Summary of Minnekhada Park Association's 2024 Western Toad Monitoring Program

Prepared by Julie Kanya, Steve Smith, & Esmeralda Martinez Bonilla

Background:

Minnekhada Park Association (MPA) is a citizens-empowered organization, incorporated as a society in Victoria, B.C. In partnership with Metro Vancouver, MPA's mission is to preserve, protect and enhance the natural environment of Minnekhada Regional Park, while advocating respect, appreciation and enjoyment of the Park's natural and historic attributes as well as recreational resources. As part of this work, MPA develops and implements a variety of events and programs. This report summarizes the 2nd year of the "Trail Hoppers" program which monitors the park's Western Toad Population.

Minnekhada Regional Park contains a communal breeding site of the Western Toad (*Anaxyrus boreas*). Western Toads gather in large numbers at various stages of their life cycle which may give a misleading appearance of extreme abundance[1]. In actuality these groupings can represent every single breeding adult or all young produced for the entire area that year[1]. During these mass congregations at breeding sites and during mass migration between breeding and foraging/over wintering areas, Western Toads are incredibly vulnerable to disturbance and mortality[1]. Western Toads are a species of interest from a conservation perspective and are both provincially listed Yellow[2] and federally listed as Special Concern under the Species at Risk Act[3].

While Western Toads have been observed and reported informally in Minnekhada Regional Park by both park users and environmental professionals for over a decade, formal monitoring has been sporadic and minimal. A summary of Western Toad monitoring and conservation efforts were summarized in detail in the 2023 report and included incidental observations, some formal monitoring conducted by the Coastal Partners and efforts to raise awareness about the toadlet population by Coastal Partners in partnership with Metro Vancouver

At Minnekhada Park toadlets emerge from the marsh by the thousands during the summer, coinciding with hiking season and peak park usage. This leaves the toadlets vulnerable to being trampled by park users and subject to vehicle mortality, particularly on Quarry Road. There is less currently known about impacts to adult toads during their spring migration because their migration occurs in the evening when the park is closed. Vehicle traffic in the area is likely low after dark offering the mature toads some protection against roadkill mortality. However road-killed breeding age toads have been observed anecdotally on the lane leading to Minnekhada Lodge from Oliver Road. This lane experiences isolated high traffic before and after private events at the Lodge which occur in the evening when adult toads are on the move. There are also concerns that vehicle traffic on Quarry Road may increase as the area develops in preparation for the opening of Widgeon Marsh Regional Park and the proposed expansion of Gilley's

Quarry. That said, planned improvements and upgrades to Quarry Road may provide an opportunity for MPA to engage with decision makers to advocate for Western Toad conservation to be considered with the road design (toadlet underpass, fencing, etc.). As a result of these factors MPA endeavored to monitor mature Western Toads in the spring of 2024 in addition to the toadlet monitoring program established in 2023.

2024 marks the second year of the “Trail Hoppers” program and was made possible through financial support of the Metro Vancouver Regional Parks Foundation as part of the Fire Recovery fundraising campaign and with the organizational support of Metro Vancouver Regional Parks.

Purpose

The Western Toad population at Minnekhada is regionally significant. This is in large part because of the somewhat unique topography. Minnekhada Marsh is in a basin surrounded almost completely by forested, higher terrain on all sides. This provides an almost perfect setup to support the Western Toad life cycle, which in turn greatly enhances the food web. Adults thrive in the surrounding rainforest environment and then return to the marsh to reproduce in late spring. Water moving slowly through the marsh provides nutrients for tadpoles and toadlets. In turn, the mass emergence of toadlets, before and after their metamorphosis, provides a substantial food source for other local species. If the Western Toad does not continue to thrive, it is safe to say this will have a negative impact on other parts of this ecosystem.

Unfortunately for the Western Toad, this perfect home is also enjoyed by an increasing number of humans, and the toads must cross pathways and roads in order to complete their objectives. This results in a level of mortality, which we are aware of but has not, recently at least, been quantified. That is the overall purpose of this program. To better understand the human impacts to the Western Toad life cycle. By understanding and quantifying this perhaps we can help to identify ways to mitigate the level of human caused mortality. By continuing to monitor the toads annually MPA hopes to develop a long-term dataset which can be used to develop strategic initiatives that promote the conservation and preservation of the Western Toad population in the park. The following focus areas were established in 2023 and continue to guide the program objectives;

- Where are the "hotspots" where high levels of human caused mortality occur or are likely to occur?
- Are there specific pathways they follow or do they more or less distribute randomly?
- Do these change over time?
- What are the environmental triggers for adult toads to begin their migration to the marsh and for toads/toadlets to migrate to the forest?
- What might be the impacts of increased road traffic, specifically on Quarry Road adjacent to the marsh?
- What other species most benefit from these patterns?
- Are there invasive species present that pose a substantial threat?

MPA will continue to refine and adjust the program objectives as the dataset grows. Recommendations to decision makers on mitigation efforts will likely not come until a more complete picture is in place.

Methods:

Western Toadlet Monitoring

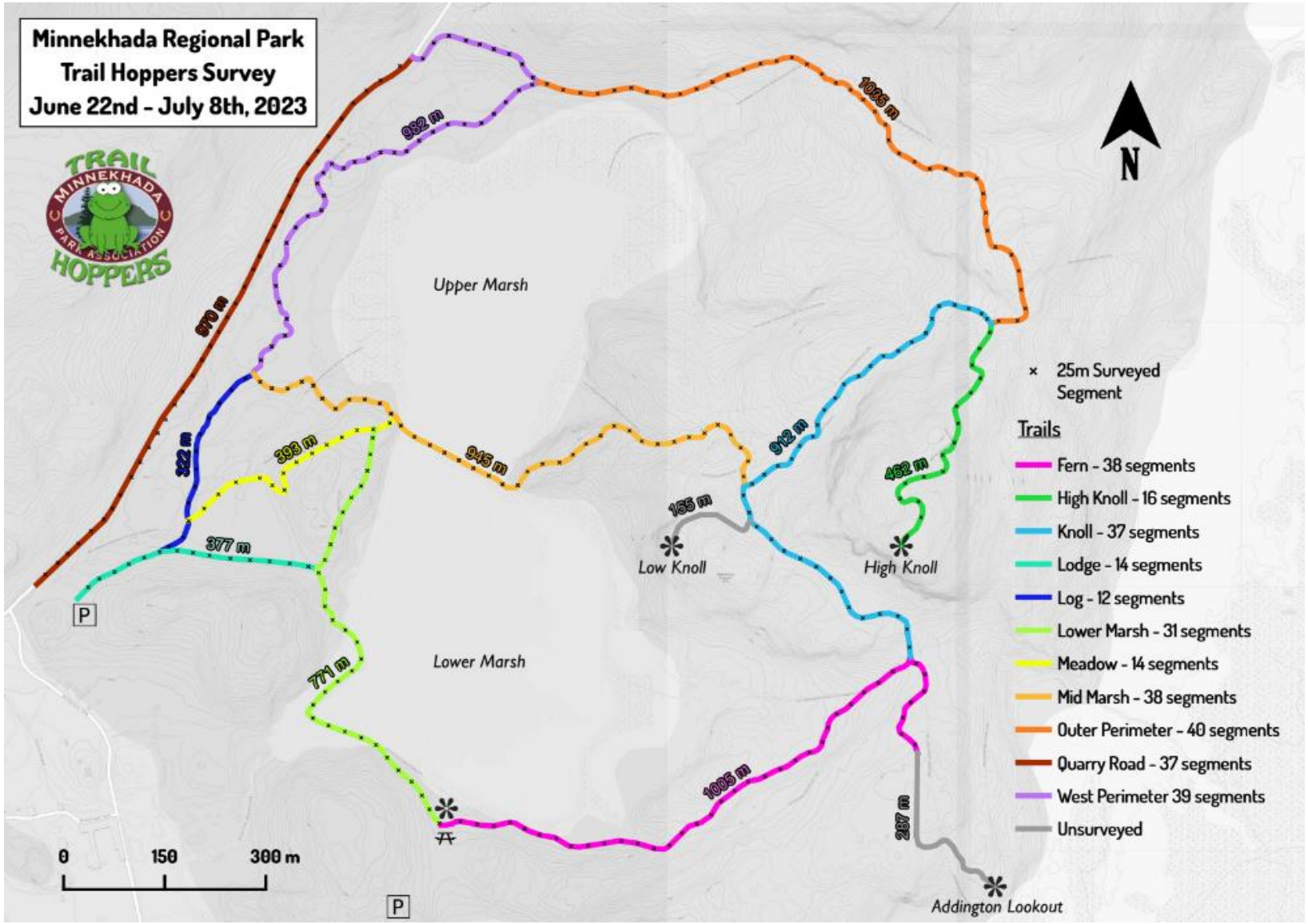
Survey transects were established around Minnekhada Regional Park in 2023 to determine where the Western Toadlet migration crosses trails within the park (Fig 1). The transects are roughly 1- 1.5 km and follow the established trail system within the park. The transects were then divided further into 25 m segments. Each segment was marked using GPS, and a geotagged map was created for reference. Volunteers then used the map on the Avenza app to navigate and follow the segments.

