Western Painted Turtle Recovery in Lower Mainland Watersheds - Year 2

FWCP Project No. COA-F21-W-3295
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Western Painted Turtle headstart and original solitary female (7-1) basking at Minnekhada in May 2020. Photo: Elinor Craig

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EXECUTIVE SUMMARY

The goal of this project is to recover 10 populations of British Columbia's only remaining native freshwater turtle species; the Pacific Coast population of Western Painted Turtle (WPT) that is federally endangered (SARA-listed) and provincially red-listed, in Lower Mainland Watersheds. This will be accomplished by increasing the recruitment through releasing head-started turtles (while maintaining the genetic distinctiveness of BC), monitoring the populations' recovery, and providing and monitoring effectiveness of essential habitat such as basking features, overwintering and nesting habitat (as per the recovery plans recommendations).

This project is led by WPT South Coast Recovery Group; a partnership between the Coastal Painted Turtle Project (CPTP) (lead by Aimee Mitchell), Wildlife Preservation Canada (WPC) (lead by Andrea Gielens who operates head-starting at the Vancouver Zoo) and the Ministry of Forests, Lands and Natural Resource Operations and Regional Development (MFLNRORD) (lead by Kym Welstead Provincial WPT Recovery Team chair and operator of the head-stating facility in North Vancouver).

The CPTP has already begun to address immediate threats that may result in direct mortality through measures such as nests predator exclosures, signage, site rehabilitation, and fencing as well as restoring habitat and long-term productivity at the currently known occupied sites in these watersheds (Coquitlam, Alouette and Stave); including Colony Farm, Minnekhada Regional Park, Jerry Sulina Municipal Park and Silvermere Lake. Much of this work was also previously sponsored by FWCP in various multi-species at risk projects in all three watersheds since 2011. However, follow-up monitoring through population assessments (mark-recapture as well as basking and nesting surveys) have had limited funding from other project supporters. Assessing the functioning of past and planned restoration activities as well as survival and health of head-started individuals is essential in order to effectively apply adaptive management and ensure long-term success of the recovery efforts.

The project objectives are to support and conduct all Western Painted Turtle conservation and recovery activities highlighted in the Provincial Recovery Plan and Federal Recovery Strategy in the Coquitlam, Alouette and Stave watersheds with a focus on currently occupied and augmented sites. This proposed project with FWCP will further address the threats by securing long-term matched funding for the head-starting program as well as for post-release and post-restoration monitoring. Activities include: Head-starting support (staff, food and equipment) both at the Vancouver Zoo (Andrea Gielens) and at MFLNRORD facility in North Vancouver (Kym Welstead). The field component includes; nesting monitoring, habitat restoration, nesting beach maintenance and population monitoring (trapping) to track success of head-started turtles that are released as well as tracking overall population health. In summary, the main objective is to restore, maintain and monitor turtle populations and survival habitat throughout these three Lower Mainland FWCP watersheds. This project is envisioned as a 5-year program (began April 2019), with focus on currently occupied and augmented sites in the watersheds to restore, maintain and monitor Western Painted Turtle populations.

These objectives align with several Priority Actions as outlined in the three Watershed Action Plans (Coquitlam-COQ, Alouette-ALU and Stave-SFN); including: **Priority 1** - **1) Action 4: Species and Habitat-based Actions for Fish and Wildlife (ALL)** – Implement high priority habitat and/or species-based actions, **2) Action 8: Monitoring and Evaluation (ALU and SFN)** – Assess success of past habitat-based actions supported by FWCP, **3) Action 17, 20, and 19: Habitat-based actions – Wildlife Species at Risk (COQ, ALU and SFN, respective actions)** – Implement priority species and habitat-related conservation actions in recent Recovery Strategies, and **Priority 2** - **4) Action 23 and 26: Habitat-based actions-Wildlife** (**COQ and ALU, respective actions**) – Implement wetland and riparian restoration projects that are identified as high priorities through inventory, mapping and assessment.

Recommendations for future work include continued population monitoring at all sites to further assess success of recovery actions, following up on past and newly completed restorations and adaptions to head-starting methods to account for biota considerations (this includes a biofiltration set up that was established in April 2020 at the Greater Vancouver Zoo).

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1.0 INTRODUCTION

British Columbia's only remaining native freshwater turtle species; the Pacific Coast population of Western Painted Turtle (WPT) is federally endangered and provincially red-listed[1,2]. Western Painted Turtles may be found in most types of permanent lentic water bodies at low elevations but also requires upland terrestrial habitat for nesting and dispersal between habitats. There are only 18 known sites occupied by Western Painted Turtle (Pacific Coast population) in the Lower Fraser Valley and 10 of them exist within the Coquitlam, Alouette and Stave Watersheds.

The main threats to Western Painted Turtle recovery at these 10 locations include but are not limited to: habitat degradation and lack essential features (such as basking, overwintering or nesting sites), direct road mortality (can be addressed through fencing), low or no recruitment, poor or no juvenile survivorship (can be mitigated through head-starting), nesting predation (nest protection and monitoring), invasive species predation and competition/spreading diseases (addressed through head-starting and removal of invasive species)[1,2]. Climate change is an emerging threat as there is a possibility of only females being produced in the population as turtles are temperature sex determinate.

Head-starting benefits the populations by increasing the juvenile survivorship rate, through reduced predation from bullfrogs and other predators, ensure a balance gender distribution, and increasing the chances of survival in their hazardous first year. Building on the successes of the head-starting program in 2014-2018, this project will continue to support and secure partnership funding to continue the population recovery of Western Painted Turtles at sites with little to no recruitment due to low population numbers. The project is a long-term project as female turtles do not start nesting until they are 8-10 years old. Thus, there is a need to secure long-term partnerships to help in the implementation and monitoring the successes.

2.0 GOALS AND OBJECTIVES AND LINKAGE OF FWCP ACTION PLANS

The goal of the project is to recover these 10 populations by increasing the recruitment through releasing head-started turtles (while maintaining the genetic distinctiveness of BC), monitoring the populations' recovery, and providing and monitoring effectiveness of essential habitat such as basking features, overwintering and nesting habitat (as per the recovery plans recommendations). This project is led by WPT South Coast Recovery Group; a partnership between the Coastal Painted Turtle Project (CPTP) (lead by Aimee Mitchell), Wildlife Preservation Canada (WPC) (lead by Andrea Gielens who operates head-starting at the Vancouver Zoo) and the Ministry of Forests, Lands and Natural Resource Operations and Regional Development (MFLNRORD) (lead by Kym Welstead Provincial WPT Recovery Team chair and operator of the head-stating facility in North Vancouver).

The Coastal Painted Turtle Project, has already begun to address immediate threats that may result in direct mortality through measures such as nests predator exclosures, signage, site rehabilitation, and fencing as well as restoring habitat and long-term productivity at the currently known occupied sites in these watersheds; including Colony Farm, Minnekhada Regional Park, Jerry Sulina Municipal Park and Silvermere Lake. Much of this work was also previously sponsored by FWCP in various multi-species at risk projects in all three watersheds since 2011. However, follow-up monitoring through population assessments (mark-recapture and surveys)[3,4] have had limited funding from other project supporters. Assessing the functioning of past and planned restoration activities as well as survival and health of head-started individuals is essential in order to effectively apply adaptive management and ensure long-term success of the recovery efforts.

