

Western Pond Turtle Head-starting and Reintroduction

Progress Report 2002 - 2003



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Western Pond Turtle Head-starting and Reintroduction

Jun. 2002 thru Sept. 2003

Progress Report BPA Project #2001-027-00

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Abstract:

This report covers the results of the western pond turtle head-starting and reintroduction project for the period of June 2002-September 2003. Wild hatchling western pond turtles from the Columbia River Gorge were reared at the Woodland Park and Oregon Zoos in 2002 and 2003 as part of the recovery effort for this Washington State endangered species. The objective of the program is to reduce losses to introduced predators like bullfrogs and largemouth bass by raising the hatchlings to a size where they are too large to be eaten by most of these predators.

In 2002, 27 females from the two Columbia Gorge populations were equipped with transmitters and monitored until they nested. Four more females carrying old transmitters were also monitored; only one of these transmitters lasted through the nesting season. In 2003, 30 females were monitored. Twenty-three of the females monitored in 2002 nested and produced 84 hatchlings. The hatchlings were collected in fall 2002 and reared in captivity at the Woodland Park and Oregon zoos in the head-start program. Twenty-seven of the turtles monitored in 2003 nested. Six of the turtles nested twice, producing a total of 33 nests. The nests will be checked in September and October 2003 for hatchlings.

Of 121 head-started juvenile western pond turtles collected in the Columbia Gorge during the 2001 nesting season, 119 were released at three sites in the Columbia Gorge in 2002, and 2 held over for additional growth. Of 86 turtles reared in the head-start program at the Woodland Park and Oregon Zoos fall 2002 through summer 2003, 67 were released at sites in the Columbia Gorge in summer of 2003, and 15 held over for more growth. Fifty-nine juveniles were released at Pierce National Wildlife Refuge in July 2002, and 51 released there in July 2003. Sixteen of those released in 2002 and 16 released in 2003 were instrumented with radio transmitters and monitored for varying amounts of time for survival and habitat use between the time of release and August 2003, together with juveniles from the 2001 release which were monitored from June 2001 through August 2003, and juveniles from the 2000 release which were monitored from August 2000 through August 2003. The number of functioning transmitters varied due to transmitter failures and detachments, and availability of replacement transmitters, as well as opportunities to recapture turtles. By August 15, 2003, a total of 39 turtles were being monitored: 6 from the 2000 release, 8 from the 2001 release, 10 from the 2002 release, and 15 from the 2003 release.

During the 2002 field season trapping effort, 280 turtles were captured in the Columbia Gorge, including 236 previously head-started turtles. During the 2003 trapping season, 349 turtles were captured in the Columbia Gorge; 304 of these had been head-started. These recaptures, together with confirmed nesting by head-start females and visual re-sightings, indicate the program is succeeding in boosting juvenile recruitment to increase the populations. Records were also collected on 160 individual painted turtles captured in 2002 and 189 painted turtles captured in 2003 during trapping efforts at Pierce NWR, to gather baseline information on this native population. Eight female painted turtles were monitored by telemetry during the 2002 nesting season; 4 nests were recorded for these animals, plus 35 nests located incidentally. Preferred habitat for nesting was identified based on the telemetry results, to be considered in anticipating future turtle habitat needs and in management planning at Pierce NWR. Bonneville Power Administration (BPA) funding supported activities in the Columbia River Gorge from June 2002 through September 2003.

Acknowledgments

This project is a federal/state/private cooperative effort that has been in progress since the late 1980s. Activities conducted during this report period were primarily funded by BPA in cooperation with Washington Department of Fish and Wildlife (WDFW), the U.S. Fish and Wildlife Service (USFWS), the Woodland Park Zoo and the Oregon Zoo. Additional funding was provided by the Aquatic Lands Enhancement Account for support of volunteers to assist with field activities in 2002 and 2003. Kate Slavens, WDFW, and Frank Slavens, Woodland Park Zoological Society, coordinated and led the trapping and monitoring of female turtles to obtain hatchlings for head-starting. Dana Payne directed the head-starting of turtles at the Woodland Park Zoo. David Shepherdson and Blair Csuti facilitated the head-starting of hatchling turtles at The Oregon Zoo in Portland. Joe Engler, US Fish and Wildlife Service, facilitated the release and monitoring of juvenile pond turtles at the Pierce National Wildlife Refuge (NWR) in the Columbia Gorge. Steven Clark, Kathleen Perillo, Kate MacKinnon, and Susan Van Leuven, WDFW; and volunteers David Swanson, Adam Fahnestock, DJ Scates, and Deanna Brown monitored released juvenile turtles at the Pierce NWR. Eric Holman, Mary McCallum, and Kate MacKinnon, WDFW, and volunteer Lee Lynn Thompson conducted trapping at the Skamania County site, and were assisted by other volunteers in monitoring female pond turtles there. Susan Van Leuven was assisted in trapping turtles at Pierce NWR by Eric Holman, Michelle Groesbeck, Steven Clark, Kathleen Perillo, Kate MacKinnon, Lisa Renan, and Jeff Azerrad, of WDFW; Don Ross and Sara McFall, USFWS; Lisa Hallock, Washington Department of Natural Resources; and volunteers Casey Parsons, Julie Memarian, Kelly Harlan, Rob Kraii, and Michelle Westerman. Susan Van Leuven coordinated and led the monitoring of female painted turtles at the Pierce NWR. Volunteers Julie and John Memarian, Josh Holowatz, and Tess Gingrich assisted WDFW and USFWS staff in monitoring female painted turtles at Pierce NWR. Dennis and Sondra Clark donated volunteer time to assist with checking nests in the fall for hatchling turtles. David Anderson participated in all aspects of the work in the Columbia River Gorge. A number of volunteers, including Jerry Novak, Giovanni Fagioli, Paula Fagioli, David Swanson, David Bachman, Mike Teller, Kevin Hawkins, and others from The Oregon Zoo, assisted in the monitoring of female pond turtles at the Klickitat County and Skamania County sites. The labors of all of these individuals were and are essential to the success of the 2002 and 2003 field seasons for western pond turtle recovery in Washington.

Introduction

The western pond turtle (*Clemmys marmorata*) is classified since 1993 as an endangered species in Washington and is considered a Species of Concern by the U.S. Fish and Wildlife Service since 1992. The western pond turtle is declining throughout its range and is highly vulnerable to extirpation in Washington. The species was once well distributed in southern Puget Sound lowland lakes and ponds and in the Columbia River Gorge. The western pond turtle has been essentially extirpated from Puget Sound and, within the Washington portion of the Columbia River Gorge, only two small, isolated populations remain in Skamania and Klickitat counties.