Surveys were conducted over the two-week toadlet migration period using volunteers (July 7th to July 18). Surveys were conducted in the evening (5:00 pm – 8:00 pm) when the toadlets were most active. Volunteers were instructed to record the date, start and end time, weather conditions, number of live toadlets observed per segment, and number of dead toadlets observed per segment.

Volunteers worked in groups of at least three per transect. One volunteer followed the segments on the map and acted as the scribe, another focused on counting live toadlets, and the third counted dead toadlets. If four volunteers were available for a segment, two volunteers would count the live toadlets. Volunteers were given clickers to keep count of the toadlets per segment. Volunteers were asked to toss any dead toadlets to the side of the trail to avoid double counting the dead toadlets. All data was collected using datasheets and then transferred into an Excel spreadsheet (Appendix

1). Several maps showing the relative abundance of live and dead toadlets along the transects were created using the data collected over the migration period.

Figure 1: Map of Minnekhada Regional Park separated into 10 transects for toadlet migrations survey.



Adult Western Toad Monitoring:

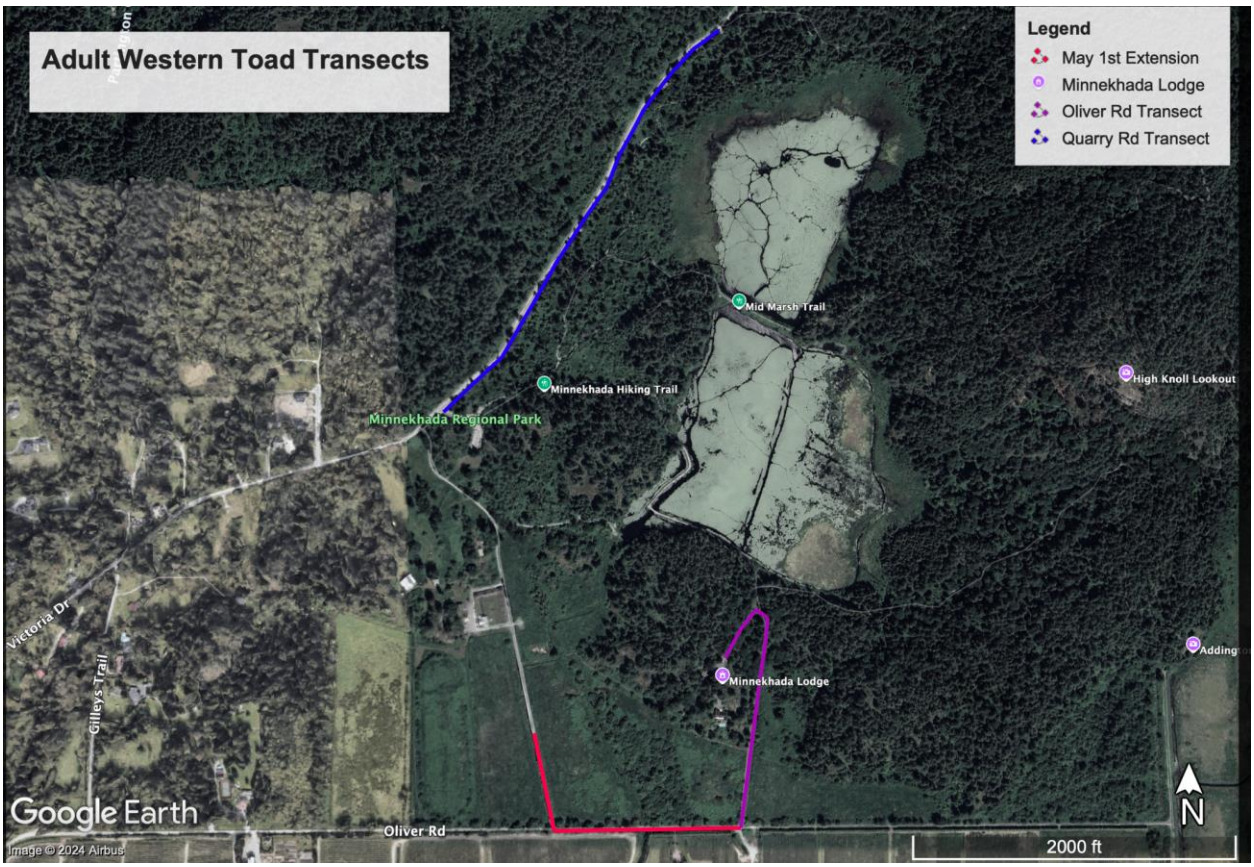
Survey transects were established at Minnekhada Regional Park to identify where adult Western toads cross major roads around the park (Figure 2). There are two transects in total: the first, located on Quarry Rd, spans approximately 1 km, while the second, on Oliver Rd, begins at the gate and ends at the Lodge, covering a length of about 1.4 km. On May 1st the transect was extended to include part of Oliver Rd and turned into Minnekhada Farm. The transects are located in areas where road mortalities are possible. The limited survey locations ensure MPA can maximize its manpower and focus on areas of greatest concern. Adult toads will move within the Minnekhada trail system but given that migration takes place after sunset (when the park is closed) there is limited concern for the toads on the walkable trail system within the park.

Adult Western Toad surveys were conducted during the 2-month migration period (April–May). Volunteers went out 1-3 times per week during the migration period trying to choose the days of the week with highest humidity. Monitoring took place over 10 days, with four days spent at the Oliver Rd transect and six days at the Quarry Rd transect. The coordinator waited until temperatures were at least 10 degrees Celsius at dusk to start surveying adult toads. Survey's started right at dusk and went until there was no more toad activity (usually 2-3 hrs.). Volunteers will be instructed to record the date, start, and end time, weather conditions, number of live toads seen per segment, and number of dead toads per segment and the number of vehicles using the road. Volunteers will also be instructed to record all incidental observations that may affect the toad migration on the datasheet (appendix 2).

Ideally volunteers will be in groups of 3-5 for efficiency and safety purposes. In groups of five, two volunteers will focus on looking and counting toads on the west side of the road and, two will be focused on counting toads on the east side of the road and one volunteer will act as the look out for incoming vehicles or wildlife. For surveys on Oliver Rd. groups of three will be enough as the road is not as wide or as traffic. Vehicle speed is also limited. When a toad is found (dead or alive) an exact GPS coordinate was taken and transcribed onto the datasheet along with any other relevant notes. If possible a photo was also taken. If the toad was in the middle of the road volunteers were instructed to carefully nudge the toad along to the side of the road. It is important that volunteers do not touch the live toads as being species of special concern means they can only legally be handled with a permit. In addition amphibians have sensitive skin. Western Toads absorb oxygen through their skin. Residue on hands and clothes (lotion, sweat, bug-spray, sunscreen etc.) could be absorbed into their bodies to their detriment.

Several maps were created showing the number of adult Western Toads were found crossing roads around Minnekhada.

Figure 2: Adult Western Toad Transect established March 2024 (including transect extension May 1st)



Results:

Western Toadlet Monitoring:

Monitoring was conducted over 6 days during a 2 week period. All 10 transects were monitored at least once during the season. Where time and resources allowed transects were surveyed twice. Raw data is included in Appendix 3.

In 2024, there was a significant decrease in the number of toadlets emerging from the marsh compared to 2023 (Figure 3). The Lower Marsh transect, which had the highest abundance of toadlets in 2023, saw little to no activity this year. Anecdotal evidence from other breeding sites suggests a pattern in which years of high migration numbers are often followed by years with significantly lower numbers, alternating between the two. It is also possible that the timing of the monitoring events did not align well with the migration resulting in underestimated counts.

Similar to 2023, this year we identified the Mid Marsh transect and Western Perimeter transect as hotspots for toadlet migration. The highest toadlet mortality occurred along the Mid Marsh transect, which is to be expected as it is one of most used trails in the park. The toadlet hotpots were found along waterways and often followed small streams coming into the marsh. The following maps (Figures 4-6) visualize where toadlets were found in greatest abundance (including dead and alive).

Figure 3: Shows a map comparing total number of Western Toadlets surveyed between 2023 and 2024.

