forests and are active on the surface during spring and fall when temperatures are cooler and the ground is damp from rain or snow melt; during warmer and drier conditions, they retreat underground. (Nussbaum et al 1983). In addition to decaying logs, Ensatina are found under leaf litter, bark, and rocks. Ensatina are common and appear to be well distributed throughout their historic range in Washington (Hallock and McAllister 2005c).

Crother et al (2008) reports that the taxonomy of Ensatina is complex and still being debated, and as many as 11 species have been suggested. Crother et al. (2008) recognizes seven subspecies and Nussbaum et al (1983) report that the Oregon Ensatina (*Ensatina eschscholtzii oregonensis*) is the only subspecies that occurs in Washington.

Other species

A few other species were expected to occur within the Reserve but were not detected in our surveys. The western painted turtle (*Chrysemys picta*) and northwestern salamander (*Ambystoma gracile*) occur within the riparian wetlands of the Reserve (Cory Samia, City of Vancouver, pers. comm.). Slater (1955) noted the following species as occurring in Vancouver, Clark County: western toad (*Anaxyrus boreas*), Oregon spotted frog (*Rana pretiosa*), American bullfrog (*Lithobates catesbeianus*), and northern red-legged frog (*Rana aurora aurora*). Slater (1955) and Hallock and McAllister (2005d, 2005e) also noted western red-backed salamanders (*Plethodon vehiculum*), and northwestern salamanders (*Ambystoma gracile*) as occurring in Clark County. Hallock and McAllister (2005f, 2009) noted rough-skinned newt (*Taricha granulosa*), and bullfrog (*Lithobates catesbeianus*) as occurring in Clark County. American bullfrog, an introduced species, can have significant effects on native amphibian species. The Oregon spotted frog, a state has declined dramatically from its original distribution mostly as a result of wetlands and hydrologic alteration (Hallock and McAllister 2005g, McAllister and Leonard 1997). The Oregon spotted frog is a candidate for listing under the federal Endangered Species Act and is listed by Washington State as a State Endangered species. Additional surveys should be conducted earlier in the breeding season to determine if these species are present within the Reserve. A more thorough survey targeting reptiles within FOVA and the Reserve should also be conducted.

Summary

Three out of ten species expected to inhabit the Reserve were observed. However, no amphibian species were documented in FOVA. Two species previously reported as potentially occurring in the area of FOVA by Benvenuti (1993), western toad and western red-backed salamander, were not detected. No non-native species or special status species were detected in this inventory.

Tables 4 and 5 provide a summary of amphibian and reptile species present in the Reserve.

Table 4. Amphibian species documented in Vancouver National Historic Reserve, and their status. Yes^C = previously confirmed but not detected in this inventory; ** = federal or state listed species of concern; # = introduced species.

Genus and Species	Common Name	Code	Special Status Species	Non-native Species	FOVA	Vancouver National Historic Reserve Species Detected
Terrestrial breeding species						
Caudata — salamanders						
Ensatinas						
<i>Ensatina eschscholtzii</i>	Ensatina	ENES			No	Yes
Woodland Salamanders (Family Plethodontidae)						
<i>Plethodon vehiculum</i>	Western red-backed salamander	PLVE			No	No
Aquatic breeding species						
Anurans						
Brown frogs (Family Ranidae) ¹						
<i>Rana aurora</i>	Northern red-legged frog	RAAU	**		No	No
<i>Rana pretiosa</i>	Oregon spotted frog	RAPR	**		No	No
American Water Frogs						
<i>Lithobates catesbeianus</i> (formerly <i>Rana catesbeiana</i>) ²	American bullfrog	RACAT		#	No	No
Chorus Frogs						
<i>Pseudacris regilla</i>	Pacific treefrog. Pacific chorus frog	PSRE			No	Yes
North American Toads						
<i>Anaxyrus boreas</i> (formerly <i>Bufo boreas</i>)	Western toad	BUBO	**		No	No

¹ Crother 2008

² See ITIS (www.itis.gov) and Crother 2008

Table 4. Amphibian species documented in Vancouver National Historic Reserve, and their status. Yes^C = previously confirmed but not detected in this inventory; ** = federal or state listed species of concern; # = introduced species (continued).

Genus and Species	Common Name	Code	Special Status Species	Non-native Species	FOVA	Vancouver National Historic Reserve Species Detected
Aquatic breeding species						
Caudata — salamanders						
Mole Salamanders						
<i>Ambystoma gracile</i>	Northwestern salamander	AMGR				Yes ^C
<i>Ambystoma macrodactylum</i>	Long-toed salamander	AMMA				Yes
Pacific newts (Family Salamandridae)						
<i>Taricha granulosa</i>	Rough-skinned newt	TAGR			No	No

One Garter snake, the common garter snake (*Thamnophis sirtalis*), was observed incidental to this survey and is reported here to assist in verification of reptiles present in the Reserve (Table 5).