The Washington Department of Fish and Wildlife (WDFW) wrote a recovery plan for the species in Washington in 1999 (Hays et. al 1999). The plan calls for establishing a total of 7 populations of more than 200 turtles each - 4 in the Columbia Gorge and 3 in Puget Sound. Achieving this recovery objective will require an ongoing program of head-starting hatchling turtles, captive breeding, and reintroduction until population numbers are increased to ensure the species' survival in Washington. Population size must be sufficient to overcome the effects of juvenile mortality by introduced predators such as bullfrogs and warm-water fish, and such sources of juvenile mortality must be reduced or eliminated. The total number of western pond turtles in Washington is estimated to be fewer than 650 individuals, many of them young turtles that went through the head-start program at the Woodland Park Zoo. The WDFW and the Woodland Park Zoo have been working cooperatively on this recovery effort since 1990, and were joined in 2000 by The Oregon Zoo.

WDFW has acquired land in Klickitat County containing the most important population remaining in the state. This land is currently being managed as part of the Klickitat Wildlife Area. The US Forest Service acquired over 200 acres of western pond turtle habitat at the Skamania County site in 2002-2003. These parcels contain the second largest population of western pond turtles in the state. Improvements for the benefit of the turtles are planned and being implemented at both sites.

Project Area

The project area consists of three sites in the Columbia River Gorge in Klickitat and Skamania counties. The largest naturally occurring population of western pond turtles is in Klickitat County and numbers approximately 235 turtles. The Klickitat population consists of a lake group and a pond complex group. Although the lake and pond complex are connected geographically, turtles have only rarely been documented moving between them. The WDFW owns and manages these critical wetlands.

The second site, in Skamania County, contains the only other naturally occurring population in the Columbia River Gorge. This site is a mosaic of private and public land ownership. The U.S. Forest Service currently manages all public lands associated with this site. The western pond turtle population at this location is estimated at approximately 121 individuals.

The third site in the project area, in western Skamania County, is the Pierce National Wildlife Refuge (NWR). This area is the first reintroduction site for western pond turtles in the Columbia River Gorge. The goal is to establish the third of four populations needed to recover the pond turtle in the Columbia River Gorge. The site is managed by the U.S. Fish and Wildlife Service (USFWS). A total of 188 turtles have been released at Pierce National Wildlife Refuge since the summer of 2000.

Work Description

The goal of this project is to establish four self-sustaining populations of western pond turtles in the Columbia River Gorge recovery zone. Bonneville Power Administration (BPA) funding currently provides primary support for this long-term effort. There are five objectives of the BPA project. The work conducted and results for each objective for the 2002 and 2003 field seasons are described below.

Objective 1: Inventory and Mark-Recapture Western Pond Turtles in the Columbia River Gorge.

Methods: A mark-recapture program was conducted to estimate current population size at the Klickitat and Skamania county sites. A similar program was also undertaken at Pierce NWR; however, estimated population size for Pierce NWR is based on survival rates of juvenile western pond turtles monitored in an ongoing telemetry study. WDFW captured a representative number of western pond turtles in selected ponds and lakes at each site using two types of live traps (hoop and basking). Trapping was conducted continuously from April through May at the Klickitat and Skamania county sites. Traps were checked daily. At Pierce NWR, trapping was conducted over a shorter interval of time. Traps were placed in the ponds and checked daily for a one-week period, and then removed. In 2002, sites at Pierce NWR were trapped in April, May, and July for one week each month. In 2003, all trapping at the refuge was conducted in the last three weeks of May. Turtles were also captured opportunistically by dipnet and by hand whenever possible. Individual animals were identified by previously marked notches on the carapace. Identity of head-started juvenile western pond turtles captured at Pierce NWR in 2003 was verified by checking the implanted microchip numbers, when possible. Unmarked animals were given a number by filing notches in the carapace for future identification.

In fulfillment of an agreement with USFWS for use of Pierce NWR as a western pond turtle reintroduction site and to gain information on potential issues relating to interspecific competition between western pond turtles and western painted turtles, a mark-recapture program for western painted turtles was integrated with the pond turtle trapping activity. Painted turtles occur naturally at this site, and while the two species are expected to coexist in relative harmony, studies are being conducted to monitor the painted turtle population and use of habitat, so that changes resulting from introduction of pond turtles may be detected. The same standard set of data was collected for both species during trapping, and turtles were marked in a similar fashion except that the painted turtles were notched using a different numbering system. Both species were captured concurrently using the same techniques and equipment.

Results: A total of 280 western pond turtles were captured in 2002 and 349 in 2003 (Table 1). Head-start turtles comprised 82% and 85%, respectively, of the total number of turtles captured at the two wild population sites in 2002 and 2003 in Klickitat and Skamania counties, revealing the importance of the program in adding recruits to the extant populations. At Pierce NWR, all western pond turtles present are the result of head-start reintroductions, and thus equal 100% of the captures.

Table 1. Columbia River Gorge western pond turtle trapping results for 2002 and 2003.

Location	2002			2003		
	# turtles	# head starts	# adult females	# turtles	# head starts	# adult females
Klickitat County	189	151	23	224	189	25
Skamania County	52	46	4	66	56	5
Pierce NWR	39	39	0	59	59	0
Total	280	236	27	349	304	30

At Pierce NWR, 160 individual painted turtles were captured in 2002. Of these, 53 were caught twice, 17 three times, and 1 four times. The rate of recapture was too low to generate a population estimate of acceptable precision. In 2003, when the trapping effort was concentrated into three consecutive weeks, 189 individual turtles captured; 82 animals were caught twice, 27 three times, 7 four times, and 2 five times.

Population and survival rates were estimated for the three pond turtle sites in the Columbia Gorge in 2001 (Table 2). Estimates for the Klickitat and Skamania County sites were generated using the Jolly-Seber model, based on the trapping results from 2002 and earlier years. The estimate for Pierce NWR is based on survival rates observed for head-start western pond turtles released at the refuge and monitored by radio telemetry in an ongoing study.

Table 2. Population and survival estimates for three western pond turtle populations in the Columbia River Gorge in 2001.