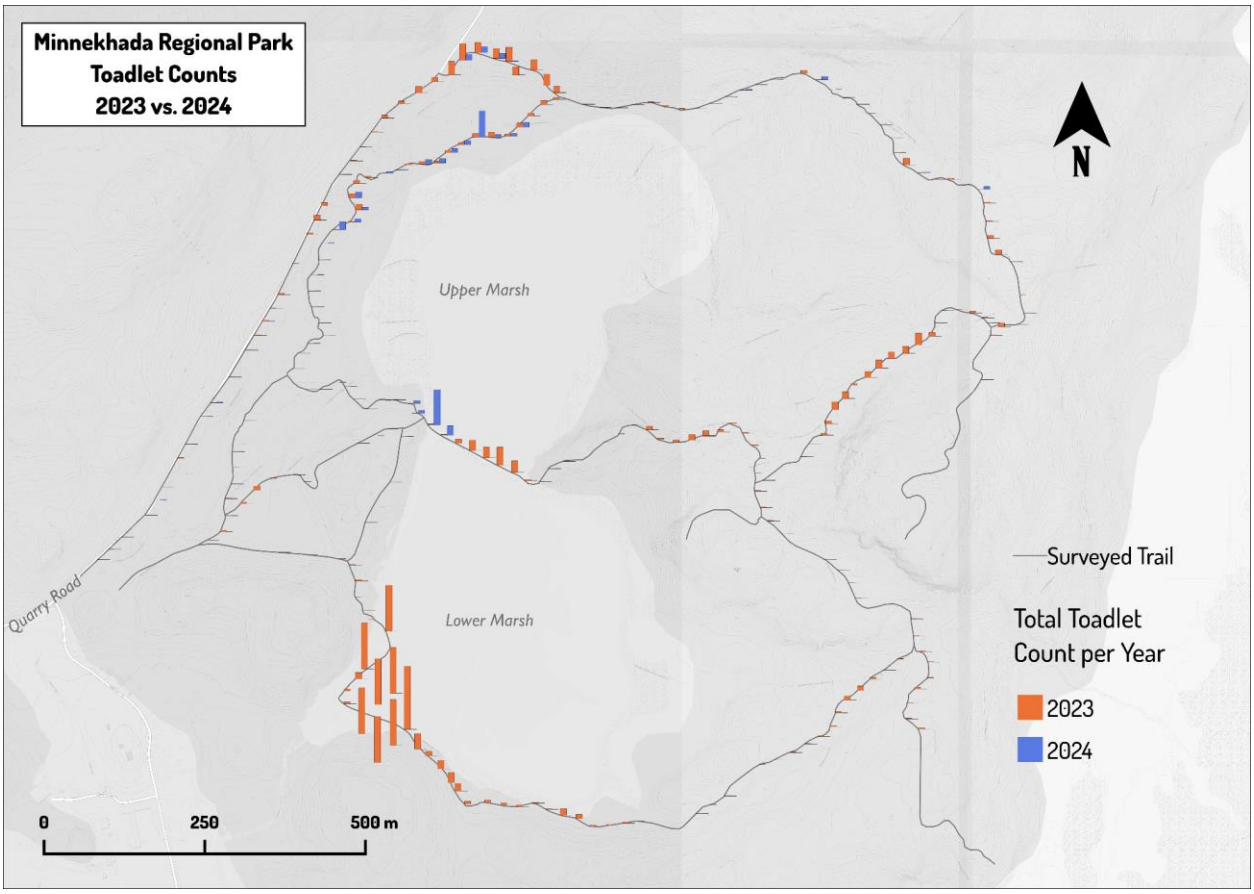


Figure 4: Shows a heat map of the live Western Toadlets surveyed between July 7th and July 18th in 2024.

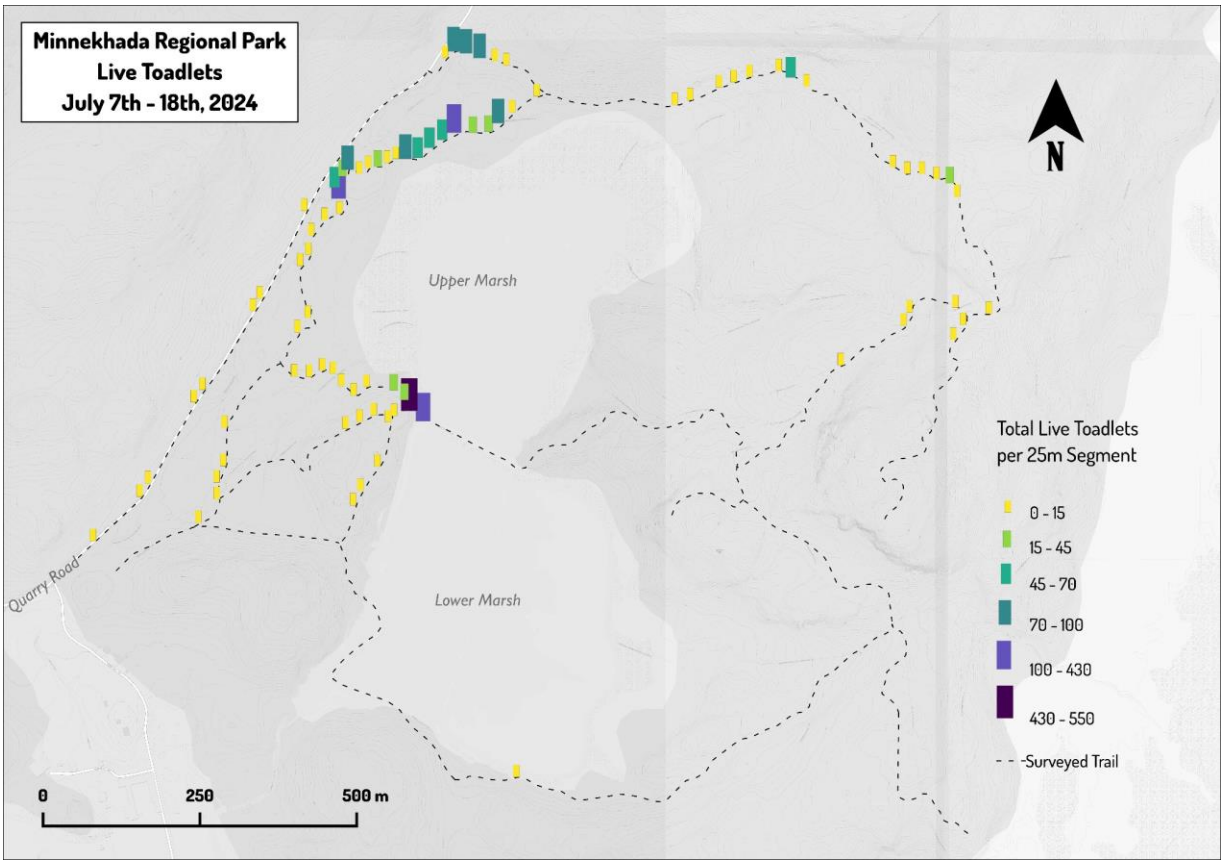


Figure 5: Shows a heat map of the dead Western Toadlets surveyed between July 7th and July 18th in 2024.

