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Periodic Status Review for the Western Pond Turtle

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Washington Department of
FISH AND WILDLIFE
Wildlife Program

The Washington Department of Fish and Wildlife maintains a list of endangered, threatened, and sensitive species (Washington Administrative Codes 232-12-014 and 232-12-011). In 1990, the Washington Wildlife Commission adopted listing procedures developed by a group of citizens, interest groups, and state and federal agencies (Washington Administrative Code 232-12-297). These procedures include how species listings will be initiated, criteria for listing and delisting, a requirement for public review, the development of recovery or management plans, and the periodic review of listed species.

The Washington Department of Fish and Wildlife is directed to conduct reviews of each endangered, threatened, or sensitive wildlife species at least every five years after the date of its listing by the Washington Fish and Wildlife Commission. These periodic reviews include an update on the species status to determine whether the species warrants its current listing or deserves reclassification. The agency notifies the general public and specific parties interested in the periodic status review at least one year prior to the end of the five-year period so that they may submit new scientific data to be included in the review. The agency notifies the public of its recommendation at least 30 days prior to presenting the findings to the Fish and Wildlife Commission. In addition, if the agency determines that new information suggests that the classification of a species be changed from its present state, the Department prepares documents to determine the environmental consequences of adopting the recommendations pursuant to requirements of the State Environmental Policy Act.

This is a periodic status review for the Western Pond Turtle. It was reviewed by species experts and was available for a 90-day public comment period from September 24 through December 23, 2016. All comments received were considered during the preparation of the final periodic status review. The Department intends to present the results of this periodic status review to the Fish and Wildlife Commission for action at a meeting on January 13, 2017, in Vancouver.

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Cover background photo of turtle habitat in Klickitat County by Kate Slavens; inset photo of Western Pond Turtle hatchling by Michael Durham, Oregon Zoo.

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Western Pond Turtle conservation in Washington is a cooperative effort of federal, state and private entities that has been in progress since the late 1980s. Woodland Park Zoo, Frank Slavens and Kate Slavens were instrumental in saving Western Pond Turtles in Washington and have dedicated decades of expertise, funding and hard work toward recovery efforts. The Oregon Zoo joined as a collaborator in 1998 and has also been an integral partner in recovery work. WDFW and many partners and cooperators have provided funds and resources toward recovery, habitat acquisition and habitat management, including the U.S. Forest Service, U.S. Fish and Wildlife Service, Washington Department of Natural Resources, Washington State Parks and Recreation Commission, Washington Department of Transportation, Klickitat Wildlife Area, South Puget Sound Wildlife Area, Skamania Forest Youth Success Program and Skamania County Weed Control. The Bonneville Power Administration (BPA) provided funding to support Western Pond Turtle research in the 1990s and recovery efforts in the Columbia Gorge from 2001 to 2011. In recent years, additional partners have joined the Washington Department of Fish and Wildlife (WDFW) to help with shell disease, including determining the cause, investigating treatments and caring for the turtles as they recover from treatment. These partners include the Woodland Park Zoo, Oregon Zoo, PAWS Wildlife Center, Sustainability in Prisons Project, Cedar Creek Corrections Center, Larch Corrections Center, Washington State University, Zoo/Exotic Pathology Services, University of Illinois, VCA Veterinary Specialty Centers of Seattle, VCA Northwest Specialty Center of Clackamas (Oregon), and the AZA Saving Animals from Extinction (SAFE) Western Pond Turtle initiative. To assist with finding recovery sites, Treg Christopher (WDFW) developed a pond suitability analysis for South Puget Sound. Lastly, WDFW thanks the many biologists, zoo staff, veterinarians, graduate students and volunteers who have dedicated their expertise, research efforts and time toward Western Pond Turtle recovery efforts since 1989. Many of their names can be found in the acknowledgements sections of WDFW reports such as Hays et al. (1999), Holman et al. (2012) and Schmidt and Tirhi (2015).

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EXECUTIVE SUMMARY

The Western Pond Turtle (*Actinemys marmorata)* is a medium-sized, semi-aquatic turtle and is one of two freshwater turtle species native to Washington. Western Pond Turtles were historically distributed through central and southern Puget Sound from Snohomish to Thurston counties, along the Columbia Gorge in Skamania and Klickitat counties, and in Clark County. Currently, the species occurs at six locations in the state, including three sites in Skamania County, and one each in Klickitat, Mason and Pierce counties. The turtles inhabit lakes, ponds and wetlands. They also require the availability of adjoining open upland habitats.

Western Pond Turtles were listed as endangered in Washington in 1993. They were likely locally common in parts of their Washington range historically, but due to factors such as habitat loss, overharvest and introduction of non-native plants, fish and bullfrogs, only about 150 turtles persisted at the two remaining Columbia Gorge sites by 1994. The Puget Sound population was effectively extirpated with the exception of 12 turtles that were opportunistically collected and placed into a captive breeding program at Woodland Park Zoo. Through various recovery actions, including release of captive-bred and wild-bred head-started turtles, the statewide population in 2015 had increased to a total of 800–1,000 turtles at six locations. Two of the sites, Sondino and the Pierce County site, each contain about 250 turtles and together hold half or more of the state's population. These sites are the only ones with population estimates above recovery objectives.

Recovering this species is challenging because of the turtles' slow rate of growth, delayed sexual maturity, limited ability to disperse, complex habitat requirements and the high mortality of eggs and hatchlings. Additionally, Washington populations are at the northern extreme of the species' range. The cool summers typical of maritime climate can slow embryo development and result in high variation in hatchling success especially in South Puget Sound. Such variability may have had less impact on the species' persistence when pond turtles were more common because the long life span of the turtles provided many decades of nesting opportunities. As a result of these intrinsic factors, the recovery process is slow and many decades of effort will be required.

Important known or suspected threats to Western Pond Turtles in Washington include diseases; predation and competition with other species, especially the non-native American Bullfrog (*Lithobates catesbeianus*); habitat loss and degradation; and small population size and low genetic variation. Recently, shell disease has emerged as a major concern and was found to infect 29–49% of examined turtles in each of the six populations in 2013–2014. At present, it is unclear whether shell disease is causing turtle mortality and negatively affecting reproduction and recruitment, although it is suspected. It appears to occur mostly in head-started turtles, though the relatively few truly wild turtles confound this apparent association.

A variety of recovery actions have directly benefited Western Pond Turtle populations in Washington. All populations continue to be supplemented with head-started juveniles raised at Woodland Park Zoo and Oregon Zoo. From 1991 to 2015, a total of 2,200 captive-bred and wild-bred head-started turtles were released through this program. Investigations are underway to monitor the extent and impacts of shell disease and determine the cause and best treatment of the disease. Other recovery activities include conservation planning; habitat management, restoration and creation of wetlands; population monitoring; research; and predator management focusing primarily on bullfrog removal.

While progress has been made in recovering Western Pond Turtles, the Washington recovery plan goals for downlisting them to threatened have not been met. The statewide population size remains too small and is still heavily reliant on supplementation with head-started individuals. Natural recruitment remains low due to factors such as low hatching success and predation on hatchlings. The recovery sites continue

to need annual management to maintain suitable habitat conditions, especially for nesting. Lastly, the consequences of shell disease are not well understood at this time, but likely will setback recovery if the disease impacts reproductive output and/or the lifespan of the turtles. Consequently, it is recommended that the Western Pond Turtle remain a state endangered species in Washington.

INTRODUCTION

This periodic status review summarizes the biology, population status, threats, and recent management actions directed at Western Pond Turtles (*Actinemys marmorata*) in Washington. It also assesses whether the species should retain its current endangered status under state law or be reclassified to another status. Substantial new information has become available on Western Pond Turtles since the publication of the state's recovery plan (Hays et al. 1999).

Figure 1. Adult Western Pond Turtle (Photo by WDFW).