The project objectives would be to support and conduct all Western Painted Turtle conservation and recovery activities highlighted in the Provincial Recovery Plan and Federal Recovery Strategy[1,2] in the Coquitlam, Alouette and Stave watersheds with a focus on currently occupied and augmented sites. This proposed project with FWCP will further address the threats by securing long-term matched funding for the head-starting program as well as for post-release and post-restoration monitoring. Activities include: Head-starting support (staff, food and equipment) both at the Greater Vancouver

Zoo (Andrea Gielens) and at MFLNRORD facility in North Vancouver (Kym Welstead). The field component would include; nesting monitoring, habitat restoration, nesting beach maintenance and population monitoring (trapping) to track success of head-started turtles that are released as well as tracking overall population health. In summary, the main objective is to restore, maintain and monitor turtle populations and survival habitat throughout these three Lower Mainland FWCP watersheds. This project is envisioned as a 5-year program (began April 2019), with focus on currently occupied and augmented sites in the watersheds to restore, maintain and monitor Western Painted Turtle populations (Table 1).

Table 1. Western Painted Turtle sites in the Lower Mainland Region Watersheds.

No.	Western Painted Turtle sites	Watershed	Status and Works completed	Works planned
1	Mundy Park (Lost and Mundy Lakes)	Coquitlam	Augmentation completed (head-started turtles released)	Population monitoring and habitat restoration (nesting habitat installation) planned 2019 (Year 1), monitoring and adaptive management planned for 2020-2024 (Years 2-5)
2	Colony Farm Regional Park	Coquitlam	Occupied, MV Parks currently conducting some restoration (wetland construction) as part of trail expansion project	Augmentation and restoration planned (nesting and basking habitat installation) beginning 2020 (Year 2), monitoring and adaptive management planned for 2021-2024 (Years 3-5)
3	Lafarge Lake	Coquitlam	Replacement site sought	Replacement site sought
4	Deboville Slough	Coquitlam	Occupied, basking habitat installed 2014	This site is considered part of the Minnekhada population so augmentation, monitoring and restoration works are focused at that site. Although population monitoring would include this site beginning in 2020.
5	Minnekhada Regional Park	Coquitlam	Augmentation ongoing since 2014, basking habitat installed 2011 and nesting 2018	Continued augmentation, population and completed habitat restoration monitoring throughout all project years
6	Pitt-Addington Marsh	Alouette	Augmentation ongoing since 2016, nesting and basking habitat installed in 2016	Continued augmentation, population and completed habitat restoration monitoring throughout all project years
7	Jerry Sulina Municipal Park	Alouette	Augmentation completed (head-started turtles released), nesting habitat installed 2012	Habitat restoration monitoring throughout all project years
8	Kanaka Creek	Between Alouette and Stave	Replacement site sought	Whonnock Lake may be potential replacement site
9	Whonnock Lake	Stave	Potential replacement site for Kanaka Creek	Habitat assessments and partnership building planned in Year 1 and Site Management Plan (SMP) to establish head-starting, restoration and monitoring schedule to be developed in Year 1 if supported by land manager (City of Maple Ridge). Begin to implement SMP in 2020-21 (Year 2)
10	Silvermere Lake	Stave	Augmentation ongoing since 2016, basking habitat installed 2017, nesting habitat installed 2018	Continued augmentation, population and completed habitat restoration monitoring throughout all project years

These objectives align with several Priority Actions as outlined in the three Watershed Action Plans (Coquitlam-COQ, Alouette-ALU and Stave-SFN); including: **Priority 1** - **1) Action 4: Species and Habitat-based Actions for Fish and Wildlife (ALL)** – Implement high priority habitat and/or species-based actions, **2) Action 8: Monitoring and Evaluation (ALU and SFN)** – Assess success of past habitat-based actions supported by FWCP, **3) Action 17, 20, and 19: Habitat-based actions – Wildlife Species at Risk (COQ, ALU and SFN, respective actions)** – Implement priority species and habitat-related conservation actions in recent Recovery Strategies, and **Priority 2** - **4) Action 23 and 26: Habitat-based actions-Wildlife** (**COQ and ALU, respective actions**) – Implement wetland and riparian restoration projects that are identified as high priorities through inventory, mapping and assessment[5,6,7].

3.0 STUDY AREA

The study area for this project encompasses 10 Western Painted Turtle occupied sites in the Lower Fraser Valley within the Coquitlam, Alouette and Stave Watersheds. Although the 10 sites that are being focused on are limited to lower reaches of all three watersheds, the study area still encompasses watershed boundaries for each watershed to ensure any additional sightings or possible recovery sites are included for future potential consideration (Figs 1. and 2). For example, a new record of a Western Painted Turtle was obtained from the west of Stave Lake and near Cannell Lake in Mission in July 2019. That area was mapped as a new Western Painted Turtle occupied site and will be part of updates to the Federal Recovery Strategy as of summer of 2020.

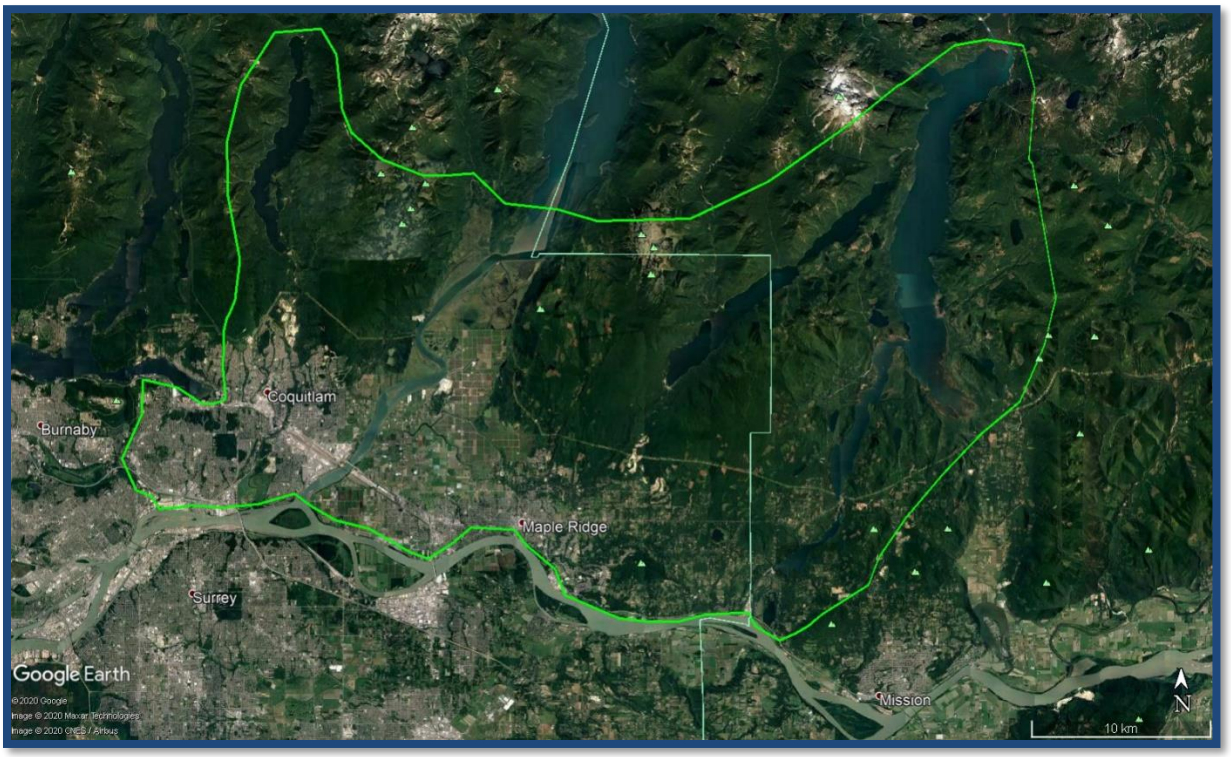

Figure 1. Study area for FWCP Coastal Western Painted Turtle Recovery Program in Lower Mainland Watersheds.

