

FISH-BEAR LAKES WESTERN TOAD INVENTORY & HIGHWAY 31A TOAD MORTALITY STUDY

2015 Field Season

FWCP FINAL REPORT W-F16-22



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**Student volunteer helping toadlets cross Highway 31A.
W. McCrory photo.**

Cover photo: www.icandyfilms.com

EXECUTIVE SUMMARY

A preliminary reconnaissance-level study of the western toad (*Anaxyrus boreas*) was conducted at Fish/Bear Lakes from May 3 - October 15, 2015. The study area is partly on Crown land, with three large parcels of private land that occupy major toad habitat areas and migration routes. Highway 31A and the Wagon Road recreation trail are the two public motorized corridors through the study area.

The study was funded by the small grant program of the Fish and Wildlife Compensation Program (FWCP), with some supplemental support from the Valhalla Wilderness Society. A choice was made to spread the small budget to cover field sampling throughout the spring-to-fall toad season as part of the pilot study. This resulted in the best preliminary results possible but with small sample sizes such as for adult toad mortality surveys.

A high level of coordination and excellent cooperation was experienced with the BC Ministry of Transportation and Infrastructure (MoTI) and BC Ministry of Forests, Lands and Natural Resources Operations (MFLNRO) – FWCP section. Opportunistic public education occurred throughout the study, including a large interpretive sign and hand-outs at the Fish Lake rest stop. The largest land owner was contacted and appraised of the project throughout the study period. The owner of the other two private parcels will be contacted in 2016.

The Fish/Bear Lake study design and implementation benefitted from the research and helpful input of biologists involved with the FWCP western toad project at Summit Lake. Jakob Dulisse was an advisor to our study and carried out the breeding site surveys at Fish Lake.

Our main 2015 field findings were as follows:

- Our study confirmed that western toads in our study area have the same three traditional migrations as reported at Summit Lake (Dulisse 2015) and elsewhere: adult spring migration to breeding lake, post-breeding dispersal away from lake and large toadlet (metamorph) summer migrations to terrestrial habitat. Adults migrated at night while toadlets migrated during the day. Toadlet migrations in 2015 appeared correlated to summer rain events as previously observed in 2014.
- Fish Lake was identified to be a major western toad breeding lake of likely regional significance; with lesser breeding at Bear Lake. Toadlets were on average small and approximately one-half the size of toadlets reported at Summit Lake. Toad and toadlet numbers were impossible to estimate but in early May adult toads were very numerous in Fish Lake and later in the summer toadlets would number in the hundreds of thousands.
- **Adult Breeding:** When the study commenced on May 6 the lake ice had already melted and high numbers of adults were observed in Fish Lake. Studying the lake surface with binoculars at twilight confirmed a very high level of adult crepuscular activity not observable during the day. Adults in amplexus (breeding position) and egg laying was already underway. Surveys on May 13 identified three main breeding/egg mass areas at Fish Lake along the north and west shore.

This data would appear to fit the pattern with that reported in the scientific literature of an “explosive” breeding strategy at communal breeding sites where large numbers of adults aggregate over a 1- or 2-week period. In this case the first two weeks of May would appear to the prime migration and breeding time.

- Adult toad migration on Highway 31A: Twenty-seven segments for live and dead adult toads were established along 2.3 km of Highway 31A from the east end of Fish Lake to just beyond the west end of Bear Lake. Thirteen night-time walking or drive-by surveys recorded a total of 133 live adult toads crossing the highway between May 6 and July 19, 2015. Of the four sub-areas, the majority of live adults (N = 115) were found on highway segments 1-2 to 11-12 along the north side of Fish Lake, with smaller numbers elsewhere. The highest road counts of live adults were between May 6 and May 16, 2015, when an average of five counts showed 21.6 live adult toads/night survey. For the latter part of May, three counts showed a drop to 5.3 adult live toads/night survey. Counts in June and until July 19 showed only a small amount of adult toad night-time activity in relation to Highway 31A.
- Adult toad mortality on across Highway 31A: Between May 6 and October 14, 2015, a total of 34 daytime walking and drive-by surveys were made to locate adult toads dead on the road (DOR) along the 2.3 km transect on Highway 31A. During this period, we documented a total mortality of 45 adult toads: 17 females, 7 males and 21 unidentified. As to be expected, the highest total traffic mortality recorded (34) for the spring period and overall survey season was on the north side of Fish Lake, where the most live adult toads were also recorded crossing. The highest number of dead toads also corresponded fairly well with the segments where the highest number of migrating adults were counted. Of the 45 adult toad deaths recorded, the highest number (26) was during the first two weeks of May, corresponding to the period of the highest number of adults recorded crossing Highway 31A. After this, mortality dropped off considerably, corresponding well with the cessation of the breeding season.
- Timing of tadpole-toadlet metamorphosis and staging areas: Metamorphosis from tadpole to toadlet appeared to commence around July 15 and continue for approximately one month. Tens of thousands of toadlets staged in large aggregations, mostly at the three main breeding sites 1, 2, and 3 at Fish Lake. These sites are characterized by a shallow shoreline with some emergent vegetation and dense shoreline shrub or low vegetation cover.
- Toadlet migrations: Toadlet migrations from Fish Lake were observed to occur in daytime and to stage from the three main breeding/aggregation sites, with each having a different migratory route. Timing of migration may have been synchronous from each of the staging areas, for example, when mass movement was triggered by rain events during hot weather; or perhaps by persistent wet and cold weather later in the season when the need to migrate to the uplands to hibernate would have been more urgent for later developing metamorphs. The one-month metamorphosis period would help explain why we recorded at least 4 different migration events by toadlets away from Fish lake.
- Some toadlet migrations away from Fish Lake did not cross Highway 31A. Where they did cross the pavement, primarily at the breeding area 1 (Fish Lake rest stop – segment 1-2) and once at breeding area 2 (segment 4-5), the daytime migration events coincided with the high daily level of tourism traffic, resulting in considerable but unmeasured mortality.

- The 4 toadlet migration events at the Breeding Area 1 (Fish Lake rest stop) were July 20, July 27-28, August 5-12 and August 24. All toadlets had disappeared from the staging area by August 30. Pathways of the four migrations away from the rest stop did not vary in July, but in August varied in subtle but significant ways that will eventually have some relevance to any proposed mortality mitigation measures. During July, the metamorphs travelled *en mass* east through the rest area (when tourists were often present) and then crossed the highway northeast. Toadlets during the two smaller migration events in mid- and late August tended to travel more eastward and not cross Highway 31A at the rest stop.
- Breeding Area 2 (middle lake) toadlets, despite high aggregations, had only one documented migration event north across the highway on July 27. Other than this date, even when Breeding Area 1 (rest stop) toadlets were migrating *en mass* across the highway in 2014 and 2015, no middle lake toadlets were observed on the highway. This needs to be more carefully monitored in 2016.
- Breeding Area 3 (west end of lake) had the largest number of toadlets that migrated mostly to the west and south-west through the large wetland/shrub zone and on an ATV road, with only a few appearing to move north across highway 31A. Migration events occurred on July 27-28, and from August 15-16 to perhaps August 24. All migration events here appeared to be over by August 30. Migration events may have occurred on July 20, and the August 15-16 one may have started as early as August 5. All toadlet activity here occurred on private land.
- Overall highway mortality to migrating adults and toadlets in 2015 was considered to be an important conservation concern.

Experimental mitigation: With the assistance of Summit Lake toad biologists, we used our preliminary research results to study feasible ways to mitigate the population threat from the road kills, such as culverts and underpasses. This included an experimental directional fence with a temporary wooden bridge to test if migrant Fish Lake toadlets would cross under the nearby Goat Creek highway bridge. We found they did. Some ad hoc bucketing of toadlets was done and we found some locals coming and doing this on their own.

Recommendations: The study team recommends at least another two years of research that expands surveys to Bear Lake and peripheral transect areas, continued coordination with MoTI and FWCP-MFLNRO, continued high level of public education, and greater coordination with surrounding landowners and adjacent rail-to-trail managers. The team also recommends working with MFLNRO-FWCP on a conservation plan to address all issues related to the toads, including protection of core wetland and core terrestrial habitats, recreational motorized impacts, private land, logging, and others.

1.0 INTRODUCTION AND BACKGROUND

The western toad, which has been extirpated from large areas of its historic range in the US, is blue-listed in BC and federally considered a species at risk. A study by Dulisse and Hausleitner (2010) found that the West Kootenays support a high density of breeding toads, with the population at Summit Lake of likely regional and provincial significance (Dulisse et al. 2011).

Summit Lake, and recently and to a lesser degree, Fish-Bear Lakes (40 km from Summit Lake) have now become important focal areas for efforts to conserve western toads. The FWCP *Action Plan for Small Lakes* has identified western toads at Bear Lake as a priority for the next five years. Our 2015 pilot study (Year 1) identified one breeding area at Bear Lake (north side of the highway) but nearby Fish Lake (south side of the highway) was shown to have a much higher western toad breeding population, likely of regional significance. However, it must be pointed out that the names of the two lakes have historically been used interchangeably so that what FWCP may refer to as Bear Lake may actually be the eastern-most, Fish Lake. In any event, both lakes are now a priority for our proposed Years 2 & 3 study.

Since 2005, Valhalla Wilderness Society (VWS) biologists and members have documented traffic mortality to migrating adult toads and toadlets on Highway 31A at Fish and Bear Lakes. The two lakes are situated about half-way way between the villages of New Denver and Kaslo and have a high level of tourism traffic, often on summer days when there are mass toadlet migrations across the highway. In the past, VWS organized a number of volunteer toadlet bucketing brigades at Fish Lake and has kept track of some of the toadlet migration events and associated rainy weather patterns. We also discussed our observations and concerns with biologists involved with the long-term Summit Lake western toad study. Eventually, community funding support and interest led to the 2015 VWS pilot study of western toad ecology and mortality/mitigation at Fish-Bear Lakes. This 5-month study was largely guided by the Summit Lake toad study. Herpetology expert Jakob Dulisse was hired to provide advice in the study design and implementation. The Summit Lake toad study team lent valuable support and field advice throughout. Funding was \$5,000 from the FWCP (Ref. No. W-F16-22) and \$3,000+ from VWS.

A formal progress report and financial statement was submitted to Crystal Klym at FWCP on October 22, 2015, indicating that most of the scientific conditions of our 2015 contract had been met, with the exception of not setting up formal toadlet transect plots due to budget constraints.

It is to be emphasized that the 2015 pilot study results recommended that another two years of better-funded field research and mitigation experimentation is needed (guided at all levels by Summit Lake toad project) in order to ensure that whatever final mitigation recommendations we make to MoTI and MFLNRO, they are based on sound and credible research done over a long enough time frame to cover all of the toad migration annual variations.

2.0 GOALS AND OBJECTIVES

1. Carry out a three-year research project on western toad breeding/migration biology at Fish-Bear Lakes to establish a sound database to guide final recommendations for mitigation actions to reduce species mortality at hotspot migration crossing sites on Highway 31A at Bear and Fish Lakes, and adjacent multi-use recreation trail.
2. Use research results to guide a high level of public education and coordination with agencies, private landowners, the recreational trail society and others on the need to conserve western toads.

3.0 STUDY AREA

3.1 Location

Fish and Bear lakes are located at an elevation of between approximately 1,120-1,140 metres and about 14 km east of New Denver. This area is somewhat higher in elevation than the 764 m elevation Summit Lake toad study area near Nakusp. The area is in a mountain pass, with numerous avalanche paths used by grizzly and black bears in the spring. A large forest fire in about 1912 burned the whole area so that most is now second-growth conifers and deciduous species.

Both Fish and Bear lakes are immediately adjacent to Highway 31A which runs for 2.3 km between the lakes (Figure 1). They both drain eastward, Bear Lake via a small connector stream into Fish Lake and then into the Kaslo River. Goat Creek enters the Kaslo River 100 m east of the outlet at Fish Lake.

A first step in May 2015 was to define the main study area. To do this we did a number of initial nighttime adult toad live count and daytime highway mortality adult toad “test” surveys along Highway 31A that extended beyond the east end of Fish Lake (towards Kaslo) and the west end of Bear Lake (towards New Denver). This helped to determine the core area of toad highway migration routes and mortality areas within the Fish-Bear Lakes complex. An initial breeding area survey by canoe at Fish Lake was also helpful. We found no adult toads beyond Goat Creek bridge at the east end of Fish Lake but did find a small number of adults crossing Highway 31A at the west end of Bear Lake. Based upon these results, the primary study area was defined as the 2.3 km Highway 31A corridor between Zincton just west of the west end of Bear Lake and Goat Creek bridge just east of the Fish Lake rest stop, and inclusive of the adjacent Wagon Road recreation trail and riparian and lower elevation mountain habitats (see Figure 7).



Figure 1. Fish-Bear Lakes western toad study area within the Highway 31A corridor extending 2.3 km from Goat Creek Bridge (east, #1) to Zincton (west, #27), and inclusive of adjacent riparian and lower elevation mountain habitats. Numbered highway sections correspond with physical landmarks along the highway that delineate field sampling transects.

Once we determined toadlet staging areas and migrations at Fish Lake the study area was expanded to include the large, private land wetlands that form a toad migration and connectivity zone between Bear and Fish Lakes. The study area was also expanded to include the Wagon Road Trail to the north of Fish Lake.

Although it would have been desirable, we did not have the time to survey the Bear Lake Road (old Highway 31A) on the north side but plan on doing so in 2016.

3.2 Historic context

The current Highway 31A route was originally developed as a transportation corridor in 1893 when the Kaslo and Slocan (K & S) narrow-gauge railroad was constructed to haul silver-lead-zinc ore from the mines at Sandon. The railroad was, unfortunately, built right along the riparian edge of the east shore of Fish Lake. As well a miners' hotel was built on nearby private land known as "Scottie's Place." Eventually, the New Denver-Kaslo Highway, which was started as a wagon road, was constructed near to the railroad. In the 1890s, the CPR took over the K & S rail line and ran it until the mid 1950s when it was abandoned and eventually converted to paved Highway 31A. The old highway has now become the recreational multi-use "Wagon Road Trail" managed by a Kaslo to Sandon rail-to-trail society.