Location	Population Estimate (95% Confidence Interval)	Survival Estimate (95% Confidence Interval)
Klickitat Site	234.11 (210.99 - 257.24)	not available
Skamania Site	121.42 (103.11 - 139.73)	not available
Pierce NWR	74.10 (67.08 - 78.00)**	.95 (.86 - 1.00)*

*Dates August 2000 through November 2001; estimate is for combined 2000 and 2001 cohorts of head-start western pond turtles released at the refuge.

**Derived by subtraction based on known number of animals released and survival rate.

Objective 2: Maintain Head-start Program.

Methods: The program of head-starting wild hatchlings and evaluating their survival and growth using mark-recapture, was maintained. Adult female western pond turtles were captured at the Klickitat and Skamania sites during April and May using hoop and basking live traps. All captured pond turtles were identified, weighed, and measured. Adult females were equipped with Advanced Telemetry System model 7PN radio transmitters, which have an expected life of 344 days and weigh 14 g. Transmitters were attached to the carapace using epoxy adhesive. The females were monitored until egg-laying occurred. Nest sites were identified and protected from predation with wire mesh exclosures. After the summer incubation period, hatchlings were removed from nests in late September and early October. These turtles were taken to Woodland Park Zoo and the Oregon Zoo for rearing over the winter. Following the period in captivity (October to July), juveniles were released into the Klickitat ponds and lake, the Skamania ponds, and ponds at the Pierce NWR for population augmentation.

Results: A total of 31 female western pond turtles were monitored for nesting during the 2002 breeding season (Table 3). Weights of the captured female turtles ranged from 448 to 737 g. Mean weights were 591 g at the Klickitat sites and 590 g at the Skamania ponds. Carapace lengths ranged from 147 to 171 mm (mean = 156 mm at Klickitat sites; 160 mm at the Skamania ponds).

The females were monitored for nesting activity from 15 May - 15 July 2002, except for 3 turtles whose old transmitters failed before the end of the season. Turtles began laying eggs on 10 June and continued until 27 June. Of the monitored females, 23 were documented to nest (17 at the Klickitat ponds, 2 at the Klickitat lake, and 4 at the Skamania site).

The 23 nests were protected with wire exclosures and checked in September for hatched eggs. Predicted hatching dates were 100 days from the date of laying and hatching occurred from 18 September to 1 October 2002. The 23 nests produced 84 hatchlings out of 117 eggs laid (72% hatching success) (Table 3). Average clutch size for the 23 nests was 5.1 eggs per nest; average number of hatchlings per nest was 3.7.

Table 3. Western pond turtle nesting results in the Columbia Gorge, Washington, 2002.

Location	# Females Monitored	Capture Dates	Date Laid	# Nests	# Eggs	# Fertile	# Hatched
Klickitat County ponds	21	6 April - 13 June	10 - 27 June	17	85	74	61
Klickitat County lake	3	19 April - 17 May	13 - 27 June	2	13	11	11
Skamania County ponds	7	12 - 25 May	20 - 24 June	4	19	14	12
Total	31*			23	117	99	84

*Four turtles carried old transmitters; only one of these transmitters lasted through the nesting season.

The 84 hatchlings (61 from the Klickitat ponds, 11 from the Klickitat lake, and 12 from the Skamania ponds) were collected from the nests and transported from the field to the head-start program at Woodland Park Zoo in Seattle and the Oregon Zoo in Portland. Six hatchlings did not survive to the date of collection. One yearling from the Skamania site and 3 hatchlings from the Klickitat ponds were also captured by hand and in traps in spring 2002 and taken to

Woodland Park Zoo for headstarting. Two young turtles collected in 2001 were held over for an extra year to attain more growth before release. Forty-four turtles were over-wintered at the Woodland Park Zoo and 42 at the Oregon Zoo, for release back to the wild in summer 2003.

During the 2003 breeding season a total of 30 female western pond turtles were monitored for nesting (Table 4). Weights of the captured female turtles ranged from 449 to 851 g. Mean weights were 634 g at the Klickitat sites and 709 g at the Skamania ponds. Carapace lengths ranged from 142 to 177 mm (mean = 159 mm at Klickitat sites; 171 mm at the Skamania ponds).

Table 4. Western pond turtle nesting results in the Columbia Gorge, Washington, 2003.

Location	# Females Monitored	Capture Dates	Date Laid	# Nests
Klickitat County ponds	20	4 April - 3 July	30 May - 4 July	24*
Klickitat County lake	5	27 April - 9 June	4 - 18 June	3
Skamania County ponds	5	27 April - 16 June	6 - 17 June	6
Total	30			33

*Six turtles produced two nests.

The females were monitored for nesting activity from 15 May – 15 July, 2003. The first nest was recorded on 30 May and the last nest documented 4 July 2003. Of the monitored females, 26 were known to nest (18 at the Klickitat ponds, 3 at the Klickitat lake, and 5 at the Skamania site). Six of the turtles at the Klickitat ponds produced a second nest; including a turtle that had originally been head-started and released in 1991.

The 33 nests were protected with wire exclosures and will be checked in September for hatched eggs. Based on weather patterns and effects on incubation times, predicted hatching dates are 90 days from the dates of laying, which would be between 29 August and 3 October 2003.

In summer of 2002, 119 head-start turtles were released in the Columbia Gorge: 24 at the Klickitat ponds, 29 at the Klickitat lake, 7 at the Skamania site, and 59 at Pierce NWR. In summer of 2003, 67 turtles were released: 8 at the Klickitat Ponds, 3 at the Klickitat lake, 5 at the Skamania site, and 51 at Pierce NWR. This brought the total number of head-start turtles released since 1991 to 212 for the Klickitat ponds, 95 for the Klickitat lake, 146 for the Skamania pond complex, and 188 at Pierce NWR.

One yearling from the Klickitat site, and 10 hatchlings from the Klickitat ponds and 2 hatchlings from the Skamania site were captured by hand and in traps in spring 2003 and taken to Woodland Park Zoo. Fifteen head-start turtles collected in 2002 were kept over for an extra year to attain more growth before release. Three two-year old wild pond turtles were captured at the Klickitat ponds. These were measured, marked, and returned to the ponds.

A database is being maintained on all turtles that have been handled and marked in Washington, with an individual specimen page of all observations and capture information for each turtle. There are now a total of 877 individual specimen pages for Washington turtles, including wild caught, captive-bred, head-started, and opportunistically obtained captive breeding stock. These records cover the years from 1985-2003.

Objective 3: Establish New Populations of Turtles.