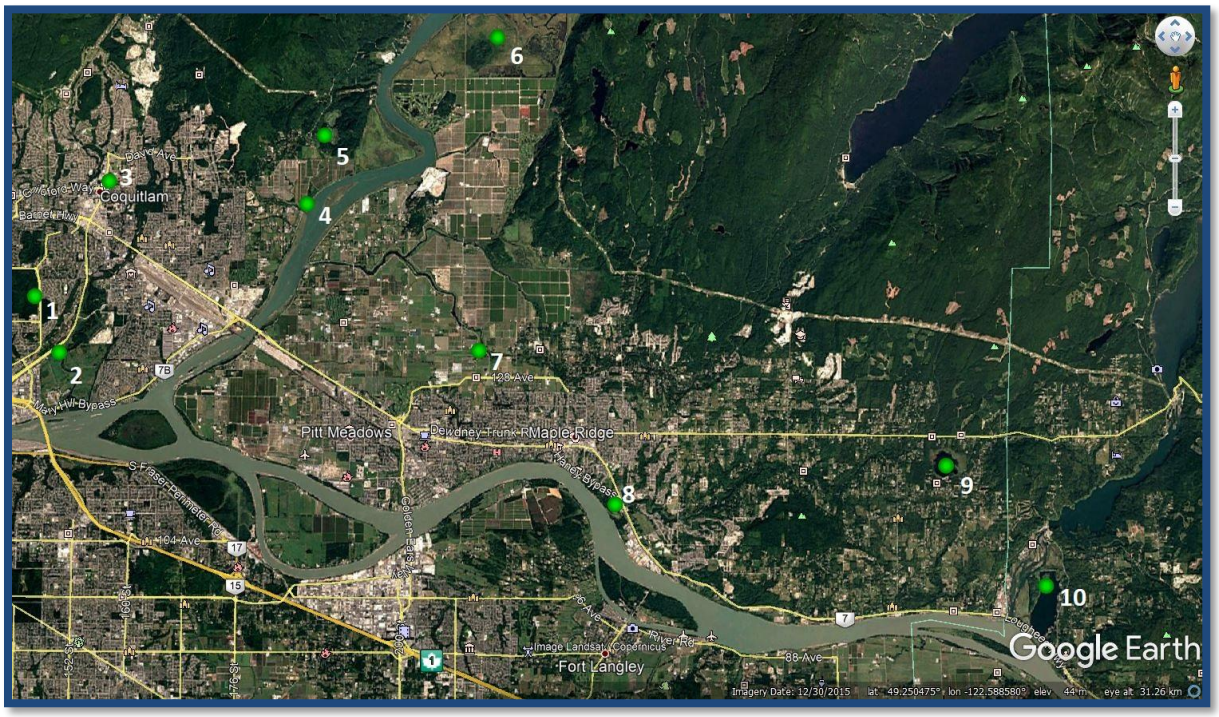

Figure 2. Western Painted Turtle Recovery Sites in Lower Mainland Watersheds.

Five sites are in the Coquitlam watershed, while two each are in the Alouette and Stave watersheds and one site (Kanaka Creek) is between the Alouette and Stave Watersheds (Table 1; Figs. 1 and 2). Coquitlam Watershed sites include three sites in Municipal Parks (MP) (Mundy Park, Lafarge Lake and Deboville Slough) and two Metro Vancouver Regional Parks (MVRP) (Colony Farm and Minnkehada Marsh). Alouette Watershed sites include one MP (Jerry Sulina) and one provincial Wildlife Management Area (WMA) (Pitt-Addington Marsh). Stave Watershed sites include one MP (Whonnock Lake) and one site (Silvermere Lake) that has both private and First Nations (Kwantlen) ownership. Working with our partners and supporters at all these sites in critical to long-term success of the program. Important partners in regards to monitoring, threat mitigation and habitat restoration include the Cities of Coquitlam, Maple Ridge and Mission, the provincial South Coast Land Management Conservation Program (manage WMAs), Metro Vancouver Regional Parks, Kwantlen, Katzie and Kwikwetlam First Nations and private landowners at Silvermere Lake.

4.0 METHODS

4.1 Western Painted Turtle population assessments

Assessments to monitor populations at occupied Western Painted Turtle (*Chrysemys picta bellii*) sites in the Coquitlam, Alouette and Stave Watersheds, involved several different monitoring methods. These included basking and nesting surveys as well as trapping (mark-recapture techniques) in order to gather as much information about the health and status of the populations. In addition, to continuing to monitor existing individuals in these populations prior to head-starting, an important goal of this project is to assess survival and growth of head-started individuals used to restore sites identified as being critically low (<20 individuals)[2].

Basking surveys

Basking surveying for turtles occurred during peak basking time (10 am – 3 pm) and were conducted using binoculars from shore from April through September weather-dependent following RISC standards for this species (Fig. 3)[8,9]. Ideally at least

three surveys are conducted on optimal survey days to increase confidence in non-detections[10]. Any non-native released turtles (typically Red-eared Slider (*Trachemys scripta elegans*) in our region) encountered were also recorded.

Figure 3. Western Painted Turtle population assessments (basking surveys) at Minnekhada Marsh MVRP, Coquitlam River Watershed (Upper) and Silvermere Lake in Stave River Watershed (Lower) in summer 2020.

Nesting surveys

Known and potential nesting habitat adjacent was surveyed for emerging hatchlings in April-May at Silvermere Lake as that was the only site with previously confirmed nesting and hatchling emergence activity. All other occupied sites are almost entirely composed of head-started individuals that will not be mature enough to be nesting for 1-5 more years or only had individual adults recovered and are not suitable as recovery sites (i.e., Kanaka Creek). As hatchlings emerge from the ground, they leave holes with a diagnostic shape. As hatchling turtles are very difficult to spot in wetland vegetation, these emergence holes are the easiest way to confirm recruitment at a site. Nesting areas were also surveyed for females moving on land in search of a spot to lay their eggs, in mid-May to mid-July. During the nesting season, evidence of nesting can also be detected via the observation of 'test pits' (Fig. 4). Female turtles often come up over several nights or weeks 'testing' areas they may want to lay and only excavate a small portion of a potential nest.

Figure 4. Western Painted Turtle nesting 'test pit' at Silvermere Lake, Stave River Watershed.

Citizen Science sighting sign pilot program at Minnekhada Metro Vancouver Regional Park

In an effort to engage local citizens in reporting turtle sightings and aid project members in responding in real time to nesting females on land, a pilot sighting sign program was initiated in this project year (Year 2-2020-21) (Appendix I and II). Particularly, due to covid-19 limiting interactions with the public and partners this program enabled participation of locals and partners in the monitoring and protection of turtles in their area. Depending on the response of the pilot at Minnekhada RP, the program would be expanded to all sites in Year 3.

Trapping

Live-trapping was conducted using D-traps (1 ½" mesh, Wildlife Control Supplies Collapsible Turtle Trap) for a 10-day period[9]. Traps were set so that at least 1/3 of the trap was out of the water to avoid accidental drowning of turtles and other animals (Fig. 5). These traps were most often baited with canned sardines, however other bait materials (e.g., cat food) were also used depending on weather and availability of bait. Bait was attached near the back end of the trap to encourage turtles to swim through the funnel opening. Traps were checked twice daily and if necessary (bait gone or severely degraded), bait would be replaced during the trapping period (Fig. 6).