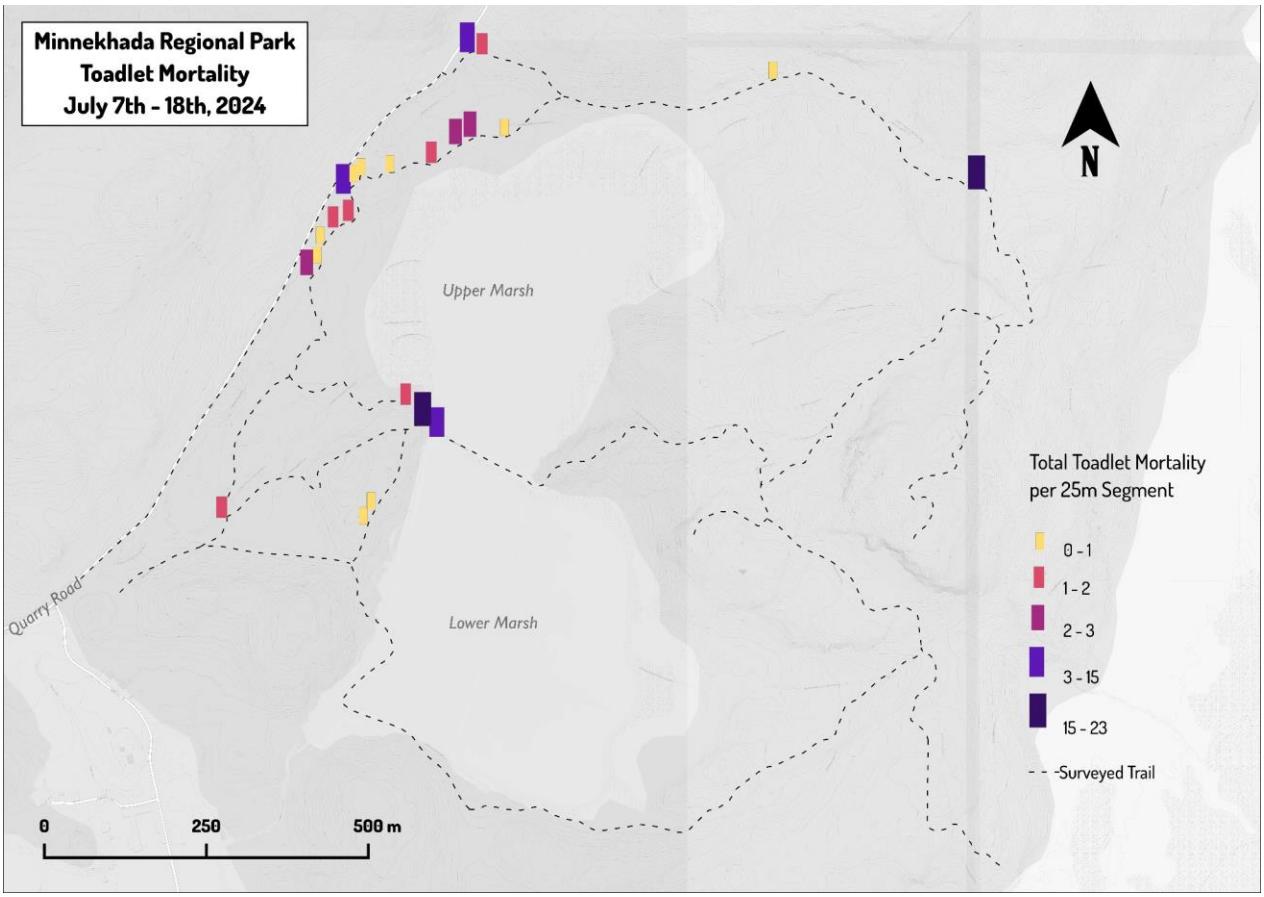
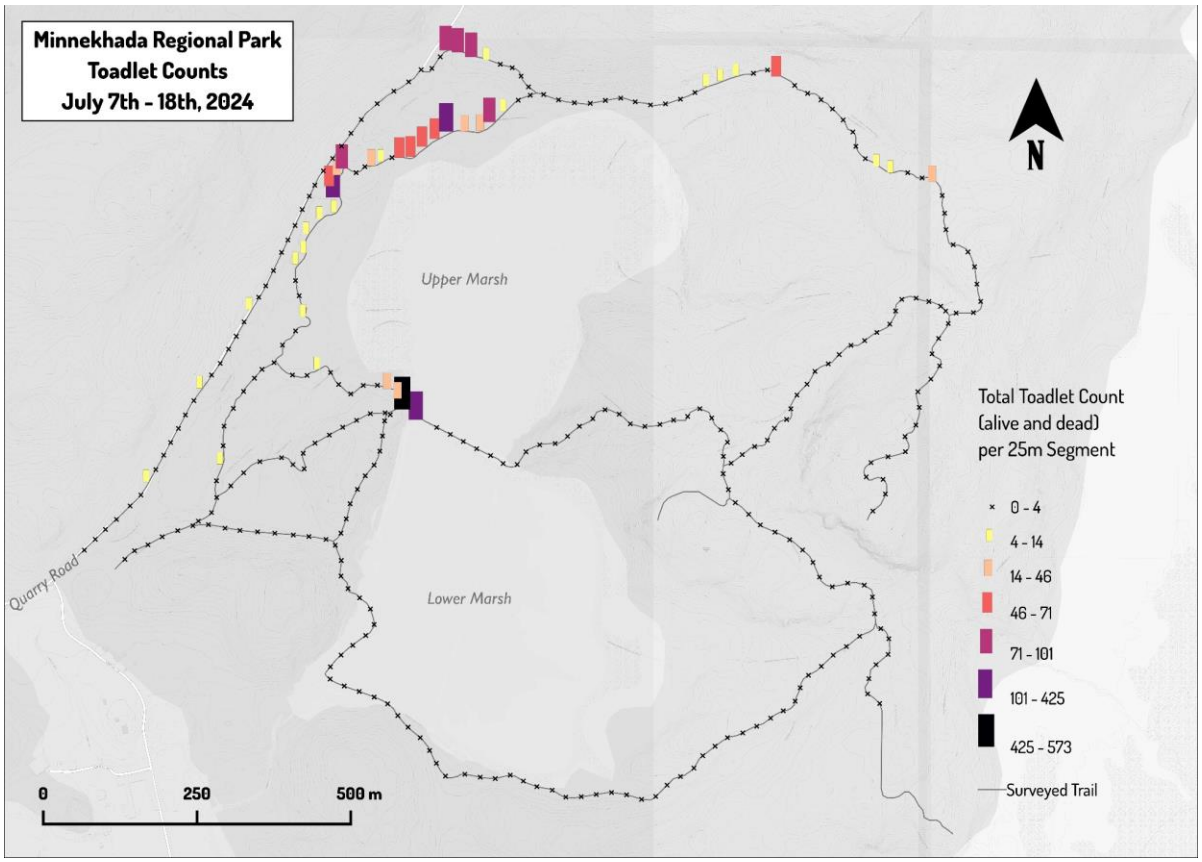


Figure 6: Shows a heat map of the total number of Western Toadlets (dead & alive) surveyed between July 7th and July 18th in 2024.



Results for Adult Western Toad Monitoring:

During the 10 day migration period we encountered a total of 51 alive and 13 dead adult Western Toads across both transects. The following maps (figure 7-9) highlight where along the transects the most toads were found both dead and alive. We believe most if not all toad deaths were caused by being run over by a passing car. On Quarry Rd a vehicle tally was also done and although the transect was not too heavily trafficked by cars, those who did drive down the road often did at very high speeds for the road conditions. The only vehicles permitted on Oliver Rd during toad migration time are related to booked events at the Lodge. Although there was limited access to cars on Oliver Rd we saw the highest mortality rate on this transect on May 19th (Figure 9). We believe this was due to an event that was held at the Lodge the night prior which was also a night with optimal conditions for toad migration. Therefore were likely toads crossing the road, roughly at the same time people were using the road to come to or leave an event at the Lodge. With a dark narrow road it is difficult impossible for cars to see and avoid the toads crossing the road. Without awareness it is unlikely that event-goers would know or care to look out for toads.

Figure 7: Shows a map with all the Adult Western Toads survey between April and May 2024