Table 5. Reptile species documented in Vancouver National Historic Reserve, and their status. Yes^C = previously confirmed but not detected in this inventory.

Reptile Species	Common Name	Special Status Species	FOVA	Vancouver National Historic Reserve
<i>Thamnophis ordinoides</i>	Northwestern garter snake		No	No
<i>Thamnophis sirtalis</i>	Common garter snake		No	Yes
<i>Chrysemys picta</i>	Western painted turtle		No	Yes ^C

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Appendix A. NCCN aquatic amphibian survey protocols and datasheets.

NCCN Amphibian Inventory Standard Operating Procedure for Aquatic Amphibian Surveys

CONTENTS

Materials
Procedures
Water Sample Collection
Survey Form Field Definitions
Species List and Codes
ARMI Survey Form 2001

This survey protocol is designed for use in the North Coast and Cascades Network (NCCN) Amphibian Inventory for lentic habitat. Each wetland will be sampled for amphibians, a variety of habitat variables measured, and water samples collected for analysis in a lab. It is important that standardized methods be used to collect these data, so that they are comparable among wetlands within the Network.

Field crews will have read all appropriate SOPs prior to starting field work. Sampling procedures will be checked by an experienced staff member (e.g., subproject lead) prior to sending novice samplers out into the field.

MATERIALS

1. map of study area - indicating location of wetland patches to be characterized
2. data notebook – blank datasheets copied on waterproof paper (sample datasheet attached)
3. thermometer - for measuring air and water temperatures
4. GPS - for determining wetland location and area
5. dipnets - net mesh suitable for capturing small amphibian larvae
6. pH meter - for characterizing H⁺ ion content
7. TDS/conductivity meter - for characterizing aquatic conductivity
8. DO meter or BOD bottles
9. water sample containers - 120ml and 250ml plastic bottles
10. voucher specimen vials 1/2 filled with formalin
11. waders and wading shoes
12. ruler- to measure amphibian lengths

PROCEDURES

Survey Techniques:

*Note: Although all of the tasks below need to be completed at each wetland, the specific order of completion is not critical. If amphibian sampling will stir up too much sediment to get clean water samples, these sensitive tasks should be completed first. Otherwise it is up to the discretion of the team to determine which tasks to complete in what order.

Datasheet Management:

Upon arrival at each wetland to be sampled begin a new data sheet. If multiple discrete bodies of water are encountered when the crew approaches a site, fill out a separate form for each. If ponds are not discrete (are connected with channels or are part of a wet meadow) cover the area as a single site on one sheet.

Mapping:

1. Draw a map of the wetland perimeter (use box on page 2 of data sheet)
 - be sure to orient drawing to North arrow on map
 - use codes to indicate approximately where each survey activity is conducted (e.g., water Samples, Temperature, and GPS)
2. Include details of habitat on map (where large concentrations of emergent veg occur, overhanging veg, etc.)

GPS Location:

1. Find location along the shoreline where the GPS unit receives a strong signal, indicate location on map.
2. Log points at that location for 1-2 minutes (use UTM NAD27 format)
 - a. Record the UTM Zone, coordinate locations, and the estimate of error (EPE preferably <5m) on the data sheet.
 - b. Record the filename as it was saved.
 - do not record elevation from the GPS, it is not very accurate. Determine elevation from topography map.

Amphibian Surveys:

1. These surveys will generally be conducted by teams of 2 individuals and can be conducted at the same time as the aquatic habitat characterizations or separately (depending on crew size).
 - a. Record all stages of development observed for each species (see attached species list)
 - b. Walk the perimeter of the wetland, stopping every 10 meters, or at 20 evenly spaced stations, to scan for embryos and larvae. One person wades, the other walks on shore.
 - c. At each of the stations, look for amphibians and make dipnet sweeps to capture individuals to ensure definitive species identification (*Only continue dipnetting while potentially occurring species remain undetected). Release identified specimens at the point of capture. If moveable cover items are present move them to see if larvae are

hiding beneath them. Identify any embryos or larvae to species, or if not possible preserve a voucher specimen in a labeled vial of 10% buffered formalin.

d. Vegetated areas and other habitats likely to harbor embryos and larvae will also be intermittently sampled using dipnets

e. Once evidence of current breeding activity for a species is detected (i.e., embryos, tadpoles, or metamorphs from the current breeding season) and recorded, searches for that species/stage should cease (to conserve time).

f. If one or more species remain undetected following a complete circuit of the wetland, other habitats where they are likely to occur (e.g., vegetated areas away from the shoreline) should be searched prior to declaring them absent.