DESCRIPTION AND TAXONOMY

Description. The Western Pond Turtle is a medium-sized, long-lived, semi-aquatic turtle. Coloration is variable and also differs by location, sex and age. The carapace (upper shell) is low in profile and olive brown to black, often with faint light reticulations radiating from the center of the scutes (shields; Fig. 1). The plastron (lower shell) is yellow with varying amounts of dark blotches (Fig. 2). Both shells have growth ridges on the scutes that wear away with age but can be counted up to about 12 years of age (B. Bury, pers. comm.). Head and leg color is a mix of dark and yellow speckling, dots, or reticulations. Hatchlings are 25–31 mm (1.0–1.22 in.) long and weigh 3.0–7.0 g (0.11–0.25 oz.) (Fig. 3). Most adults are 160–180 mm (6–7 in.) long and weigh 500-700 g (1–1.5 lb.), with a maximum length of 241 mm (9.5 in.) and weight of approximately 1,200 g (42 oz.). Older males are somewhat larger than older females. Secondary sexual characteristics become apparent when the turtles reach 110 mm (4.3 in.) in carapace length (Holland 1994). Adult males (≥125 mm [≥4.9 in.] carapace length) differ in appearance from females in having larger heads, a heavily angled snout, a yellowish to white throat, a thicker tail with the cloaca positioned outside the shell margin, and a slightly concave plastron (Hays et al. 1999, Bury et al. 2012a).

Figure 2. Adult Western Pond Turtle and its plastron (Photo by Shelly Ament, WDFW).

Figure 3. Hatchling Western Pond Turtle (Photo by Ryan Hawk, Woodland Park Zoo).

Taxonomy. This species was originally described by Baird and Girard in 1852 from Puget Sound, Washington. Classified in the family Emydidae and the order Testudines, this species was known as Western Pond Turtle or Pacific Pond Turtle (*Clemmys marmorata*) for more than a century, but currently the phylogeny and taxonomy are in flux. Recent molecular and genetic analyses indicate that *Clemmys* is comprised of different evolutionary lineages (i.e., paraphyletic; Spinks et al. 2014). This has prompted changes to the genus and subsequent

naming conflicts and it may take some time for the generic name to stabilize (Bury et al. 2012a, NatureServe 2015). The widely recognized names Western Pond Turtle and *Actinemys marmorata* are used here.

LEGAL STATUS

The U.S. Fish and Wildlife Service (USFWS) was petitioned to list the Western Pond Turtle under the federal Endangered Species Act in 1992, but concluded the listing was not warranted. The USFWS was petitioned again in 2012 and determined that a formal status review was warranted. The 12-month findings process started on June 9, 2015, and results of this review are pending (Giese et al. 2012, USFWS 2015).

The Western Pond Turtle was state listed as endangered in Washington in 1993 and a recovery plan was completed in 1999 (WDFW 1993, Hays et al. 1999). The turtle's status in Oregon is sensitive-critical (ODFW 2008), it is a species of special concern in California (Nafis 2016) and it is on British Columbia's Red List (B.C. Conservation Data Centre 2016). The NatureServe (2015) global rank is G3G4, with the following state and province ranks: British Columbia, presumed extirpated (SX); Washington, critically imperiled (S1); Oregon, imperiled (S2); California, vulnerable (S3); and Nevada, vulnerable (S3). Western Pond Turtles are also identified as a Species of Greatest Conservation Need in the Washington, Oregon, and California State Wildlife Action Plans and a Species of Conservation Priority in the Nevada Wildlife Action Plan.

DISTRIBUTION

North America. The current range of the Western Pond Turtle extends from Washington south to Baja California, chiefly to the west of the Cascade-Sierra crest (Fig. 4; Barela and Olson 2014). Most extant populations occur in Oregon and California. The species is considered extirpated from British Columbia (British Columbia Ministry of Environment 2015), but it is unclear if it ever occurred there naturally (Cook et al. 2005, Matsuda et al. 2006).

Washington. Washington historical records suggest a fairly limited distribution restricted to central and southern Puget Sound from Snohomish County to Thurston County, and Skamania and Klickitat counties in the Columbia Gorge (Figs. 4, 5; Hays et al. 1999). Currently, the species occurs at six locations including three sites in Skamania County and one each in Klickitat, Mason and Pierce counties (Fig. 5).

Figure 4. Western Pond Turtle range.

NATURAL HISTORY

Habitat requirements. Western Pond Turtles require a mosaic of aquatic and terrestrial habitats, both of which are comparable in terms of conservation importance. They can be found in permanent and intermittent aquatic habitats, including still and flowing water from sea level to approximately 1,370 m (4,500 ft.) (Holland 1994, Bury et al. 2012b). They usually do not occur in areas exposed to regular human intrusion (Hays et al. 1999, Bury et al. 2012b), but there are a few exceptions (B. Bury, pers.

comm.). In Washington, they are found associated with ponds, small lakes and wetlands at elevations below 300 m (985 ft.) (Hays et al. 1999).

Lakes, ponds and wetlands are used for foraging, mating, thermoregulation and overwintering. Important features of aquatic habitats include underwater refugia, areas of still or slow flowing water, and basking structures. Underwater refugia include submerged rocks and vegetation, woody debris, mud bottoms and undercut banks (Hays et al. 1999, Bury and Germano 2008, Rosenberg et al. 2009). Emergent basking sites in or adjacent to aquatic habitats include floating logs, mats of vegetation and mud banks.

Western Pond Turtles spend considerable amounts of time in the upland areas surrounding aquatic habitats and may use these during any month of the year (Reese and Welsh 1997). Uplands are used for nesting, aestivating (i.e., dormancy during hot and dry periods), dispersal and overwintering (Reese and Welsh 1997, Hays et al. 1999). In Washington, pond turtles occur in open upland habitats that receive extensive sun exposure such as prairies in the Puget Sound region, oak-pine savanna and other more open forest types in the Columbia Gorge, and pasture (WDFW 1993, Hays et al. 1999). Locations with leaf litter from deciduous shrubs and trees are conducive for aestivation and overwintering.

Nesting almost always occurs within 100 m (328 ft.) of water at locations with southern exposure, short vegetation such as grasses and forbs, little or no overstory shrub or tree canopy, and well-drained compact soils with significant clay/silt content (Holland 1994, Hays et al. 1999, Lucas 2008; B. Bury, pers. comm.). With few exceptions, hatchlings overwinter in the nest and emerge in the spring. A study in Oregon found that hatchlings initially remained in the vicinity of the nest (≤2 m [≤6.6 ft.]), sometimes re-entered the nest, and then moved around in different terrestrial habitats (Rosenberg and Swift 2013). On average, it took 49 days (range 28–64 days) after emergence before the hatchlings entered water. During that time, they moved to multiple locations in a broad range of vegetation types, where they embedded themselves in soil or buried themselves under vegetation or debris. At Washington's Klickitat County site, hatchlings can be found in uplands until about mid-May (E. Holman, pers. comm.).

Overwintering can occur in either aquatic or terrestrial environments. In water, the turtles overwinter in bottom sediments and undercut banks. On land, they typically bury themselves under leaf litter or duff in open, shrubby and forested habitats (Reese and Welsh 1997). In Klickitat County, turtles overwinter at locations with 80–90% shrub and tree canopy coverage, with most under or near Oregon White Oak (*Quercus garryana*) (Hays et al. 1999). A radio-telemetry study of 37 head-started juveniles at one of Washington's Skamania County sites found that 92% spent the summer in water and then moved into the uplands to overwinter, while the remaining turtles stayed in water. Almost all turtles that overwintered in the uplands did so under forest canopy with a shrub component. Percent cover of trees, distance to water and leaf litter depth were the most important features differentiating overwintering sites from random sites (Vander Haegen et al., in prep.).

Behavior. Adult Western Pond Turtles become active as soon as water temperatures are warm enough and basking is possible. This can occur on warm days from late January in South Puget Sound (T. Schmidt, pers. comm.) and early February in Klickitat County (Slavens 1995). Activity is primarily, but not exclusively, diurnal (K. Slavens, pers. comm.). Turtles are most active at water temperatures above 15°C (59°F; Bury and Germano 2008). They spend a great deal of time basking in and out of water. Pond turtles are wary and secretive. They will rapidly flee from their basking sites into water when disturbed by the sight or sound of people and are sensitive to human disturbance even at relatively long distances (≥100 m [≥328 ft.]; Bury and Germano 2008).