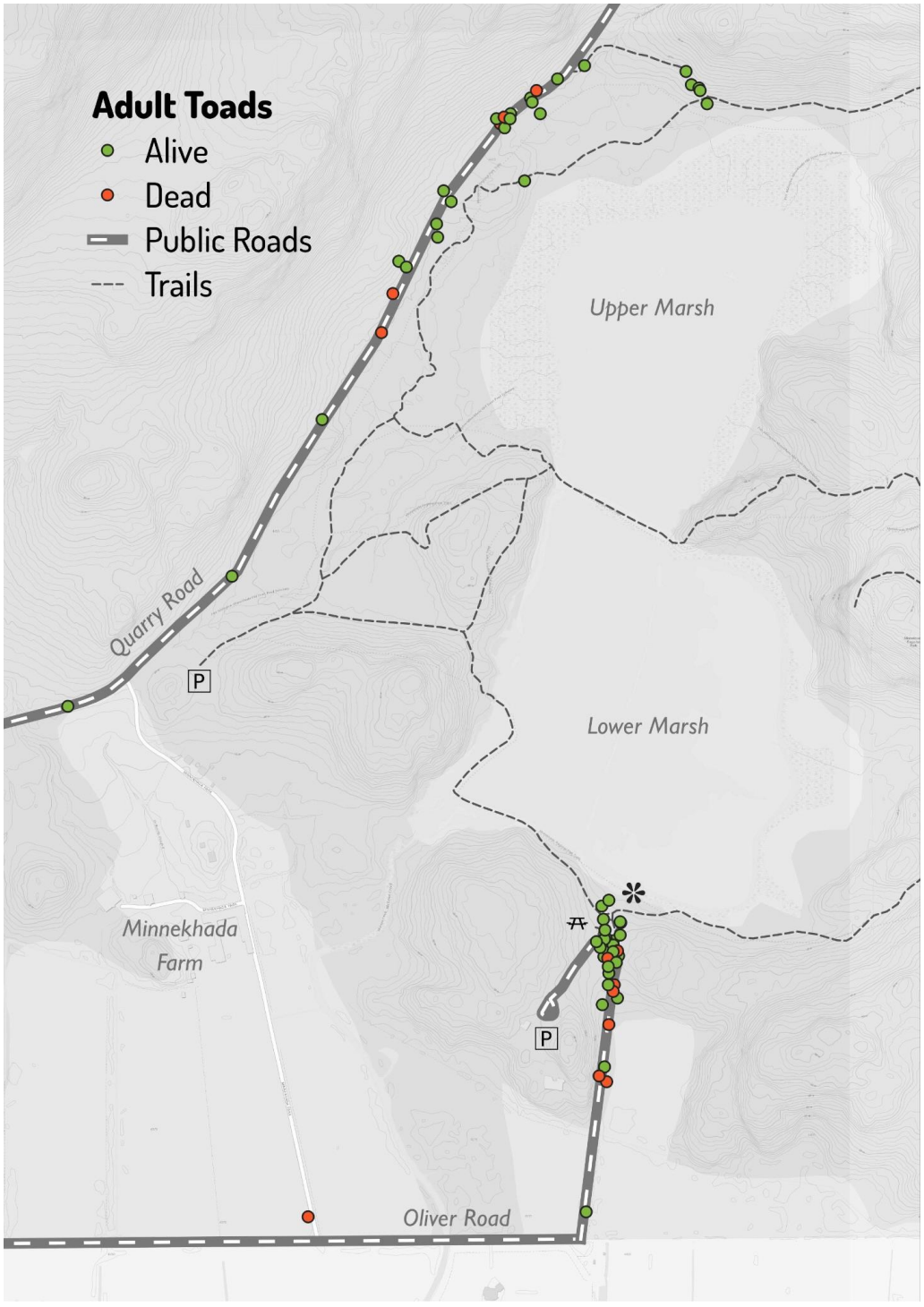


Figure 8: Shows a map of all the adult Western Toads surveyed on the Quarry Road transect. With each survey date shown on a different map.

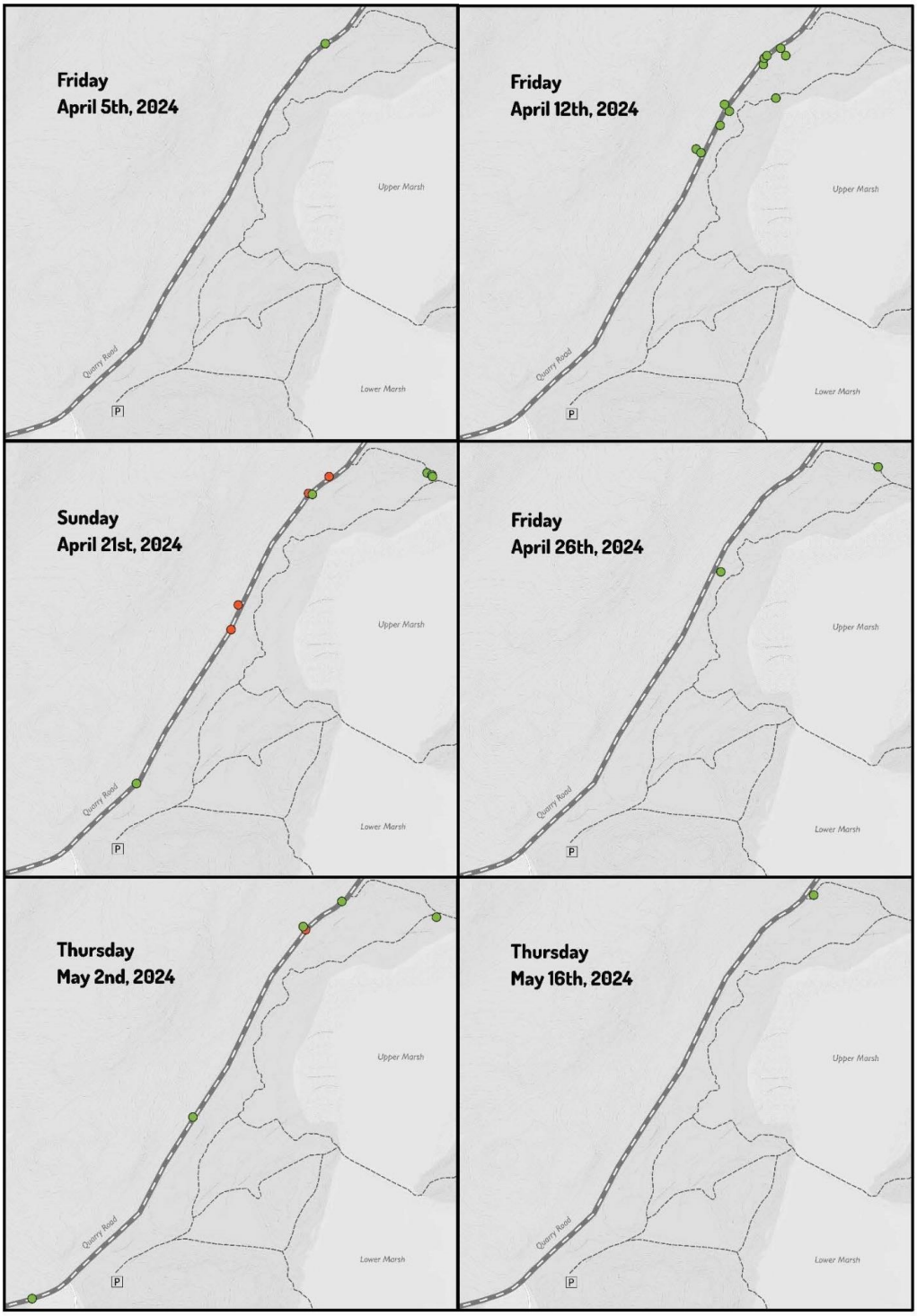
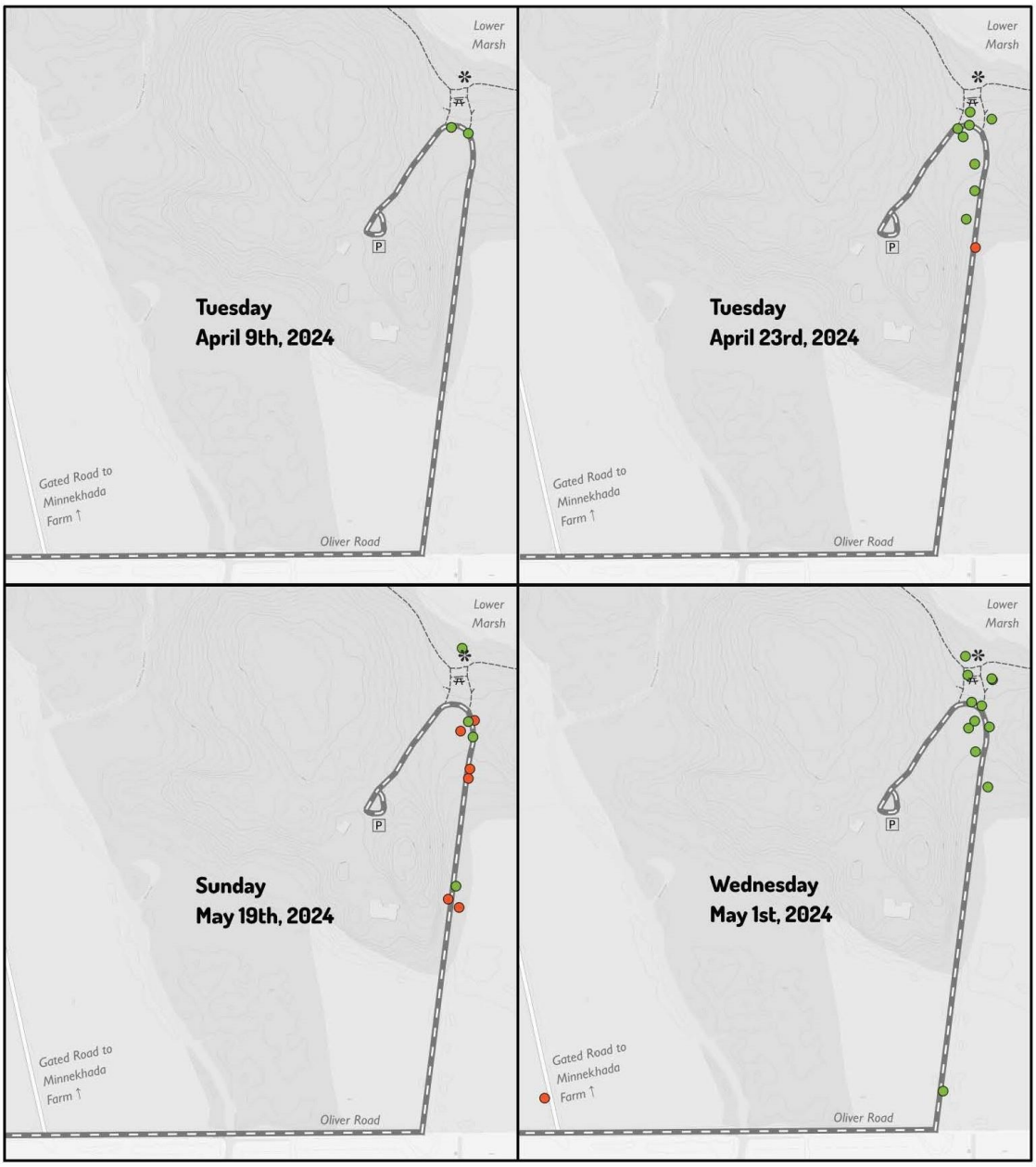


Figure 9: Shows a map of all the adult Western Toads survey on the Oliver Rd transect. With each survey date shown on a different map.