2. Each team should collect voucher specimens (generally a single larva of each species present) at 10% of the ponds located in each randomly chosen watershed. Sufficient information will be recorded on the labels and data sheets such that it can be determined where the sample was collected and what species are represented. A subsample (about 10 of a stage per species) of amphibians will be measured and a few individuals will be collected as vouchers and for the health and disease survey (see the Animal Collection SOP).

3. Each species detected will be recorded on a separate line on the datasheet. The species name (or a set abbreviation) will be recorded and if a voucher was preserved “Y” will be circled. Counts or estimates of individuals will also be recorded. If the numbers of larvae are too high to count, the field crew will estimate the numbers of individuals seen. For egg masses, if they are distinct they will be counted. If masses can’t be counted, the number of eggs seen at the site will also be estimated (for example, a crew member can count all the eggs/larvae found within a square quarter-meter and extrapolate to estimate the total number observed). Also note any frog or toad species heard calling, and/or metamorphosed amphibians incidentally encountered around the area of the wetland.

Aquatic Habitat Characterization:

1. Estimate the percent of the surface area with floating (reaching the surface) or emergent aquatic vegetation.

2. Estimate the percent of the pond bottom made up by each of the substrate categories.

Fish Presence/Absence:

While characterizing habitat and surveying for amphibians watch for any evidence of the presence of fish.

a. Watch for fish in shallows and rising to feed on the surface

b. If not yet detected, search 30 meters up inlet and outlet streams where fish may be more visible.

c. If present indicate species, if determined, on the Species list of the datasheet.

Water Quality Characterization:

1. Record air temperature (in the shade and 1 m above ground) and water temp (in the sun and 10 cm below the surface) in Celsius.
2. pH and conductivity measurements.
 - a. Calibrate both meters at the beginning of each day. Calibrate pH meter using pH 4 and 7 stock buffers. Measure the check solution to see if is accurate.
 - b. Rinse cup 3 times with site water, collect sample of water in cup, insert pH meter and follow procedures for measuring pH.
 - c. Rinse cup 3 times with site water, collect new sample, insert conductivity meter and allow equilibrating, recording reading. If meter does not stabilize after 2 minutes record the low and high range of the current readings.
 - d. Store pH and conductivity meters as required by the manufacturer and the MORA QA/QC protocol.
 - e. If a raft is used, take DO and Temperature profiles beginning at the surface. If a shoreline sample is taken, follow Mount Rainier National Park QA/QC protocols for using the DO meter or collecting a sample in a BOD bottle.
 - f. Collect a sample (see below) to analyze for ANC (alkalinity).

Notes:

1. The remaining space on the data sheets should be used to record any additional notes.
2. Team members are encouraged to write extensive notes about features of each site not encompassed by the required data fields. Notes can also explain that data which may look weird are actually correct. For example if the pH readings never stabilized this would be a good place to note this fact. The notes will help those of us who are not there understand the collected data, the conditions at that site, how difficult it was to get to that site, etc.
3. Think of the notes as a journal to record anything.

Data Management:

1. Prior to leaving each site one crew member (preferably one who was not recording data) will check over the datasheet to make sure that all fields have been filled (data or NA), that all recorded data is clearly legible, and that the reported data do not have any obvious errors.
2. Once the data is checked the crew member should initial the 'Field Checked'

WATER SAMPLE COLLECTION

1. When collecting water samples avoid areas of dense aquatic or overhanging vegetation. Collect samples as far from shore as practical from a depth of 25 cm (10 in) where possible. Avoid inclusion of surface film and suspended sediments or organic material. Sampling is to be done first and/or in an area not disturbed by other sampling procedures.
2. Collect water in 1 L plastic bottle in the area of amphibian habitat. Take care not to introduce surface "scum" into the bottle. Avoid stirring up the pond bottom. If filtering is required, filter the sample immediately at the site.

3. Label with site name, date, time, data sheet number, and other pertinent information. Store sample bottles on ice in cooler.

SURVEY FORM FIELD DEFINITIONS

Date - Write the date as month, day, year (e.g. 11 Aug, 1993). The three letter abbreviation for the month is less ambiguous and more readily recognized than 8-11-93.

Begin Time - Record the time that the survey began, not the arrival time at the locality.

End Time - Record the time when the survey ended, not time you finished taking notes and gathering up equipment.

Search Minutes - This is the total time (in minutes) spent searching for amphibians multiplied by the number of active observers. Do not include time spent processing specimens, recording notes, or taking photographs. If two or more people spend differing amounts of time searching, use the average time.