3.3 Land use and ecological context

Highway 31 A is the main transportation corridor. The Wagon Road Trail through the study area is also public access (See Figure 7).

There are a number of roadside pullouts between highway 31A and Fish Lake, the main developed one being the popular MoTI rest stop at the east end of Fish Lake. This has an outhouse, twin bear-proof garbage containers and three picnic benches with fire pits. At the east end is a small boat launch area. The MoTI contractor, Yellowhead Road and Bridge (YRB) manages the rest stop. Goat Creek Bridge is approximately 125 m east of the rest stop, with a large MoTI weather station just to the north. There are a number of parcels of private land in the study area.

3.4 Ecological context

Bear and Fish Lakes are in the Moist Warm Interior Cedar-Hemlock (ICHmw2) biogeoclimatic subzone of the Kootenay Lake Forest District. This subzone occurs between 500 m and 1450 m in elevation and is characterised by hot, moist summers and very mild winters with light snowfall. Tree species of this forest type include Douglas-fir (*Pseudotsuga menziesii*), western larch (*Larix occidentalis*), hybrid white spruce (*Picea engelmannii* X *glauca*), western hemlock (*Tsuga heterophylla*), and western redcedar (*Thuja plicata*). Common shrubs found here include falsebox (*Paxistima myrsinites*) and black huckleberry (*Vaccinium membranaceum*). Twinflower (*Linnaea borealis*), prince's pine (*Chimaphila umbellata*), queen's cup (*Clintonia uniflora*), and one-leaved foamflower (*Tiarella trifoliata*) are some of the herbs found in this subzone (Braumandl and Curran 1992).

Both lakes have populations of rainbow trout (*Oncorhynchus mykiss*). Local knowledge supports they were introduced in the early days (W. McCrory pers. comm.). Two gold fish (sp.?) were observed at the east end of Fish Lake in about 2010 (W. McCrory pers. comm.).

4.0 METHODS

Background research was first done to familiarize the Fish-Bear Lakes study team with the results of the Summit Lake western toad study and other toad studies available online.

4.1 Sampling design: Determination of highway transects and segments for adult toads and highway and off-highway transects for toadlet staging and migration

An important first step in the study (as per one of our FWCP conditions) was to establish a transect sampling-Google Earth mapping system to record adult toad Highway 31A crossings and mortality. To do this, we did a number of initial nighttime vehicle surveys along Highway 31A between the Retallack and Zincton townsites and counted and recorded the location of adult toads. We also did a number of daytime adult toad mortality surveys along the same stretch of highway. As part of this reconnaissance, we also identified and GPSed key landmarks along the highway, such as roadside signage, culverts and pull-outs, that would serve to define survey segments. From these initial results we determined the core study area and numbered segments (Figure 1). This approach was more relevant for our study area than to establish adult toad highway segments every 100 m as was done at Summit Lake (Dulisse et al. 2011).

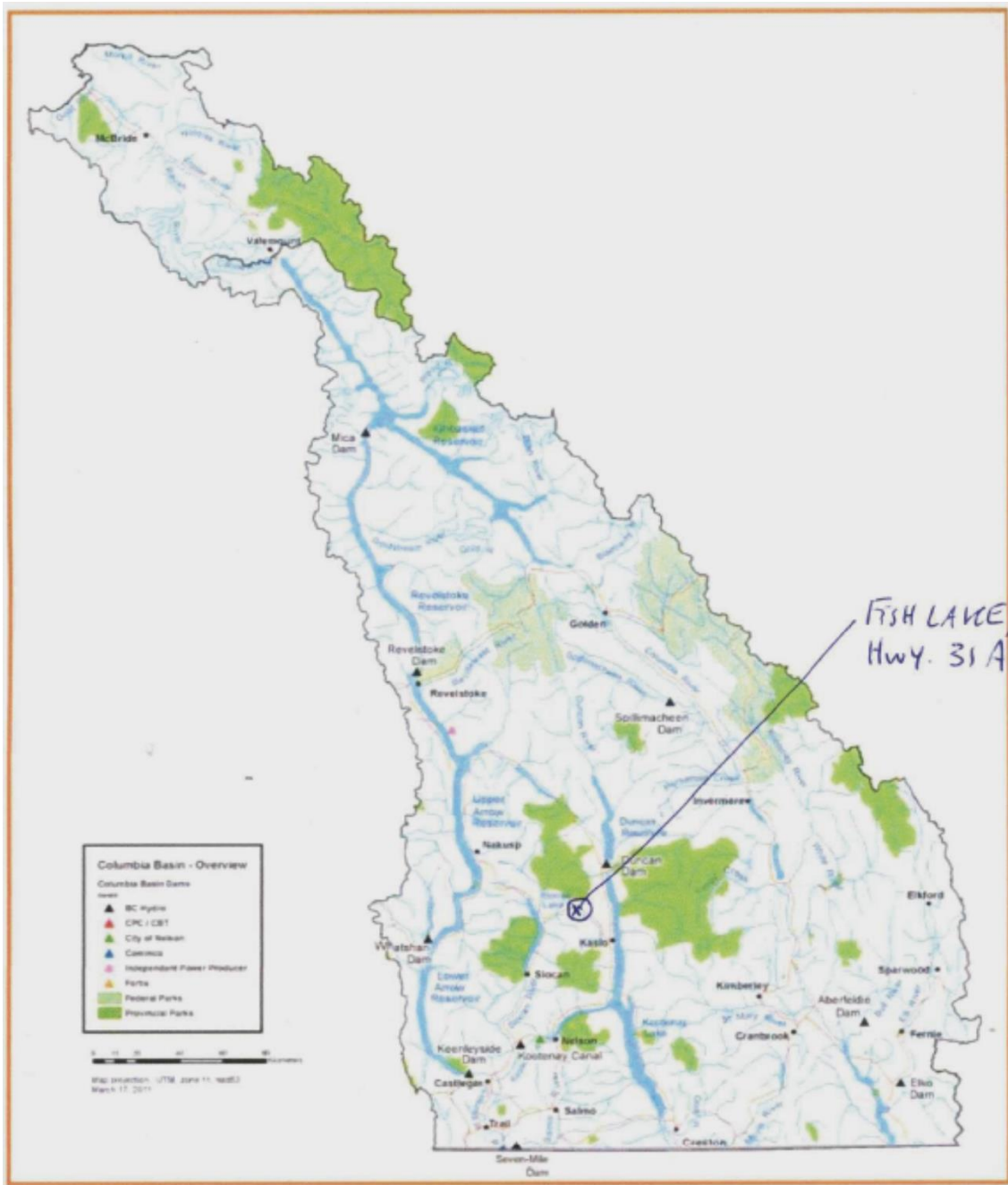


Figure 2. Location Map. (<http://fwcp.ca>)

Monitoring toadlet migrations by establishing detailed toadlet transect plots as was done at Summit Lake (Dulisse et al. 2011) was well beyond the budget of this 2015 pilot study. Instead we used shoreline transects to make observations and map locations of toadlets, crude estimates of numbers, direction of travel when migrating, and segment of highway used for migration crossing. When toadlet migrations occurred, this transect approach was expanded to the adjacent rail-to-trail north of the highway at Fish Lake as well as an ATV trail and logging road on private land at the west end of Fish Lake. For Year 2 we will review whether it is feasible to continue with our 2015 toadlet migration transects in adjacent areas or establish more detailed toadlet transect plots as used Summit Lake (Dulisse et al. 2011).

4.2 Determination of breeding/egg-laying areas & breeding season

In 2015, the Fish-Bear Lakes study team did not have the field experience and capacity to carry out the detailed breeding surveys done at Summit Lake. Thus, determination of breeding areas was first done in early spring (Mid-May) by a canoe shoreline survey by Jakob Dulisse and his assistant, using their extensive experience from Summit Lake. They used observations of toad egg masses, presence of adult toads in amplexus (mating position), and stages of development to determine the main breeding areas. These areas were delineated using GPS waypoints transferred to a Google Earth map. The Fish-Bear Lakes study team then did some follow up observational research by carefully wading the shoreline areas and observing breeding pairs of adult toads as well as eggs masses.

In 2015, we also discovered that another incidental method to loosely determine breeding adult toad abundance in Fish Lake was to do a binocular survey at dusk with the right back light conditions on the water surface. This helped us determine the actual extent on the lake surface of crepuscular adult toad distribution.

It is worth noting for future reference that researchers at Summit Lake recorded the following extensive details for their breeding surveys (Dulisse et al. 2011):

We recorded current weather, wind, rain in the past 24 hours and start and end times. Breeding sites were identified as those having multiple pairs of adult toads in amplexus (mating position). Toads observed were identified to life stage A=Adult, E=Egg, J=Juvenile (tadpole/larva), S=Subadult (includes juveniles and young of the year). Tadpoles were aged according to Gosner (1960): 1=No limb buds (GS 25), 2=Limb buds (GS 26-30), 3=Ankles and small feet (GS 31-35), 4=Large feet (GS 36-40), 5=Arm buds (GS 41), 6=Arms and tail (GS 42), 7=Tail resorbing (GS 43-45), 8=Tail resorbed (GS 46). We made estimates of tadpole lengths and numbers and took notes on tadpole movements and habitat use within the lake.

4.3 Adult toad migration and post-breeding movements

We used weekly or bi-weekly nighttime walking and drive-by surveys of approximately 1-2 hours to sample for the presence of adult toads on the 2.3 km Highway 31A transect of Fish-Bear Lakes. This involved beginning just after dusk slowly walking or driving along the highway with 1-2 observers making several passes along the highway and walking along the edge of Fish Lake. Each adult toad was recorded for GPS location, transect segment number, side of highway centerline, sex, gravid state of females, and apparent direction of orientation or travel. Occasionally, adult toads were assisted to whatever side of the highway they appeared to be crossing to.

4.4 Adult toad highway mortality

A similar approach to the nighttime survey was taken during the day time to survey toad mortality along the 2.3 km Highway 31A transect. It was not always possible to do these surveys early enough in the morning to ensure ravens and other predators had not already removed the dead toads.

Each dead toad was recorded as to sex (if recognizable), size, gravid state of females, GPS and transect segment location, apparent cause of death, side of highway centre-line and orientation when killed. Large blackish splotches on the pavement were used to determine if a particularly disintegrated carcass was a female as the compressed egg masses show up as such (Dulisse, pers. comm.). Data was transferred to the Google Earth highway transect map. All carcasses were immediately removed from the highway.

4.5 Determination of timing of tadpole emergence and numbers

Weekly surveys along the margin of Fish Lake's lakeshore were done to document the maturation of tadpoles, estimate peak numbers, and track diminishing occurrences. A Go-Pro camera was used to document underwater schools of tadpoles.

4.6 Determination of toadlet emergence, staging areas and migrations

We made once or twice weekly observations along the land edge of the north side of Fish Lake to determine the first appearance of toadlets, locations of aggregations/clusters of toadlets, and crude estimate of numbers and movements from the lake. Weather patterns (rain events) were recorded throughout in order to confirm previous anecdotal observations that toadlet movements away from Fish Lake were triggered by summer rain events. When toadlets migrated, the direction of migration, timing, estimates of numbers, location of crossings on the highway and adjacent Wagon Road Trail, and other factors were observed and recorded. As noted previously, we did not use toadlet transect plots as was done at Summit Lake.

4.7 Determination of toadlet size and weight

To determine size toadlets were measured with a ruler from tip of nose to rear of body. To determine the average weight, toadlets (ideally up to 50 or more) were captured and placed in a small plastic sandwich bag. This was weighed with a 100 g Pesola micro-scale. The weight of the sandwich bag was deducted from the total weight of the bag with the toadlets and then the average weight in grams of each toad was determined. Unfortunately, due to time constraints, we only did this once.

4.8 Methods for public outreach

As the 2015 Fish-Bear Lakes toad study progressed, public outreach became increasingly important. We collaborated with MFLNRO personnel and Summit Lake researchers to adapt what had been done for the Summit Lake toad project in order to mount a large interpretive sign at the Fish Lake rest stop. We also revised a 2-page brochure to distribute at the rest stop in a fixed information box. Given the heavy public use of the rest stop area, we developed and posted warning signs that were posted in the picnic area and along the Wagon Trail near Goat Creek in order to protect toadlets during migration. The project was featured in a news story in the Valley Voice newspaper. In addition, whenever we encountered members of the public during our work, we endeavoured to explain the research project in a positive manner.

4.9 Methods for project coordination

We identified key persons we needed to collaborate with on the project to ensure its success, including the Ministry of Transportation and Infrastructure manager, an adjacent large landowner, MFLNRO's recreational trail coordinator, and the local rails-to-trails society. When contacted, we discussed the objectives of our project, some interim results, and our ideas for potential mitigation. When necessary, we met with collaborators at the study area.

4.10 Methods for mitigation measures

A background literature search was first done of highway toad mortality and mitigation measures with particular emphasis on the Summit Lake toad study. A field evaluation at Fish Lake using the adult toad and toadlet migration "hotspots" for crossing highway 31A and the adjacent Wagon Road Trail was also used to ascertain options for mitigation measures. The existing boat launch at the Fish Lake rest stop was evaluated for damage to breeding toads, egg masses and staging toadlets. We mapped any existing culverts including location, presence of water passing through, diameter and length. We also mapped the Goat Creek Bridge including the width to install a separate artificial bridge underpass to guide toadlets along the creek bank under the highway bridge.

4.11 Method for measuring levels of highway traffic

When doing adult toad surveys at night the number of vehicles, type (commercial, recreational, general), direction of travel and time were recorded as incidental data. MoTI were approached for any traffic counting data they might have. We also set up a digital remote wildlife camera on a tree on the north-west side of the Goat Creek Bridge to test if this would measure traffic. This was a Primos Truth Camera 35 Ultra.