Reproduction. In Oregon, females become reproductive when they reach a carapace length of at least 130–135 mm (5.1-5.3 in.) and are about 10–12 years of age (Holland 1994). In South Puget Sound, where hatchlings experience accelerated growth for the first ten months after they hatch as part of the head-

starting process, females begin nesting when they reach a carapace length of 146–167 mm (5.7–6.6 in.) and are 7–12 years of age (Schmidt and Tirhi 2015). In South Puget Sound, eggs are laid from mid-May to early July and in the Columbia Gorge from late May to mid-July. Nesting peaks in both regions in mid-June (Hays et al. 1999, Schmidt and Tirhi 2015). Gravid females may make excursions onto land before actually nesting. They generally leave the water in late afternoon or early evening and commonly remain on or near the nest site overnight (Slavens 1995, Bury and Germano 2008). Some fidelity to nesting sites has been observed (Bury et al. 2012b). Females are sensitive to disturbance during nesting excursions and may return to water if disturbed (Holland 1994). In Washington, females consistently lay at least one nest per year and double-clutching is regularly observed (Hays et al. 1999, Schmidt and Tirhi 2015). Clutch size ranges from 2 to 13 eggs (Hays et al. 1999, Bury et al. 2012b). Incubation time in the Columbia Gorge is 94–127 days (Holland 1994, Slavens 1995). Incubation takes longer in South Puget Sound due to cooler temperatures. In 2010, hatching in this region was delayed by up to 58 days compared to nests in Klickitat County because of poor weather (Reitz 2011).

Hatching success rate is dependent on weather during the incubation period, with cool weather or too much moisture in the nest able to cause total nesting failure (Slavens 1995, Hays et al. 1999). In South Puget Sound, variation in annual weather contributes to inconsistent hatching success. At the Mason County introduction site, initial attempts to allow nests to incubate naturally failed and the suitability of the nesting substrate is uncertain. Weather conditions are more suitable for nesting in the Columbia Gorge, especially in Klickitat County. Western Pond Turtles have temperature-influenced sex determination. Higher temperatures (>27°C [>81°F]) produce higher ratios of females (Ewert et al. 1994 cited in Bury and Germano 2008). This is taken into consideration for eggs that are incubated for the South Puget Sound recovery sites. Juvenile growth rates vary with many factors, including diet and site conditions such as water and air temperatures.

Diet and foraging. Western Pond Turtles are dietary generalists that forage exclusively in aquatic habitats because they can only swallow food when under water. Aquatic invertebrates make up the majority of their diet, but some plant material is also consumed. Vertebrates are a small part of their diet. It is not clear if the turtles actually capture vertebrate prey or mostly exploit dead or weakened animals. They have been observed catching and eating living newly metamorphosed Western Toads (*Anaxyrus boreas*) at the Mason County reintroduction site (B. Murphie, pers. comm.). They are known to consume carrion, have been observed scavenging on a variety of vertebrates and will quickly consume fresh fish carcasses they encounter and that are placed in traps (Holland 1994, Bury and Germano 2008; E. Holman, pers. comm.).

Movements. Movements of Western Pond Turtles vary with habitat, size of the aquatic system, suitability of upland habitat, season, climate, environmental stress (*e.g.*, drought, high stream flow), sex, and life stage. A summer study in a northern California stream found the average home range size of males was 1 ha (2.5 ac.), females 0.3 ha (0.7 ac.) and juveniles 0.4 ha (1 ac.) (Bury and Germano 2008). In general, Western Pond Turtle nests and overwintering sites are within 100 m (328 ft.) and 250 m (820 ft.), respectively, of aquatic habitat if suitable sites are available (Holland 1994). Along the central coast of California, a 10-year study with over 2,100 turtles found the greatest distance moved was a turtle traveling 5 km (3.1 mi.), with all remaining individuals moving less than 3 km (1.9 mi.) (Holland 1994).

In Washington, where almost all Western Pond Turtles are marked with unique shell notches and PIT tags, overland movement distances appear to be related to habitat quality (Slavens 1995, Lucas 2008). In the Columbia Gorge, most turtles are regularly encountered in the same pond or lake indicating they are sedentary. However, some interchange of turtles between water bodies does occur (Slavens 1995). Turtles have moved distances of 243 m, 518 m and 762 m (800 ft., 1,700 ft. and 2,500 ft.) between water bodies (E. Holman, pers. comm.). The Klickitat County site has ample nesting habitat, thus it appears that females typically do not move ≥100–150 m (328–492 ft.) to nest. At one site in Skamania County, however, females were tracked up to 381 m (1,250 ft.) away from water to nest. The maximum distance

moved by 34 juveniles from water to their overwinter locations was 150 m (492 ft.) in Skamania County (Vander Haegen et al., in prep.).

Demography. Survival is thought to be low for hatchlings and juveniles ≤ 3 years old because their small size makes them vulnerable to predation. Survivorship increases once the turtles grow to a carapace length of 110 mm (4.3 in.). Holland (1994) suggested that only 10–15% of the ≤ 3-year-old age classes survived annually, whereas an average of 95–97% of adults survived annually. Individuals have been documented to live 55 years in the wild (Bury et al. 2012b).

In Washington, Murphie and Skriletz (2014) found annual survivorship for adult females was 95% (95% CI = 90–97%) in Mason County. Vander Haegen et al. (2009) documented survival rates of ≥ 90% for turtles with carapace lengths of 80–90 mm [3.1–3.5 in.]) in Skamania County. Schmidt and Tirhi (in prep.) found overwinter survival in Pierce County averaged 77% for newly released, head-started juveniles with carapace lengths of 77-102 mm (3.0-4.0 in.). In the latter two studies, the turtles were only 1-year-old but because they were head-started they were the size of 3-year-old wild turtles.

Sources of mortality for Western Pond Turtles include predation, vehicular traffic, disease and drought. Known predators of turtles and their eggs include Largemouth Bass (*Micropterus salmoides*) and other fish, American Bullfrogs (*Lithobates catesbeianus*), Great Blue Herons (*Ardea herodias*), Bald Eagles (*Haliaeetus leucocephalus*) and other raptors, American Black Bears (*Ursus americanus*), North American River Otters (*Lontra canadensis*), Striped Skunks (*Mephitis mephitis*), Raccoons (*Procyon lotor*) and other mammalian carnivores as well as humans (Holland 1994, Hays et al. 1999, Niemela and Bury 2012, Bury et al. 2012b; B. Murphie, pers. comm.; E. Holman, pers. comm.). Known sources of human-caused mortality and/or removal of turtles from the wild include capture for food or pets, wanton shooting, vehicle mortality and accidental capture in fishing line or nets (Bury 1982, Hays et al. 1999, Murphie and Skriletz 2014).

POPULATION AND HABITAT STATUS

Western Pond Turtles are declining and of concern throughout their range although many populations still persist in the core of the range in southern Oregon and northern California. Declines are most severe in the northern and southern parts of the range, specifically in Washington, southern California and Baja California (Bury et al. 2012a).

Washington past. The species may have been locally common in South Puget Sound, but had become essentially extirpated by the 1980s (Hays et al. 1999). Those present in this region today are the offspring of twelve turtles that were opportunistically collected and placed into a captive breeding program at Woodland Park Zoo in the 1990s. The number of sites historically occupied in this region is unknown. Similarly, little is known about the history, sizes and numbers of populations in the Columbia Gorge. Only two populations remained in this region by the mid-1980s (Hays et al. 1999). In 1994, a year after state listing, the entire Washington population in the wild was estimated at 156 turtles, with 117 turtles counted in Klickitat County and 39 turtles in Skamania County (Hays et al. 1999). In 1998, following the initiation of head-starting and captive rearing, the population had grown to 311 turtles at three sites: 176 turtles in Klickitat County, 109 in Skamania County and 26 turtles in Pierce County (Hays et al. 1999).

Washington present. The total number of Western Pond Turtles in Washington has gradually increased since 1998. Based on the most recent capture and population data (Tables 1, 2), an estimated population of 800–1,000 turtles occurred statewide in 2015 at six sites (four in the Columbia Gorge and two in South Puget Sound; Fig. 5). Two sites, Sondino and the Pierce County site, each hold about 250 turtles and together represent half or more of the state's population. Most of the pond turtles in Washington have been head-started, but small numbers of wild turtles persist at the Sondino and Bergen sites. It is unlikely

that other pond turtle populations have persisted in the state, but the possibility remains that turtles may exist in areas that have not been accessible for survey.