Site ID – A unique identifier for the site represented by the data sheet. In ONP we are using the naming convention of 2 letters designating what major drainage the site is in followed by a number. No spaces or dashes between the letters or numbers. If a new pond is found by one already named, the new pond can be named with the name of the nearby pond followed by an “a”, then “b” for a 2nd new pond, etc. Example: Eagle Lakes in the Lyre drainage or named LY1, LY2, LY3.

Observers - Enter the initials of the observers present.

Sentinel Site – Circle NO. There are no sentinel sites in this inventory.

Location - This is a description that would allow someone not familiar with the area to find the pond again. For example: 200m NE of Lake Constance. Also, it is a good place to put the name of a lake if it has an official name (Hidden Lake). Use mapped landmarks that are not likely to change. Some localities are difficult to describe and the UTM coordinates will be the most descriptive, but a narrative description is important to confirm the general location.

State - Enter state name.

County - Enter county name.

Ownership – Indicate land ownership

Index Area - Many sites will be in designated index areas. If so, enter the name of the area.

Sample Unit (HUC #) - Index areas will be broken down into sample units, in our case these are 6th field watersheds.

UTM Zone - Enter the zone number, which in the continental United States ranges from 10 on the west coast to 19 in the east. UTM zones are always indicated in the lower left corner of USGS topographic maps.

UTM Coordinates - This is a pair of numbers that are x and y coordinates. In North America, the two numbers are northings and eastings. Location of each site will be recorded using a hand held GPS unit in the field. If surveying more than 1 km of a creek, stream, or river, enter the UTM coordinates for both the beginning and ending location. For lakes and ponds, enter the coordinates for the edge of the water if using a GPS or from the center of the water body if obtaining the coordinates from a USGS 7.5' topographic map.

Datum (Database only) - This refers to the base map projection. The datum is always indicated in the lower left corner of USGS topographic maps. If using a GPS unit to get UTM coordinates, check the GPS setup menu to see which datum is being used. UTM

coordinates are generally associated with either the 1927 North American datum or 1983 North American datum. Latitude/longitude coordinates are usually given in reference to the WGS84 datum. Using the wrong datum can result in significant positional errors.

Error – error estimate of Garmin 12XL GPS unit (preferably this is less than 5m).

GPS File – the name of the saved waypoint marking the location of a wetland.

Elevation - This should be taken from a 7.5' topographic map (or ArcView data) since elevations from GPS units are not sufficiently accurate. Make sure to indicate the elevational units.

Species Present At Site – All amphibians and a selected group of other organisms will be recorded in these fields including garter snakes, some invertebrates, and fish. Each species is recorded in one line.

Amphibians - Indicate the number of adults, paedomorphs (rarely seen and difficult to determine— adult amphibians but in aquatic physical form permanently), juveniles, larvae, eggs and egg masses observed for each amphibian species at a site. Adults and juveniles can typically be counted, but it is often necessary to estimate the number of anuran and salamander larvae. . Circle E if estimated or C if all the larvae or egg masses were actually counted. Note that this is not an estimate of the total number that might occur at the survey site, but the actual number of individuals seen during the survey. Some amphibian larvae do not metamorphose within one year. If size classes can be clearly distinguished, record a count for each size-class. If the number of egg masses can be counted then do so and record as EM, #, C. If the egg masses cannot be separated then estimate the number of eggs or egg masses and record as E or EM, #, E.

Fish Species - List the kinds of fish observed. If fish cannot be identified to the species level, use the lowest taxonomic level possible, e.g. families: salmonidae, centrarchidae, cyprinidae.

Garter Snakes –Indicate if any were seen and list species if able to identify.

Inverts - Indicate if certain predatory invertebrates were detected.

Method – Record how the animals were identified. Were they captured and held in a hand for close inspection (H), see from a distance but not held (V), or heard calling only (A).

* Remember to record other interesting/unusual species sightings in the notes section on the back of the datasheet.

Physical and Chemical Environment

Weather - Circle one of the choices: clear overcast, rain, snow.

Wind - Circle one of the choices: calm, light, gusty, strong

Beaver Sign – Use only one code, choosing the strongest indicator for your location (1=see beaver, 2=hear beaver, 3=lodge, 4=current dam, 5=old dam, 6=cuttings).

pH - Record pH.

Air Temperature - Measure the air temperature in the shade at approximately 1 meter off the ground. Centigrade.

Water Temperature - Measure the water temperature near the surface either in the vicinity of any amphibians that are located, or approximately 0.5 meter out from the edge of the water. Since temperature can be quite variable in standing water, try to select a location that is representative of the site. Centigrade.

Conductivity - Measure with meter.

Color - Indicate if water appears to be clear or stained (i.e. from leaf tannins)

Turbidity - Is the water clear or cloudy?