5.0 RESULTS AND OUTCOMES

We treated the 2015 program as a reconnaissance-level study. By spreading out the small FWCP \$5000 budget for field sampling from spring to fall our results were better than expected but also resulted in small sample sizes and gaps in sampling efforts. Considerably more public outreach, coordination with MoTI and mitigation experimentation was actually done than originally planned at the start of the field season. Assistance and advice from biologists involved with the Summit Lake toad study (Jakob Dulisse, Irene Manley and Katherine McGlynn) proved extremely helpful.

Our final but preliminary report was submitted to FWCP in January 2016 and after some feedback was approved for release of the final funds. We then obtained some supplemental support funding from the Valhalla Wilderness Society to complete the data analysis, mapping and the final write-up of this report.

5.1 Highway transects and segments for adult toads and highway and off-highway transects for toadlet staging and migration

Figure 1 shows the 2.3 km Highway 31A survey transect with 27 segments from Fish Lake to Bear Lake and Figure 3 shows just the segments at Fish Lake. The adjacent transects for toadlet aggregation (shoreline) and toadlet migrations (rail-to-trail, etc.) will be mapped during the 2016 field season as we will be adding some new peripheral transects. For example, due to the discovery in 2015 of a small numbers of adult toads and a few toadlets crossing the highway at the west end of Bear Lake (segments 24-26), in 2016 we will be

establishing a transect along the Wagon Road Trail at the north-west corner of Bear Lake starting at segment way point 27.



Figure 3. Highway 31A survey transect segments along Fish Lake.

5.2 Breeding areas and season

Fish Lake

The reconnaissance-level study commenced on May 6, 2015. Adult breeding activity appeared already well underway in Fish Lake and a small number of egg clusters were observed. All ice had already melted off the lake; although there were still small patches of snow in some of the shaded valley bottom forested areas. The receding snowline was about 1/8 of the way up the London Ridge mountain to the north of Fish Lake. One adult grizzly bear was observed on the Zincton slide north of segments 24-27, following a similar pattern as adult western toads of a downward migratory pattern from up-mountain winter hibernation sites in early spring.

On May 6, small numbers of amplexus pairs or single toads were observed at the boat launch at the Fish Lake rest stop and along the shore to the west as determined by wading along the shallower sections of shore and avoiding stepping on any toads and egg masses. The shoreline survey on this date was done from 7:00-7:45 p.m. The largest numbers of adults observed near the north shore during the evening survey were eight amplexus pairs at the boat launch in shallow water (2-15 cm depth). There were 3-4 long strings of blackish toad eggs. These were the only egg masses observed at the time; although the marshy west end of the lake was not surveyed.

One could have concluded from the wading survey that there were very few toads in Fish Lake in early May. However, by observing the calm lake surface through binoculars at dusk (with some backlight) literally hundreds of adult toads were observed swimming or floating stationary on the surface of the lake, some well over 100 m from shore. This was quite a surprising discovery. It was impossible to do a detailed count but one could easily conclude that the “lake was full of toads” i.e. a high but indeterminate numbers of adult toads breed at Fish Lake in the spring.

On May 13, 2015, Jakob Dulisse and his assistant Anna Lamb-Yorski did a canoe survey of toad breeding areas along the Fish Lake shoreline. Three breeding areas were identified (red lines in Figure 4). The westernmost breeding site (Breeding Area 3) was large and had by far the most eggs. Many of the eggs had recently hatched and it appeared that breeding activity was largely over. The middle site (Breeding Area 2) appeared to be at around the same stage, chronologically, as Breeding Area 3. Breeding Area 1 (at the rest area) had unhatched eggs and a few pairs of adult toads laying still. No hatched eggs were seen here.



Figure 4. Red lines show main adult toad breeding areas in Fish Lake identified during the pilot study. Blue markers indicate locations of migrating adult toads observed during a one-night survey in mid-May, 2015.

On May 16, no breeding pairs in amplexus were observed along the shore at the Fish Lake rest stop and peak breeding appeared to be over at this site. Throughout the remainder of May and into early June, adult toads continued to move back and forth south across the highway on the north side of Fish Lake (Appendix 2. Table 5).

This data would appear to fit the pattern with that reported in the scientific literature of an “explosive” breeding strategy at communal breeding sites where large numbers of adults aggregate over a 1- or 2-week period (COSEWIC 2012). In this case the first two weeks of May would appear to be the prime migration and breeding time at Fish Lake.

Bear Lake

In 2015, we did not do any breeding surveys around Bear Lake. However, a small number of adult toads were recorded in the spring crossing the highway along the south side of Bear Lake and the short distance from the west end of Bear Lake to Zincton; with an apparent small crossing at the west end of Bear Lake (Appendix 2. Table 5). In August we also recorded several toadlets along the edge of the highway in the same location at the west end. This suggested that the west end of Bear Lake is also likely a western toad breeding area. In 2016, we will include this area and Bear Lake in our breeding site and other surveys.

5.3 Adult toad nighttime movements across Highway 31A

Raw data for both the 2015 live and dead adult toad surveys is to be found in Appendix 1, Table 4. Thirteen nighttime walking and drive-by surveys to sample for the presence of live adult toads on Highway 31A between the west end of Bear Lake and the east end of Fish Lake were conducted from May 6 to July 19. After this budget and time constraints dictated that we spend more time on documenting toadlet staging areas, migrations and highway mortality. As well, by late July adult toad use of the highway appeared nominally low for the amount of time and expenditure that it took a researcher to drive out and do a count. The surveys involved 1-2 passes up and down the 2.3 km highway transect over a period of about one hour after dark. Although the survey period had more to do with the convenience of our own diurnal patterns, according to one study on Vancouver Island almost all radio-tracked movements of western toads occurred at night within 1-4 hours after dusk. Adult toad nocturnal activity was found to peak about midnight with few toads observed on night searches after 1 p.m. (Gregory 1999).

Highest live counts along north side of Fish Lake

Table 1 shows a total count of 133 live adult toads crossing the highway between May 6 and July 19, 2015. Of the four subareas, the majority of live adults (N = 115) were found on highway segments 1-2 to 11-12 along the north side of Fish Lake. Of the remaining counted, 9 were between Fish and Bear Lakes (Segments 12-13 to 14-15), 8 along the south side of Bear Lake (segments 15-16 to 25-26) and 1 was between Bear Lake and Zincton (segments 26-27 to 27-28). Nearly all of the toads observed were oriented in a direction perpendicular to or steeply diagonal to the east-west axis of the highway and appeared to be crossing one way or the other. One adult toad appeared trapped along the cement barriers on the south side of Bear Lake and was moving along the highway as a result. Direction of travel will be analyzed with the 2016 field data.

Highest adult toad live counts were early in the spring

Table 2 shows that the highest road counts of live adults were between May 6 and May 16, 2015 when an average of five counts showed 21.6 live adult toads/night survey. For the latter part of May, three counts showed a drop to 5.3 adult live toads/night survey. The three counts in June yielded a continuing decline to 2.7 adult live toads/night survey. Two counts in July (July 3 & 19) gave 0.5 live toads/night survey (Table 2).

Table 1: Total number of live adult toads per survey bout per approximate two-week period on Highway 31A from May 6-July 19, 2015

Observers	Date	Time period	Total		Unid. + Total
			Male	Female	
WM	May 6/15	20:30-21:26 p.m.	8	1	9
MM	May 10/15	20:49-21:45	4	20	24
JD & AL	May 13/16	21:24-22:24	35	5	1 Unid. 41
MM	May 14/16	21:30-22:25	2	6	FishLk. 8
MM	May 16/15	21:05-22:45	2	24	26
	5 counts				Avg. 21.6
WM	May 20/15	20:00-20:25	2	0	2
WM	May 24/15	21:06-21:36	0	1	1
MM	May 30/15	21:13-22:55	4	8	1 Unid. 13
	3 counts				Avg. 5.3
MM	June 5/15	21:13-22:55	3	2	5
WM	June 15/15	21:30-21:56	0	0	0
WM	June 24/15	21:55-22:46	2	1	3
	3 counts				Avg. 2.7
WM	July 3/15	10:15-10:30	0	1	1
WM	July 19/15	13:35-13:45	0	0	0
	2 counts				Avg. 0.5
TOTAL	13 counts		62	69	(2 Unid.) 133

Main adult toad crossing areas

Table 2 shows that only segments on the north side of Fish Lake had total counts of 5 or more adult toads for the overall survey period. All 11 segments on the north side of Fish Lake were used by migrating adult toads from May 5 to July 19 (Appendix 1, Table 1) while eight had total of 5 or more adults sampled for the survey period. The highest use highway crossing areas appeared to correspond well with the three breeding areas identified at Fish Lake. Of the Fish Lake segments with counts greater than 5 individuals, a total of 27 adults were counted in or at breeding area #1 (Rest Stop), 21 in or at breeding area #2 (middle) and the largest number, 49, at or near breeding area #3 (west end). Overall the west end also appeared to be the largest breeding area and visually appeared to have the highest number of toadlets.

5.4 Adult toad highway mortality highest at Fish Lake

Between May 6 and October 14, 2015 a total of 34 daytime walking and drive-by surveys were made to locate adult toads dead on the road (DOR) along the 2.3 km transect on Highway 31A. During this period, we documented a total mortality of 45 adult toads: 17 females, 7 males and 21 unidentified (See Table 5). In the majority of cases, dead toads were found on or along the highway asphalt and clearly had been struck by vehicles. Of particular interest, on May 2 three dead adult toads (2 female, 1 male) were found at the Fish Lake boat launch 3 m from shore, likely having been killed by predators.

Table 2. Highway 31A segments where a total 5 or more live adult toads were counted during the May 5 – July 19, 2015 survey period (Total nocturnal counts = 13).

Highway Segment	Total LIVE Toads	Sex (Female (F), Male (M), Unidentified (U))			Total DEAD Toads	Sex (Female (F), Male (M), Unidentified (U))			Nearest Breeding Area or at Breeding Area [Fish Lake only]
		Female	Male	Unidentified		Female	Male	Unidentified	
Goat Ck. to W. End Fish Lake	LIVE	Female	Male	Unidentified	DEAD	Female	Male	Unidentified	1) Fish Lake Rest Area 2) Middle Fish Lake 3) West End of Fish Lake
1-2	9	4	5	0	3	1	1	1	Near 1
2-3	11	5	5	1	7	2	1	4	At 1
3-4	7	3	4	0	1	0	0	1	Near 1
7-8	13	8	5	0	2	1	0	1	At 2
8-9	8	6	2	0	1	1	0	0	Near 2
9-10	22	11	11	0	6	1	1	4	At 3
10-11	27	15	12	0	7	0	1	6	At 3
11-12	8	1	7	0	3	1	1	1	Near 3

As to be expected, the highest total traffic mortality recorded (34) for the spring period and overall was on the north side of Fish Lake where the most live adult toads were also recorded crossing. Five dead toads were recorded on the highway stretch between Fish and Bear Lakes, five along Bear Lake and on beyond the west end of Bear Lake.

Along the north side of Fish Lake, segments 2-3, 9-10 and 10-11 each had a total spring mortality greater than five, with the highest proportion towards the west end of Fish Lake corresponding well with the highest adult toad migratory traffic (Table 5).

5.5 Seasonal adult toad mortality corresponds with highest migration period

Of the 45 adult toad deaths recorded, the highest number (26) was during the first two weeks of May, corresponding to the period of the highest number of adults recorded crossing Highway 31A. After this, mortality dropped off considerably including the last weeks of May and into June - although our sample sizes were small. Ten daytime surveys in July found only one dead adult, nine surveys in August only one and none were found during four surveys in September and October.

Although we initially extrapolated this data to estimate the total number of adults hypothetically killed over the survey period per each two week period, due to feedback from FWCP it was decided because of the small sample size and other questions to drop this estimate from our 2105 report. However, we will revisit this in 2016.

As expected, during the peak of spring breeding migration activity in the first two weeks of May the average mortality was highest, 5.2 toads/survey (N = 5). Although night traffic would have been less at this time of year than during summer peak tourism season (July & August), the much higher proportionate numbers of adults migrating across the highway in early May would explain the higher mortality. In the last two weeks of May the mortality was 1.3 toads/survey (N = 3). Mortality remained about the same during the first two weeks

of June (1.0) and then increased slightly later in June (2.5). However, this was based on a very low sample size. For July the mortality was 0.4 toads/night survey (N=10); August 0.6 toads/night (N=9); September 0 toads/night (N=2); and early-mid October 0 toads/night (N=2). Although our sampling effort varied over time for each month period, the general trend of declining road kill for adults from spring to fall is consistent with other studies.

Although this data represents a small sample size it does give a good index that night mortality from road traffic in the spring could be an important conservation concern for the Fish Lake subpopulation of western toads. However, we are unsure how the adult mortality data fits in with the overall Fish Lake adult toad population and reproductive potential where the loss of each gravid female with their 12,000 eggs could have a significant but undetermined bearing on population viability.

Of interest and for comparison, in 2013, researchers at Summit Lake documented a total of 276 dead adult toads on Highway 6 (Dulisse 2014).

Table 3: Total number of dead adult toads on Highway 31A per each approximate bi-monthly survey from May 6 to Oct. 13, 2015

Time period	Total # daytime counts	Total Male	Total Female	Unid.	Total	Avg./survey
May 6 -14	5	3	8	15	26	5.2
May 17 -31	3	1	2	1	4	1.3
June 6-15	1	1	0	0	1	1.0
June 21-27	2	1	3	1	5	2.5
July 1-31	10	0	3	1	4	0.4
Aug. 1- 31	9	1	1	3	5	0.6
Sept. 1-31	2				0	0.0
Oct. 1- 13	2				0	0.0
TOTAL	34	7	17	21	45	

5.6 Timing of tadpole emergence and numbers at Fish Lake

Due to a gap in our surveys, the timing of the main emergence of tadpoles in Fish Lake was not accurately determined. J. Dulisse recorded some eggs hatched on May 15. On May 16, egg masses at Breeding Area 3 (rest stop) and Breeding Area 2 (middle of the lake – Figure 4) were still intact and no tadpoles observed. Then on June 5, a GoPro camera placed underwater about 2 m from shore at Breeding Area 3 captured thousands of tadpoles moving together along the lake bottom. Also on June 27, three large circular schools of tadpoles about 0.5 m diameter and 30 m or so long per school were observed off the shore at the rest stop. Numbers were hard to guess but a million might come close.