Conclusions and Next Steps:

Toadlet migration timing can vary based on a variety of factors and as such MPA recognizes that multiple years of monitoring is needed to establish patterns. We also recognize the high conservation value of mature, breeding aged toads versus toadlets.

Recommended next steps are as follows:
Near Term (1-2 years)

- Continue toad and toadlet monitoring to grow existing data set
- Increase utilization of the Avenza Geomapping app for count teams. Potentially expand to allow for incidental “citizen science” reporting for trained volunteers.
- Continue to engage park users and promote the Trail Hoppers program via pop-up “Nature Tables” alongside breeding surveys and volunteer opportunities
    - Investigate new ways to connect with Minnekhada Lodge user groups to ensure adult toads are protected when events coincide with migration
- Connect with Fraser Valley Conservancy to observe their toadlet fencing project at Ryder Lake in 2025 and consider applications in Minnekhada
- Explore new technologies and survey methods such as use of wildlife camera
- Share findings and explore opportunities to collaborate with other local conservation and naturalist groups such as Coastal Partners in Conservation, Fraser Valley Conservancy and the Burke Mountain Naturalists.

Longer Term (2-5 years)

- Engage Metro Vancouver, City of Coquitlam and other stakeholders/decision makers to collaborate on Western Toad conservation with particular focus on future upgrades to Quarry Road and mitigation measures within the park (culverts, bridges, fencing) where data supports it.
- Create a long-term multi-year analysis of the toadlet and toad data post-2025 season.
- Breeding surveys by land and water (non-motorized watercraft)
- Research other toad/toadlet programs to better understand best practices (example Cumberland)

Acknowledgments:

This work would not have been possible without the support of our volunteers!

Steve Smith	Christine Thurlow	Hannah Cockerman
Devin Doughty	Tara Chyzyj	Liam Archbold
Pam Hirakata	Julie Kanya	Angela Martinez
Eloisa Diaz Neito	Lara Charles	Sean Copper
Carol MacLeod	Dean Callaghan	Eli Hugo Ruclen
Abby Morrison	Brittany Savoie	Katherine Brynjolfson
Celia Deluca	Eileen Fast	Laura Gorjao
Kirk Miles	Brad Klassen	Will Sorensen
Alison Smithson	Victoria Dupont	Lux Gorjao

In addition to volunteering during the surveys we would also like to recognize Giselle Bonney for her tireless work mapping the 2024 data. All the maps included in this report were created by

Giselle. These maps are an invaluable resource to help us understand the data and a tool to share it with the public in an easy to understand visual format.

References

1. http://www.nicolanaturalists.ca/files/Kentucky-Alleyne-Toad-Report-FINAL-Dec-2012.pdf
2. https://www.env.gov.bc.ca/wld/documents/westerntoad.pdf
3. https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/management-plans/western-toad-2020.html
4. https://www.minnekhada.ca/wp-content/uploads/sites/22/2023/06/Copy-of-Western-Toad-Summary-Report_2015-16-Aimee-Mitchell.pdf

Appendix 1: Sample Datasheet used for Western Toadlet Monitoring

Observer(s) name…….. Date ……

Time (start): _____ Time (end): _____

Air temp (°C): _____ Water temp (°C): _____ Wind (circle): calm light moderate high
Rain (circle): none drizzle light moderate heavy
Cloud cover (circle): clear <25% Moderate 25%-50% Overcast >50%

Toad abundance categories (if large numbers seen; otherwise count): **N** (none); **VL** (very low) <10; **L** (low): 10 – 100; **M** (medium): 100 – 500; **H** (high) 500- 1000; **VH** (very high) >1000

Transect Name[1]	**ection**	**# Toadlets, Live** (N, L, M, H, VH, EH)[2]	**# Toadlets, Dead**[3]	**Direction of Travel** (N, E, S or W)	**Notes** (predators, e.g bull frogs, adult toads, people)
	1				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	11				
	12				

Appendix 2: Datasheet used for adult Western Toad monitoring

Observer(s) name…….. Date ……

Time (start): _____ **Time (end):** _____

Air temp (°C): _____ **Wind (circle):** calm light moderate high Vehicle Tally:
Rain (circle): none drizzle light moderate heavy
Cloud cover (circle): clear <25% Moderate 25%-50% Overcast >50%

Toads	**GPS Coordinates**	**Direction of Travel** (N, E, S or W)	**Dead or Alive**	**Picture (Y or No)**	**Notes** (predators, e.g bull frogs,, people)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					

Appendix 3: Raw Data for Western Toadlet Monitoring 2024

Transect Name	Date	Segment	Alive Toadlets	Dead Toadlets
Mid Marsh Trail	7/7/24	1	0	0
Mid Marsh Trail	7/7/24	2	0	0
Mid Marsh Trail	7/7/24	3	0	0
Mid Marsh Trail	7/7/24	4	0	0
Mid Marsh Trail	7/7/24	5	0	0
Mid Marsh Trail	7/7/24	6	0	0
Mid Marsh Trail	7/7/24	7	0	0
Mid Marsh Trail	7/7/24	8	0	0
Mid Marsh Trail	7/7/24	9	0	0
Mid Marsh Trail	7/7/24	10	0	0
Mid Marsh Trail	7/7/24	11	0	0
Mid Marsh Trail	7/7/24	12	0	0
Mid Marsh Trail	7/7/24	13	0	0
Mid Marsh Trail	7/7/24	14	0	0
Mid Marsh Trail	7/7/24	15	0	0
Mid Marsh Trail	7/7/24	16	0	0
Mid Marsh Trail	7/7/24	17	0	0
Mid Marsh Trail	7/7/24	18	0	0
Mid Marsh Trail	7/7/24	19	0	0
Mid Marsh Trail	7/7/24	20	0	0
Mid Marsh Trail	7/7/24	21	0	0
Mid Marsh Trail	7/7/24	22	0	0
Mid Marsh Trail	7/7/24	23	0	0
Mid Marsh Trail	7/7/24	24	0	0
Mid Marsh Trail	7/7/24	25	0	0
Mid Marsh Trail	7/7/24	26	140	15
Mid Marsh Trail	7/7/24	27	550	23

Mid Marsh Trail	7/7/24	28	44	0
Mid Marsh Trail	7/7/24	29	44	2
Mid Marsh Trail	7/7/24	30	0	0
Mid Marsh Trail	7/7/24	31	1	0
Mid Marsh Trail	7/7/24	32	4	0
Mid Marsh Trail	7/7/24	33	4	0
Mid Marsh Trail	7/7/24	34	3	0
Mid Marsh Trail	7/7/24	35	11	0
Mid Marsh Trail	7/7/24	36	2	0
Mid Marsh Trail	7/7/24	37	3	0
Mid Marsh Trail	7/7/24	38	0	0
Log Trail	7/12/24	1	2	0
Log Trail	7/12/24	2	0	0
Log Trail	7/12/24	3	2	2
Log Trail	7/12/24	4	2	0
Log Trail	7/12/24	5	7	0
Log Trail	7/12/24	6	0	0
Log Trail	7/12/24	7	1	0
Log Trail	7/12/24	8	0	0
Log Trail	7/12/24	9	0	0
Log Trail	7/12/24	10	0	0
Log Trail	7/12/24	11	0	0
Log Trail	7/12/24	12	0	0
Perimeter Trail	7/12/24	1	0	0
Perimeter Trail	7/12/24	2	3	0
Perimeter Trail	7/12/24	3	7	0
Perimeter Trail	7/12/24	4	0	0
Perimeter Trail	7/12/24	5	0	0
Perimeter Trail	7/12/24	6	4	3