As part of conducting population assessments, a dip net was carried in the kayak at all times in case there were opportunities for hand-capturing turtles. A combination of methods was used since this is known to increase capture success[11]. Although Western Painted Turtles were targeted, Red-eared Sliders were also often caught during trapping sessions. Turtles of both species were processed in much the same way.

Figure 5. Population assessments (trapping set up – D-trap) at Minnekhada Marsh MVRP, Coquitlam River Watershed.

Figure 6. Population assessments (trap set-up) at Minnekhada Marsh MVRP (L) and Pitt-Addington WMA (R).

Each turtle (of sufficient size) was marked using a file to notch an indent into the carapacial scutes (a non-invasive permanent marking method). A site code was marked on a scute on the left side of the carapace and a code identifying the individual was marked on a scute on the right side (Fig 7 – shows a turtle marked at Site 39 as Individual 2). Photos were taken of the carapace, plastron, head and left/right front feet claws of every individual. The following characteristics were then measured using a tape measure, calipers and scale:

- Height (cm)
- Weight (g)
- Plastron width and length (cm)
- Carapace width and length (cm)
- Right and left front middle claws (cm)
- Total tail length, tail length to cloaca, tail width at cloaca and plastron (cm)
- Sex and age are determined based on measurements and overall appearance (e.g., males are generally smaller, have longer claws, and a longer proportional distance of their tail to their cloaca from the plastron)
- Any special identifying features, such as scaring, were also noted.
- Photos were taken and compiled into catalogues on a per site basis for future monitoring and identification of individual turtles* (*notches have proven to only be useful within a couple years of first marking as they fade or natural chips or injuries can obscure the notch ID – photos should always be compared with potential notch codes to ensure correct identification and re-notching should be conducted if code unclear).

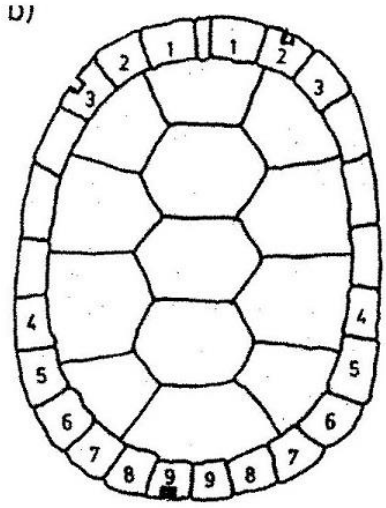

Figure 7. Shell notching system used on Western Painted Turtles on the South Coast of BC.

Following a protocol developed by Elinor Hughes for the Ministry of Environment[12], caudal blood samples were also collected from adult and juvenile (of sufficient size) Western Painted Turtles for future genetic analyses. Samples are collected from the tail, placed on white paper and are kept in labeled (with Site Name, Date, Sex, and ID code of turtle) coin envelopes. Head-start juvenile turtles are also inserted with a pit tag (8mm Biomark MiniHPT8) prior to release. In order to identify individual head-starts, along with a photo catalogue, a pit tag reader (Biomark HPT Lite) was used to scan any captured juveniles.

4.2 Western Painted Turtle habitat restoration and threat mitigation

Critical degraded habitat features that required restoration or enhancement were identified through habitat and threat assessments at Western Painted Turtle occupied sites that were completed throughout the South Coast from 2009 through 2013[13]. The most commonly used habitat restoration and threat mitigation measures were creation of nesting beaches, installation of basking logs, installing predator exclosures over occupied nests, and educational interpretive signage installation. Several sites in the Coquitlam, Alouette and Stave Watersheds have already had turtle habitat restoration completed as part of various multi-species at risk projects since 2011 (Fig. 8, Table 1.)[14, 15, 16,17]. This has included artificial nesting beaches installed at Minnekhada Marsh MVRP, Pitt-Addington March WMA, Jerry Sulina MP and Silvermere Lake. Basking habitat has also previously been installed at Minnekhada Marsh MVRP, Deboville Slough MP, Jerry Sulina MP and Silvermere Lake.

Figure 8. Western Painted Turtle habitat restoration sites at Silvermere Lake, Stave River Watershed.

Artificial nesting beaches

Artificial nesting beaches are comprised of a loam soil substrate mix based on the literature (40% silt, 40% sand, and 20% clay) as that was expected to be both attractive to nesting turtles and promote high overwintering survival and recruitment[2,18,19,20]. Because this soil mix is often not readily available from rock quarries, a truckload of sand, a truckload of silt, and a half truckload of brown clay was usually ordered and an excavator mixed it on site. The slope was then leveled out and/or grass and vegetation in the area were removed where the nesting site was to be created in order to lay the substrate mixture to a depth of at least 30 cm. The nesting beaches were shaped so that various slopes (from flat to about 30°) would be present for nesting turtles to choose from. For all sites, the location of nesting beach creation was chosen based on south-facing aspect, appropriate elevation (above historical high flood levels for the site), and when possible, observations of previous turtle nesting attempts[2].

Basking log installation

Basking logs were added to attract turtles to nesting sites, and to provide additional thermoregulation sites and habitat in areas where competition was likely high from invasive Red-eared Sliders. Prior to placement in water, basking logs were outfitted with a metal eyelet to loop cable and attach anchors to both ends of log to ensure it would stay in place. Logs were then installed using kayaks/boats to tow logs to desired location, and anchors released. Basking logs (sometimes as a pair attached to one another by chain) were often installed within close proximity to known, potential, and/or restored nesting areas.

Monitoring use and maintenance of previously-installed critical habitat features

Part of basking survey monitoring also included assessing use of basking habitat that was previously installed as part of critical habitat restoration. Assessments were made to determine if basking habitat was still usable or needed some adaptive management (i.e., moving its location if it shifted). Part of nesting monitoring also included checking previously installed beaches for signs of activity and maintaining them at least once annually to ensure the habitat remained usable and suitable for turtle nesting, egg development and hatchling recruitment. Maintenance primarily included weeding, trimming invasive vegetation, such as Himalayan Blackberry (*Rubus armeniacus*), and raking substrate to maintain the appropriate slope.

Threat mitigation

As part of threat mitigation at occupied turtle sites, predator exclosures (4- or 5-inch squared hardware cloth mesh cut into flat sections with common nails attached by zap straps to the four corners) are installed at any identified nest laid by a Western Painted Turtle (Fig. 9). These exclosures have proved to be close to 100% effective at preventing predation of eggs or hatchlings at other sites they have been used to protect over 50 nests per year (i.e., at Burnaby Lake and Nicomen Slough)[21]. One other important threat mitigation technique is to install educational signage, sometimes including anti-poaching signs, at sites with confirmed Western Painted Turtle populations. Generally, this is done in conjunction with installation of critical habitat features.

Figure 9. Western Painted Turtle predator exclosures at Burnaby Lake (L), MVRD and with emerge holes at Nicomen Slough, FVRD

4.3 Western Painted Turtle captive husbandry and releases

Captive husbandry and releases

Head-starting occurred at the Greater Vancouver Zoo and MFLNRORD North Vancouver locations to produce turtles for releases to augment critically low wild populations (Figs. 10 and 11). Eggs collected from wild nests are artificially incubated and reared to a weight of 30 grams; at this size they are beyond the gape size of invasive predators like wide-mouthed bass

and bull frogs and ensures they survive their hazardous first year. To reach that size, turtles are usually overwintered in captivity for at least one year, while maintaining ideal conditions for growth (water temperatures maintained at an average of 25.5°C, full spectrum lighting, heat lamps for basking and fed daily).