The latest date tadpoles were observed was August 13, with a small number at Breeding Area 1 (rest stop).

5.7 Timing of toadlet metamorphosis, staging areas, numbers and migrations at Fish Lake

Timing of metamorphosis & staging areas - 2015

Prior to July 5, no toadlets were observed at the Fish Lake rest stop Breeding Area 1. We were unfortunately unable to do any surveys between July 6 - 23, 2015. By July 24, the shoreline near the rest stop and just west of the boat launch there (Breeding Area 1) had aggregations of tens of thousands of toadlets. This suggested that the main metamorphosis probably occurred sometime around the middle of July. However, on July 24 there still remained a large number of tadpoles near the shore including a few without legs indicating that metamorphosis was not complete. At the large culvert at mid lake (Breeding Area 2) there were also large clusters of toadlets with some tadpoles along the vegetated shoreline. At the vegetated mud flats at the west end of the lake (Breeding Area 3) there were tens of thousands of toadlets but the shore was too muddy to check the water for tadpoles.

These and later observations indicated that after hatching most toadlets aggregated along the shoreline at their three main breeding sites at Fish Lake and also staged their different migrations from these sites.

The latest date tadpoles were observed was on August 13 when a small number were sighted at the Fish Lake rest stop. At this time, we suspected this would possibly be late for the toadlets to be able adapt to their terrestrial environment and then successfully migrate. The last recorded migration from the rest stop was recorded on August 25 and after that no toadlets were found along the lake shore.

What is particularly relevant from the above-mentioned observations is that tadpoles at Fish Lake metamorphosed to toadlets over the period of a month or longer, which would help explain why there were at least four different toadlet migrations spanning a similar time frame.

Toadlet (juvenile, metamorph) migrations

Observations of toadlet migrations in previous years at Fish Lake, along with our 2015 field research, indicated that toadlet migrations from the natal lake to hibernation habitats were more or less consistent with migrations documented at Summit Lake and elsewhere. However, nothing is known of the hibernation habitat areas of Fish Lake toadlets and adults. Since our study area is at a higher elevation than the hibernation habitats selected could be different than at Summit Lake. Much of the habitat on the north side mountain is a mix of deciduous/coniferous forest interspersed with avalanche chutes. We have no idea how far the toadlets migrate from Fish Lake. When they migrate, western toads tend to creep and crawl and then pause, rather than hop like frogs. Quite often when crossing Highway 31A toadlets were observed to quickly crawl a short distance and then stop for a short period on the pavement, thus increasing their risk of being killed by traffic. This slow pace of toadlet migration away from Fish Lake is consistent with a study in Oregon that found that toadlets traveled away from their breeding sites at a rate of 84 metres/day (Bull 2009).

How far BC's inland temperate rainforest toadlets travel from their natal lakes before they hibernate is not known. Based on the study done in Oregon (Bull 2009), within eight weeks of metamorphosis toadlets travelled up to 2.7 m from breeding sites, with drainages used as dispersal corridors. On Vancouver Island, Davis (2000) found metamorphs within 300 metres

of breeding sites.

Toadlet migrations observed at Fish Lake rest stop. August 2014

Following is a summary of August 2014 observations of toadlet migrations at the Fish Lake rest stop based on field notes in Appendix 3.

In 2014, some casual monitoring by biologist Wayne McCrory was done of toadlet migrations and highway mortality at the Fish Lake rest stop. In August, 2014 two large migration events and associated high traffic mortality were observed at the rest stop involving tens of thousands of toadlets crossing highway 31A. Both migrations were observed during daylight hours and coincided with rain events during periods of very hot weather, one on August 12 and the other on August 14. What was noteworthy compared to 2015 results was that toadlets at the rest stop crossed in a more northward direction, travelling directly across the highway rather than the n.e. – e. orientation of the two main migration events documented across the highway in August, 2015. As well, the August 14, 2014 large migration involved thousands of toadlets crossing along the stretch of the highway from the boat launch to 30 m w. of the boat launch road (Figure 5). This was something that was not observed in 2015 when they crossed somewhat more to the east. This only highlights the need for two more years to study to cover all of the variations in toadlet migration patterns and possible adult toad migrations.



Figure 5. August 14, 2014 toadlet migration across Highway 31A just west of Fish Lake Rest Stop. In 2015, toadlets tended to cross the road 100 m to the east and were not observed crossing here.

Fish Lake toadlet migrations-2015

Following is a summary of our 2015 observations of toadlet migrations at the Fish Lake based on field observation as compiled in Appendix 3.

- Our 2015 field observations indicate that toadlet dispersal movements from the three breeding areas at Fish Lake had quite different and unique directional patterns. All migrations took place during daylight hours. Timing of migration may have been similar from each the staging areas, for example, when mass movement was triggered by rain events during hot weather; or perhaps by persistent wet and cold weather later in the season when the need to migrate to the uplands to hibernate would have been more urgent for late metamorphs.
- In all, in 2015 we found that there were at 4-5 different toadlet migration events from the staging area along the shoreline at the Fish Lake rest stop. Lake shore survey transects from June to September showed that the main toadlet pre-migration staging areas were in alignment with the three main breeding sites. These were also the only areas of the lakeshore with shallow water with emergent vegetation and shoreline shrub cover. A subarea at the red bench near the west end of Fish Lake had some of these criteria but consistently had only small numbers of toadlets.
- The 4 toadlet migration events at the Breeding Area 1 (Fish Lake rest stop) were July 20, July 27-28, August 5 (likely), August 5 to 15-16 and August 24. All toadlets had disappeared from the staging area (Figure 6) by August 30. Pathways of the 4-5 different mass movement events of toadlets away from the rest stop, including direction of travel and route taken through and from the lakeshore staging areas, varied in subtle but significant ways that will eventually have some relevance to any proposed mortality mitigation measures.
- The two late July migrations involved one with small numbers and one numbering in the tens of thousands. During each, the metamorphs were focused on travel east through the rest stop (when tourists were often present) and then crossing the highway north-east, with heavy mortality (Segment 1-2). Toadlets during the two smaller migration events in mid and late August tended to travel more eastward and not directly cross Highway 31A. These movements varied, with the August 15-16 toadlets crawling across the lawn at the rest stop and then to the south side of the Goat Creek Bridge. During the last, small event on August 25, toadlets traveled along the beach in front of the picnic area and then towards the creek outlet where they disappeared in the dense undergrowth. At this time lower water levels made for a wider beach travel corridor.
- Breeding Area 2 (middle lake) toadlets, despite high aggregations, had only one documented migration event north across the highway on July 27 when about 100-200 were killed by traffic (segment 4-5). In general, other than this date, even when Breeding Area 1 (rest stop) toadlets were migrating en mass across the highway, no middle lake toadlets were observed on the highway.
- Breeding Area 3 (west end of lake) had the largest number of toadlets that migrated mostly to the west and south-west through the large wetland/shrub zone and on an ATV road, with only a few appearing to move north across highway 31A. Migration events occurred on July 27-28, August 15-16 to perhaps August 24. Events may have occurred on July 20 and August 5 but were not verified. All migrations events here appeared over by August 30. All toadlet activity here occurred on private land.



Figure 6. July 27, 2015 part of large toadlet aggregation on shoreline three metres west of Fish Lake rest stop boat launch site (Breeding Area 1).

Bear Lake toadlet migrations-2015

The following summary is based on field observations (Appendix 3). On the same days that toadlets were migrating across Highway 31A at Fish Lake we also checked the pavement surface at the west end of Bear Lake (**Segment 24-25**) where adults had crossed in the spring. We did not observe any toadlets here until August 23 when one toadlet was found in the s. side lane, moving s., about 30 m east of the end of the lake. It was moved to the s. side of the road. Another two toadlets were found along the pavement edge, appearing dead from the heat.

It is recommended that more intensive surveys be done at Bear Lake in 2016. We suspect most of the adult and toadlet migrations may be taking place on the north side of the west end of Bear Lake and that the west end is a breeding area.

5.8 Toadlet size and weight

As observed on July 24, tadpoles were very small and appeared to be about ½ the size of those observed by Wayne McCrory in previous years other than 2014. The different hatches at Fish Lake remained approximately the same tiny size throughout the late summer to the last ones observed migrating on August 25 – although some size variances were observed on this date.

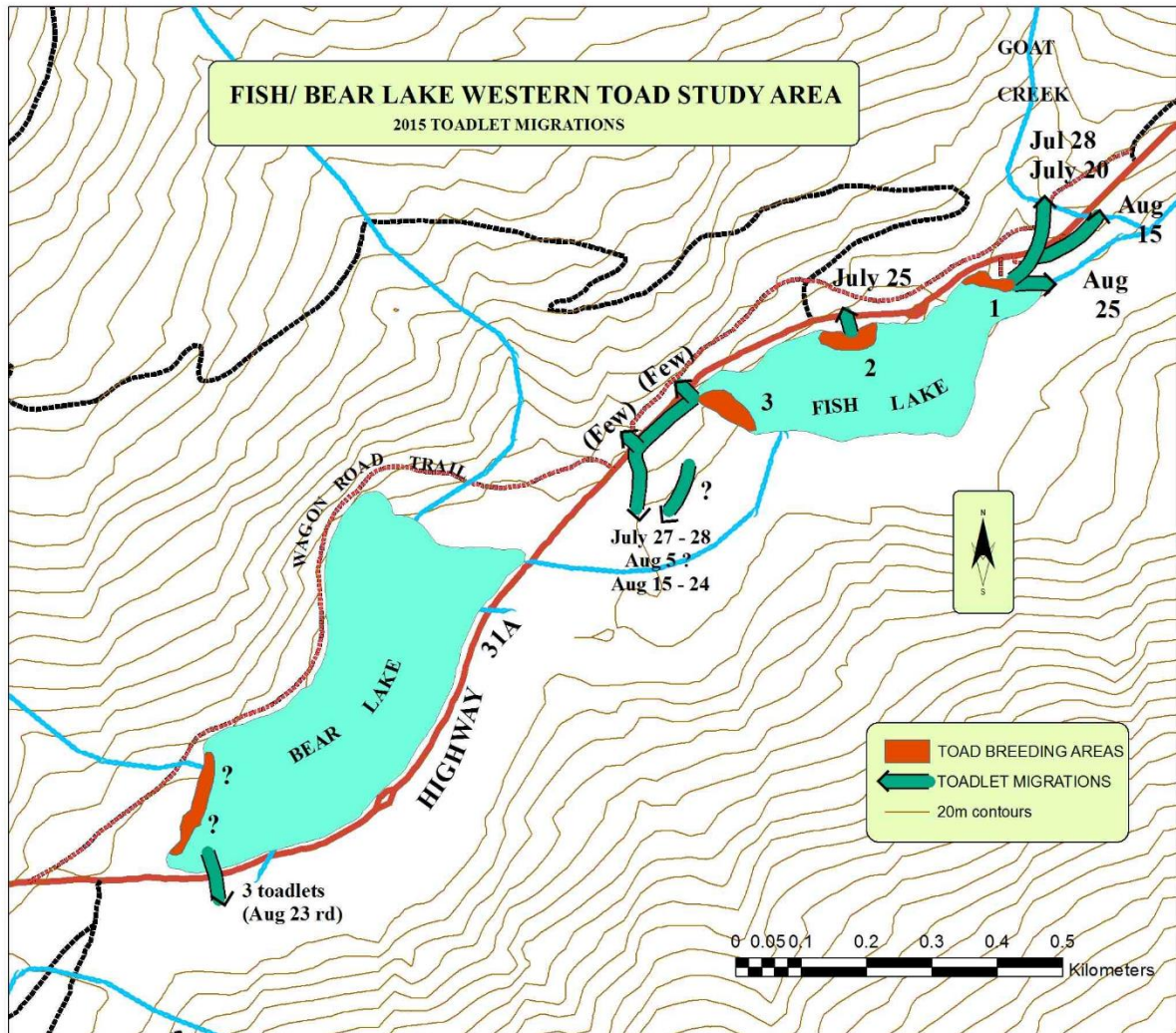


Figure 7. Study area map showing toad breeding areas (red) and toadlet migrations (green) documented in 2015.

The body length from tail to head of a small number of toadlets measured in early August was 5 – 6 mm. On August 25, 45 toadlets were captured from the rest stop lake shore and placed in a small plastic zip-lock bag. Using a 100 g Pesola micro-scale, the toadlets and bag weighed 19 g. A sandwich bag weighs 2.4 g (Anna Lamb-Yorski, pers. comm.). The 45 toadlets weight of 16.6 g averaged 0.37 g each. This is approximately half of the average weight of 0.60 g of toadlets at Summit Lake in the same season (Anna Lamb-Yorski, pers. comm.). We have no explanation for the smaller body size in our study area. Our study area (1,133 m) is considerably higher (360 m) in elevation than Summit Lake (764 m).

According to one review involving breeding adults of two amphibian species, body size and condition are correlated with and can be proxies for multiple fitness measures including fecundity, survival, endurance, and immunity (Veysey Powell and Babbitt. 2015).



Figure 8. In 2015 Fish Lake toadlets were consistently small, about the size of a dime, and $\frac{1}{2}$ the size of the ones at Summit Lake.