Perimeter Trail	7/12/24	7	6	1
Perimeter Trail	7/12/24	8	7	1
Perimeter Trail	7/12/24	9	3	2
Perimeter Trail	7/12/24	10	8	2
Perimeter Trail	7/12/24	11	130	0
Perimeter Trail	7/12/24	12	54	4
Perimeter Trail	7/12/24	13	43	1
Perimeter Trail	7/12/24	14	96	1
Perimeter Trail	7/12/24	15	4	0
Perimeter Trail	7/12/24	16	1	0
Perimeter Trail	7/12/24	17	25	1
Perimeter Trail	7/12/24	18	10	0
Perimeter Trail	7/12/24	19	2	0
Perimeter Trail	7/12/24	20	71	0
Perimeter Trail	7/12/24	21	67	2
Perimeter Trail	7/12/24	22	66	0
Perimeter Trail	7/12/24	23	61	3
Perimeter Trail	7/12/24	24	422	3
Perimeter Trail	7/12/24	25	40	0
Perimeter Trail	7/12/24	26	40	1
Perimeter Trail	7/12/24	27	80	0
Perimeter Trail	7/12/24	28	6	0
Perimeter Trail	7/12/24	29	0	0
Perimeter Trail	7/12/24	30	1	0
Perimeter Trail	7/12/24	31	0	0
Perimeter Trail	7/12/24	32	0	0
Perimeter Trail	7/12/24	33	0	0
Perimeter Trail	7/12/24	34	3	0
Perimeter Trail	7/12/24	35	14	0
Perimeter Trail	7/12/24	36	81	0
Perimeter Trail	7/12/24	37	99	2

Perimeter Trail	7/12/24	38	90	4
Perimeter Trail	7/12/24	39	2	0
Perimeter Trail	7/12/24	40	0	0
Fern Trail	7/15/24	1	0	0
Fern Trail	7/15/24	2	0	0
Fern Trail	7/15/24	3	0	0
Fern Trail	7/15/24	4	1	0
Fern Trail	7/15/24	5	0	0
Fern Trail	7/15/24	6	0	0
Fern Trail	7/15/24	7	0	0
Fern Trail	7/15/24	8	0	0
Fern Trail	7/15/24	9	0	0
Fern Trail	7/15/24	10	0	0
Fern Trail	7/15/24	11	0	0
Fern Trail	7/15/24	12	0	0
Fern Trail	7/15/24	13	0	0
Fern Trail	7/15/24	14	0	0
Fern Trail	7/15/24	15	0	0
Fern Trail	7/15/24	16	0	0
Fern Trail	7/15/24	17	0	0
Fern Trail	7/15/24	18	0	0
Fern Trail	7/15/24	19	0	0
Fern Trail	7/15/24	20	0	0
Fern Trail	7/15/24	21	0	0
Fern Trail	7/15/24	22	0	0
Fern Trail	7/15/24	23	0	0
Fern Trail	7/15/24	24	0	0
Fern Trail	7/15/24	25	0	0
Fern Trail	7/15/24	26	0	0
Fern Trail	7/15/24	27	0	0

Fern Trail	7/15/24	28	0	0
Fern Trail	7/15/24	29	0	0
Fern Trail	7/15/24	30	0	0
Fern Trail	7/15/24	31	0	0
Fern Trail	7/15/24	32	0	0
Fern Trail	7/15/24	33	0	0
Fern Trail	7/15/24	34	0	0
Fern Trail	7/15/24	35	0	0
Fern Trail	7/15/24	36	0	0
Fern Trail	7/15/24	37	0	0
Fern Trail	7/15/24	38	0	0
Lower Marsh	7/15/24	1	0	0
Lower Marsh	7/15/24	2	0	0
Lower Marsh	7/15/24	3	0	0
Lower Marsh	7/15/24	4	0	0
Lower Marsh	7/15/24	5	0	0
Lower Marsh	7/15/24	6	0	0
Lower Marsh	7/15/24	7	0	0
Lower Marsh	7/15/24	8	0	0
Lower Marsh	7/15/24	9	0	0
Lower Marsh	7/15/24	10	0	0
Lower Marsh	7/15/24	11	0	0
Lower Marsh	7/15/24	12	0	0
Lower Marsh	7/15/24	13	0	0
Lower Marsh	7/15/24	14	0	0
Lower Marsh	7/15/24	15	0	0
Lower Marsh	7/15/24	16	0	0
Lower Marsh	7/15/24	17	0	0
Lower Marsh	7/15/24	18	0	0
Lower Marsh	7/15/24	19	0	0

Lower Marsh	7/15/24	20	0	0
Lower Marsh	7/15/24	21	0	0
Lower Marsh	7/15/24	22	0	0
Lower Marsh	7/15/24	23	0	0
Lower Marsh	7/15/24	24	0	0
Lower Marsh	7/15/24	25	1	1
Lower Marsh	7/15/24	26	2	1
Lower Marsh	7/15/24	27	0	0
Lower Marsh	7/15/24	28	2	0
Lower Marsh	7/15/24	29	0	0
Lower Marsh	7/15/24	30	0	0
Lower Marsh	7/15/24	31	3	0
Lower Marsh	7/15/24	32	4	0
Lodge Trail	7/15/24	1	0	0
Lodge Trail	7/15/24	2	0	0
Lodge Trail	7/15/24	3	0	0
Lodge Trail	7/15/24	4	0	0
Lodge Trail	7/15/24	5	0	0
Lodge Trail	7/15/24	6	0	0
Lodge Trail	7/15/24	7	0	0
Lodge Trail	7/15/24	8	0	0
Lodge Trail	7/15/24	9	0	0
Lodge Trail	7/15/24	10	0	0
Lodge Trail	7/15/24	11	0	0
Lodge Trail	7/15/24	12	0	0
Lodge Trail	7/15/24	13	0	0
Lodge Trail	7/15/24	14	0	0
Meadow Trail	7/15/24	1	0	0
Meadow Trail	7/15/24	2	0	0

Meadow Trail	7/15/24	3	1	0
Meadow Trail	7/15/24	4	3	0
Meadow Trail	7/15/24	5	2	0
Meadow Trail	7/15/24	6	0	0
Meadow Trail	7/15/24	7	0	0
Meadow Trail	7/15/24	8	0	0
Meadow Trail	7/15/24	9	0	0
Meadow Trail	7/15/24	10	0	0
Meadow Trail	7/15/24	11	0	0
Meadow Trail	7/15/24	12	0	0
Meadow Trail	7/15/24	13	0	0
Meadow Trail	7/15/24	14	0	0
Knoll Trail	7/17/24	1	0	0
Knoll Trail	7/17/24	2	0	0
Knoll Trail	7/17/24	3	0	0
Knoll Trail	7/17/24	4	0	0
Knoll Trail	7/17/24	5	0	0
Knoll Trail	7/17/24	6	0	0
Knoll Trail	7/17/24	7	0	0
Knoll Trail	7/17/24	8	0	0
Knoll Trail	7/17/24	9	0	0
Knoll Trail	7/17/24	10	0	0
Knoll Trail	7/17/24	11	0	0
Knoll Trail	7/17/24	12	0	0
Knoll Trail	7/17/24	13	0	0
Knoll Trail	7/17/24	14	0	0
Knoll Trail	7/17/24	15	0	0
Knoll Trail	7/17/24	16	0	0
Knoll Trail	7/17/24	17	0	0
Knoll Trail	7/17/24	18	0	0

Knoll Trail	7/17/24	19	0	0
Knoll Trail	7/17/24	20	0	0
Knoll Trail	7/17/24	21	0	0
Knoll Trail	7/17/24	22	0	0
Knoll Trail	7/17/24	23	0	0
Knoll Trail	7/17/24	24	0	0
Knoll Trail	7/17/24	25	0	0
Knoll Trail	7/17/24	26	3	0
Knoll Trail	7/17/24	27	0	0
Knoll Trail	7/17/24	28	0	0
Knoll Trail	7/17/24	29	0	0
Knoll Trail	7/17/24	30	0	0
Knoll Trail	7/17/24	31	1	0
Knoll Trail	7/17/24	32	2	0
Knoll Trail	7/17/24	33	0	0
Knoll Trail	7/17/24	34	0	0
Knoll Trail	7/17/24	35	0	0
Knoll Trail	7/17/24	36	1	0
Knoll Trail	7/17/24	37	0	0
High Knoll Trail	7/17/24	1	3	0
High Knoll Trail	7/17/24	2	1	0
High Knoll Trail	7/17/24	3	0	0
High Knoll Trail	7/17/24	4	0	0
High Knoll Trail	7/17/24	5	0	0
High Knoll Trail	7/17/24	6	0	0
High Knoll Trail	7/17/24	7	0	0
High Knoll Trail	7/17/24	8	0	0
High Knoll Trail	7/17/24	9	0	0
High Knoll Trail	7/17/24	10	0	0
High Knoll Trail	7/17/24	11	0	0