The statewide population size remains below the recovery goal and is still heavily reliant on supplementation with head-started individuals. Head-started turtles contribute to recovery efforts by successfully reproducing, but natural recruitment remains low because of factors such as low hatching success due to a lack of suitable nesting conditions and predation on hatchlings. Therefore, upward trends in the number of turtles at recovery sites are primarily due to augmentation of populations with head-started turtles.

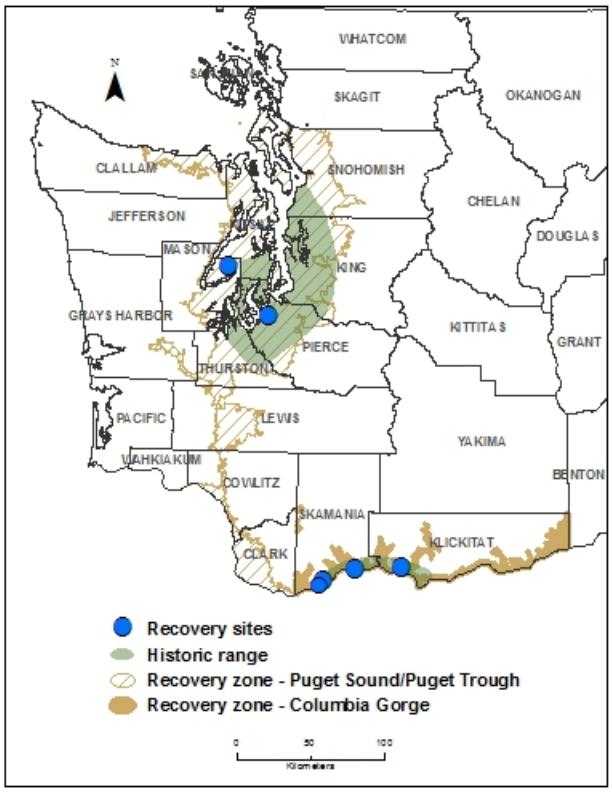

Figure 5. Western Pond Turtle historical range, recovery sites and recovery zones in Washington.

Population estimates in the Columbia Gorge are based on mark-recapture efforts (Table 1), while the South Puget Sound estimates are the highest counts of individual turtles trapped and observed basking (Table 2). In this report, the highest counts are used as an index to population size but they are not actually population estimates. Highest counts are biased toward those turtles most likely to be visible basking and juvenile turtles are likely underrepresented (B. Murphie, pers. comm.). Due to a variety of factors affecting survey conditions, accurate population estimates at Sondino and highest counts at the Pierce County site are more attainable than at the other recovery sites. Despite attempts to improve accuracy by WDFW, mark-recapture methods appear unable to efficiently estimate actual population size and can only track population trends at complex wetland systems such as Pierce National Wildlife Refuge (NWR) (Holman et al. 2011).

Table 1. Population estimates of Western Pond Turtles at four recovery sites in the Columbia Gorge, Washington, 2003–2014, based on mark-recapture efforts (Holman et al. 2015).

Site	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Sondino	-[1]	-	-	-	371	342	301	-	-	246	-	251
Bergen	-	-	-	-	-	-	97	105	86	-	-	-
Pierce NWR	62	74	114	77	66	65	-	-	41	-	-	-
Beacon Rock[2]	-	-	-	-	-	-	-	-	-	-	-	-

[1] Dashes indicate that no surveys were conducted. [2] Table 3 provides the number of head-started turtles released.

Table 2. Highest annual counts of Western Pond Turtles at two recovery sites in South Puget Sound, Washington, 2003–2015, based on counts of trapped or basking individuals.

Site	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Pierce Co.[1]	32	33	66	45	48	54	58	76	95	92	91	154	245
Mason Co.[2]	-[3]	-	-	37	46	73	78	91	85	117	98	-	-

[1] Schmidt and Tirhi (2015), [2] Murphie and Skriletz (2014), [3] Dashes indicate that no surveys were conducted.

Current Washington recovery sites. The following provides a brief description of the six recovery sites. Each site has been protected through landowner agreements or purchase by WDFW. The sites are disjunct and occur at distances too far apart to allow natural dispersal between populations with the possible exception of Pierce NWR and Beacon Rock that are located about 3 km (1.8 mi.) apart. More detailed information on these sites appears in Hays et al. (1999), Van Leuven et al. (2006), Paroulek (2008), Murphie and Skriletz (2011), Holman et al. (2012), and Schmidt and Tirhi (2014).

Sondino. This site in Klickitat County covers about 80 ha (200 ac.) of turtle habitat in the WDFW Klickitat Wildlife Area. Habitat includes a lake, pond complex and suitable adjacent upland habitat. The site holds the largest pond turtle population in Washington and is one of two naturally occurring populations in the state. Population estimates generated from mark-recapture trapping indicate a downward trend from a high of 371 turtles in 2007 to the most recent estimate of 251 turtles in 2014 (Table 1; Holman et al. 2015). This trend may result from "overharvest" for other sites as this population has provided the majority of turtles for establishing new sites in the Columbia Gorge (M. Vander Haegen, pers. comm.). That and other potential contributing factors, such as bullfrog predation and shell disease, are being addressed (see Management Activities).

Bergen. This site in Skamania County is a mosaic of about 80 ha (200 ac.) of U.S. Forest Service (USFS) land and 26 ha (65 ac.) of adjacent private lands that have been secured for turtle conservation. Habitat includes an extensive lake, pond and wetland complex within a forest and pastureland environment. This site contains the only other naturally occurring population in Washington. The most recent population estimate generated from mark-recapture trapping was 86 turtles in 2011, which was 11–18% lower than the previous two years (Table 3; Holman et al. 2015). Western Pond Turtles also occur on private lands in the surrounding landscape, but little information exists regarding the extent of occupation or the number of turtles (E. Holman and K. Slavens, pers. comm.).

Pierce National Wildlife Refuge. This site in Skamania County is owned by the USFWS. Habitat includes a complex of creeks, ponds, sloughs and adjacent upland habitat. Turtles were reintroduced to the site in 2000. Mark-recapture trapping data indicate that the population grew to 114 turtles in 2005, then fell to 41 turtles in 2011, which is the last year data are available (Table 2; Holman et al. 2015). The small population size generated from the mark-recapture work should be viewed cautiously because trapping conditions at this site can be problematic and because the turtles are not confined to the water bodies where trapping takes place. For instance, trapping in 2011 was complicated by high water conditions that likely reduced trapping efficiency due to the huge expanse of water. Flood conditions that year may have also resulted in some emigration of turtles away from the site (Holman et al. 2015).

Beacon Rock State Park. This site in Skamania County is managed by the Washington State Parks and Recreation Commission. Habitat includes a constructed mitigation wetland and adjacent aquatic sites. Turtles were introduced here in 2007. No population estimates have been generated for this site, but 204 turtles have been released to date.

Pierce County. This site occurs within a 36-ha (90-ac.) WDFW wildlife area managed for urban wildlife and the recovery of Western Pond Turtles. The area dedicated to pond turtle recovery covers 4.9 ha (12 ac.) and includes a 1.2-ha (3-ac.) wetland mitigation site with adjacent grass uplands. Turtles were introduced to the site in 1996. Census data, based on trapping and observation of marked turtles, indicate a fairly continuous upward trend as a result of augmentation with head-started turtles. The most recent census counted 245 turtles in 2015 (Table 2).

Mason County. This site is on Washington Department of Natural Resources lands and is mostly managed for timber production but is also heavily used for recreation. The main habitat for turtles is a shallow 8-ha

(20-ac.) pond that was formed when a beaver dam flooded abandoned farmlands; additional wetlands occur in the vicinity (Murphie and Skriletz 2014). This population had been maintained through augmentation with head-started turtles that were released annually until 2013. This is reflected in a generally increasing trend in basking turtles counted from 2005 to 2013 (Table 2). The current population trajectory for this site is unknown, as monitoring and augmentation have not taken place since 2013.