5.9 2015 Actions to coordinate and mitigate human-caused disturbance and mortality to Fish Lake toad life cycle stages

During the 2015 field season we decided to implement mitigation measures supported by our research and that had received agency approval from MoTI, MFLNRO and the Kootenay-Boundary Forest District Recreation Officer. Consultations were made with the toad research and monitoring team at Summit Lake. On July 18, Irene Manley, MFLNRO – FWCP biologist did a tour with us at Fish Lake and provided suggestions for mitigation of highway mortality, signage and so on. On July 22 biologist Wayne McCrory met toad researchers Kat McGlynn and Irene Manley at Summit Lake to view the new underpass and be briefed on the types of deflection fences they use at Summit Lake. Consultations with the adjacent large land-owner and rails-to-trails society were commenced and mitigation possibilities and concerns discussed.

These are summarized as follows:

a) *Closure of boat launch at Fish Lake rest stop*

After a field information meeting at Fish Lake rest stop on July 5 with Bart Chenuz, Area Manager (roads) for MoTI, he had the vehicle access to the boat launch blocked off with three large sections of cement abutments. Although this did not prevent people from carrying their canoes and boats to the lake, it did curtail the threat of damage to breeding toads, egg

masses and toadlets that congregate along the shore at this site. He also approved our use of warning signage and installation of other information venues at the rest stop.

b) *Creation of a 3-4 m non-mowed grass edge along the rest stop lake shore.*

At the July 5 meeting, Mr. Chenuz also agreed to have the YRB contractor not mow the lawn at the rest stop within 3-4 m of the lake shore to provide better cover for the toadlets.

c) *Toadlet warning signs at rest stop, along the Wagon Road Trail.* Different types of small warning signs were prepared and staked at the entrance to the rest stop and along the lakeshore to caution people not to step on toadlets. Similar signs were also posted at key points on the adjacent Wagon Road Trail including the bridge. The text for this sign was approved by Justin Dexter, the district recreation officer. We also later went over the signage with a representative of the rail-to-trail society.

d) *Deflection fencing and toadlet wooden crossings at Goat Creek bridge*

Similar signage was posted at the two temporary wooden crossings placed on each side of the Goat Creek highway bridge. These crossings were started on July 28 with the placing of long (5-6 m) lengths of slab wood on the south side of the bridge and under the bridge to encourage toadlets to cross under the bridge to the other side. Slab wood was also placed across Goat Creek on the north side of the bridge, with the rounded side up. A few toadlets were placed on the crossings but only went a short distance and then fell into the creek. Monitoring suggested the toadlets were not using the slab wood. It was then decided to try wooden bridges with sides since it was observed that the toadlets often migrated along edges such as the edge of the pavement of the cement abutments along the highway edge. This was something that was pointed out to us by the biologists from Summit Lake. The better bridging was installed on August 11 with the help of several volunteers. On the north side, three 5.3 m long pine 2" x 6" (planed) were assembled together with wooden cross-pieces screwed on the underside. Boards 1" x 6" were screwed on as sides and some gravel was shoveled on the surface. The bridge spanned the creek. On the south side, we did a similar structure but used only two planks width and similar sides. The bridge was angled down into the boulders under the creek where more 2" x 6" were placed to the opposite side of the creek and bridge for the toadlets to go under the highway.

We tested a small number of toadlets and they almost immediately started across. On August 13, MFLNRO biologist Kat McGlynn set up plastic directional fences along the w. bank of Goat Creek on both sides of Goat Creek to funnel migrating toads into the wooden bridge crossing structures. The design of these temporary fences are described in McGlynn (2015). In order to monitor toadlet use, the crossings were periodically surveyed and toadlets in and on the structures were recorded. Limited evidence suggested this was working.



Figure 9. Temporary plastic deflection fence built in August 2015 to direct migrating toadlets on to artificial wooden bridge crossing under the Highway 31A Goat Creek Bridge.

One of the issues that needs to be addressed with respect to the potential for a permanent directional fence and permanent toadlet bridge under the main Goat Creek bridge has to do with a design to withstand winter snowplowing debris at the bridge. On February 1, 2016 Wayne McCrory visited the area and took photographs of the snow conditions at the bridge site. On the downstream side, YRB had plowed out the wide pull out area on the s.w. side of the bridge, leaving a 5 m high snow berm along the w. edge of Goat Creek. All of the stream bed was filled with seasonal and debris snow so that none of the creek was visible for 8 m below the highway bridge and the depth of snow was up to about 0.3 m below the top edge of the bridge.

On the n. side, there was less in-filling with running water visible in a small 2 m diameter hole in the deep snow-debris covering the creek about 5-6 m above the n. edge of the bridge. Any toadlet crossing bridge-underpass design considerations will have to take into account snow loading, salt-gravel-sand contamination and other factors if a permanent structure is to be recommended at the end of the study.

Highway traffic control

On August 28, Wayne McCrory and Marcy Mahr again met with Bart Chenuz (MoTI) to update him on the research and mitigation. We discussed safety concerns and the lack of speed control of Highway 31A traffic past the rest stop area when it is congested with tourist vehicles as well as risks involved with the public on their own volition bucketing toadlets across the highway. Imposing a speed limit or crosswalks did not appear to be options. Mr.

Chenuz tentatively approved the posting of large sandwich signs at some distance on either side of the rest stop that basically would say: SLOW – congested area ahead.

Bucketing

Over the course of the research we estimate we helped about 20 adult toads off the highway (at night) and safely bucketed about 1,000 toadlets across. We also noted that some members of the public brought their children to bucket toadlets and have been doing this for years.



Figure 10. As part of our public education program, children and others were allowed to assist toadlets under supervision such as helping a toadlet onto the artificial bridges.

Existing culverts

We identified three different culverts under highway 31A along the north side of Fish Lake. The length, diameter and condition of these was measured in order to test them as toad/toadlet underpasses next year. More research needs to be done on this possible mitigation feature.

5.10 Community and media events

- Large info. sign installed at Fish Lake rest stop modeled after Summit Lake sign, early August. FWCP logo on sign & funding support mentioned in text (Figure 11).
- Two-page info. pamphlets (colour) prepared with help of Kat. M. & several hundred placed in pamphlet distribution box at Fish Lake. Late August. FWCP logo on sign & funding support mentioned in text. It was estimated that thousands of people stop during the summer months at this popular rest stop, many reading the sign and also looking at the toadlets along the shoreline. Researchers probably interacted positively with 100-200 visitors explaining why the research was being done.
- Marcy Mahr does interview on Co-op radio (Shift Happens) on toad project. Aug. 4. Mentions support by FWCP.
- VWS places ad in Valley Voice on June 3 re-Fish Lake toad project and acknowledges FWCP funding support.
- Selkirk College outdoor ecology-bear safety course in late June also features toad study at Fish Lake and FWCP funding support - acknowledged by instructor Wayne McCrory.
- VWS has feature article in Valley Voice on August and acknowledges FWCP funding support.
- Toad project discussed with adjacent land owner and numerous visitors at Fish Lake informed of FWCP funding support.
- Wayne McCrory also gave a feature talk on the toad study at Fish Lake rest stop on toad study to 16 students and teachers for Lucerne into learning week. FWCP funding support acknowledged.
- Toad study and FWCP funding support was featured in VWS annual newsletter.

6.0 RECOMMENDATIONS

The study team recommends:

- At least another two years of research that expands surveys to Bear Lake and peripheral transect areas.
- Continued coordination with MoTI and MFLNRO.
- Continued high level of public education, and
- Greater coordination with surrounding land-owners and adjacent rail-to-trail managers.
- Work with MFLNRO-FWCP on a conservation plan to address all issues related to the toads including protection of core wetlands and core terrestrial habitats, recreational motorized impacts, private land, logging and others.

7.0 ACKNOWLEDGEMENTS

The Fish and Wildlife Compensation Program provided the small grant that made this pilot project possible. The Valhalla Wilderness Society contributed financially to allow the project to be completed. Bart Chenuz of MoTI is thanked for his site visits and cooperative approach and mitigation suggestions. Herb Thompson of the Kaslo-Sandon Rails-to-Trails society is thanked for his cooperation. Gordon Fitchett, the owner of the private land surrounding all of Bear Lake and the west half of Fish Lake is thanked for his interest in the project and his offer to cooperate in future mitigation.

The researchers from the Summit Lake toad project were extremely cooperative and helpful throughout: Jakob Dulisse, Irene Manley, Katherine McGlynn, and Anna Lamb-Yorksi.



Figure 11. Interpretive sign at MoTI Fish Lake rest stop and toadlet staging/migration area.

8.0 REFERENCES

- Braumandl, T.F., and M.P. Curran. 1992. A field guide for site identification and interpretation for the Nelson Forest Region. Research Branch, British Columbia Ministry of Forests, Victoria, BC.
- Bull, E. L. 2009. Dispersal of newly metamorphosed and juvenile Western Toads (*Anaxyrus boreas*) in northeastern Oregon, USA. *Herpetological Conservation and Biology* 4:236-247.
- COSEWIC. 2012. COSEWIC assessment and status report on the Western Toad *Anaxyrus boreas* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xiv + 71 pp. (www.registrelep-sararegistry.gc.ca/default_e.cfm). Accessed February 12, 2016.
- Davis, T.M. 2000. Ecology of the Western Toad (*Bufo boreas*) in forested areas on Vancouver Island. Final Report. Forest Renewal Research Project. BC Ministry of Forests, Victoria, BC. 28 pp.
- Davis, T.M. 2002. Research Priorities for the Management of the Western Toad, *Bufo boreas*, in British Columbia. B.C. Minist. Water, Land and Air Protection, Biodiversity Branch, Victoria, BC. Wildlife Working Report No. WR-106
- Davis, T.M., and P.T. Gregory. 2003. Decline and local extirpation of the Western Toad, *Bufo boreas*, on southern Vancouver Island, British Columbia, Canada. *Herpetological Review* 34:350-352.
- Dulisse, J., and D. Hausleitner. 2010. 2009 West Kootenay Amphibian Survey. Report prepared for the Fish and Wildlife Compensation Program. Nelson, BC.
- Dulisse, J., D. Hausleitner, and J. Boulanger. 2011. Western Toads at Summit Lake 2010 Field Season. Report prepared for Fish and Wildlife Compensation Program. Nelson, BC
- Dulisse, J. 2015. Western toad migration at Summit Lake. 2014 season. Report for Irene Manley, Ministry of Forests, Lands and Natural Resource Operations, Fish & Wildlife Compensation Program-Section. Nelson, BC.
- Gregory, P.T. 1999. Ecology of the western toad (*Bufo boreas*) in forested areas on Vancouver Island. Final report. FRBC number HQ96142 RC. <https://www.for.gov.bc.ca/hfd/library/frbc1999/frbc1999mr113.pdf>. Accessed February 12, 2016.
- McGlynn, K. 2015. Amphibian fencing techniques and construction ideas for projects or properties. Draft. In Progress.
- Provincial Western Toad Working Group. 2014. Management plan for the Western Toad (*Anaxyrus boreas*) in British Columbia. Prepared for the BC Ministry of Environment, Victoria, BC. 29 pp. <http://www.env.gov.bc.ca/wld/recoveryplans/rcvry1.htm>. Accessed February 29, 2016.
- Species at Risk Committee. 2014. Species Status Report for Western Toad (*Anaxyrus boreas*) in the Northwest Territories. Species at Risk Committee, Yellowknife, NT.
- Veysey Powell J.S., and K.J. Babbitt. 2015. Despite buffers, experimental forest clearcuts impact amphibian body size and biomass. *PLoS ONE* 10(11): e0143505. doi:10.1371/journal.pone.0143505. Accessed February 5, 2016.

APPENDIX 1. Raw data for adult live and dead counts for 2015. Word tables were extracted from Excel tables. W. McCrory, Marcy Mahr, and Jakob Dulisse.

Table 4. FISH & BEAR LAKES RAW SURVEY DATA – 2015

LIVE and DEAD ADULT TOADS (From Excel Table).

FISH LAKE: LIVE ADULT TOADS

Date	Time	#TOAD	Sex (M/F)	Direction of Travel	UTM Zone	UTM EASTing	UTM NORTHing	WAYPT#	Hwy Segment #
MARCY'S DATA									
5/14/2015	21:30	1	F	N	11	486510	5543575		10
5/14/2015	21:42	1	F	S	11	486980	5543730		4
5/14/2015	21:57	1	F	S	11	486770	5543704		6
5/14/2015	22:00	1	M	N	11	486670	5543675		9
5/14/2015	22:06	1	F	S	11	486517	5543581		10
5/14/2015	22:14	1	M	N	11	486849	5543708		5
5/14/2015	22:24	1	F	N	11	487154	5543777		1
5/14/2015	22:25	1	F	?	11	487165	5543785		2
5/16/2015	21:23	1	F	N	11	486530	5543593		10
5/16/2015	21:38	1	F	N	11	487164	5543782		1
5/16/2015	21:47	1	F	N	11	487167	5543782		1
5/16/2015	21:52	1	F	S	11	487015	5543749		3
5/16/2015	21:58	1	F	N	11	486678	5543673		8
5/16/2015	21:58	1	F	N	11	486673	5543676		8
5/16/2015	22:00	1	F	N	11	486599	5543647		9
5/16/2015	22:00	1	F	N	11	486601	5543646		9
5/16/2015	22:00	1	F	N	11	486605	5543648		9
5/16/2015	22:00	1	F	N	11	486603	5543648		9
5/16/2015	22:04	1	F	N	11	486536	5543599		10
5/16/2015	22:04	1	F	N	11	486538	5543599		10
5/16/2015	22:04	1	F	N	11	486540	5543600		10
5/16/2015	22:05	1	F	N	11	486499	5543564		10
5/16/2015	22:05	1	F	N	11	486501	5543566		10
5/16/2015	22:09	1	F	N	11	486504	5543568		11
5/16/2015	22:18	1	F	S	11	486619	5543654		8
5/16/2015	22:29	1	M	?	11	487039	5543760		2
5/16/2015	22:35	1	F	?	11	487139	5543768		2
5/16/2015	22:35	1	F	S	11	487143	5543767		2
5/16/2015	22:43	1	F	N	11	487031	5543757		2
5/16/2015	22:43	1	F	N	11	487010	5543746		3
5/16/2015	22:44	1	F	N	11	486517	5543581		10

FISH LAKE: LIVE ADULT TOADS (CONT.)