Methods: Some of the juvenile western pond turtles reared in the head-start program were released at Pierce NWR to establish a new population of turtles in the Columbia Gorge. A representative subset of these turtles was tracked by radio telemetry to determine survival and habitat use.

A total of 188 turtles were released during the first four years of the reintroduction program (40 in 2000; 38 in 2001; 59 in 2002; and 51 in 2003). All years, turtles were released at three bodies of water on the refuge; Pierce Lake, the Beaver Pond, and South Slough. In 2001, 2002, and 2003, turtles were also released at a new pond, Domestic Spring (also called North Slough).

Sixteen of the juveniles released in 2002 and 16 released in 2003 were fitted with 2.8 g BS-2GT transmitters (Holohil Limited, Corp., Ontario, Canada) measuring 18 mm across, with a 20 cm flexible whip antenna and encased in a waterproof resin. Some of the transmitters were temperature sensitive; the number of pulses per second decreased with lowered temperatures; expected battery life was nine months at 30°C. Non-temperature sensitive transmitters had a battery life of seven months. They were painted with enamel model paint to aid in remote identification. The transmitters were affixed to the carapace using Stikki-Wax. These turtles, along with the turtles with transmitters from the 2000 and 2001 cohorts, were monitored twice weekly during seasons when turtles were active, and once weekly in winter when the turtles were dormant.

Trapping was conducted at Pierce NWR in April, May and July 2002; and May 2003. Turtles captured during the trapping effort and for transmitter replacement were weighed and measured to obtain information on growth rates of released juveniles.

Results: Radio tracking of instrumented turtles has yielded detailed information on habitat use and survival at Pierce NWR. Twenty-six turtles were being tracked at the end of 2002, up from 18 turtles at the end of 2001. The program benefited from improved transmitter attachment techniques in 2002; only 1 transmitter was lost to detachment, compared to 6 the previous year. Five transmitters failed prematurely by an average of 4.6 months each. Two turtles were lost to the study due to transmitter failure at the end of expected battery life, when they could not be relocated for capture and attachment of new transmitters. However, at least 8 other turtles carrying dead transmitters were captured opportunistically and during the trapping effort and re-instrumented, thereby restoring them to the program. The maximum number of active transmitters in 2002 was 30, in late summer after the release of the 2002 cohort of head-start turtles. By mid-May 2003 only 20 turtles still had functioning transmitters. Eight turtles with dead transmitters were captured during May trapping and fitted with new transmitters. Following the release of the 2003 cohort of juvenile turtles, a total of 39 turtles were being tracked.

The high survival rate observed in 2001 for released monitored turtles (Table 2) continued through 2002, with only two documented mortalities among instrumented turtles for the year. One turtle from the 2002 release was presumed taken by a predator after its transmitter was found 21 November with tooth marks on it, about 60 m from the turtle's last known hibernaculum. Another turtle, released in 2002, was found dead of an unknown cause on 17 December at its upland wintering spot. Necropsy analysis by a zoo veterinarian produced inconclusive results. A turtle was found 1 October alive but with bite marks on its shell, possibly from an encounter with a coyote. A veterinarian determined that the direct injuries were not life-

threatening, but that because lowered metabolism during dormancy reduces turtles' ability to heal and suppress infection, loss could occur due to secondary factors. This turtle was left in the care of the Oregon Zoo for the winter and re-released at the refuge in April 2003. Cases of intervention, which prevented probable mortality, will be taken into account in evaluating survival.

In April 2002, the onset of the active season for pond turtles, a total of 18 turtles were being monitored. Six were in Pierce Lake, where they spent the entire season. Of 7 turtles located in or near the Beaver Pond during spring, 2 stayed in the pond, and the other 5 moved to Pierce Lake. Five turtles were in Domestic Spring (pond) for the entire active season. There were no turtles with functioning transmitters in the South Slough in April. However, during the 2002 trapping effort, 2 turtles in South Slough that had been previously instrumented were recaptured and equipped with new transmitters. These turtles remained in the slough until they moved upland for the dormant season.

In July 2002, new head-started transmitter-equipped turtles were released at the refuge. Five were released into Pierce Lake, where they remained until moving upland to estivate. Five were released into Beaver Pond; 1 of these emigrated to Pierce Lake, and the others stayed in the general vicinity of the pond. Three new turtles were placed in Domestic Spring, and 3 were added to South Slough. All of these turtles finished the active season at or near the site of release.

A few of the new turtles left the water soon after they were released at Pierce NWR. One turtle from Pierce Lake left the water 23 July, 5 days after being released. Another was found upland 24 July south of Beaver Pond, another near Domestic Spring 1 August, and another at South Slough 30 July. By 27 August, 4 of the 5 turtles in South Slough were upland, possibly in response to declining water levels. Available water was limited to pools at that time. The movement upland during summer is a behavior observed among newly released turtles, but not in pond turtles from earlier releases at the refuge.

Of 29 turtles monitored into the 2002 dormant season, 25 were wintering upland by that time, 2 were in water, and 2 were in low-lying streamside habitats that sometimes flooded. The turtles wintering in Domestic Spring occupied the same pond during summer. Turtles monitored by telemetry moved up to 280 m from their summer ponds before settling into a wintering spot. The mean distance between winter location and summer pond was 67 m (Fig. 1). Eleven of the upland turtles wintered closer to other bodies of water than to those they exited in fall. Monitored pond turtles only briefly utilized Hardy Creek during the active season, yet 4 turtles overwintered in the streambed, on the bank, or on a flat adjacent to the creek draw. Two of the upland turtles entered ephemeral pools in late winter. One upland turtle wintered closer to Beaver Pond than to Pierce Lake, where it resided in summer 2002. Four other turtles wintered close to small, relatively fast-flowing streams which feed their summer ponds.