Habitat status in Washington. The six recovery sites can be characterized as at least moderately disturbed with alterations to the terrestrial or aquatic habitat, or both. Uplands adjacent to aquatic sites show signs of prolonged human use, such as structures, trails, unpaved roads or timber harvest. The Sondino and Bergen sites have a history of grazing and this still occurs on private lands surrounding Sondino. Some of these disturbances may have been beneficial to Western Pond Turtles. For instance, USFS developed a stand thinning prescription in the vicinity of the Bergen site with a goal of reducing fire hazard and improving forest health. This work included consultation with WDFW and enhanced upland habitat for pond turtles by providing habitat for migration and aestivation (Holman et al. 2011).

Potential habitat limitations for creating self-sustaining populations at the six recovery sites include issues related to vegetation management, suitable nesting conditions and adequate habitat to support population expansion. Habitat management for the turtles can also be challenging due to inadequate financial resources, lack of management authority, competing use of resources, landowner preference and multiple landowners (Pramuk et al. 2013). Some level of vegetation management is required annually to control invasive plant species and maintain open areas with short vegetation at all sites except Sondino, where minimal vegetation management is needed. Suitable nesting conditions are of particular concern in South Puget Sound due to the cooler, wetter conditions of the region. Murphie and Skriletz (2014) expressed concern that soil type, moisture levels and a dense vegetation understory appeared to be contributing to reduced nest success and egg development at the Mason County site. All sites with the exception of the Pierce County site have adequate habitat to support large pond turtle populations, either within the actual recovery site or in adjacent areas. The Pierce County site has adequate pond habitat to support a population large enough to satisfy the recovery objective of at least 200 turtles, but the pond complex would likely need to be expanded for the number of turtles to significantly increase beyond this number (Schmidt and Tirhi 2014).

FACTORS AFFECTING CONTINUED EXISTENCE

Natural factors. Recovering this species is challenging because of the turtles' slow rate of growth, delayed sexual maturity, limited ability to disperse, complex habitat requirements and the high mortality of eggs and hatchlings. Additionally, Washington populations are at the northern extreme of the species' range. The cool summers typical of maritime climate can slow embryo development and result in high variation in hatchling success especially in South Puget Sound. Such variability may have had less impact on the species' persistence in the past when pond turtles were more common because their long life span provided many decades of nesting opportunities. As a result of these intrinsic factors, the recovery process is slow and many decades of effort will be required.

Adequacy of existing regulatory mechanisms. As a state endangered species, Western Pond Turtles are protected from hunting, possession, malicious harassment, and killing (RCW 77.15.120). Possession and intentional destruction of the species' nests and eggs are also prohibited. No federal protections exist for the species, but a 12-month review to consider federal listing under the Endangered Species Act started on June 9, 2015, and results are pending. The USFS and U.S. Bureau of Land Management designate the Western Pond Turtle as a Sensitive Species in Washington

Wetlands in Washington receive some protections under the federal Clean Water Act (CWA), Washington State Clean Water Act, State Water Pollution Control Act and state Shoreline Management Act. Actions

affecting wetlands may also be regulated by local jurisdictions under a local government's Critical Areas Ordinance. The proposed action, size of the wetland and whether the wetland is considered isolated determine the level of protection and regulatory jurisdiction (WSDOE 2011). In the Columbia River Gorge, wetlands as well as terrestrial habitats occupied by Western Pond Turtles are protected through the Columbia River Gorge National Scenic Area.

Diseases. Shell disease has emerged as a major concern for Washington's populations of Western Pond Turtles. A similar disease is known to occur in pet turtles as a result of poor water quality and husbandry conditions (*e.g.*, turtles kept in water contaminated with feces, urine and decaying food), but it is uncommon in wild turtles. Clinical signs in pet turtles include small pitting lesions and soft spots in the shell, fluid under the scutes (the keratin layer) and foul odor. Western Pond Turtles may develop some of these same clinical signs, but they also commonly exhibit more severe defects in the scutes and boney tissue with deep pitting lesions that expose the underlying bone and frequently penetrate into the body cavity. In pet turtles, the disease can often be effectively treated by a veterinarian and improved water quality, but in Western Pond Turtles, treatments have unknown rates of success with recurrences documented in some treated individuals.

Photographic evidence shows that shell disease was present in Washington's populations dating back to at least 2003 when the photo archive was initiated. Research in 2013–2014 found that 29-49% of examined turtles in each of the six populations had external evidence of shell disease (Holman et al. 2014, Schmidt and Tirhi 2014). Severity of the disease varied from minor discoloration of the keratin or a few small pitting lesions to multiple severe, deep lesions with extensive damage to the underlying bone and overall shell. Subsequently, the use of CT scans has revealed that some turtles with no clinical or gross signs of shell disease do have subclinical (internal) indications of the disease, suggesting an even higher prevalence of turtles in Washington with the disease (K. Haman, pers. comm.). The scans have also shown that the disease in some turtles is much more extensive than indicated by external examination. Further, irregular appearance in bone has been noted in CT scans of head-started turtles as young as two years old (M. Iredale, pers. comm.). Whether these irregularities are lesions associated with shell disease remains unknown. Though the disease is primarily observed in head-started turtles, it has also been documented in three wild turtles that were not head-started (Holman et al. 2014; T. Schmidt, pers. comm.). Two of these turtles did spend time in captivity as part of the South Puget Sound breeding program (T. Schmidt, pers. comm.)

It is unclear how shell disease is affecting turtle lifespan, reproduction and recruitment in the wild. Based on photographs taken of individual turtles from 2003 to 2014, it appears that the disease progresses slowly and that some turtles have had the disease for over a decade. However, the extensive shell damage characterizing some individuals suggests that these turtles may die from the disease.

In 1990, an upper respiratory disease (URTD) caused by an unidentified pathogen was detected in the Sondino population and killed more than a third (at least 36 animals) of the Western Pond Turtles present (Hays et al. 1999). No further outbreaks have been documented in Washington, but two cases are known to have occurred in Oregon (B. Bury, pers. comm.). Non-native "pet" turtles released into the wild remain a threat to Western Pond Turtles because of their potential for carrying diseases to which pond turtles have not been exposed.

Predation and competition with other species. Introduced and native predators affect the survival of Western Pond Turtles in each of the Washington populations. The predator of primary concern is the introduced American Bullfrog, which is widespread and abundant in lowland waters of the state. Bullfrogs are present at five of the six pond turtle recovery sites, but have not yet colonized the Pierce County site. Anecdotal observations during the past 20 years at Sondino suggest that hatchling pond turtle recruitment increased when bullfrog numbers were reduced (E. Holman and F. Slavens, pers. comm.).

During bullfrog control efforts at this site in 2015, five bullfrogs were found to contain six hatchling turtles and these were taken in the spring as the newly emerged hatchlings were first moving to water (Rockney 2015). Two of the sites occupied by Western Pond Turtles have non-native, warm-water fish (*e.g*. Largemouth Bass) that are also capable of consuming hatchlings. At one of these sites, competition with fish for food may also be an issue based on the observation of some turtles being stunted in size. Native predators also can be problematic, especially when they take nesting females and nests. In 2016, six adult female pond turtles were taken by either river otters or Raccoons at the Pierce County site, prompting the need for predator control (M. Tirhi, per. comm.).

Painted Turtles (*Chrysemys picta*) are native to Washington and occur at Beacon Rock State Park, Pierce National Wildlife Refuge and Bergen. Although they may compete with Western Pond Turtles for food and basking sites, they are not considered detrimental. In Washington, the overwhelming majority of non-native turtles found in the wild are Pond Sliders (*Trachemys scripta;* also commonly called "Red-eared Sliders"). These turtles were likely purchased as pets but then were released into the wild when they became problematic to keep. In addition to carrying diseases that could threaten native turtles, Pond Sliders complete with native turtles for food and basking sites. None of the six recovery sites are currently known to have non-native turtles present, but Sondino did in the past (Hays et al. 1999).