Date	Time	#TOAD	SexT (M/F)	Direction of Travel	UTM Zone	UTM EAST-ing	UTM NORTH-ing	WAYPT#	Hwy Segment #
5/30/2015	21:13	1	F	N	11	486511	5543582	3-mm	10
5/30/2015	21:32	1	M	N	11	486527	5543590	4-mm	10
5/30/2015	21:34	1	F	N	11	486548	5543611	5-mm	10
5/30/2015	21:48	1	F	N	11	487045	5543761	6-mm	2
5/30/2015	21:56	1	F	N	11	486627	5543658	7-mm	9
5/30/2015	22:02	1	F	N	11	486368	5543465	8-mm	12
5/30/2015	22:09	1	M	N	11	486484	5543551	9-mm	10
5/30/2015	22:33	1	F	N	11	486552	5543610	10-mm	8
5/30/2015	22:37	1	M	N	11	486490	5543561	11-mm	10
5/30/2015	22:46	1	F	S?	11	487159	5543754	12-mm	1
5/30/2015	22:53	1	M	N	11	487035	5543756	13-mm	2
5/30/2015	22:55	1	F	N	11	486986	5543737	14-mm	3
6/5/2015	22:16	1	F	S	11	486634	5543663	44-mm	9
6/5/2015	22:27	1	M	S	11	486369	5543456	45-mm	12
6/5/2015	22:33	1	M	S	11	486522	5543586	46-mm	9
6/5/2015	22:54	1	M	N	11	486334	5543430	47-mm	12
MM [47]									
WAYNE'S DATA						LATITUDE	LONGITUDE		
5/6/2015	21:03	1	M	?					9
5/6/2015	21:04	1	M	N					7
5/6/2015	21:14	1	M	S					8
5/6/2015	21:17	1	M	S					4
5/6/2015	21:21	1	M	S					10
5/6/2015	21:21	1	M	S					10
5/6/2015	21:23	1	M	N					10
5/6/2015	21:23	1	F	N					10
5/6/2015	21:24	1	M	N					11
5/10/2015	21:25	1	F	S					10
5/10/2015	21:27	1	M	N					10
5/10/2015	21:27	1	M	N					10
5/10/2015	21:27	1	F	S					10
5/10/2015	21:27	1	F	S					10
5/10/2015	21:28	1	F	N					9
5/10/2015	21:28	1	F	N					9
5/10/2015	21:28	1	F	N					9
5/10/2015	21:28	1	F	N					9
5/10/2015	21:30	1	F	N					7

FISH LAKE: LIVE ADULT TOADS (CONT.)

Date	Time	#TOAD	SexT (M/F)	Direction of Travel	UTM Zone	UTM EAST-ing	UTM NORTH-ing	WAYPT#	Hwy Segment #
5/10/2015	21:30	1	F	S					7
5/10/2015	21:30	1	M	N					7
5/10/2015	21:31	1	M	?					7
5/10/2015	21:31	1	F	?					7
5/10/2015	21:31	1	F	N					7
5/10/2015	21:31	1	F	N					7
5/10/2015	21:31	1	F	N					7
5/10/2015	21:31	1	F	N					7
5/10/2015	21:31	1	F	N					7
5/10/2015	21:35	1	F	N					4
5/20/2015	22:12	1	M	S					10
5/20/2015	22:12	1	M	S					10
5/24/2015	21:30	1	M	N		50.02.706	117.11.161		10
7/3/2015	22:20	1	F	N					8
		WM [33]							
			<u>55F</u>						
			<u>25M</u>						
TOTAL LIVE:									
[MM+WM]		80	0U						
JAKOB'S DATA									
5/13/2015	21:24	1	M	N		486542	5543608	47-jd	10
5/13/2015	21:24	1	M	N		486558	5543622	48-jd	9
5/13/2015	21:24	1	M	N		486579	5543632	49-jd	9
5/13/2015	21:24	1	M	N		486579	5543632	49-jd	9
5/13/2015	21:24	1	M	N		486579	5543632	49-jd	9
5/13/2015	21:24	1	M	N		486579	5543632	49-jd	9
5/13/2015	21:24	1	M	N		486579	5543632	49-jd	9
5/13/2015	21:24	1	M	S		486705	5543688	50-jd	9
5/13/2015	21:24	1	M	S		486765	5543708	51-jd	8
5/13/2015	21:24	1	M	S		486782	5543704	52-jd	6
5/13/2015	21:24	1	M	N		486802	5543712	53-jd	6
5/13/2015	21:24	1	M	S		487026	5543753	54-jd	3
5/13/2015	21:24	1	M	N		487002	5543750	55-jd	3
5/13/2015	21:24	1	M	N		487027	5543752	56-jd	3
5/13/2015	21:24	1	M	N		487126	5543762	57-jd	2
5/13/2015	21:24	1	M	N		487126	5543762	57-jd	2
5/13/2015	21:24	1	M	N		487144	5543762	58-jd	1

FISH LAKE: LIVE ADULT TOADS (CONT.)

Date	Time	#TOAD	SexT (M/F)	Direction of Travel	UTM Zone	UTM EAST-ing	UTM NORTH-ing	WAYPT#	Hwy Segment #
5/13/2015	21:24	1	M	N		487163	5543775	59-jd	1
5/13/2015	21:24	1	M	N		487163	5543775	59-jd	1
5/13/2015	22:00	1	M	S		487103	5543767	60-jd	2
5/13/2015	22:00	1	M	N		486879	5543704	61-jd	5
5/13/2015	22:00	1	M	N		486782	5543709	62-jd	5
5/13/2015	22:00	1	M	N		486611	5543651	63-jd	9
5/13/2015	22:00	1	F	N		486540	5543610	65-jd	9
5/13/2015	22:00	1	M	N		486512	5543584	66-jd	11
5/13/2015	22:00	1	M	N		486512	5543584	66-jd	11
5/13/2015	22:00	1	M	N		486512	5543584	66-jd	11
5/13/2015	22:00	1	M	N		486502	5543579	67-jd	11
5/13/2015	22:00	1	M	N		486502	5543579	67-jd	11
5/13/2015	22:00	1	F	N		486454	5543535	68-jd	12
5/13/2015	22:00	1	F	N		486445	5543528	69-jd	12
5/13/2015	22:24	1	F	N		486434	5543517	70-jd	12
5/13/2015	22:24	1	M	S		486502	5543578	71-jd	11
5/13/2015	22:24	1	F	N		486708	5543692	72-jd	8
5/13/2015	22:24	1	M	N		486731	5543694	73-jd	7
5/13/2015	22:24	1	M	N		486777	5543709	74-jd	7
5/13/2015	22:24	1	M	N		486836	5543700	75-jd	5
5/13/2015	22:24	1	M	N		487031	5543761	76-jd	3
5/13/2015	22:24	1	U	N?		487044	5543751	77-jd	2
5/13/2015	22:24	1	M	N		487151	5543768	78-jd	1
5/13/2015	22:24	1	M	N		487151	5543768	78-jd	1
	JD [41]		5F						
			35M						
			1U						
			60F						
FISH LAKE	TOTAL LIVE TOADS ALL OBS:	121	60M						
			1U						

BEAR LAKE: LIVE ADULT TOADS

Date	Time	#TOAD	SexT (M/F)	Direction of Travel	UTM Zone	UTM EAST-ing	UTM NORTH-ing	WAYPT#	HWY SEGMENT #
MARCY'S DATA									
5/10/2015	21:15	1	F	?					25
5/10/2015	21:22	1	F	?					25
5/10/2015	21:22	1	F	?					25
5/10/2015	21:45	1	F	?					24
5/16/2015	22:47	1	F	N					14
5/16/2015	22:48	1	M	S					19
5/16/2015	22:52	1	F	N					26
5/30/2015	23:07	1	U	?	11	485749	5542980	15-mm	20
6/5/2015	23:08	1	F	W	11	486197	5543303	48-mm	15
WAYNE'S DATA					LATITUDE	LONGITUDE			
5/24/2015	21:36	1	F	S	50.02.340	117.11.976			24
6/24/2015	22:00	1	M	S	50.02.579	117.12.007			13
6/24/2015	22:00	1	F	S	50.02.579	117.11.458			13
			9F						
BEAR LAKE	TOTAL LIVE TOADS ALL OBS:	12	2M						
			1U						

FISH LAKE: DEAD ADULT TOADS

Date	Time	#TOAD	Sex (M/F)	Direction of Travel	Hwy Lane E/W bound	Eggs? Y/N	UTM Zone	UTM EASTing	UTM NORTHing	WAYPT#	HWY SEGMENT#
MARCY'S DATA											
5/14/2015	21:17	1	F	?	W	?	11				6
5/14/2015	22:24	1	F	N	E	Y	11				1
5/17/2105	6:53	1	F	N?	E	N	11				6
5/31/2015	7:20	1	U	N?	W	N	11	486731	5543694	18-mm	7
6/6/2105	7:48	1	M	S	E	na	11	486544	5543601	49-mm	10
WAYNE'S DATA											
								LATITUDE	LONGITUDE		
5/9/2015	6:15	1	F	na	na	?					2
5/9/2015	6:15	1	F	na	na	?					2
5/9/2015	6:15	1	U	na	na	?					2
5/9/2015	6:20	1	U	?	?	?					3
5/9/2015	6:25	1	U	?	?	?					9
5/9/2015	6:25	1	U	?	?	?					9
5/9/2015	6:30	1	U	?	?	?					10
5/10/2015	21:31	1	M	N	?	na					7
5/10/2015	21:35	1	F	?	?	?					6
6/21/2015	13:31	1	M	?	E	na		50.02.766	117.10.761		1
6/21/2015	13:27	1	F	?	E	N?		50.02.704	117.11.196		9
6/27/2015	12:50	1	U	?	E	?		50.02.680	117.11.265		10
6/27/2015	12:55	1	F	?	E	?		50.02.628	117.11.354		12
7/20/2015	10:00	1	F	?	E	?		50.02.617	117.11.374		12
8/13/2015	13:15	1	M	?	E	na		50.02.742	117.10.886		2

FISH LAKE: DEAD ADULT TOADS (CONT.)

Date	Time	#TOAD	SexT (M/F)	Direction of Travel	Hwy Lane E/W bound	Eggs? Y/N	UTM Zone	UTM EAST-ing	UTM NORTH-ing	WAYPT#	HWY SEGMENT#
8/15/2015	13:00	1	U	?	?	?					1
TOTAL			21								
[MM+WM]											
			<u>9F</u>								
			<u>4M</u>								
			<u>8U</u>								
JAKOB'S DATA											
5/6/2015	13:30	1	F	?	?	N	11	486840	5543694	jd-5	5
5/6/2015	13:30	1	F	?	?	Y	11	486787	5543703	jd-6	8
5/6/2015	13:30	1	U	?	?	N	11	486606	5543652	jd-7	9
5/6/2015	13:30	1	U	?	?	N	11	486596	5543643	jd-8	9
5/6/2015	13:30	1	U	?	?	N	11	486547	5543597	jd-9	10
5/6/2015	13:30	1	U	?	?	N	11	486525	5543589	jd-10	10
5/6/2015	13:30	1	F	?	?	Y	11	486461	5543539	jd-11	11
5/6/2015	13:30	1	U	na	na	?	11	487056	5543737	jd-13	2
5/6/2015	13:30	1	U	na	na	?	11	487056	5543737	jd-13	2
5/6/2015	13:30	1	U	na	na	?	11	487056	5543737	jd-13	2
5/13/2015	14:45	1	U	?	?	?	11	486984	5543736	jd-44	10
5/13/2015	14:45	1	U	?	?	?	11	486546	5543614	jd-45	10
5/13/2015	14:45	1	U	?	?	?	11	486484	5543564	jd-46	11
5/13/2015	22:00	1	M	N	?	na	11	486633	5543659	jd-64	9
5/13/2015	22:00	1	M	S	?	na	11	486502	5543579	jd-67	11
TOTAL			15								
[JD]											
			<u>3F</u>								
			<u>2M</u>								
			<u>10U</u>								
			<u>12F</u>								
FISH LAKE			36								
TOTAL											
DEAD											
TOADS											
ALL											
OBS:											
			<u>6M</u>								
			<u>18U</u>								

BEAR LAKE: DEAD ADULT TOADS

Date	Time	#TOAD	SexT (M/F)	Direction of Travel	Hwy Lane E/W bound	Eggs? Y/N	UTM Zone	EASTing	NORTHing	WAYPT#	TRANSECT#
MARCY'S DATA											
5/17/2015	6:48	1	F	N	E	N	11	486307	5543411		13
5/31/2015	7:06	1	M	N	E		11	485649	5542988	17-mm	25
WAYNE'S DATA											
6/16/2015	7:10	1	F	?	E	?		LATITUDE	LONGITUDE		26
7/20/2015	10:30	1	F	?	E	?		50.02.584	117.11.451		24
7/22/2015	3:00	1	U	?	?	?		50.02.584	117.11.451		24
7/29/2015	2:50	1	F	?	E	?		50.02.565	117.11.475		13
8/11/2015	2:15	1	U	?	?	?		50.02.572	117.11.472		22
8/13/2015	2:30	1	F	?	?	Y?		50.02.585	117.11.452		22
8/16/2015	2:00	1	U	?	E	?					13
BEAR LAKE	TOTAL DEAD TOADS ALL OBS:	9	5F <hr/> 1M								3U

APPENDIX 2

Table 5. Results of all 2015 drive-by and walking surveys of LIVE and DEAD adult toads crossing Highway 31A within 27 highway segments between Fish & Bear Lakes. Refer to Figure 1 for segment locations. Note that highway segment 11-12 extends slightly past Fish Lake and highway segments 25-26 and 26-27 extend slightly past Bear Lake to Zincton. Segments are grouped into four survey areas for a breakdown of totals by area.