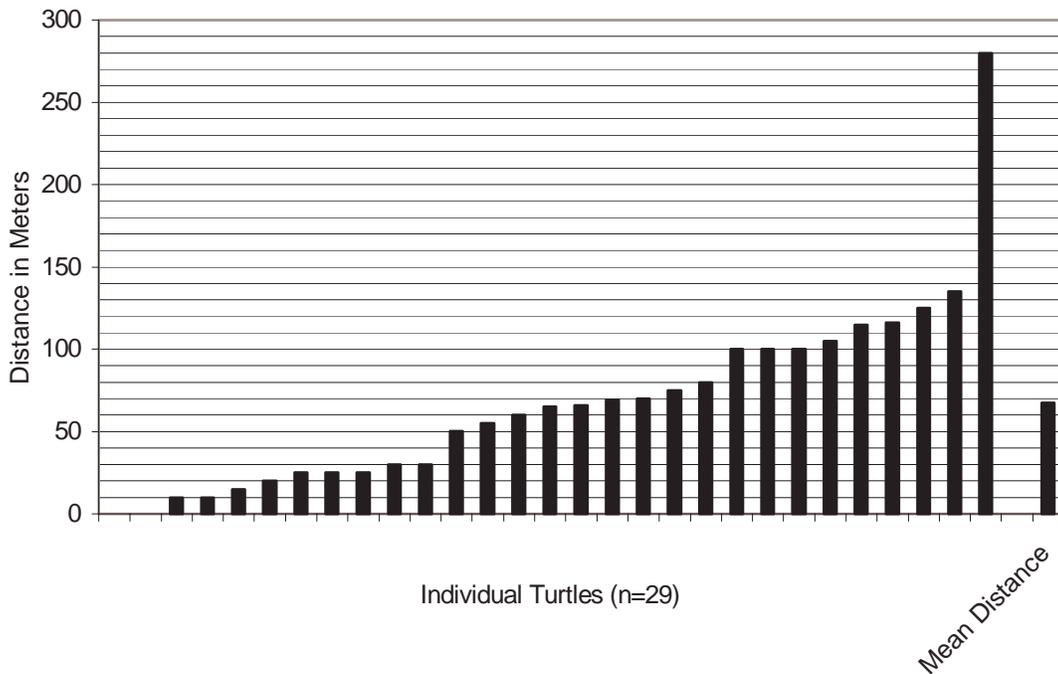


Figure 1. Distance traveled by juvenile western pond turtles between summer pond and wintering site at Pierce NWR in fall – winter 2002.

In September 2002 most turtles left the water, and by late October, 25 turtles were in their upland hibernacula; the last two moved upland in November. Two of the turtles occupied locations which were initially dry but later flooded as winter precipitation added to stream flow.

Turtles overwintering in upland areas in 2002-2003 dispersed in a pattern similar to that of earlier years. Turtles that wintered upland typically left the water and moved into a woodland area via a draw. The dominant tree species in woodlands used by the monitored turtles are cottonwood (*Populus trichocarpa*), ash (*Fraxinus latifolia*), and oak (*Quercus garryana*) (Table 5). The turtles usually selected areas that had a shrubby understory composed of snowberry (*Symphoricarpos albus*), rose (*Rosa* spp.), and/or Himalayan blackberry (*Rubus discolor*). They burrowed under 5-10 cm of leaf litter and duff to establish hibernacula. Upland turtles frequently moved from 1-20 m or more during September through November. Most turtles were stationary in January and February.

Table 5. Habitats used by western pond turtles at Pierce National Wildlife Refuge for wintering sites in 2002 – 2003.

Number of Turtles	Vegetation Type	Comments
10	Cottonwood and ash, often with understory of rose, snowberry and Himalayan blackberry	
4	Oak and ash with understory of snowberry and rose	
4	Douglas fir, maple and mixed hardwoods	
3	Ash with reed canary grass	
3	Mixed hardwoods <i>not</i> dominated by ash, oak, or cottonwood	
2	Water	One of these established its hibernaculum upland but was flooded for 9 of 17 weeks
1	Willow	Hibernaculum was on a sandbar in a streambed with a willow canopy
1	Reed canary grass	The first turtle in three years to overwinter without tree cover

Aquatic turtles moved often within a limited area of about 20 sq m, and within 5 m of the shoreline. One turtle spent the entire winter in water, two wintered in low-lying areas that frequently flooded, and one made several short sorties of 5 m or less to enter or exit a stream during the winter. Transmitter failures resulted in loss of contact with 5 upland turtles during the winter. One probably died (the transmitter was found with tooth marks on it); the other four were observed in water in spring 2003.

The earliest detectable movements by turtles in 2003 occurred 25 January to 6 February, when 15 moves of 3-5 m each were noted. Daytime highs reached 9°-10°C during that time. On 13 February, one turtle had moved 60 m from its hibernaculum to within 2 m of water. Temperatures dropped, and turtle movements tapered off. Most turtles returned to water between the second week of March and the first week in May (Fig.2). In mid-March, 15 of 22 upland turtles moved, and the first 3 turtles entered the water 13 March. By the end of March, 8 turtles had returned to water.

The last turtle to return to water unassisted did so 27 May. One turtle was placed in water 3 June, because the animal had lost over 20% of its pre-winter body weight and showed no sign of moving back to the water. One week after being placed in water, the turtle had recovered more than 10% of its weight, suggesting that this individual had become severely dehydrated during extended dormancy. A natural course probably would have resulted in mortality. There was one unmonitored turtle found dead of unknown causes in April 2003.

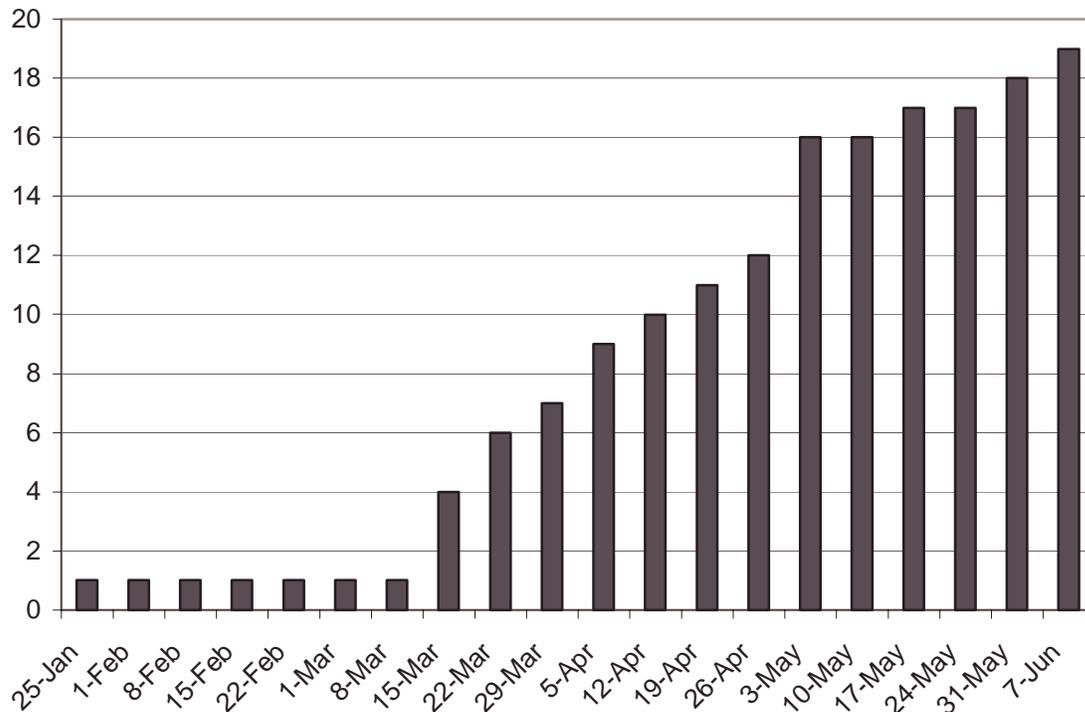


Figure 2. Number of monitored western pond turtles in water January through June, 2003, at Pierce National Wildlife Refuge, Washington.