Habitat loss and degradation. Loss and alteration of aquatic habitat and adjacent uplands has been substantial in many parts of the range of Western Pond Turtles due to human development, agriculture and flood control (Rosenberg et al. 2009). In Washington, vegetation succession from more open, herbaceous landscape to shrub and tree dominated landscape has also resulted in loss of suitable pond turtle habitat (*e.g*., Puget Sound prairies; Hays et al. 1999). One of the major limitations to recovery of Western Pond Turtles in Washington is the lack of remaining suitable habitat at the landscape level. The historical range of the species in lowland Puget Sound overlaps with 59 percent of the state's human population (OFM 2015) and is becoming increasingly urbanized. Human development pressures also exist along the lower Columbia Gorge. Consequently, opportunities to find and secure suitable habitat for pond turtle recovery are limited and declining. In addition, introduced invasive plant species such as Reed Canarygrass (*Phalaris arundinacea*), Scotch Broom (*Cytisus scoparius*) and Himalayan Blackberry (*Rubus armeniacus*) degrade the habitat that remains relative to the needs of the pond turtles by shading basking and nesting areas and, potentially creating barriers to movement due to the density of vegetation.

Small population size. Small populations are more vulnerable to stochastic events. An event that impacted Western Pond Turtles was the 2005 failure of a beaver dam at Pierce NWR that caused the loss of a primary pond used by the turtles (Van Leuven et al. 2006). Small population size can also make populations susceptible to other concerns such as an increased likelihood of inbreeding, loss of genetic variability, lower disease resistance, genetic drift and demographic fluctuations.

DNA fingerprinting in the mid-1990s revealed a lack of genetic variation in the Bergen and Sondino populations (Gray 1995). The Pierce County and Mason County populations originate from a founder population of just twelve turtles and, therefore, may also have low genetic diversity. Low genetic variation increases the risk of extinction or population decline because populations are less able, for example, to adapt to changing environmental variables or fend off novel diseases (See Disease Monitoring, Research and Treatment section).

Climate change. Limited information exits regarding the sensitivity of Western Pond Turtles to climate change. The aquatic habitats used by this species are likely to be affected by increasing temperatures and altered hydrology. For example, increased periods of summer drought could result in ponds drying for extended periods of time. While this species has evolved with and can tolerate periodic drought conditions, observations in California suggest populations can be impacted by severe and/or multi-year drought conditions (Holland 1994, Leidy et al. 2016). Holland (1994) mentions conditions in southern

and central California during 1987-1992 that in some cases resulted in local population declines of up to 85% and possibly more. Small increases in temperature (<3˚F) may also influence the sex ratios of offspring by increasing the number of females. However, warming could also potentially benefit populations in Washington by providing more warm days for developing embryos, thus enhancing reproduction in the wild (WDFW 2015).

Other conservation concerns. Western Pond Turtles are susceptible to a variety of other conservation concerns, such as trampling by livestock or large wildlife, shooting, vehicle mortality, entanglement in discarded fishing line, frequent human disturbance, rotenone use, exposure to contaminants and catastrophic events (Hays et al. 1999, Bury and Germano 2008, Pramuk et al. 2013). However, none of these are believed to currently threaten populations in Washington.

MANAGEMENT ACTIVITIES

WDFW, Woodland Park Zoo, Oregon Zoo and many other partners have been working to recover Western Pond Turtles in Washington since the early 1990s.

Head-starting program. Washington's head-start program began in 1990 soon after the respiratory disease outbreak at the Sondino site, with one of its goals being to increase the survival rate of hatchlings and juveniles by reducing their vulnerability to predation. The program was originally established by the Woodland Park Zoo, with the Oregon Zoo joining as a collaborator in 1998. Early methods and history of the program, including a captive breeding program, are described in Hays et al. (1999).

Head-starting involves collecting eggs or hatchling turtles from the wild, which are then incubated and reared over the winter in controlled conditions at the zoos. In recent years at Sondino, hatchlings that have already emerged from the nest in the spring are captured and taken to be head-started. The turtles are raised in captivity until they attain a weight of 50 g, a size large enough to avoid most predation. Turtles may be larger than 50 g when released (i.e., > 100 g; D. Shepherdson, pers. comm.). Growth to ≥ 50 g typically takes 6–12 months depending on whether the turtles are collected as hatchlings or eggs. They are then returned to the wild. Under captive conditions, hatchlings are well fed and kept warm, which allows them to experience accelerated growth rates compared to wild individuals. At release, they are about the size of a wild three-year-old turtle. From 1991 to 2015, 2,200 head-started turtles were released, including 1,448 turtles in the Columbia Gorge recovery zone and 752 turtles in the South Puget Sound recovery zone (Table 3).

The Western Pond Turtle Population and Habitat Viability Assessment (PHVA) workshop explored the levels of mortality populations could withstand if head-starting efforts were ended (Pramuk et al. 2013). Modeling scenarios indicated that adult mortality rates were particularly important for maintaining stable

Table 3. Numbers of head-started Western Pond Turtles released at six recovery sites in Washington from 1991–2015.

Recovery Zone	Site	Year recovery site was established	Total head-starts released
South Puget Sound	Pierce County[1]	1996	427
South Puget Sound	Mason County[2]	2005	325
Columbia Gorge	Sondino[3,4]	Remnant	558
Columbia Gorge	Bergen[3]	Remnant	333
Columbia Gorge	Pierce NWR[3]	2000	353
Columbia Gorge	Beacon Rock[3]	2007	204

[1] Schmidt and Tirhi (2015), [2] Murphie and Skriletz (2014), [3] Holman et al. (2014), [4] Bergh and Anderson (2015).

or increasing population dynamics, especially in the absence of head-starting. Modeled populations were never able to sustain an adult mortality rate exceeding 12.5%, even at large total population sizes. Modeling also showed that for scenarios where recruitment was largely diminished, adults would decline toward extinction but only after a 1–10-year time lag after all sub-adults had entered the adult cohort. The exception to the inevitable decline was a scenario that involved 20 years of head-starting followed by bullfrog control that reduced hatchling mortality from 95% to 85%. In that case, the population was able to sustain itself over the long-term.

The overall conclusion from the PHVA modeling scenarios was that to discontinue head-starting, other conservation programs would need to be in place to reduce adult and/or hatchling mortality to acceptable levels. Based on the information used to generate the models, requirements would include an adult mortality rate of <12.5% combined with a hatchling mortality rate of ≤85% where the population size is moderate to large (200-400 turtles) and a hatchling mortality rate of ≤80% where the population is small (50 turtles).

Disease monitoring, research and treatment. Monitoring populations to determine the extent and severity of shell disease has been ongoing since 2012. Investigations are underway to determine the causes, pathology, epidemiology, and population impacts of this disease. Such research will help determine how best to proceed in both effectively treating diseased individuals and managing diseased populations. A diverse health team has been assembled including experts in epidemiology, veterinary medicine, pathology, reptile disease, herpetology, and wildlife biology. WDFW is leading research to identify a primary pathogen and characterize shell microbiomes associated with shell disease compared to the shells of healthy turtles as well as examining a genome-wide set of genetic variants collected from individual turtles in Washington to see if any of the variants are associated with shell disease (Haman et al. in prep.; Haman et al. unpublished). The possibility that a fungal pathogen may be the causative agent is under investigation by veterinary pathologists at the University of Illinois (D. Woodburn, pers. comm.). Woodland Park Zoo and Oregon Zoo are examining husbandry practices to determine if the rapid growth rate experienced in captivity, or other aspects of husbandry, may be contributing to the development of shell disease. Veterinarians at Oregon Zoo and PAWS Wildlife Health Center have been treating turtles and the Sustainability in Prisons Project, including Cedar Creek and Larch Corrections Centers in Washington, has joined as a collaborator to care for the treated turtles until healing is complete and the turtles are ready for release back into the wild. Treated turtles are then monitored by WDFW to determine if they remain healthy and successfully reproduce.

Conservation planning. Four of the six recovery sites for Western Pond Turtles in Washington are protected by agreements between WDFW and landowners and the other two sites are on WDFW wildlife areas. WDFW developed memoranda of understanding with the USFWS in 2002, USFS in 2004 and Washington State Parks and Recreation Commission in 2007 that describe the management and responsibilities of each agency for the Pierce NWR, Bergen site and Beacon Rock State Park, respectively. WDFW has a cooperative agreement with the Washington Department of Natural Resources for use of the Mason County site for turtle recovery, including enhancement of adjacent uplands for nesting habitat.