Highway Segment (N=27)	Total LIVE Toads (N=133) (13 nite counts)			Sex (Female (F), Male (M), Unidentified (U))			Total DEAD Toads (N=45) (42 day counts)			Sex (Female (F), Male (M), Unidentified (U))			Nearest Breeding Area & at Breeding Area [Fish Lake only]
	LIVE	Female	Male	Unidentified	DEAD	Female	Male	Unidentified					
Goat Ck. to W. End Fish Lake	LIVE	Female	Male	Unidentified	DEAD	Female	Male	Unidentified	1) Fish Lake Rest Area 2) Middle Fish Lake 3) West End of Fish Lake				
1-2	9	4	5	0	3	1	1	1	Near 1				
2-3	11	5	5	1	7	2	1	4	At 1				
3-4	7	3	4	0	1	0	0	1	Near 1				
4-5	3	2	1	0	0	0	0	0	Near 1				
5-6	4	0	4	0	1	1	0	0	Part at 2				
6-7	3	1	2	0	3	3	0	0	At 2				
7-8	13	8	5	0	2	1	0	1	At 2				
8-9	8	6	2	0	1	1	0	0	Near 2				
9-10	22	11	11	0	6	1	1	4	At 3				
10-11	27	15	12	0	7	0	1	6	At 3				
11-12	8	1	7	0	3	1	1	1	Near 3				
Total	115	56	58	1	34	11	5	18					
W. End Fish Lake to E. End Bear Lake	LIVE	Female	Male	Unidentified	DEAD	Female	Male	Unidentified					
12-13	6	4	2	0	2	2	0	0	3				
13-14	2	1	1	0	3	2	0	1	3				
14-15	1	1	0	0	0	0	0	0	na				
Total	9	6	3	0	5	4	0	1					

E. End Bear Lake to W. End Bear Lake	LIVE	Female	Male	Unidentified	DEAD	Female	Male	Unidentified	
15-16	1	1	0	0	0	0	0	0	
16-17	0	0	0	0	0	0	0	0	
17-18	0	0	0	0	0	0	0	0	
18-19	0	0	0	0	0	0	0	0	
19-20	1	0	1	0	0	0	0	0	
20-21	1	0	0	1	0	0	0	0	
21-22	0	0	0	0	0	0	0	0	
22-23	0	0	0	0	2	1	0	1	
23-24	0	0	0	0	0	0	0	0	
24-25	2	2	0	0	2	1	0	1	At breeding area?
25-26	3	3	0	0	1	0	1	0	Near breeding area?
Total	8	6	1	1	5	2	1	2	
W. End Bear Lake to Zincton	LIVE	Female	Male	Unidentified	DEAD	Female	Male	Unidentified	
26-27	1	1	0	0	1	1	0	0	Near breeding area?
27-28	0	0	0	0	0	0	0	0	
Total	1	0	0	0	1	0	0	0	
Overall Total	133	69	62	2	45	17	7	21	

APPENDIX 3. Field observations of August 2014 toadlet migrations at Fish Lake rest stop (W. McCrory)

August 8. Stopped and there were thousands of small toadlets at the picnic site, along lawn at the lakeshore. No sign of migration. The weather has been very hot with no rain for at least two weeks. The hot weather continued through the weekend.

August 12. I drove by heading east about 14:15 hrs. and there were no toadlets on the road at the rest stop. It started raining 5 km to east of Fish Lake about 18:00 hrs. with the rain coming up Kootenay Lake and then up Keen Creek (i.e. not from the west). When I got to Fish Lake about 19:20 hrs., a migration was in full force with an estimated 10,000 toadlets acrossing the pavement at the rest stop, moving quite quickly. I had to drive through it. The migration was for about 30-40 m distance on the road from about the outhouse to the boat launch road to the west. There was no evidence of rain having fallen here. Fortunately for the toadlets there was not much traffic at this time of day; unlike the slaughter we observed last August that was earlier in the day.

August 13. Weather cloudy with some sun, hot. VWS director Craig Pettitt took pictures of some of the slaughter at the rest stop. He drove east about 13:30 hrs. and there no live toadlets on the road. When he came back past the rest stop about 15:30 hrs. there were 4 toadlets crossing the road.

August 14. Overcast in a.m. Started heavy rain around noon. I went to Fish Lake with four students, arriving around 13:30 hrs. The road at the rest stop was covered with toadlets, including bunches in the trees by the garbage bins that were moving to the highway. It was hard to estimate but likely 20,000 were migrating. There were only a few east of the outhouse. Most appeared to be moving straight across the highway, north. A large cluster was also coming out of the shrubs and crossing the road for about 30 m to the w. of the boat launch road where someone was driving out with a boat and trailer and then drove east on the highway over the migrating toadlets. The five of us worked in the rain until 14:45 and probably bucketed across 1,000 toads. There was considerable traffic including motor bikes, with different parties pulling in to the rest stop. What is noteworthy is that no toadlets were observed on the highway elsewhere along Fish Lake.

August 18. A bit cloudy. Very muggy. No rain. However it had continued to rain heavy on August 15 with intermittent rain on August 16-17.

I stopped at the Fish Lake rest stop around 15:00 hrs. There were no toadlets on the pavement. However, all along the lakeshore there were thick clusters. They are very sensitive and as soon as you appear, the piles break down and they head for the lake. There were thus tens of thousands more to migrate yet. I went to the area just west of the boat launch and same thing. There was a dark garter snake amongst them that slithered off. It must be having a picnic. I am glad I am not around for the next rain-triggered migration event.

Sept. 6. Was still a small amount of toadlets along the lakeshore at the Fish Lake rest stop.

APPENDIX 4. Field observations of 2015 toadlet migrations at Fish Lake

1a. Fish Lake – 2015 West end toadlet migration. Breeding Area 3 summary

This appeared to have by far the highest number of toadlets but the whole west end staging area was not surveyed. This area was not well monitored until after July 20 when one toadlet at the adjacent highway suggested a migration had started or was already occurred. One dead toadlet was also observed on the highway near here on July 27.

Migration events were observed or suspected in association with storm-rain events during periods of hot summer weather: July 20 (likely), July 27-28, August 5 (likely), August 15-16 to perhaps 24. All migrations events here appeared over by August 30.

The direction of movements was interesting in the it was westward away from the lake with most of the movements observed along the ATV trail below the highway and on the logging road that crosses the valley to the south. I suspect some of the west end toadlets also disperse along the main creek as some were observed in August on the logging road bridge over the creek. Only small numbers appear to move along the highway and cross over but I suspect this might vary from year to year. This is inconsistent with the fairly consistent numbers of adults crossing highway 31A to this west end breeding area in May. However, the lack of observations of toadlet highway crossings here during the two major 2014 August crossing events at the Fish Lake rest stop supports that the west end toadlets have mainly a west and south-west oriented dispersal pattern that does not involve crossing highway 31A.

1b. West end toadlet. Breeding Area 3 field data

July 20. While low numbers of toadlets were observed along the shore at the red bench, high numbers were observed on the mud flats at the west end of the lake. I did not spend much time looking for any movements to the west of the lake but did look along the edge of the highway. **Segment 9-10**. Only one toadlet was observed at the highway in the west end area. This was at 10:40. It was at the south edge of the pavement pointing north and I carried it across the highway and released it. No other toads were observed in any of the adjacent road side vegetation on this segment.

July 25. 13:30 hrs. Walked edge of road from wildfire sign (**segment 10-11**) to corner of Fish Lake but no toadlets observed. However, tens of thousands near shore in amongst the sedges and other vegetation.

July 27. 13:40-13:50 hrs. **Migration event**. Walked the same segment along the highway but saw no toadlets. Near the segment 10 point, there was one dead, desiccated toadlet at the edge of the pavement.

ATV Wagon Road Trail just below hwy. Segment 10-11 WRT. I walked this from about segment point 10 westward, away from the west end of Fish Lake. The small earth-moving machine observed working above the highway on private land had recently travelled along this trail, which likely borders between private land and the highway 31A right-of-way. I

counted 3 toadlets in the first 100 m and then literally thousands all moving westward along the trail (and not the highway) to the wildfire sign at point 11.

Here some were moving westward along the logging road (**Segment 11-11a WRT**). I only walked 30 m as there were hundreds of migrating toadlets that I did not want to step on. From here (**Segment 11-12**) I walked for 60 m west along the s. edge of the pavement where there were hundreds of toadlets moving west on their outward dispersal but they petered out at about 60 m from the wildfire sign. None were observed crossing the highway.

July 28. 14:50 hrs. (**Segment 11-12**). Walked 200 m on both sides of hwy. to west of wildfire sign and no toadlets. **Segment 11-11a WRT**. Walked 40 m in from hwy. Were about 1,000 toadlets moving s.w., using the logging road for travel. I turned back as did not wish to step on any. **Segment 10-11 WRT**. I walked 35 m on ATV trail but no toadlets. Tail end of large wave appears to be migrating along log road and away from the highway.

July 29. 16:10 hrs. **Segment 11-11a WRT**. Walked in log rd. for 125 m but saw no toadlets.

August 12. 17:10 hrs. There was now a decreased (low) toadlet density in the staging area-vegetated mud flats at the west end of Fish Lake when compared to the last survey in July. I walked in 200 m. Some of the toadlets appear to be moving westerly up the moist muddy subchannels. It rained on August 5 and a migration is suspected to have happened judging by the lower toadlet densities at this staging area.

August 15. 15:30 hrs. **Migration**. Weather has been very hot but some thunder showers the previous night and cloudy, moist conditions and the toadlet observations here today suggest there may have been a migratory event today. **Segment 11-11a WRT**. The 400 m log road was walked to the end on the south side of the creek between Bear and Fish lakes. No toadlets were encountered in the first 50 m but towards the bridge there were about 50 toadlets that appeared to be on the move. On the s. side of the bridge there was one toadlet 5 m from the bridge and another 8 m. It appears that many of these may represent a migration route along the riparian edges of the creek and drainage channels rather than those previously documented that came up the ATV trail from the lake to the logging road.

Segment 10-11 WRT. I walked the 150+ ATV trail to the west end of Fish Lake and counted about 100 toadlets. On the way back I walked along the s. side of the highway and saw no toadlets until near the log road at segment station 11 where there were 3 toadlets on the highway n. lane and nearly crossed and 1 still on the s. side that I carried across.

All toadlets here are still as small as the ones previously measured and weighed at the Fish Lake rest stop.

August 16. 15:30 hrs. **Migration still in progress**. Collected about 20 toadlets at pullout by wildfire sign and located them to n. side of hwy. as appeared to be oriented in that direction even though there were 100 toadlets counted in the first 30-40 m heading s.w. down the logging road on **Segment 11-11a WRT**. We turned back so as not to step on the toadlets. **Segment 10-11 WRT**. Far fewer toadlets (20-30) estimated on whole transect to lakeshore area.

August 23. 14:05 p.m. A quick check 10 m down the log road showed no toads on road or gravel pullout.

August 24. 11:00 hrs. **Migration nearly over. Segment 11-11a WRT.** None at road. 3 toadlets on bridge over creek, 1 – 3 m n. of bridge. **Segment 10-11 WRT and Segment 10-11.** None on ATV trail or along edge of highway.

August 30. 17:30 hrs. Heavy rains. **Migrations over.** All transect survey segments were checked showed no toadlets.

2a. Fish Lake - Middle lake (Large culvert & creek) toadlet migration. Breeding area 2 summary

Although in 2015 large aggregations of toadlets were observed along the lakeshore here, most often no toadlet migrations were observed across the highway when small and large migrations were observed at the Fish Lake rest stop. This is consistent with the lack of observations of toadlets crossing the highway here during the two major 2014 August highway crossing events documented at the Fish Lake rest stop. The one migration event was on July 25 when after a rain event 200-300 staged along the south (lake) edge of pavement, facing north. One hour later I observed 100 dead on the highway and the movement essentially appeared to be over.

2b. Fish Lake - Middle lake (Large culvert & creek) toadlet migrations. Breeding area 2 field data

July 20: While there were large aggregations of toadlets observed along the shore here, none were observed at 10:35 hrs. on the highway or along the edges.

July 25. 13:25-14:00 hrs. **Migration. Segment 4-5:** I first walked the highway edge here but no toadlets were observed. However, at 14:00 hrs. there were 200-300 staging, with more coming, at the south edge of the pavement, having travelled the 30 m through the undergrowth from the shore to the highway. When I checked back at 15:00 hrs. there were about 100 dead on the road, very small numbers trying to cross but higher numbers on the south side, possibly going back to the lake although it was hard to tell. I checked again at 15:40 and there were only a few crossing the highway and along the road.

July 27. 14:00-14:30 hrs. Although there was evidence at the Fish Lake rest stop of an outward toadlet migration, possibly from yesterday's rain event, there was no evidence of live or dead toadlets between the large culvert and the red bench. Large aggregations of toadlets were observed along the shore on either side of the large culvert but none were observed further than 2-3 m in the vegetation back from the lakeshore or along the creek between the lake and the culvert under the highway.

August 12. 17:20 hrs. There was now a decreased (low) toadlet density in the staging area semi-vegetated shoreline along middle Fish Lake when compared to the last survey in July. It

rained on August 5 and a migration is suspected to have happened judging by the lower toadlet densities at this mid-lake staging area.

August 15. 15:45 hrs. Weather has been very hot but some thunder showers the previous night and cloudy, moist conditions. However, but no movement activity was noted here. I checked the highway and the creekside area to the lake. There were only about 30-40 toadlets still along the lakeshore.

August 24. 11:00 hrs. None along pavement.

3a. Fish lake rest stop toadlet migration. Breeding Area 1 summary

The most field surveys were done here. Migration events were observed or suspected in association with storm-rain events during periods of hot summer weather: July 20, July 27-28, August 5 (likely), August 15-16 and August 24. All migrations appeared over by August 30.