Once hatchlings reach the required weight, they are released in spring and summer during warm and sunny days in groups of 5-20 individuals. Methods agreed upon by the WPT South Coast Recovery Group include releasing larger groups of turtles over a 5-year period to start until the goal population number at the site is reached. The goal population size is determined based on the available habitat to support a population of turtles. Once the goal population number is reached small numbers of turtles (5 or less) will continue to be released over several more years to account for mortality. Head-starts are released over multiple years to ensure not all individuals in the restored population are from the same age cohort.

Operating both the North Vancouver and Greater Vancouver Zoo WPT head-starting facilities in unison allows the project to increase capacity (numbers of turtles), increase partners, and isolate diseases and issues that can emerge in captivity. Follow-up telemetry and mark-recapture trapping studies in 2014-2018 have demonstrated that the survivorship is high for the head-started turtles (75%-100%) during the first 90 days following release and thus indicates recovery is likely feasible using these techniques.[22,23] Head-start turtles were tracked previously at two sites in this project area, including Minnekhada MVRP and Pitt-Addington Marsh WMA.

Figure 10. Head-start facility at Greater Vancouver Zoo operated by WPC, Aldergrove, BC.

Figure 11. Head-start facility at MFLNRORD Office, North Vancouver, BC.

Soft-shell study at the Greater Vancouver Zoo

A Husbandry Technician to assist with all duties at the Zoo was hired in the fall of 2019 and worked over the winter months via funds provided by this project. The technician assisted with all aspects of animal care and associated record keeping and data management, as well as preparing turtles for release. This position also allowed for further investigation into the increased incidence of soft-shell which was observed in 2018, and potential methods of treatment. Soft shell is a condition in which turtles shells gradually soften and lose their supportive function. The cause of this condition is currently unknown. Lack of Calcium has traditionally been linked to shell softening in turtles, however all turtles are offered a diverse diet with adequate calcium supplementation while in care at the zoo. Soft shell is primarily seen in individuals who appear to be less active foragers and thus decreased food intake could lead to the observed soft-shell condition. High parasite loads could also be linked to decreased fitness and soft shell, in that turtles are not effectively absorbing nutrients.

In 2019, in partnership with the Coastal Painted Turtle Project, research to better understand what causes soft shell and what the best early intervention treatment options are was initiated at the Zoo. There were two phases to this project. The first was prevention, investigating whether providing intensive individualized feeding and care would decrease the rate of soft-shell occurrence versus the current group feeding and care approach. The second phase of the experiment was treatment. Signs of soft shell usually become apparent in late fall/early winter. At this time two different treatment options were implemented in order to evaluate their efficacy: calcium + UV light baths, and antiparasitic medication for coccidian (which has been detected in the population). Effective treatment of soft shell will increase survival of head-started turtles, ultimately providing more individuals for release efforts.

5.0 RESULTS

5.1 Western Painted Turtle population assessments

Basking surveys and WPT reports

Fifteen basking surveys were conducted at six sites; Minnekhada Marsh MVRP, Lost Lake in Mundy MP, Silvermere Lake, Pitt-Addington Marsh WMA, Colony Farm MVRP and Jerry Sulina MP (Figs. 12 and 13, Table 2). Fifty basking observations were made, with a maximum of 11 Western Painted Turtles observed at one time at Minnekhada Marsh MVRP. Headstarts were observed at all sites that have been augmented except Pitt-Addington. A total five Red-eared sliders were observed at three sites; Lost Lake in Mundy MP, Colony Farm MVRP and Jerry Sulina MP.

Table 2. Western Painted Turtle basking surveys in Lower Mainland Watersheds, BC.

Site	Watershed	Date	Species	No. of turtles	Behaviour	Comments
Minnekhada	Coquitlam River	29-May-20	WPT	1	Basking on log in middle of lower marsh	
Minnekhada	Coquitlam River	03-Jun-20	WPT	5	Basking on logs	Hand-captured WPT adult F, 2 juveniles observed in concrete pond and 2 in SW marsh
Minnekhada	Coquitlam River	08-Jul-20	WPT	7	Floating in water in veg/hanging on to edge of wood piece	7 juvenile WPT observed
Lost Lake	Coquitlam River	31-May-20	WPT	3	Basking on log	1 adult and 2 juvenile WPT observed
Lost Lake	Coquitlam River	05-Jun-20	RES	1	Basking on log	1 adult RES observed
Lost Lake	Coquitlam River	12-Jul-20	WPT	4	Basking on log	1 adult and 3 juvenile WPT observed
Colony Farm	Coquitlam River	31-May-20	RES	1	Basking on floating veg mat in pond	1 adult RES observed
Colony Farm	Coquitlam River	05-Jun-20	N/A	0	N/A	N/A
Colony Farm	Coquitlam River	12-Jul-20	RES	1	Basking on floating veg mat in pond	1 adult RES observed
Silvermere	Stave River	07-May-20	WPT	7	Basking on logs/floating in veg	2 adult and 5 juvenile WPT observed
Silvermere	Stave River	09-May-20	WPT	11	Basking on logs/floating in veg	2 adult and 9 juvenile WPT observed
Silvermere	Stave River	09-Jun-20	WPT	4	Basking on logs	1 adult and 3 juvenile WPT observed
Silvermere	Stave River	08-Jul-20	WPT	2	Basking on land	1 female WPT and 1 juvenile observed
Pitt-Addington	Alouette River	8-10 July-20	N/A	0	N/A	Expansive habitat - difficult to detect turtles
Jerry Sulina	Alouette River	01-Jun-20	RES	3	Basking on logs in channel to river	3 adults RES observed
**WPT = Western Painted Turtle and RES = Red-eared Slider*			**Total**	**50**		

Figure 12. Western Painted Turtle headstart turtle basking at Silvermere Lake, Stave River Watershed in May 2020.

Figure 13. Western Painted Turtle basking at Minnekhada Marsh MVRP, Coquitlam River Watershed. Adult female WPT shown.

In addition to conducting basking surveys, our outreach for eliciting reports of Western Painted Turtles via the Citizen Science sighting sign pilot program at Minnkehada RP resulted in over 160 reports of basking and nesting turtles (Figs. 14-16).

Figure 14. Western Painted Turtle sighting sign posted at Minnekhada RP in June 2020. Nesting beach in background.

Figure 15. Basking Western Painted Turtle male headstart reported by Citizen Scientist at Minnekhada RP. Photo by J. Pal.

Nesting surveys

Western Painted Turtle nesting surveys were conducted for a total of 279 hours at the source site for the headstart program in the Deroche Area, Nicomen Slough, as well as at Silvermere Lake, as these are the sites with confirmed nesting areas (Table 3). Other sites in the project area are primarily comprised of head-start juvenile turtles that will not be mature enough to breed for 1-5 more years. However, reports were also made by the public at Minnekhada Marsh MVRP of a Western Painted Turtle on land attempting to nest on a trail in July 2020. This is the first year that a female was actually observed by a project member on land attempting to nest based on reports from sighting sign that was posted (Fig. 16).

At Nicomen Slough, 63 nests were observed to have been laid, with 46 of those nests protected for natural recruitment and 17 being removed for head-starting. At Silvermere Lake, four individual Western Painted Turtles were observed on land attempting to nest, although no nests were confirmed to have been laid while observers were present. Eight test pits were also detected and attempts were made in fall 2020 and spring 2021 to look for emerge holes and hatchlings in these areas. No emerge holes or hatchlings were detected.

Table 3. Western Painted Turtle nesting surveys in Lower Mainland Watersheds.