Western Pond Turtle stakeholders held a workshop in 2012 to develop a population and habitat viability assessment for Western Pond Turtles in Washington (Pramuk et al. 2013). The workshop was designed to achieve multiple conservation objectives including (1) evaluate the progress of the species' recovery in Washington as related to the objectives in the 1999 recovery plan (Hays et al. 1999), (2) identify management to enhance species viability in the wild, (3) determine future research needs, and (4) make recommendations for improving inter-organizational communication and operation for the benefit of Western Pond Turtle conservation and management.

To assist with locating additional Western Pond Turtle recovery sites in Washington, WDFW led the development of a pond suitability analysis for South Puget Sound in 2014. The analysis evaluated >12,000 ponds based on data and criteria provided by WDFW biologists. A screening tool allowed biologists to evaluate the top-ranked ponds and decide which were most suitable for turtle reintroductions. WDFW biologists began investigating potential sites in 2015, but reintroductions are not planned until shell disease is better understood.

Habitat management, restoration and creation. Habitat management is required at the six recovery sites to keep vegetation short and to maintain suitable areas for nesting. Activities include brush removal and mowing to maintain suitable short-grass nesting habitat and prevent encroachment by trees and shrubs; removal of invasive plants; supplementation of basking structures; ditch cleaning to maintain adequate water flow; wetland creation; and soil enhancement for nesting areas in Puget Sound. In addition, supplemental water from natural springs on neighboring properties may be available to enhance wetlands at Sondino. Water rights research is needed to determine WDFW access to this water. The USFS, USFWS, Washington State Parks and Recreation Commission and private land owners cooperate with WDFW on habitat management on their lands in the Columbia Gorge.

Monitoring and research. Capturing turtles for monitoring and research is labor and resource intensive. Every year a subset of adult females is radio-tracked to locate nests. This is necessary to obtain eggs and hatchlings for head-starting as well as to protect nests (with wire enclosures) from predation. At the Pierce County site, temperature and soil moisture data loggers have been placed in nests over many years to monitor annual variation and suitability (Schmidt and Tirhi 2015). Population monitoring has occurred regularly but not annually at five of the sites with a goal of understanding survival, growth, size and age at first reproduction, age distribution of populations and population trends. Most population monitoring resources were redirected to work related to shell disease since 2013.

Many research projects have been conducted since the state recovery plan was completed (Hays et al. 1999). Examples include: investigations of survival rates and habitat use of juvenile head-started turtles (Vander Haegen et al. 2009 and in prep.); nest site selection (Lucas 2008); maternal and environmental effects on hatchling quality (Reitz 2011); over-winter survival and causes of mortality of head-started yearlings at the Pierce County site (Schmidt and Tirhi, in prep.); and development of a more accurate population estimation method for Columbia Gorge populations (*e.g.*, Holman et al. 2011). Research on shell disease is also underway (see Disease Monitoring, Research and Treatment).

Predator management. Considerable effort has been directed toward removal of non-native predators such as bullfrogs and warm-water fish at the Sondino site (Hays et al. 1999; F. Slavens, pers. comm.). Bullfrog removal has also taken place at the Bergen site. River otters and Raccoons are occasionally removed from the Pierce County site if they are targeting turtles, especially nesting adult females (M. Tirhi, pers. comm.).

Various efforts to reduce the bullfrog population at Sondino have been attempted over the years. Woodland Park Zoo has funded the removal of bullfrog egg masses for many years. At times, adults, juveniles and tadpoles have also been killed to reduce predation on pond turtle hatchlings. Bullfrogs, however, are extremely resilient and in 2013 the number of egg masses started on an upward trend again (J. Minick, pers. comm.). In response, a new strategy was initiated in 2014 to systematically remove all life stages of bullfrogs from the site including concentrating on removal of adults in the early spring before they breed, removal of egg masses in the summer and another significant effort in the late summer and early fall to remove metamorphosing juveniles. WDFW funded the removal of frogs and tadpoles and Woodland Park Zoo funded removal of egg masses. Results from the first year were promising in terms of the number of bullfrogs of all life stages removed (Rockney 2015; J. Minick, pers. comm.), the reduction

in bullfrogs observed in 2016 and the increased observations of pond turtle hatchlings in 2016. This work will continue in 2017 and then be evaluated to determine success and how to proceed.

CONCLUSIONS AND RECOMMENDATION

Washington's statewide population of Western Pond Turtles currently numbers about 800–1,000 animals and is distributed among six locations in the western half of the state. Two populations, Sondino and the Pierce County site, each contain about 250 turtles and together hold half or more of the state's population. The state-wide estimate represents a significant improvement in population status since 1994, when just 156 turtles persisted at two locations. However, the population remains below the downlisting objectives set forth in the state recovery plan (Hays et al. 1999), which specified that at least five self-sustaining populations of ≥200 pond turtles, composed of no more than 70% adults, must be established and that each population must occupy habitat that is secure from development or major disturbance.

The state-wide population faces several important threats, including low natural recruitment and a poorly understood shell disease that affects significant numbers of turtles at each of the recovery sites. Other significant threats to pond turtles in Washington include predation by non-native bullfrogs and other species, degradation of nesting habitat caused by invasive plant species that requires ongoing management, small population size and low genetic diversity, and potential issues associated with climate change. Turtle populations at all six recovery sites require management efforts to maintain their existence, with head-starting being one of the key programs contributing to conservation. Funding to support both research and management are essential for recovery of this species. The likelihood is high that Western Pond Turtles will revert to near extirpation if head-starting, predator control and habitat management are discontinued.

For these reasons, it is recommended that Western Pond Turtles remain state listed as endangered in Washington.

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Appendix A. WDFW responses to public comments received during the 90-day public review period for the draft *Periodic Status Review for the Western Pond Turtle in Washington* conducted from September 24, 2016, to December 23, 2016. The comments presented here are summaries of the remarks provided by one or more people.

Report Selection	**Comment and Response**
General comments	1. I support the continued listing of Western Pond Turtles as a state endangered species in Washington.
	WDFW recommends that Western Pond Turtles should remain on the state list of endangered species for the reasons given in the periodic status review
Management activities	2. I support recovery efforts of Western Pond Turtles.
	WDFW agrees that the recovery efforts for Western Pond Turtles should continue. Without management activities such as head-starting, predator control and habitat management, there is a high likelihood that the species will revert to near extinction in Washington.
	3. I support the use of captive breeding to recover Western Pond Turtles. This will allow large numbers of turtles to be produced quickly and allow large-scale releases on public and private lands including green belts, water retention ponds and industrial sites.
	WDFW agrees that captive breeding and head-starting are important actions for supporting the recovery of Western Pond Turtles in Washington. Captive breeding was part of the early recovery efforts for this species in the state. Both activities have proven effective for increasing the survival rate of hatchling turtles and maintaining turtle populations. Western Pond Turtle recovery, however, will always be a slow process because the turtles take over a decade before they become sexually mature and can start reproducing and because they only produce small numbers of eggs annually.
	4. I have a pond on my property and would like to help Western Pond Turtle recovery efforts by starting a population there.
	WDFW appreciates these offers, but few sites will qualify as suitable. Each recovery site must be able to support at least 200 turtles and ideally more. Western Pond Turtles spend a great deal of time in both water and uplands. Features of the uplands are important and must include habitat that is suitable for nesting, overwintering and movement of turtles. The presence of a road near a pond almost always disqualifies a site because of the risk that the turtles will be killed by vehicles. Additionally, WDFW must be able to monitor the turtles and maintain suitable habitat conditions including controlling invasive plant species, maintaining open areas and adding basking structures. Consequently, WDFW would need a memorandum of understanding with the landowner that would guarantee agency access to the property whenever necessary and in perpetuity.