In spring 2003, some of the monitored western pond turtles returned to the body of water they occupied in the fall by an indirect route. One turtle entered a stream, which led to the pond the turtle emerged from in the fall. Two turtles entered vernal pools, and later traveled to the larger body of water they exited in fall. One turtle left Pierce Lake in the fall, moved up the dry bed of Hardy Creek where the turtle remained for the winter, then crossed Hardy Creek at high water in spring and moved overland to return to Pierce Lake. Two additional turtles did not return to the water body they exited in fall; instead they emigrated to different ponds.

In May – July 2003, 56 pond turtles were captured and measured at the Pierce NWR, and their weights compared to records from previous years (Table 6). Most were captured during the trapping effort, but 3 were netted or manually captured independent of trapping activities. A review of measurements taken on turtles captured repeatedly in the telemetry study and during trapping revealed that body weights vary by up to 12% depending on how long the animals have been active following winter dormancy, and how long they were in upland hibernacula. Therefore, the only records used in evaluating growth of head-start turtles at Pierce were those taken in May through July, after nearly all animals had resumed warm-season activities.

Turtles released in 2000 gained an average of 24.8 g/yr in approximately 3 years, for a mean weight gain of 80% since release (Table 6). Turtles released in 2001 gained an average of 55% in approximately 2 years. Turtles released in 2002 gained an average of less than 1% in weight, with 8 of the turtles experiencing a loss.

Table 6. Mean weight gain for western pond turtles released at Pierce National Wildlife Refuge, Washington, and captured in 2003.

Cohort	Number of Animals	Mean Wt. at Release	Mean Wt. Gain	Range in Wt. Gain
2000	19	92.7 g	24.8 g/yr	13 to 47 g/yr
2001	19	96.9 g*	26.8 g/yr	10 to 48 g/yr
2002	18	88.9 g	1.4 g/yr	-17 to 17 g/yr

*Mean calculated for 18 individuals.

In July 2003, 16 new head-started transmitter-equipped turtles were released at the refuge. Four were released into Domestic Spring Pond, 2 into South Slough, 6 into Pierce Lake, and 4 into Beaver Pond. These joined 23 turtles from other cohorts, for a total of 39.

As of 15 August 2003, 6 of 7 monitored western pond turtles in the South Slough had moved upland. In contrast, all 12 monitored turtles in Domestic Spring Pond were in the water, and only 2 of 15 turtles in Pierce Lake had moved upland. Water levels recede earlier in South Slough than other areas of the refuge, which probably influences turtle movement. Five of the seven turtles in South Slough have lived there at least a year, and there was one documented case of immigration to the slough by a turtle last observed in Beaver Pond, so the turtles seem able to adapt to local low-water conditions.

Although most of the turtles have remained in water habitats, several have moved to different bodies of water. Of 18 monitored turtles in Pierce Lake in July, 2 emigrated to Beaver Pond and 4 moved downstream into Hardy Creek. As of 15 August, the other turtles were in or near the body of water they occupied in summer.

The plan for reintroduction of western pond turtles at the Pierce NWR includes studies that will determine whether and how the native population of western painted turtles are affected by the addition of pond turtles. In 2002, transmitters were affixed to eight adult female western painted turtles so their habits and especially nesting habitat preferences could be monitored.

The female western painted turtles monitored in the study were captured between 23 April and 21 May, 2002. Transmitters were attached to the carapace with thickened fast-curing epoxy, 4 to 6 cm back from the anterior edge. Placement was designed to minimize interference with turtle breeding activity. The transmitter used in this study was the model RI-2B, with a battery life of 12 months and weight of 9.9g, manufactured by Holohil Systems, Ltd.; Ontario, Canada.

Painted turtles were monitored for nesting activity from April to June 21, 2002. The 8 female turtles were monitored once weekly until June 1 to identify primary use areas. A more intensive monitoring regime was initiated after June 1 to locate nests. Turtles were checked daily, every two hours from 0900 to approximately 1730. Checks were sometimes less frequent due to staff availability. The daily monitoring interval was later adjusted to a start time of 1100 and an end time of 1730 to 2130 according to turtle activity. Monitoring was extended after 1730 if turtles were out of the water, presumably preparing to nest. Such activity was rarely observed prior to 1100, so the earlier checks were dropped in favor of monitoring later in the evening when most nesting occurred.

The first painted turtle nest was documented on 2 June when a turtle without a transmitter was observed nesting. This was the first of 35 nests found incidental to the monitoring effort. Nests

were recorded for 4 of the turtles being tracked. Physical examination and/or observations of the activities of the other four turtles suggested that we had missed their nests, therefore telemetry work ended on Jun. 21. Nesting by painted turtles continued through the end of June and probably into July, but nest data was only collected through 22 June. A total of 39 nests were documented.

The telemetry results showed that western painted turtles sometimes make multiple attempts before successfully completing a nest. One turtle made three documented attempts before she returned to her usual place in the pond. This movement suggests that the turtle did finally nest, but observers were not present to record it; a nest made by an unknown turtle was found Jun. 14 near the site of the other three attempts. Another turtle made at least two attempts before completing her nest on Jun. 20. A total of 36 incomplete nest attempts were documented. Failure to complete nests was attributed to obstructions such as roots and rocks in the soil where the nest hole was initiated, and disturbances causing turtles to return to the water.

There were six instances where two different turtles nested in the same place. These nests were identifiable by presence of crushed eggs in the nest plug and often on top of the nest. Excavation of these nests revealed a large number of eggs, and sometimes damaged eggs in the nest chamber. Digging by the second turtle caused damage to the original nest.