Site	Watershed	Date	Hours spent	Observations	Comments
Nicomen	N/A	8-May-25-Jul-20	279	63 nests laid	Source site for headstarting; 46 nests protected and 17 removed for headstarting
Silvermere	Stave River	15-May-25-Jul-20	66	4 females on land	
Minnekhada	Coquitlam River	15-May-25-Jul-20	82	2 females on land	
		Total	**345**		

Figure 16. First observation of original solitary WPT female (7-1) making a nesting attempt on land in July 2020.

Trapping and hand/net captures

Two sites; Minnekhada Marsh MVRP and Silvermere Lake were trapped for a total of 21.7 days and had 5 net capture attempt sessions from early May to late September 2020 (Table 4). The only two Western Painted Turtle mature females were hand-captured at Minnekhada Marsh MVRP during net capture attempts and nesting monitoring in July 2020. One female was a previously-marked turtle (8-1) that had been captured in a trap between Deboville Slough and the Addington WMA just south of Minnekhada Marsh MVRP to be potentially part of a captive breeding program in 2014 and released back into the WMA in 2016. The other (7-1) was captured and observed for the first time by project members in 2020. Nineteen turtles were captured at Silvermere including seven headstarts. Eight turtles were caught at Minnekhada, including six headstarts (Fig. 17). No Red-eared sliders were captured. Due to Covid-19 restrictions this year no First Nations members were able to participate in trapping and capture efforts.

Table 4. Western Painted Turtle trapping results in Lower Mainland Watersheds.

SITE	Total # Headstart CHPI released	% Released Headstart CHPI captured to date	Trap Set/Net capture Dates	Total Traps Set	Total Trap Hrs	Total CHPI	# CHPI Recaps	Total Males		Total Females		# J Sex Unk	New notch Codes Used
								A	J	A	J		
Silvermere Lake	78	9.00%	May 7-12	5	575	14	5	2	2	6	3	1	3-17 to 3-34, 3-123
(LM/FV)			May 24, July 8	N/A	N/A	2	2	0	0	2	0	0	N/A
			July 31 - Aug 3	6	408.5	3	2	0	0	1	2	0	3-36
Minnekhada Marsh	143	4.20%	08-Jul	N/A	N/A	2	1	1	0	1	0	0	7-2 & 8-1
(LM/FV)			15-Jul	N/A	N/A	1	0	0	0	1	0	0	7-1
			Aug 5-7	6	318	0	0	0	0	0	0	0	N/A
			17-Aug	N/A	N/A	3	0	0	0	0	3	0	7-3 to 7-5
			28-Sep	N/A	N/A	2	0	0	0	0	2	0	7-6 & 7-7

Figure 17. Headstart Western Painted Turtles caught at Silvermere Lake (L) and Minnekhada MVRP (R). Pit tag reader shown with turtle to show pit tag ID.

5.2 Western Painted Turtle habitat restoration and threat mitigation

To mitigate important threats to Western Painted Turtles, including habitat loss through residential and commercial development, direct mortality due to transportation and service corridors, and unnaturally high nest predation due to limited safe nesting sites in urban areas and to increase populations of Western Painted Turtles, the Coastal Painted Turtle Project has successfully carried out numerous habitat restoration activities since 2009. These activities include the creation of nesting beaches and basking habitat areas, removal of introduced species, installation of basking logs, fencing, development of a population enhancement strategy, and partnership with numerous governments, and naturalist and First Nations groups.

Silvermere Lake

Silvermere Lake outside the town of Mission, BC., is home to a growing population of endangered western painted turtles. Unfortunately, safe and suitable nesting areas are lacking around the lake. The lack of nesting habitat has led to several female turtles nesting on a gravel road that runs along the northern shoreline of the lake. This puts the female turtles, nests, and hatchlings at risk of being struck and crushed by vehicles.

To reduce instances of female western painted turtles nesting on the gravel road at Silvermere Lake, the Coastal Painted turtle Project led an assessment of nesting areas along the gravel road and the construction of a safe turtle nesting beach (Fig. 18). This project was carried out in collaboration with several stakeholders including the landowner, the Coastal Painted Turtle Project, the Kwantlen First Nation and Lafarge Aggregates. Each year, the beach is maintained be members of the Coastal Painted Turtle Project to ensure weeds and grasses don't become established which would negatively impact nesting females and eggs incubating in the sand (Fig. 18).

Figure 18. Photo of recently maintained Western Painted Turtle nesting beach at Silvermere Lake. Photo by Deanna MacTavish.

Minnekhada Metro Vancouver Regional Park

At Minnekhada Regional Park, one Western Hemlock log and two Douglas Fir logs for were installed in the spring of 2020 to increase the amount of turtle nesting habitat. Metro Vancouver Regional Parks generously provided the logs that were obtained during a weir maintenance project at Minnekhada. Metro Vancouver Parks delivered the logs to the waters edge where they were launched and anchored into place by project members (Figs. 19 and 20). Maintenance of the nesting beach and the protective electric fence also occurred throughout the summer and fall of 2020 with the assistance of Coastal Painted Turtle Project volunteers (Fig. 21).

Figure 19. Installation of basking logs for turtles at Minnekhada Regional Park. Photo by Patrick Mott.

Figure 20. Western Painted Turtles (left) and Western Toad (right) using installed basking logs at Minnekhada in summer 2020. Photos by Deanna MacTavish.

Figure 21. Maintenance the electric fence battery conducted following beach weeding at Minnekhada Regional Park. Photo by Deanna MacTavish.

Lost Lake in Mundy Municipal Park

Mundy Park is a large urban park in the City of Coquitlam. Two lakes are located in the park, Mundy Lake and Lost Lake. Of the two lakes, Mundy Lake is the largest, but is also the most heavily impacted by park users, as a walking trail runs along the perimeter shoreline of the Lake. Lost Lake is also visited by park users, but human impacts are less intense at this site as there are fewer access points to the lake compared to Mundy Lake. In order to provide safe and suitable nesting habitat at Lost Lake in Mundy Park, a nesting beach was constructed in the fall of 2019 and is maintained yearly. In late summer of 2020, basking logs were installed and positioned within Lost Lake, with the help of project volunteers, to increase the availability of suitable basking habitat for turtles at the site (Fig. 22). Logs were anchored into place using galvanized steel chain and cinderblock anchors.

Figure 22. Photo of volunteer assisting with basking log installation at Lost Lake in Mundy Park. Photo by Deanna MacTavish.

Colony Farm Metro Vancouver Regional Park

As part of an extensive trail building plan by Metro Vancouver Regional Parks at Colony Farm, habitat creation for Western Painted Turtles was incorporated (Fig. 23). Construction on the planned habitat creation began in 2019 but some works extended into 2020 and more will continue into 2021. An approximately 1.5-hectare wetland complex of 3 m depth with abundant woody debris for basking and nesting habitat was constructed over the summer and fall of 2019. Fencing was also erected to surround the wetland complex at a length of 175 m. It is expected the habitat will be ready for release of head-start juvenile turtles in 2022. In March 2021, a project member along with a representative of the Colony Farm Park Association surveyed the wetland and assessed further habitat enhancements need to make the habitat more suitable for turtles (Fig. 24). Recommendations include adding floating basking logs, as most coarse woody debris is along the edge of the pond and includes root wads installed in deeper water. In addition, it is recommended native aquatic plants are added to provide cover and a food source, particularly for headstart turtles.

Figure 23. Wetland creation and nesting and basking habitat installation at Colony Farm, Coquitlam River Watershed.

Figure 24. Project member with partner, the Colony Farm Park Association, surveying newly created wetland and assessing turtle habitat features at Colony Farm in March 2021.