Site Description

Habitat Origin - Circle one of the choices: natural, man-made, or man altered.

Drainage - Circle one of the choices: permanent, seasonal. If uncertain, consult a 7.5' USGS topographic map. Seasonal streams are generally indicated with a broken blue line and seasonal ponds/lakes are hatched.

Description - Circle only **one** of the choices: lake/pond, river/stream, ditch, spring/seep, meadow/wetland, oxbow/backwater, beaver pond.

Shallows - Indicate the percent of the total site area that is <0.5 m deep.

Average Site Width (m) - This is the average width of the aquatic habitat.

Average Site Length (m) - Estimate the average length of the site.

Maximum Depth (m) - Circle one of the choices: <1.0, 1.0-2.0, >2.0

Percent of site edge searched: Estimate how much of entire site edge was searched.

Emergent/Floating Vegetation - Indicate the percent cover for emergent/floating vegetation for the entire site.

Substrate and Veg Cover - In many cases, the field site will be too large to sample as a single station so stations can be placed roughly every 10 meters or up to 20 evenly spaced stations as the crew surveys the site. Typically, a site needs to be subsampled if the entire pond from the shore cannot be seen (15m X15m). Each station (or transect) consists of a 2 meter portion of the shoreline and 3 meters out from the shore into the pond making a rectangle of area to be surveyed. Estimate the percent cover (to the nearest 10%) provided by emergent or floating vegetation for each station. At each station circle the most dominant substrate (circle only one): boulder/bedrock, cobble, mud/silt, sand/gravel, leaves/grass, downed wood.

Field Checked - A team member will initial this box after making a final check of the datasheet before leaving the field site.

Entered - Check box when data have been entered into database

SITE LOCATION:											
Index ID		Site ID		Drain-age							
State	WA	Co.		Owner-ship		Senti-nel?	Y	N			
UTM Zone	10	E			N			Error (m)			
Elev.	m ft	GPS File		HUC #							
Loca-tion											
SITE VISIT:											
Date		Visit #		Crew							
Start Time		End Time		Search Minutes (minutes times # of surveyors)							
Weather	Clear Overcast Rain Snow	WIND	Calm Light Gusty Strong	Air Temp		Water Temp					
pH		Conductivity		Water Sample: 120-ml FCC (filtered, brown)	Y	N	Water Sample: 250-ml RU (unfilter, white)	Y	N		
POND (all measurements in meters):											
Length		Width		Max Depth	<1	1-2	>2	% Shallow (<0.5m)			
Color	Clear Stained	Turbid-ity	Clear Cloudy	% Emergent Veg Cover				% of Site edge Searched			
Wetland Type	Lake/Pond Meadow/Wetland Ditch Beaver-pond River/Stream Spring/Seep Oxbow/Backwater					Perman-ance		Permanent Seasonal			
Site Origin	Natural Man-Made Altered			Beaver Sign	See Beaver	Hear Beaver	Lodge	Current Dam Old Dam Cuttings			

Figure A-1. Aquatic amphibian inventory data sheets.

Map

N ↑

Mark Locations: S = water samples, T = temperature, G = GPS location
Sketch emergent vegetation using dotted lines.

Dominant Substrate & Percent Veg Cover (up to 20 transects per site)					
% Cover					
Substrate	B D C G S M L W	B D C G S M L W	B D C G S M L W	B D C G S M L W	B D C G S M L W
% Cover					
Substrate	B D C G S M L W	B D C G S M L W	B D C G S M L W	B D C G S M L W	B D C G S M L W
% Cover					
Substrate	B D C G S M L W	B D C G S M L W	B D C G S M L W	B D C G S M L W	B D C G S M L W
% Cover					
Substrate	B D C G S M L W	B D C G S M L W	B D C G S M L W	B D C G S M L W	B D C G S M L W

B: Bedrock **D:** Boulder **C:** Cobble **G:** Grass **L:** Leaves **M:** Mud **S:** Silt **W:** Wood

Figure A-1. Aquatic amphibian inventory data sheets (continued).

E / C: Is the “count” number Estimated or precisely Counted.

Method: Hand Collected (catch and see), Visual (see from a distance only),

Aural (heard calling only).

Figure A-1. Aquatic amphibian inventory data sheets (continued).