Most of the nesting activity was concentrated around Pierce Lake. However, nesting did occur at other sites on and near the refuge. Up to 22 June there were 32 recorded nests and 24 recorded nest attempts at or near Pierce Lake, 3 nests and 3 attempts at Domestic Spring Pond (North Slough), 2 nests and 7 attempts at Beacon Rock Golf Course, adjacent to the refuge, 1 nest and 2 attempts at South Slough, and 1 nest on Hamilton Island, a present day peninsula which is across the mouth of Hamilton Creek from the refuge at its confluence with the Columbia River. An additional nest was documented at South Slough on 27 August when it was discovered incidental to pond turtle telemetry.

Western painted turtle nests were subject to predation and environmental factors that may have reduced egg and hatchling survival. Between 19 and 21 June, water levels on the refuge rose high enough to flood 6 known nests. Four were at Pierce Lake, and 1 each were at South Slough and Domestic Spring. By 22 June the water had subsided; the success of these nests is unknown. Nest predation was first noted 13 July at Pierce Lake. A group of marked and unmarked nests (created after telemetry ended) on the west shore were dug up by predators. This area was extensively excavated over the following couple weeks, and similar predation was observed at Domestic Spring and South Slough. Although this activity was concentrated in areas containing many turtle nests, isolated nests were also preyed on. The proportion of nests affected by predation is not known.

Painted turtle population demographics on the Pierce NWR are being studied. Measurements of turtles trapped in 2002 and 2003 are being compared to measurements taken by USFWS staff between 1999 and 2001. Turtles recaptured at least once during this four-year interval will be included in the study. Preliminary results show that when turtles are grouped by carapace length, distinct size classes are apparent, with notable differences between sexes. However, a review of the available information showing rate of growth suggests that the size classes may be a product of other factors besides age and sex. An objective is to develop parameters which can be used to determine maturity and approximate age of animals, particularly of juveniles. Baseline population information will also be useful in detecting any future changes due to interspecific competition with western pond turtles.

Objective 4: Control Bullfrogs and Other Predators.

Methods: Limited bullfrog control efforts were conducted at sites occupied by western pond turtles between June 2002 and August 2003. A reduced program of nonnative predator eradication was implemented as funding permitted.

The pond/lake complex in Klickitat County has benefited from an ongoing effort to eliminate bullfrogs and other nonnative predators. Adult bullfrogs were removed from these wetlands by hand capturing and incidental-capture in turtle traps. Tadpoles incidentally caught in traps and egg masses skimmed from the water surface were also disposed of.

At the Skamania County pond complex, bullfrog control has not been implemented to any significant degree. Frogs and tadpoles captured incidentally in turtle traps and by hand are removed as opportunity arises.

Bullfrog control efforts have been sporadically undertaken at Pierce NWR by refuge personnel. Staff availability is the primary limitation in the maintenance of the program. In late September and early October 2001, Pierce Lake was drawn down to concentrate aquatic animals in the remaining pool, permitting the removal of nonnative fish and bullfrog tadpoles by seining. This strategy is particularly helpful if accomplished on one- to two-year intervals since bullfrog tadpoles require two years to attain metamorphosis. Bullfrogs captured during turtle trapping and some of the egg masses observed during telemetry activities were removed in 2003. A more extensive bullfrog control program including capture of adult frogs and removal of egg masses by dipnet could be implemented, as the USFWS wildlife refuge managers are supportive of such a plan. The bullfrog population at Pierce NWR is very large, and likely is bolstered by immigration from adjacent properties along the Columbia River. All pond turtles released onto the site are too large to be eaten by bullfrogs and presumably most other nonnative predators. There are no breeding age pond turtles present yet, so there are no wild hatchlings at risk of predation by bullfrogs. It will be about five years before the first pond turtles released at Pierce NWR reach breeding age. Considering the size of the existing bullfrog population, a program of eradication should be in place within the next few years in order to ensure a better chance of turtle hatchling survival once the pond turtles reach adulthood and begin breeding.

Results: A total of 7 egg masses were skimmed from the Klickitat pond/lake complex in 2002, and in 2003 10 adult bullfrogs and 13 tadpoles were removed. Approximately 24 adult frogs were removed from the Skamania pond complex in 2002; 8 adult bullfrogs and 5 tadpoles were captured and disposed of in 2003. At Pierce NWR, 1 adult frog and 4 egg masses were removed in 2003. Seining of Pierce Lake in September 2003 resulted in removal of 90 gallons of nonnative fish and tadpoles.

Objective 5: Enhance, Restore, and Manage Habitat to Maximize Western Pond Turtle Survival and Productivity.

Methods: Habitat improvements are being carried out according to priority of need on each specific site. At the Skamania County site, mechanical mowing has been used to maintain suitable short-grass nesting habitat. Weed control is a priority at all of the sites, but especially the Skamania site, where Scots broom threatens to overtake grassland habitat adjacent to turtle ponds. Efforts are also needed to eliminate other exotics including knapweed and yellow star thistle at the Klickitat sites.

Soil sampling and analysis is being conducted at three native western pond turtle nesting sites in Klickitat, Skamania, and Pierce counties, and painted turtle nesting habitats at Pierce NWR, to identify important features of turtle nesting sites. This will aid in managing the sites for improved or expanded nesting habitat as needed after evaluation of individual sites.

An old homestead building on the Klickitat site is to be burned or demolished, with other unwanted material on the property to be removed to a local transfer station before burning takes place. Residual material left from burning will also be removed, and the disturbed area will be returned to native vegetation.

Results: WDFW has acquired 15 acres of land east of the Klickitat ponds, known as the Gunter property. Ownership transferred from The Nature Conservancy to WDFW on September 11, 2002. This property provides additional habitat protection for the western pond turtle, including nesting habitat and critical wetlands. Plans are in place to remove an old homestead for habitat restoration purposes. During the first year of this contract final arrangements were not yet complete for acquisition of the land, thereby delaying removal of the building. WDFW is currently working with the local volunteer fire department for future removal of the building. Additional funding is needed to complete this phase of the project.

WDFW is working to restore greater water flow to an old ditch that feeds the Klickitat pond complex. Dense vegetation is being removed using hand tools in the section most likely to be occupied by turtles, and a combination of hand tools and machinery in the other portions.

At the Skamania County site, approximately 7 acres of nesting habitat were mowed in spring and summer 2002 and 2003 to maintain short grass nesting habitat and control unwanted shrubby vegetation. Mowing was completed with help from Ameri Corps and other WDFW staff prior to June, when turtle nesting occurs.