WASHINGTON STATE STATUS REPORTS, PERIODIC STATUS REVIEWS, RECOVERY PLANS, AND CONSERVATION PLANS

Status Reports

2015 Tufted Puffin
2007 Bald Eagle
2005 Mazama Pocket Gopher, Streaked Horned Lark, and Taylor's Checkerspot
2005 Aleutian Canada Goose
2004 Killer Whale
2002 Peregrine Falcon
2000 Common Loon
1999 Northern Leopard Frog
1999 Olympic Mudminnow
1999 Mardon Skipper
1999 Lynx Update
1998 Fisher
1998 Margined Sculpin
1998 Pygmy Whitefish
1998 Sharp-tailed Grouse
1998 Sage-grouse
1997 Aleutian Canada Goose
1997 Gray Whale
1997 Olive Ridley Sea Turtle
1997 Oregon Spotted Frog
1993 Larch Mountain Salamander
1993 Lynx
1993 Marbled Murrelet
1993 Oregon Silverspot Butterfly
1993 Pygmy Rabbit
1993 Steller Sea Lion
1993 Western Gray Squirrel
1993 Western Pond Turtle

Periodic Status Reviews

2016 Bald Eagle
2016 Peregrine Falcon
2016 Marbled Murrelet
2016 American White Pelican
2016 Lynx
2016 Taylor's Checkerspot
2016 Columbian White-tailed Deer
2016 Streaked Horned lark
2016 Killer Whale
2016 Greater Sage-grouse
2016 Northern Spotted Owl
2016 Snowy Plover
2016 Western Gray Squirrel
2015 Brown Pelican
2015 Steller Sea Lion

Recovery Plans

2012 Columbian Sharp-tailed Grouse
2011 Gray Wolf
2011 Pygmy Rabbit: Addendum
2007 Western Gray Squirrel
2006 Fisher
2004 Sea Otter
2004 Greater Sage-Grouse
2003 Pygmy Rabbit: Addendum
2002 Sandhill Crane
2001 Pygmy Rabbit: Addendum
2001 Lynx
1999 Western Pond Turtle
1996 Ferruginous Hawk
1995 Pygmy Rabbit
1995 Upland Sandpiper

Conservation Plans

2013 Bats

Status reports and plans are available on the WDFW website at:
http://wdfw.wa.gov/publications/search.php

References Reviewed for the *Periodic Status Review for the Western Pond Turtle in Washington.*

Table B presents the 48 references cited in the *Periodic Status Review for the Western Pond Turtle in Washington*. Each reference is categorized for its level of peer review pursuant to section 34.05.271 RCW, which is the codification of Substitute House Bill 2661 that passed the Washington Legislature in 2014. A key to the review categories under section 34.05.271 RCW is provided in Table A.

Individual papers cited in the *Periodic Status Review for the Western Pond Turtle in Washington* cover a number of topics discussed in the report, including information on: 1) the species' taxonomy, distribution, and biology; 2) habitat requirements; 3) population status and trends; 4) conservation status and protections; 5) management activities; and 6) factors affecting the continued existence of the species.

Table A. Key to 34.05.271 RCW Categories:

Category Code	34.05.271(1)(c) RCW
i	(i) Independent peer review: review is overseen by an independent third party.
ii	(ii) Internal peer review: review by staff internal to the department of fish and wildlife.
iii	(iii) External peer review: review by persons that are external to and selected by the department of fish and wildlife.
iv	(iv) Open review: documented open public review process that is not limited to invited organizations or individuals.
v	(v) Legal and policy document: documents related to the legal framework for the significant agency action including but not limited to: (A) federal and state statutes; (B) court and hearings board decisions; (C) federal and state administrative rules and regulations; and (D) policy and regulatory documents adopted by local governments.
vi	(vi) Data from primary research, monitoring activities, or other sources, but that has not been incorporated as part of documents reviewed under the processes described in (c)(i), (ii), (iii), and (iv) of this subsection.
vii	(vii) Records of the best professional judgment of department of fish and wildlife employees or other individuals.
viii	(viii) Other: Sources of information that do not fit into one of the categories identified in this subsection (1)(c).

Table B Reference	34.05.271 RCW Review Category
Barela, K.L. and D.H. Olson. 2014. Mapping the Western Pond Turtle (*Actinemys marmorata)* and Painted Turtle (*Chrysemys picta)* in western North America. Northwestern Naturalist 95:1–12.	i
B.C. Conservation Data Centre. 2016. BC species and ecosystems explorer. B.C. Ministry of Environment, Victoria, British Columbia. http://a100.gov.bc.ca/pub/eswp/ Accessed June 29, 2016.	i
Bergh, S. and D. Anderson. 2015. Western Pond Turtle project report 2015. Washington Department of Fish and Wildlife, Vancouver, Washington.	vi
British Columbia Ministry of Environment. 2015. The reptiles of British Columbia: Western (Northern Pacific) Pond Turtle. http://www.bcreptiles.ca/turtles/westernpond.htm Accessed October 28, 2015.	viii
Bury, R.B. 1982. Turtle of the month (*Clemmys marmorata*) a true western turtle (Pacific Pond). Tortuga Gazette 1982:3–5.	viii

Bury, R.B. and D.J. Germano. 2008. *Actinemys marmorata* (Baird and Girard 1852) – Western Pond Turtle, Pacific Pond Turtle. Pages 001.1–001.9 *in* A.G.J. Rhodin, P.C.H. Pritchard, P.P. van Dijk, R.A. Saumure, K.A. Buhlmann, J.B. Iverson, and R.A. Mittermeier, editors. Conservation biology of freshwater turtles and tortoises: a compilation project of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group. Chelonian Research Monographs No. 5, Installments 1–2. http://www.iucn-tftsg.org/cbftt Accessed July 25, 2016.	i
Bury, R.B., H.H. Welsh, Jr., D.J. Germano and D.T. Ashton. 2012a. Objectives, nomenclature and taxonomy, description, status and needs for sampling. Northwest Fauna 7:1–7.	i
Bury, R.B., D.T. Ashton, H.H. Welsh, Jr., D.A. Reese and D.J. Germano. 2012b. Synopsis of biology. Northwest Fauna 7:9–19.	i
Cook, F.R., R.W. Campbell, and G.R. Ryder. 2005. Origin and current status of the Pacific Pond Turtle (*Actinemys marmorata*) in British Columbia. Wildlife Afield 2(2):58–63.	i
Giese, C.L.A., D.N. Greenwald and T. Curry. 2012. Petition to list 53 amphibians and reptiles in the United States as threatened or endangered species under the Endangered Species Act. Center for Biological Diversity, Tucson, Arizona. 454 pp.	viii
Gray, E. 1995. DNA fingerprinting reveals lack of genetic variation in northern populations of the western pond turtle (*Clemmys marmorata*). Conservation Biology 9:1244–1255.	i
Haman K.H., R. McLaughlin, R. Kodner and WDFW Western Pond Turtle Health Team. 2016. In prep. Characterization and comparison of the microbiome on carapace/plastron from healthy western pond turtles and those impacted by shell disease.	vi
Haman K.H., K.W. Warheit and WDFW Western Pond Turtle Health Team. 2016. In progress. Genome wide association of shell disease in western pond turtles in Washington. Washington Department of Fish and Wildlife, Olympia, WA.	vi
Hays, D.W., K.R. McAllister, S.A. Richardson and D.W. Stinson.1999. Washington state recovery plan for the Western Pond Turtle. Washington Department of Fish and Wildlife, Olympia, Washington. 66 pp.	ii, iii, iv
Holland, D.C. 1994. The Western Pond Turtle: habitat and history. U.S. Department of Energy, Bonneville Power Administration, Portland, Oregon. www.efw.bpa.gov/environment/ew/ewp/docs/reports/wildlife/w62137-1.pdf	i
Holman, E. and D. Anderson. 2014. Western Pond Turtle project report, 2013. Washington Department of Fish and Wildlife, Vancouver, Washington. 7 pp.	vi
Holman, E., D. Anderson, M. Vander Haegen and G. Olson. 2011. Western Pond Turtle project report for Bonneville Power Administration. BPA Project #2001-027–00. Progress Report for March 2010–Feb. 2011. Washington Department of Fish and Wildlife, Vancouver, Washington. 14 pp.	vi
Holman, E., D. Anderson, M. Vander Haegen, G. Olson, W. Chang and B. George. 2012. Western Pond Turtle project report for Bonneville Power Administration. BPA Project #2001-027-00. Progress Report for March 2011–Feb. 2012. Washington Department of Fish and Wildlife, Vancouver, Washington. 21 pp.	vi
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Reese, D.A. and H.H. Welsh. 1997. Use of terrestrial habitat by Western Pond Turtles, *Clemmys marmorata*: implications for management. Pages 352–357 *in* Proceedings: conservation, sestoration and management of tortoises and turtles. New York Turtle and Tortoise Society, Mamaroneck, New York.	i
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