5.3 Western Painted Turtle captive husbandry and releases

Between both facilities, a total of 128 head-start turtles were released in 2020 into four sites in Lower Mainland Watersheds; Lost Lake in Mundy MP, Minnekhada Marsh MVRP, Pitt-Addington Marsh WMA and Silvermere Lake (Fig. 25). Although in previous years First Nations (including Kwikwetlam, Katzie and Kwantlen), project partners (including the City of Coquitlam) and local stewardship groups (including the Minnekhada Park Association) were able to participate in all releases, that was not possible this year due to Covid-19. However, strong relationships were maintained with all these groups.

Greater Vancouver Zoo-Wildlife Preservation Canada facility

In 2020, head-starting capacity at the Greater Vancouver Zoo facility was able to be increased; with 355 eggs collected, resulting in 267 hatchlings which were overwintered for release in 2021 (Fig. 25). In 2020, the Zoo released 100 juvenile turtles at FWCP turtle sites (Fig. 26). All individuals received a health assessment prior to release. This included pit-tagging for unique identification and recording final weights. In addition, accurate plastron photos were taken to assist with individual identification upon recapture during subsequent population monitoring and assessment of head-starting activities.

Figure 25. Headstart Western Painted Turtles at Greater Vancouver Zoo, Aldergrove, BC.

Figure 26. Released headstart enjoying its first swim at Silvermere Lake in 2020.

Soft-shell study follow up at the Greater Vancouver Zoo

Following from the 2019 investigation into the incidence of soft-shell in headstart turtles where no difference in the development of this disease was observed with various care treatment trials, an attempt to address potential bioflora causes for the development of soft-shell, active biofiltration rearing set-ups were established in 2020 (Fig. 27). Through information sharing with partners in Washington and Oregon, this filtration method has been found to benefit water quality and turtle health. Biofiltration involves the filtration of water through “bio balls” and filter media which are inoculated with complex water, preferably from the natal site. The bio balls and filter media increase the surface area on which beneficial fungal and bacterial communities can grow, increasing their diversity and helping to maintain water quality.

In such a system minimal water is removed during any needed cleaning in order to maintain the biological integrity of the system. Recent research in both animal and human health fields have found that the diversity of micro-organisms on the surface of the body can impact overall health and the body’s response to infectious disease. The link between microfloral diversity and positive health outcomes has been observed in amphibians for whom bacterial communities present on the skin can produce metabolites that inhibit the growth of toxic Chytrid fungus, a leading cause of the global amphibian decline[24].

Figure 27. Biofiltration turtle husbandry set-up at Oregon Zoo, Portland, WA, USA.

Recent work with pond turtles in the Pacific Northwest has revealed a correlation between fungus Emydomyces testavorans and another shell deterioration condition known as ulcerative shell disease[25]. Analysis of water from the rearing enclosures that were completely emptied (ie "dump and fill" method) and cleaned daily showed a dramatic decrease in diversity of fungal communities leaning strongly towards E. testavorans. Enclosures that were provided a biofiltration system more closely mirrored the fungal diversity profile of wild environments.

However, unfortunately soft-shell rates were roughly the same as experienced in 2019, with 35% of 2020 hatchlings succumbing to the disease. The implication of Cryptosporidium, 'Crypto' in the vast majority of mortalities this year has led to new treatments with preliminary success, providing hope methods to mitigate soft-shell successfully in future will be established.

Crypto is a difficult disease to treat because the cryptosporidium organism encapsulates, i.e. it creates a protective barrier around itself. Eliminating the parasite in the animal and removing it from the environment is complicated by this life history trait. Facility staff worked with the resident veterinarian at the Zoo to come up with two anti-parasitic treatments that we are using consecutively on affected animals this year. For the already affected 2020 cohort, one round of treatment with Ponazuril followed by a round of Humatin is being completed. Both medications are being used in order to most effectively and quickly target the problem in the acutely affected animals this year.

In 2021, the facility will be changing the young hatchling rearing setup to decrease turtle density in the rearing tubs while focusing on head starting from diverse source populations. Upon consultation with staff at the Ontario Turtle Conservation Centre, decreasing density in conjunction with our medication trials will help ensure that there are no confounding effects of density on feeding frequency and caloric/vitamin availability.

The facility maintained their Husbandry Technician position overwinter to assist with all duties at the zoo site this season and over the winter months. The technician assists with all aspects of animal care and associated record keeping and data management, as well as preparing turtles for release. This position has also allowed the facility to continue to further investigate the increased incidence of soft shell.

North Vancouver head-starting facility

For the first time the facility did not overwinter any turtles from 2019 that were not big enough for release in 2020. Most turtles will mature to the 30 grams within a 12-month period (Fig. 28 and 29). The North Vancouver facility is directly

partnered with BCCF who manage the contractors that are hired with FWCP funds. These staff make sure the turtle tanks are cleaned and the turtles are well fed. The Ministry of Forests, Lands and Natural Resource Operations and Rural Development (MFLNRORD) pays for the cost of running the lab which is in the BC Park Facility at the bottom of Mt. Seymour. The food and lighting/filter costs are jointly paid for through this FWCP-MFLNRORD partnership.

In 2020, 28 head-started turtles (over 30 grams) from the North Vancouver facility were released at the following sites in Lower Mainland Watersheds (additional head-starts were released at other sites outside the study area).

Lower Mainland Watersheds

May 5, 2020 - 14 turtles released at Pitt-Addington Marsh

April 14, 2020 – 14 turtles released at Minnekhada Marsh Regional Park

Head-starting site

October 6, 2020 – 4 turtles released at Nicomen Slough to augment the host site (where the best South Coast genetic population is located/breeding and is our source population for eggs for head-starting).

Figure 28. Eggs hatching at head-start facility at MFLNRORD office in North Vancouver, BC.

Figure 29. Hatchlings at head-start facility at MFLNRORD office in North Vancouver, BC.

5.4 Summary of Western Painted Turtle recovery actions and partner engagement in 2020-21

In 2020, population monitoring was completed at four sites (Lost Lake-Mundy MP, Minnekhada Marsh MVRP, Pitt-Addington Marsh WMA and Silvermere Lake). Restoration was completed at two sites (Colony Farm MVRP and Minnekhada Marsh MVRP) and threat mitigation, in the form of signage, was completed at two sites (Silvermere and Minnekhada Marsh MVRP) (Table 5; Appendix I).

Table 5. Western Painted Turtle Recovery Actions in Lower Mainland Watersheds 2020-21.