Table 6-Scientific and common names of amphibians and reptiles found in the Pacific Northwest west of the Cascade Range from northern California to British Columbia

Scientific name ^a	4-letter code	Common name ^a
Amphibia, order Urodela (salamanders):		
Family Ambystomatidae-		
<i>Ambystoma gracile</i>	AMGR	Northwestern salamander
<i>A. macrodactylum</i>	AMMA	Long-toed salamander
Family Dicamptodontidae-		
<i>Dicamptodon copei</i>	DICO	Cope's giant salamander
<i>D. ensatus</i>	DIEN	California giant salamander
<i>D. tenebrosus</i>	DITE	Pacific giant salamander
<i>Rhyacotriton olmpicus</i>	RHOL	Olympic salamander
Family Plethodontidae-		
<i>Aneides ferreus</i>	ANFE	Clouded salamander
<i>A. flavipunctatus</i>	ANFL	Black salamander
<i>A. lugubris</i>	ANLU	Arboreal salamander
<i>Batrachoseps attenuatus</i>	BAAT	California slender salamander
<i>B. wrighti</i>	BAWR	Oregon slender salamander
<i>Plethodon dunni</i>	PLDU	Dunn's salamander
<i>P. elongatus</i>	PLEL	Del Norte salamander (includes <i>P. stormi</i>)
<i>P. larselli</i>	PLLA	Larch Mountain salamander
<i>P. vandykei</i>	PLVA	Van Dyke's Salamander
<i>P. vehiculum</i>	PLVE	Western red-backed salamander
Family Salamandridae-		
<i>Taricha granulosa</i>	TAGR	Rough-skinned newt
<i>T. rivularis</i>	TARI	Red-bellied newt
<i>T. torosa</i>	TATO	California newt
Amphibia, order Anura (frogs and toads):		
Family Leiopelmatidae, <i>Ascaphus truei</i>	ASTR	Tailed frog
Family Bufonidae, <i>Bufo boreas</i>	BUBO	Western toad
Family Hylidae, <i>Hyla regilla</i>	HYRE	Pacific treefrog
Family Ranidae-		
<i>Rana aurora</i>	RAAU	Red-legged frog
<i>R. boylei</i>	RABO	Foothill yellow-legged frog
<i>R. cascadae</i>	RACA	Cascades frog
<i>R. catesbeiana</i>	RACT	Bullfrog (introduced)
<i>R. clamitans</i>	RACL	Green frog (introduced)
<i>R. pretiosa</i>	RAPR	Spotted frog
Reptilia, order Chelonia (turtles):		
Family Emydidae-		
<i>Chrysemys picta</i>	CHPI	Painted turtle
<i>Clemmys marmorata</i>	CLMA	Western pond turtle
Reptilia, order Squamata (lizards and snakes):		
Family Anguidae-		
<i>Gerrhonotus coeruleus</i>	GECO	Northern alligator lizard
<i>G. multicarinatus</i>	GEMU	Southern alligator lizard
Family Iguanidae-		
<i>Phrynosoma douglassii</i>	PHDO	Short-horned lizard
<i>Sceloporus graciosus</i>	SCGR	Sagebrush lizard
<i>S. occidentalis</i>	SCOC	Western fence lizard
Family Scincidae, <i>Eumeces skiltonianus</i>	EUSK	Western skink
Family Boidae, <i>Charina bottae</i>	CHBO	Rubber boa
Family Colubridae-		
<i>Coluber constrictor</i>	COCOA	Racer
<i>Contia tenuis</i>	COTE	Sharptail snake
<i>Diadophis punctatus</i>	DIPU	Ringneck snake
<i>Lampropeltis getulus</i>	LAGE	Common king snake
<i>L. zonata</i>	LAZO	California mountain kingsnake
<i>Masticophis taeniatus</i>	MATE	Striped whipsnake
<i>Pituophis melanoleucus</i>	PIME	Gopher snake
<i>Thamnophis couchi</i>	THCO	Sierra garter snake
<i>T. elegans</i>	THEL	Western terrestrial garter snake
<i>T. ordinoides</i>	THOR	Northwestern garter snake
<i>T. sirtalis</i>	THSI	Common garter snake
Family Crotalidae, <i>Crotalus viridis</i>	CRVI	Western rattlesnake

^a Scientific and common names follow Banks and others (1987).
Sources: Nussbaum and others (1983) and Stebbins (1985).

Figure A-2. Scientific and common names of amphibians and reptiles found in the Pacific Northwest (Corn and Bury, 1990).

Appendix B. NCCN terrestrial survey protocols and datasheets.

NCCN Amphibian Inventory Standard Operating Procedure for Amphibian Terrestrial Surveys

Site Selection

We will survey all appropriate habitat for which a safe and legal access route can be found. National Wetland Inventory maps, USGS topographical maps, and Vegetation or Forest Inventory maps will be used to locate appropriate habitat. Availability of maps varies for each park. NWI maps in ArcView files are available at:

X:\ArcGIS\Data\Shapefiles\Network\wetlands

Boundaries of the NCCN parks are at:

X:\ArcGIS\Data\Shapefiles\Network\boundaries

Safety precludes sampling areas that are located on slopes >34 degrees.