High Knoll Trail	7/17/24	12	0	0
High Knoll Trail	7/17/24	13	0	0
High Knoll Trail	7/17/24	14	0	0
High Knoll Trail	7/17/24	15	0	0
High Knoll Trail	7/17/24	16	0	0
Quarry Rd	7/18/24	1	0	0
Quarry Rd	7/18/24	2	1	0
Quarry Rd	7/18/24	3	0	0
Quarry Rd	7/18/24	4	0	0
Quarry Rd	7/18/24	5	0	0
Quarry Rd	7/18/24	6	1	0
Quarry Rd	7/18/24	7	12	0
Quarry Rd	7/18/24	8	0	0
Quarry Rd	7/18/24	9	0	0
Quarry Rd	7/18/24	10	0	0
Quarry Rd	7/18/24	11	0	0
Quarry Rd	7/18/24	12	0	0
Quarry Rd	7/18/24	13	1	0
Quarry Rd	7/18/24	14	14	0
Quarry Rd	7/18/24	15	0	0
Quarry Rd	7/18/24	16	0	0
Quarry Rd	7/18/24	17	0	0
Quarry Rd	7/18/24	18	0	0
Quarry Rd	7/18/24	19	0	0
Quarry Rd	7/18/24	20	10	0
Quarry Rd	7/18/24	21	3	0
Quarry Rd	7/18/24	22	0	0
Quarry Rd	7/18/24	23	0	0
Quarry Rd	7/18/24	24	0	0
Quarry Rd	7/18/24	25	0	0

Quarry Rd	7/18/24	26	0	0
Quarry Rd	7/18/24	27	1	0
Quarry Rd	7/18/24	28	0	0
Quarry Rd	7/18/24	29	0	0
Quarry Rd	7/18/24	30	0	0
Quarry Rd	7/18/24	31	0	0
Quarry Rd	7/18/24	32	0	0
Quarry Rd	7/18/24	33	0	0
Quarry Rd	7/18/24	34	0	0
Quarry Rd	7/18/24	35	0	0
Quarry Rd	7/18/24	36	0	0
Quarry Rd	7/18/24	37	0	0
Lower Marsh	7/18/24	1	0	0
Lower Marsh	7/18/24	2	0	0
Lower Marsh	7/18/24	3	0	0
Lower Marsh	7/18/24	4	0	0
Lower Marsh	7/18/24	5	0	0
Lower Marsh	7/18/24	6	0	0
Lower Marsh	7/18/24	7	0	0
Lower Marsh	7/18/24	8	0	0
Lower Marsh	7/18/24	9	0	0
Lower Marsh	7/18/24	10	0	0
Lower Marsh	7/18/24	11	0	0
Lower Marsh	7/18/24	12	0	0
Lower Marsh	7/18/24	13	0	0
Lower Marsh	7/18/24	14	0	0
Lower Marsh	7/18/24	15	0	0
Lower Marsh	7/18/24	16	0	0
Lower Marsh	7/18/24	17	0	0
Lower Marsh	7/18/24	18	0	0

Lower Marsh	7/18/24	19	0	0
Lower Marsh	7/18/24	20	0	0
Lower Marsh	7/18/24	21	0	0
Lower Marsh	7/18/24	22	0	0
Lower Marsh	7/18/24	23	0	0
Lower Marsh	7/18/24	24	0	0
Lower Marsh	7/18/24	25	0	0
Lower Marsh	7/18/24	26	0	0
Lower Marsh	7/18/24	27	0	0
Lower Marsh	7/18/24	28	0	0
Lower Marsh	7/18/24	29	0	0
Lower Marsh	7/18/24	30	0	0
Lower Marsh	7/18/24	31	0	0
Lower Marsh	7/18/24	32	0	0
Outer Perimeter Trail	7/13/24	1	0	0
Outer Perimeter Trail	7/13/24	2	0	0
Outer Perimeter Trail	7/13/24	3	0	0
Outer Perimeter Trail	7/13/24	4	0	0
Outer Perimeter Trail	7/13/24	5	0	0
Outer Perimeter Trail	7/13/24	6	0	0
Outer Perimeter Trail	7/13/24	7	0	0
Outer Perimeter Trail	7/13/24	8	0	0
Outer Perimeter Trail	7/13/24	9	3	0
Outer Perimeter Trail	7/13/24	10	2	0
Outer Perimeter Trail	7/13/24	11	0	0
Outer Perimeter Trail	7/13/24	12	11	0
Outer Perimeter Trail	7/13/24	13	5	0
Outer Perimeter Trail	7/13/24	14	5	1
Outer Perimeter Trail	7/13/24	15	0	0
Outer Perimeter Trail	7/13/24	16	1	0

Outer Perimeter Trail	7/13/24	17	55	0
Outer Perimeter Trail	7/13/24	18	4	0
Outer Perimeter Trail	7/13/24	19	0	0
Outer Perimeter Trail	7/13/24	20	0	0
Outer Perimeter Trail	7/13/24	21	0	0
Outer Perimeter Trail	7/13/24	22	0	0
Outer Perimeter Trail	7/13/24	23	0	0
Outer Perimeter Trail	7/13/24	24	0	0
Outer Perimeter Trail	7/13/24	25	0	0
Outer Perimeter Trail	7/13/24	26	13	0
Outer Perimeter Trail	7/13/24	27	5	0
Outer Perimeter Trail	7/13/24	28	2	0
Outer Perimeter Trail	7/13/24	29	1	0
Outer Perimeter Trail	7/13/24	30	22	22
Outer Perimeter Trail	7/13/24	31	1	0
Outer Perimeter Trail	7/13/24	32	0	0
Outer Perimeter Trail	7/13/24	33	0	0
Outer Perimeter Trail	7/13/24	34	0	0
Outer Perimeter Trail	7/13/24	35	0	0
Outer Perimeter Trail	7/13/24	36	0	0
Outer Perimeter Trail	7/13/24	37	0	0
Outer Perimeter Trail	7/13/24	38	0	0
Outer Perimeter Trail	7/13/24	39	1	0
Outer Perimeter Trail	7/13/24	40	0	0

Appendix 4: Raw Data for Adult Western Toad Monitoring

Survey Date	Start Time	End Time	Temperature (c)	Toads Seen	GPS Coordinates	Dead or Alive
April 9, 2024	20:00	21:30	6	1	49.296661, -122.699906	Alive
				2	49.296614, -122.699689	Alive
April 12, 2024	20:00	22:00	9	1	49.30479, -122.70352	Alive
				2	49.30558, -122.70269	Alive
				3	49.30647, -122.70170	Alive
				4	49.30659, -122.70167	Alive
				5	49.30664, -122.70159	Alive
				6	49.30664, -122.70104	Alive
				7	49.30710, -122.70089	Alive
				8	49.30678, -122.70119	Alive
				9	49.30292, -122.70005	Alive
				10	49.30571, -122.70283	Alive
				11	49.30531, 122.70296	Alive
				12	49.30168, -122.70632	Alive
April 21, 2024	20:20	22:20	10	1	49.30400, -122.70398	Dead

				2	49.30447, -122.70377	Dead
				3	49.30658, -122.70160	Alive
				4	49.30695, -122.69810	Alive
				5	49.30692, -122.69808	Alive
				6	49.30699, -122.69824	Alive
				7	49.30692, -122.70111	Dead
				8	49.30660, -122.70171	Dead
				9	49.30106, -122.70675	Alive
April 23, 2024	20:20	22:00	14	1	49.29613, -122.69978	Alive
				2	49.29613, -122.69978	Alive
				3	49.29565, -122.69977	Dead
				4	49.29635, -122.69978	Alive
				5	49.29679, -122.69984	Alive
				6	49.29665, -122.70000	Alive
				7	49.29673, -122.69956	Alive
				8	49.29668, -122.69985	Alive
				9	49.29658, -122.69993	Alive
April 26, 2024				1	49.30715, -122.69834	Alive
				2	49.30515, -122.70296	Alive
ıy 1, 2024				1	49.29597, -122.69961	Alive
				2	49.29647, -122.69986	Alive

				3	49.29648, -122.69959	Alive
				4	49.29653, -122.69978	Alive
				5	49.29669, -122.69982	Alive
				6	49.29692, -122.69987	Alive
				7	49.29708, -122.69990	Alive
				8	49.29689, -122.69956	Alive
				9	49.29688, -122.69955	Alive
				10	49.29666, -122.69969	Alive
				11	49.29627, -122.69977	Alive
				12	49.29339, -122.70019	Alive
				13	49.29333, -122.70534	Dead
ıy 2, 2024				1	49.30658, -122.70184	Alive
				2	49.30706, -122.70072	Alive
				3	49.30676, -122.69795	Alive
				4	49.30652, -122.70178	Dead
				5	49.30295, -122.70508	Alive
				6	49.29949, -122.70979	Alive
May 16, 2024				1	49.30722, -122.70022	Alive
May 19, 2024				1	49.29652, -122.69961	Dead
				2	49.29645, -122.69979	Dead
				3	49.29613, -122.69967	Dead

				4	**49.29606, -122.69969**	**Dead**
				5	**49.29496, -122.69981**	**Dead**
				6	**49.29503, -122.69995**	**Dead**
				7	**49.29514, -122.69985**	**Alive**
				8	**49.29653, -122.69969**	**Alive**
				9	**49.29715, -122.69977**	**Alive**
				10	**49.29640, -122.29963**	**Alive**