No.	Western Painted Turtle sites	Watershed	Status and Works completed (including Year 1 and Year 2 of this project)	Works planned
1	Mundy Park (Lost and Mundy Lakes)	Coquitlam	Augmentation completed (head-started turtles released); Population monitoring and habitat restoration (nesting habitat and fencing installation, signage development at Lost)	Monitoring of population and habitat enhancement and adaptive management planned for 2020-2024 (Years 2-5)
2	Colony Farm Regional Park	Coquitlam	Occupied, Metro Vancouver Regional Parks currently conducting some restoration (wetland construction and nesting habitat installation) as part of trail expansion project	Restoration monitoring and adaptive management planned for 2020-2024 (Years 2-5). Restoration suitability assessment for augmentation in 2021 (Year 3). Augmentation planned beginning 2022 (Year 4) if deemed suitable at that time.
3	Lafarge Lake	Coquitlam	Replacement site sought	Currently, Lost and Mundy Lakes used as replacement
4	Deboville Slough	Coquitlam	Occupied, basking habitat installed 2014	This site is considered part of the Minnekhada population so augmentation, monitoring and restoration works are focused at that site. Although population monitoring would include this site beginning in 2021 (Year 3).
5	Minnekhada Regional Park	Coquitlam	Augmentation ongoing since 2014, basking habitat installed 2011 and nesting 2018; Augmentation, population and habitat restoration monitoring and installation of fencing and basking habitat, capture of 8 adult and headstart turtles during capture attempts and nesting monitoring	Continued augmentation, population and completed habitat restoration monitoring throughout all project years
6	Pitt-Addington Marsh	Alouette	Augmentation ongoing since 2016, nesting and basking habitat installed in 2016; Augmentation, population and habitat restoration monitoring (Year 1 and Year 2)	Continued augmentation, population and completed habitat restoration monitoring throughout all project years
7	Jerry Sulina Municipal Park	Alouette	Augmentation completed (head-started turtles released), nesting habitat installed 2012, Habitat restoration monitoring/adaptive management (Year 1 and Year 2)	Habitat restoration monitoring throughout all project years; augmentation of Neeves restoration site in same critical habitat polygon beginning in 2021 (Year 3).
8	Kanaka Creek	Between Alouette and Stave	Replacement site sought; Meetings and planning with City of Maple Ridge at Whonnack Lake-Site Management Plan (SMP) finalized. Pre-release consultation still in progress.	Whonnock Lake may be potential replacement site. Plan to be finalized in Year 3-landowner dependant.
9	Whonnock Lake	Stave	Potential replacement site for Kanaka Creek. Habitat assessments and partnership building and SMP to establish head-starting, restoration and monitoring schedule developed. Pre-release consultation still in progress.	Begin to implement SMP in 2021-22 (Year 3)-landowner dependant
10	Silvermere Lake	Stave	Augmentation ongoing since 2016, basking habitat installed 2017, nesting habitat installed 2018; Augmentation, population and habitat restoration monitoring. Capture of 20 adult and headstart turtles during capture attempts and nesting monitoring. Mitigation including fencing and signage jointly pursued with Kwantlen FN.	Continued augmentation, population and completed habitat restoration monitoring throughout all project years. Habitat enancement and additional nesting habitat installation on IR land planned in 2021 (Year 3).

Although in 2019, engagement in head-start releases at all sites with population augmentation included participation by First Nations (Kwikwetlam, Katzie and Kwantlen), project partners (City of Coquitlam) and local stewardship groups (Minnekhada Park Association) occurred (Fig. 30-33), this was not possible in 2020 due to Covid-19 restrictions. However, partnership were maintained and are strong, with eagerness by all groups to actively participate in 2021.

Figure 30. Head-start release with Kwikwetlam First Nation members and City of Coquitlam staff at Minnekhada Marsh MVRP, Coquitlam River Watershed in 2019.

Figure 31. Members of Katzie First Nation participating in trapping efforts at Pitt-Addington WMA, Alouette River Watershed in 2019.

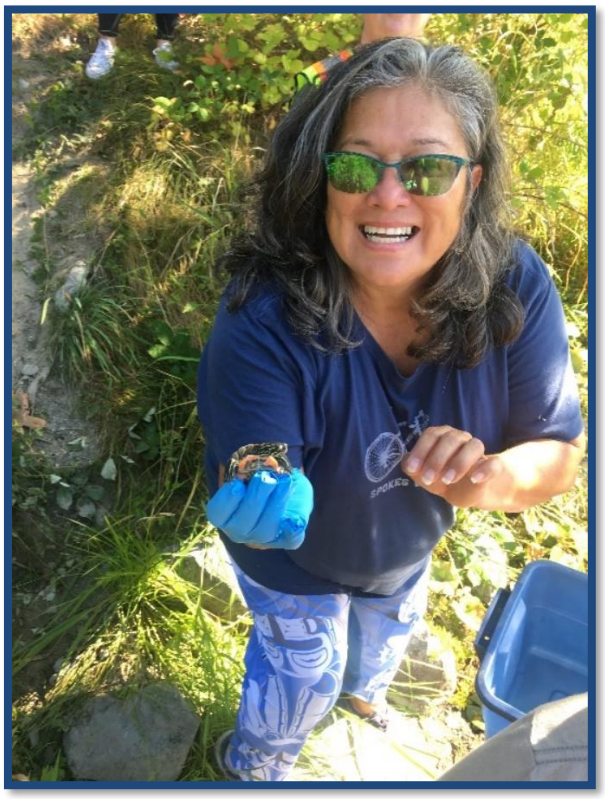

Figure 32. Kwantlen First Nation member releasing head-start WPT at Silvermere Lake, Stave River Watershed in 2019.

Figure 33. Coastal Painted Turtle Project, Kwantlen First Nation, Wildlife Preservation Canada and Fish and Wildlife Compensation Program members at Silvermere Lake headstart release, Stave River Watershed. From left to right, Aimee Mitchell (CPTP), Fern Gabriel (KFN), Maja Hampson (WPC) and Julie Fournier (FWCP) in 2019.

Although the typical attendance and hosting of stewardship events were also not possible in 2020 due to Covid-19, several web-based opportunities for outreach including hosting a live stream for homeschool students from the Greater Vancouver Zoo's Conservation Corner as well as three webinars with our partners Pacific Parklands and Metro Vancouver Parks were provided. An outdoor Turtle Talk was also provided to the Port Coquitlam Beavers group and participation by local children took place at Minnekhada MVRP and Silvermere Lake (Figs. 34 and 35).

Figure 34. Outdoor Western Painted Turtle Talk for Port Coquitlam Beavers, Coquitlam River Watershed in October 2020.

Figure 35. Western Painted Turtle release at Minnekhada MVRP, Coquitlam River Watershed in June 2020.

Partnership activities Metro Vancouver Regional Parks have leading and funding all the restoration works at Colony Farm and providing additional basking logs at Minnekhada Marsh. The Minnekhada Park Association coordinated volunteers to participate in basking and nesting monitoring training provided by project members at that site. Project members also provided this training to staff our source site at Nicomen Slough (Fig. 36).

Figure 36. Nesting monitoring and turtle processing training at headstart source site, Nicomen Slough, FVRD in May 2020.

6.0 DISCUSSION AND RECOMMENDATIONS

Recommendations to continue to address priority actions for Western Painted Turtle and their habitats in Lower Mainland Watershed include:

1) Continued population monitoring of all head-start sites is recommended; including basking and nesting monitoring and population assessments via capture (i.e., trapping and hand-net capture) to assess head-start growth, health and survival and to document reproductive success.

2) Monitoring of use of restored habitat features (i.e., turtle nesting beaches at Silvermere, Minnekhada and Lost Lake) is recommended to ensure the habitat provided is successfully producing hatchling turtles and increasing recruitment in the population leading to increasing populations at this site. Without continued monitoring of restored habitat features it is not possible to ensure the restoration efforts continue to provide a positive impact on population recovery.

3) Restoring or enhancing habitat (i.e., second location enhanced at Silvermere for turtle nesting, completion of Colony Farm wetland construction) is recommended to ensure WPT populations continue to benefit from conservation actions and having properly function habitats to continue to increase or maintain populations and achieve the ultimate goal of limiting population declines and restoring populations.

4) Continued collecting eggs for incubation and raising hatchlings in captive facilities is recommended to continue augmenting populations until population goals are reached at each site.

5) Follow up on soft-shell study (including testing alternative parasite medication and assessing a biofiltration tank set up for head-starts) is highly recommended to reduce mortality due to this condition.

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9.0 APPENDICES

Appendix I and II. FWCP recognition and Partnership and engagement activities

Silvermere Lake Western Painted Turtle Interpretive sign in partnership with Kwantlen First Nations- DRAFT – edits still be finalized

Minnekhada Metro Vancouver Regional Park Western Painted Turtle sighting sign – pilot citizen science initiative