On a topographic map or aerial photo of the study area, determine the number of 30 minute searches (plots) to use in appropriate habitat, assuming a 30m radius for each plot. The center of each 30 min. search plot should be at least 75 m from any forest edge (if possible). Also determine the path to follow between searches, with compass headings and approximate distances. Record the outlines of the plots on the air photo or map overlay.

Field Habitat Measurements

The following measurements are to be recorded from the plot center:

- Primary forest association series
- Canopy cover to the nearest 20%
- Slope
- Aspect
- Presence of streams, seeps, or talus
- Record the relative cover of each overstory species present – these numbers add to 100%.
Include any deciduous trees present
- For each of the size class categories record the percent of stems from each tree species.
Should sum to 100% going across columns
- Record the absolute cover of understory components for the 3 most important (dominant) species in each category using the 6 cover categories listed
- Record the percent cover of grasses, mosses, and L.O. debris

CWD: For each 30m plot, mark 4 evenly distributed lines, radiating from the plot center to the plot edge. Record the distance (cm) that the line is in contact with down wood and record the decay class for each object (Figure 1).

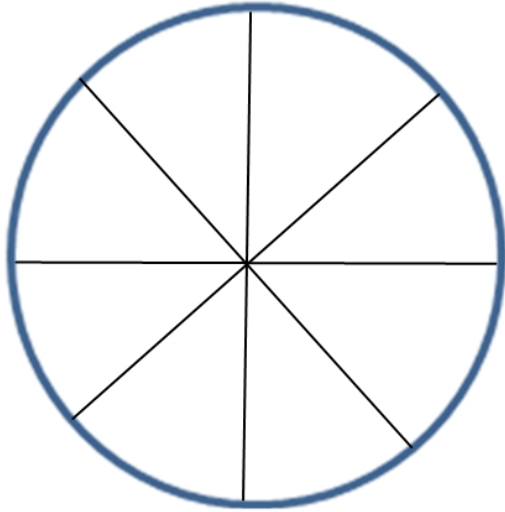


Figure 1. 30m plot with 8 transects for recording coarse woody debris.(Note: Data recorded for only 4 transects in this study as CWD data collection was time consuming and limited the amount of time available for amphibian searches).

Field Herp Surveys

Each plot will be searched for 30 worker-minutes during daylight (>1 hr after sunrise and before sunset). A search consists of workers methodically visually searching for amphibians over the entire area of the plot and looking under as much loose wood, bark, or rock that can be lifted and restored to a condition similar to its original state. Workers should not tear apart decayed logs or completely dig up talus or piles of decaying wood. For example, a worker encountering a heavily decayed log that is still largely intact should attempt to move and replace pieces of decayed wood. It is permissible to break apart a small portion of the log (up to 10%) in this process.

Night time surveys, using a spotlight, should be conducted to verify absence of species expected that were not observed during daytime searches of sites.

Field Quality Assurance

After each survey, the field leader will review the data forms for completeness and accuracy and then initial the top of the form in the space provided.

Field QA:

Entered by:

Survey ID#:

Page 1

Cluster #		Stand		Drainage		
Crew			Verification Plot?	Y	N	
PDOP		Date				
Uncorrected UTM Coord.		File	Corrected UTM Coord.			
N	E		N	E		
Forest						
Tot. Cov. (near. 20%)		Slope:		Aspect:		
Stream:	Y	N	Seep:	Y	N	
Talus:						
Y						
N						
Canopy cover and stem density by size class.						
Species	%Cov	1(0-23)	2(23-53)	3(53-81)	4(81-122)	5(>122)
All Stems						
Record absolute cover of understory components for the 3 most important species in each category. Use cover classes of <1, 1-5, 6-25, 26-50, 51-75, 76-100%.						
Category	Sp1	%Cov	Sp2	%Cov	Sp3	%Cov
Ust. Conifer						
Ust. Decid.						
Shrubs						
Ferns						
Forbs						
Total Cover of	Grasses:		Mosses:		L.O.Debris:	

Figure B-1. Terrestrial amphibian inventory data sheets.

[illegible]

Notes:

Figure B-1. Terrestrial amphibian inventory data sheets (continued).

Herp Sp.	Sex	Stage	SVL(mm)	UL	LL	MB	Hab
	M F U	E L J A P U					
	M F U	E L J A P U					
	M F U	E L J A P U					
	M F U	E L J A P U					
	M F U	E L J A P U					
	M F U	E L J A P U					
	M F U	E L J A P U					
	M F U	E L J A P U					
	M F U	E L J A P U					
	M F U	E L J A P U					
	M F U	E L J A P U					
	M F U	E L J A P U					
	M F U	E L J A P U					
	M F U	E L J A P U					
	M F U	E L J A P U					
	M F U	E L J A P U					
	M F U	E L J A P U					
	M F U	E L J A P U					
	M F U	E L J A P U					
	M F U	E L J A P U					
Habitats: D1-3 = Wood of decay classes 1-3; R=Rock; S=Stream/seep; O=other.							