Pathways of movement including direction of travel and route taken through and from the rest stop lakeshore staging area varied in subtle but significant ways that have some bearing on proposed mitigation measures in the future. The one small and one major migration event in late July appeared to focus on traveling n.e. through the rest stop (when tourists were often present) and then crossing the highway, with heavy mortality. We did not document the apparent August 5 large migration. The two smaller migration events in mid and late August were more eastward, not across the highway. Even these varied with the August 15-16 one traveling through the rest stop and then to the s. side of the Goat Creek bridge and the last (Aug. 25) traveling along the beach only and apparently down the outlet creek. A summary of these is as follows:

- On July 20 small numbers toadlets moved through the rest stop and crossed the highway n.e. from the garbage bin area. This was a short migration period due to the return of hot weather and the pavement drying out late in the morning that appeared to cause toadlets to die on the hot pavement and thus stultify the migration.
- On July 25 there was a very large migration that appeared to involve tens of thousands of toadlets. Most of these moved through the trees at the rest stop in a n.e. direction and then crossed the highway at the garbage bin-outhouse area in a n.e. direction. At least 1,000 were estimated to be killed on the highway. On July 27 there were no toadlets moving in the core migration area but peripheral areas to the n.e. had about 900-1300 toadlets still dispersing n.e.: 400-600 on the Wagon Road Trail incl. 200-300 crossing the wooden bridge and 500-700 clustered on the n. and s. sides of the Goat Creek bridge on the west banks. These appeared to be crossing on the outside iron girders of the highway bridge. On the n.e. side 20-30 had already crossed and were migrating e. along the cement abutment at the edge of the highway.
- The heavy rain event on August 5 likely triggered a large migration but this was not confirmed but reported to us anecdotally.

- On August 15-16 a small migration event occurred through the rest stop but none appeared to cross the highway but travelled along the s. defined “edge” of the pavement to the s. side of the Goat Creek bridge where they were using the new wooden bridge structure we built for them to cross under the Goat Creek bridge. Some also appeared to be moving through the undergrowth along the s. edge of the pavement.
- August 25 was the last migration observed, which was different from August 15-16. About 500-800 were slowly making their way eastward on the beach in front of the picnic area and appeared to be moving e. down the creek at the outlet or perhaps crossing at the log jam and going up the mountain on the s. side of the lake.

3b. Fish lake rest stop toadlet migration. Breeding Area 1 field data

This site (**Segment 1-2**) was the most intensively surveyed.

July 20. First toadlet migration observed after some rainfall last night after several days of very hot weather. We are not sure of the date of the first migration due to our not doing any surveys between July 5 and July 20.

10:10 hrs. Rest stop. **Small migration event**. Dense aggregations were observed along the shore just west of the boat launch site. Hundreds of toadlets were also observed on the rest stop lawn moving north-easterly towards the highway. I noted 20-30 perched on the side of the large cement barrier that had been placed at the boat launch to block off boat access to protect the toads and toadlets. No toadlets were observed crossing the highway and none were observed along a transect along the adjacent Wagon Road Trail just to the north. At 11:20 hours I counted 100 toadlets crossing the road in front of the boat launch and garbage bins. Some were being killed by tourism traffic. However, the pavement had dried up and was now absorbing heat from the hot sun. I assisted the 5-6 toadlets left on the highway but some appeared stationary and dead from the increased heat. The movements to the highway from the rest stop lawn appeared to suddenly stop by 11:30 and the ones left on the lawn no longer appeared to be moving north-east towards the highway.

July 22. No rainfall since July 19. Similar large aggregations just to west of boat launch with only a few scattered on the lawn.

July 25. 13:30-15:40 hrs. 13:30: Started raining heavy yest. p.m. and still raining in a.m. and now. **Second and large migration observed taking place**. This appeared the largest yet with few toadlets left along the usual staging area near the boat launch. I would estimate that tens of thousands moved today. Thousands were moving n.e. across lawn and on the road at the same time there was a considerable amount of tourism traffic. An estimated 1,000 were crossing the highway in a n.e. direction or straight across, with quite a number killed. The numbers had increased by 14:00 hrs. with thousands still moving n.e. at the rest stop, most under the trees near the highway, past the garbage bins and outhouse (as tourists walked around), many trying to cross the highway. The numbers observed killed at this time was

likely over 1,000. I left to check other areas and when I came back at the rest stop at 15:30-15:40 hrs. there were still 200-300 observed on the wet pavement, but many of these appeared killed by traffic. There were still large clusters near the road at the boat launch and east of the outhouse, still appearing to be migrating in the rain. Goat Creek and the Wagon Road Trail were not checked on this date.

July 27. 14:00-14:30 hrs. **Peripheral migration important**. It had rained hard all day on July 26 with the weather now clearing and the pavement mostly dry, even though there was still a small amount of drizzle. There were no toadlets on the road at the rest stop. Tens of thousands were aggregated in large clumps along the shore just w. of the boat launch, in the usual place but smaller aggregations were noted on small sites with black exposed soil on the (now closed) boat launch pathway. No toadlets were observed on the lawn or by the outhouse where they had been observed the other day. These observations suggest that the previous migration on July 25 likely was over but that the recent rain had not caused further migration from the staging areas. However, toadlets observed still migrating in the following peripheral migration zone were likely from July 25 or possibly July 26. Goat Creek bridge: No toadlets were observed along the edge of the highway between the rest stop and the bridge. However, an aggregation of 200-300 was observed on the w. bank at the s. side of the bridge, with a small number down in the boulders along the creek. Another 200 were observed along the edges of the cement abutments leading up to the bridge, these appeared to be making their way to the bridge. One was observed crossing eastward on the outer metal girder on the s. edge of the bridge. On the n. side of the bridge, one was observed crossing eastward on the outer metal girder as well, with one at the creek bank and only another 10 at the west end of the abutment that comes in to the bridge. There were also 200-300 clustered on top of the bank right at the w. edge of the n. side of the bridge, perhaps staging to cross on the outer steel girder. Noteworthy was that on the east side of Goat Creek, about 20-30 toadlets had crossed and were scattered along the 100 m long cement abutment (obviously having crossed the edge of the bridge) with a few also still moving through the grass towards the east. I did not record it but I did photograph a medium-size light brown garter snake coiled up about 3 m away from the e. end of the abutment where the toadlets crossed to the thicker vegetation.

Wagon Road Trail (segment WRT 1-2): At 14:00 hrs. at the top of the short road from the highway (past the weather station) there were 200-300 toadlets moving up the road and n.e towards the Wagon Road Trail bridge. At about 14:30 when I checked again there were far fewer. There were 200-300 crossing the bridge eastward, in the leaves, and appearing to stick to the edges where there is a wooden border.

July 28. 15:05. **Segment 1-2**. Toadlets aggregated along shore at rest stop at same place as yesterday. No new movements. Goat Creek Bridge. Still 200-300 aggregate on w. bank on s. side of bridge in same area and 300-400 on n. side, with some trying to move n. up steep rocky bank along edge of Goat Creek.

July 29. 16:15 hrs. **Segment 1-2**. Only small numbers along shore off of the rest area lawn but still one large aggregation on shore just w. of boat launch. Goat Creek Bridge. There were only 50-100 today, and the large cluster that was just to the s. of the artificial crossing site was gone. On the n. side, it was the same with only 50-100. Along the n.e. side

of the bridge and abutment I saw no toadlets but the same garter snake as the other day when toadlets were moving along here was still coiled 3 m from the end.

August 12. 17:20 hrs. **Possible August 5 migration. Residual migration still occurring.**

There was now a decreased (low) toadlet density in the staging area along the shore just west of the boat launch compared to the last survey in July. It rained on August 5 and a migration is suspected to have happened judging by the lower toadlet density at this staging area and the residual migrants observed today. There were a few toadlets hiding in the spaces between the cement abutments towards Goat Creek bridge. Much later at 19:30 hrs. volunteers found one toadlet by the outhouse and another 10-12 moving along the s. edge of the pavement towards the Goat Creek Bridge. All of these were relocated across the highway. This suggests the tail end of a large migration after the Aug. 5 rainstorm. Goat Creek bridge. On the s. side, we installed a plank bridge. There were only about 12 toadlets. These were down in the creek bed and were relocated to the trees n.e. of the bridge. On the n. side, a new plank bridge was installed. 2-3 toadlets were picked up in the creek bed and relocated to the trees on the opposite side. Otherwise no other toadlets were observed on the n. side and there was no garter snake waiting at the end of the abutments on the n.e. side of the highway. Wagon Road Trail (segment WRT 1-2). A survey was made up the small ATV trail on the east side of Goat Creek to the Wagon Road Trail, across the bridge, and back down to the highway. No toadlets were observed.

August 13. While installing plastic barrier fences at wooden crossings at Goat Creek bridge, similar observations of toadlet numbers and distribution were made as yesterday.

August 15. 15:45 hrs. **Small migration through rest stop.** Weather has been very hot but some thunder showers the previous night and cloudy, moist conditions today may have triggered some toadlets to migrate. There were now only small numbers of toadlets along the lakeshore transect in front of the lawn and just to the w. of the boat launch as well as some migrating through the trees near the highway. Some 30-40 toadlets were collected in a bucket from between the cement blocks at the boat launch and the outhouse. Some of these were jammed up against the bases of tree trunks near the outhouse and garbage bins. There were relocated across the highway.

None were observed crossing the highway or on the (segment WRT 1-2), Wagon Road Trail Bridge or any of these associated small trails. However, at the s. side wooden bridge we built at Goat Creek bridge, there were 3-4 toadlets on each side of the plastic diversion fence. Another 3-4 were working their way down the bridge so it is working. Another 3-4 had worked their way around the Goat Creek side of the fence and these, plus another, were collected and moved to the n. e. side. A mother and several of her children picked up about 20 toadlets from areas just to the west of the wooden bridge on the s. side of Goat Creek and put on the bridge. This included several toadlets that were in the recently mowed vegetation 2 m off of the pavement.

I also observed small numbers of toadlets moving towards the s. side of the Goat Creek crossing from the rest stop, more through the vegetation than along the very edge of the pavement. **This time there appears to be more direct migration movement from the rest**

stop staging areas only to the s. side crossing of Goat Creek. These movements appear to have some variances.

August 16. 14:00 hrs. Very hot. No toadlets observed moving through the rest stop treed area near the outhouse and garbage bins. Small numbers along the beach in front of the picnic areas but the usual staging area west of the boat launch is empty. None were observed crossing the highway. We bucketed 40 toadlets from the beach to n.e. of the Goat Creek bridge. Another mother and several children had come to help toadlets across the road and picked up about 20 toadlets at the rest stop and near the wooden crossing and I showed them where to release them on the n. side. They had also collected 3-4 juvenile frogs that I told them needed to be put back in Fish Lake – which they did.

Goat Creek bridge: 14:30 hrs. **Migration still occurring.** One toadlet crossing artificial bridge on n. side. On s. side was a steady stream of small numbers moving along each edge of artificial fence to the board bridge and using the bridge. A small number were assisted. Probably 15-20 crossed over the period of an hour. **Segment WRT 1-2.** None were observed on the Wagon Road Trail, bridge, etc. However, an ATV came along and as well there was a truck camper camped at the small campsite on the w. side of Goat Creek just off the Wagon Road Trail. This should be closed off during toadlet migration season.

August 23. 14:30 p.m. **Had been some rain on August 21-22 that appears to have triggered some migration along the beach?** The water levels have dropped to provide a wider (1 m) beach than previously. The decreasing water levels over the summer may influence staging and movements from the rest stop with more using the beach rather than the lawn as more of the beach becomes exposed. Only one toadlet was found just w. of the boat launch but about 100 were scattered along the beach and edge of lawn in front of the picnic area. Five were moved to the east side of the Wagon Road bridge.

No toadlets were observed on the Wagon Road trail, Wagon Road bridge or at the Goat Creek wooden crossings or between the crossings and the rest stop. A search amongst the rest stop movement area in the trees showed no toadlets.

August 24. 10:00 hrs. None on beach just w. of boat launch but one in grasses towards cement abutments. This was located across the highway. Only 10-20 along beach in front of picnic site. None in other areas at Goat Creek or Wagon Road Trail bridge.

August 25. 14:00 hrs. **Last migration along beach at rest stop different pathway than previous.** There were no toadlets on the beach just w. of the boat launch but there were 500-800 estimated to be on the beach in front of the picnic area, far more than the last survey. Where did they all come from. Weighed 45 in a bag, some were twice the size of others but still all small. These were released on e. side of Wagon Road Trail bridge. The toadlets on the beach were definitely moving eastward towards the outlet of the lake where 5-6 were noted in the riparian. None were found on the lawn. A search to the Goat Creek wooden bridges and Wagon Road Trail bridge showed no toadlets. It was concluded that this last migration was different than the others in that only the beach and riparian at the lake outlet

were being used – and either the toadlets were crossing the log jam at the outlet to migrate west up the mountain or following the creek downstream.

August 30. 17:30 hrs. Heavy rains. **Migrations over**. All transect survey segments showed no toadlets. One juvenile spotted frog along the beach in front of the picnic area.

Sept. 5. 17:00 hrs. Heavy rains. **Migrations over**. All transect survey segments showed no toadlets.

APPENDIX 5. Field observations of 2015 toadlet migrations at Bear Lake

August 23. 18:40 hrs. **Small toadlet migration**. Although we checked the roadside adult toad crossing area at the west end of Bear Lake (**Segment 24-25**) on the same days as we did our July-August toadlet surveys at Fish Lake, we did not find any toadlets until August 23 when one toadlet was found in the s. side lane, moving s., about 30 m east of the end of the lake. It was moved to the s. side of the road. Another two along the edge appeared dead from the heat. N 50 02 334 W 17 11 983.

August 24. 11:25 hrs. No toadlets along edge of highway (**Segment 24-25**) and also the lakeshore below the cement abutment. Waded mud flats and log debris shoreline for about 100 m now that water levels have dropped. Red osier shrubs, some emergent grasses/sedges. No toadlets. I checked along the highway for 300 m and found no culvert that might be re-designed for a toad/toadlet crossing.

END