At Pierce NWR, ongoing weed control efforts are being conducted by refuge staff and outside the scope of the current project objectives.

Summary and Conclusions

The cooperative effort to augment the two existing pond turtle populations in the Columbia River Gorge and establish western pond turtles at Pierce NWR has resulted in positive, measurable success. Trapping results for 2003 show that the head-start program has made a very large contribution toward recruitment of young turtles into the population. Of the 224 turtles captured at the Klickitat sites, 189 (84%) were head-start turtles. At the Skamania site, 85% of the 66 turtles captured were head-starts of various ages.

These results also suggest that survival of head-started turtles is high. At the time trapping was conducted, a total of 296 head-start turtles had been released since 1991 at the Klickitat sites. Sixty-four percent of these were recaptured in 2003. At the Skamania site, 40% of the 141 head-start turtles released were recaptured. The 2003 trapping effort at Pierce NWR captured 59 (43%) of the 137 turtles that had been released at the site. Actual survival rates are higher; not all turtles present are captured in traps.

The monitoring of wild adult female western pond turtles during the nesting season is the foundation of the head-start program. The 56 nests identified in 2002 and 2003 were found by regularly locating female turtles by radio telemetry. These nests are the source of the eggs for head-starting. The 23 nests found in 2002 yielded 84 hatchlings, which were reared for the 2003 release by Woodland Park Zoo and the Oregon Zoo. Three wild hatchlings and 1 yearling captured by hand and in traps during spring 2002 were also added to the rearing program at Woodland Park Zoo, and re-released in July 2003. Thirty-three nests were found in 2003, and will be checked for hatchlings September through October. In spring 2003, 1 wild yearling and 12 hatchlings were captured and placed in the head-start program, for re-release in 2004.

The reintroduction of western pond turtles at Pierce NWR is in its fourth year, and is already showing positive results. Of the 137 juvenile pond turtles released from 2000 through 2002, 69 of them (50%) were recaptured in spring 2003. Fifty-nine of the turtles were caught during trapping and incidentally in May; another 10 were recaptured for transmitter replacement. Turtles released in 2000 gained an average of 24.8 g/yr in approximately 3 years, for a mean weight gain of 80% since release. Turtles released in 2001 gained an average of 55% in approximately 2 years. Turtles released in 2002 gained an average of less than 1% in weight.

Monitoring juvenile pond turtle movements over three years at Pierce NWR has shown a pattern of seasonal migration to and from the water. The turtles began to leave the ponds with the onset of drought conditions in late summer. They headed upland, where they usually continued to move until entering winter dormancy. By early November, 75-100% of the turtles being monitored were upland and dormant. The few turtles over-wintering in the ponds made only short moves and remained a few meters from shore. Turtle movement resumed as weather warmed in late winter. The turtles gradually re-entered the ponds beginning in early March, with the last turtles returning to water in the first week of June. The turtles did not always return to the same pond they were released into, and during the season of activity turtles were found to move to different ponds on the site. These ponds are also occupied by western painted turtles. The two species of turtles intermingle freely, sharing the same basking spots and other favored habitats.

Only two documented mortalities occurred among transmitter-equipped juvenile pond turtles between 1 June 2002 and 15 August 2003. Both animals were from the 2002 cohort. One was

lost to predation, and the other died of unknown causes in its winter form. One additional turtle was injured by a predator, and taken to the Oregon Zoo for observation during the winter. This turtle was re-released at the refuge in April. Another turtle was placed in water in June 2003 to prevent probable mortality due to severe dehydration. There was one unmonitored turtle found dead of unknown causes in April 2003.

Trapping results indicate that the native population of painted turtles at Pierce NWR is large, and that these animals also move around the refuge. Monitoring female painted turtles by telemetry showed that the western shore of Pierce Lake is a heavily used nesting area, but that the turtles also nest in other areas including Domestic Spring pond, South Slough, the golf course adjacent to the refuge, and on Hamilton Island adjacent to the refuge. Turtle measurements in trapping records from 1999 through 2003 are being analyzed for demographic and growth information, to determine the baseline condition of the painted turtle population. This will aid in detecting any future changes in the painted turtle population that may be related to the presence of western pond turtles.

Removal of nonnative predators is a key objective for improvement in survival rates for hatchling pond turtles. A program of eliminating tadpoles and adult bullfrogs, surveying ponds every other day for presence of egg masses, and skimming egg masses from the ponds has proven effective in reducing the bullfrog population at the Klickitat sites. The reduction in the bullfrog population at the Klickitat sites through a comprehensive program suggests that implementation at the other sites would also be effective. Limited resources during 2002 and 2003 necessitated a reduction in the scale of bullfrog control activities; however, adult frogs, tadpoles, and egg masses were removed from wetlands in Klickitat and Skamania counties as opportunities arose during other work.

Habitat improvement projects vary according to site-specific needs. About 7 acres of nesting habitat is mowed annually at the Skamania County site to ensure that heavy vegetation does not overtake the grassy nesting areas. Arrangements are being made for removal of an unwanted building on part of the Klickitat County pond complex site, to free space for supplementation of natural habitat. Weed species, including Scots broom and yellow star thistle, are identified and targeted for control according to need at the particular sites. Soils at turtle nesting sites are being studied for common characteristics, to aid in identifying and developing turtle nesting habitat.

The success of the western pond turtle project in the Columbia Gorge is due to the interest and commitment of effort and resources by many people and organizations. The contributions of all parties are gratefully acknowledged.

Summary of Expenditures

The following summary covers the original contract period of June 1, 2002 - May 31, 2003 (Table 7) and the amended contract period of June 1, 2003 - September 30, 2003 (Table 8).

Table 7. Summary of BPA funded expenditures (approx) June 1, 2002 – May 31, 2003.

Object A - Salary	66,888
Object B - Benefits	12,946
Object C - Contract	9,971
Object E - Equipment	13,545
Object G - Travel	1,963
Total Expend	\$105,313
Agency OH	21,378
Contract Total	\$ 126,691

Table 8. Summary of BPA funded expenditures (approx.) June 1, 2003 – September 30, 2003.

Object A - Salary	24,830
Object B - Benefits	6,573
Object C - Contract	
Object E - Equipment	6,579
Object G - Travel	13
Total Expend	\$ 37,995
Agency OH	9,499
Contract Total	\$ 47,494