Figure B-1. Terrestrial amphibian inventory data sheets (continued).

Appendix C. Water quality descriptions for aquatic breeding sites, species present, and fish presence for Vancouver National Historic Reserve.

Table C-1. Aquatic habitat measurements and descriptors.

Site ID	Length (m)	Width (m)	Max Depth (m)	% Shallow Area (<0.5m)	Color of water	Turbidity	Emergent Vegetation Cover %	% of Site Edge Searched	Wetland Type	Permanence	Site Origin
FV5	250	120	<1	100	Clear	Clear	100	70	Meadow/Wetland	Seasonal	Altered
FV8	50	30	<1	100	Stained	Clear	75	100	Lake/Pond	Permanent	Natural
FV10	300	1.5	<1	100	Clear	Clear	10	100	River/Stream	Permanent	Natural
FV11	400	100	1-2	25	Stained	Cloudy	10	60	Oxbow/Backwater	Permanent	Natural
FV12	75	75	1-2	50	Stained	Clear	20	100	Lake/Pond	Permanent	Natural

Table C-2. Water quality descriptions for aquatic breeding sites, species present, and fish presence.

Site ID	Start Date	Location Description	Air Temp (°C)	Water Temp (°C)	Conductivity (µS/cm)	Species Present	Life Stage	Count	SVL (mm)	Fish Presence
FV5	08-Apr-03	Depressional Wetland NE of Water Recourse Education Center	14	12	1100	AMMA	L	10		FALSE
FV5	08-Apr-03	Depressional Wetland NE of Water Recourse Education Center	14	12	1100	PSRE	A	1		FALSE
FV5	08-Apr-03	Depressional Wetland NE of Water Recourse Education Center	14	12	1100	PSRE	A	1	25	FALSE
FV5	08-Apr-03	Depressional Wetland NE of Water Recourse Education Center	14	12	1100	PSRE	A	1		FALSE
FV5	08-Apr-03	Depressional Wetland NE of Water Recourse Education Center	14	12	1100	THSI	A	1		FALSE
FV8	08-Apr-03	Depressional Wetland NE of Water Recourse Education Center	20	20	1345	FROG (unknown species)	A	2		FALSE
FV8	08-Apr-03	Depressional Wetland NE of Water Recourse Education Center	20	20	1345					TRUE (unknown species)
FV10	09-Apr-03	Small stream draining depressional wetland flowing S of Water Resource Ed. Center	9	10		PSRE	A	5		FALSE
FV11	09-Apr-03	Slough immediately S of Water Resource Ed. Center	14	14	1226					TRUE (Stickleback)
FV12	09-Apr-03	Pond on west side of Water Resource Ed. Center	12	16	358	PSRE	A	1		FALSE

Appendix D. Terrestrial and incidental habitat characteristics.

Table D-1. Terrestrial habitat characteristics associated with species detection.

Dominant forest type, soil temp, aspect and slope recorded at center of plot. See Table D-2 for description of habitat classes.

Survey Date	Survey Type	Site ID	Species Code	Stage	SVL (mm)	Seep, Stream, or Talus	Habitat at Detection (see Table D-2 for description)	Dominant Forest Type	Soil Temp (°C)	Aspect	Slope (%)
4/8/2003	Terrestrial	FV6	ENES	A	45	N	D4	Deciduous	11	S	1
4/8/2003	Terrestrial	FV7	AMMA	A	36	Y (stream)	Other (Bark slab)	Deciduous	10	S	2
4/8/2003	Terrestrial	FV7	AMMA	A	42	Y (stream)	Other (Bark slab)	Deciduous	10	S	2
4/9/2003	Incidental	F9	AMMA	A	38		D3	NA	12	E	0

Table D-2. Habitat decay class descriptors.

Log characteristics	Log Decay Class				
	1	2	3	4	5
Bark	intact	intact	trace	absent	Absent
Twigs <3cm (1.18in)	present	absent	absent	absent	Absent
Texture	intact	intact to partly soft	hard, large pieces	small, soft, blocky pieces	soft and powdery
Shape	round	round	round	round to oval	Oval
Color of wood	original color	original color	original color to faded	light brown to faded brown or yellowish	faded to light yellow or gray
portion of log on ground	log elevated on support points	log elevated on support points but sagging slightly	log is sagging near ground	all of log on ground	all of log o ground

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 389/120512, April 2013

National Park Service
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