Western Toad Breeding Site Inventory for Gwaii Haanas National Park Reserve and Haida Heritage Site 2005-2006

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Introduction

Rationale

The Western Toad (*Bufo boreas*) was designated a species of "Special Concern" by COSEWIC in November 2002 due to widespread and unexplained declines in the southern part of its range in British Columbia (COSEWIC 2002). Although it is currently yellow listed in BC, the Western Toad is ranked an S4 species, indicating that it is considered to be of conservation concern. *B. boreas* is the only IUCN red-listed amphibian species occurring in Canada. The IUCN listing was also prompted by the severe and rapid declines in abundance and range further south (USA). While the causes of theses declines remain largely unknown, they likely include habitat loss and alteration, disease, and introduced exotic predators and competitors (Wind and Dupuis 2002). Within Gwaii Haanas, Western Toads are protected from habitat loss, but remain vulnerable to the other identified threats.

The Western Toad is the only amphibian species native to Haida Gwaii (the Queen Charlotte Islands). In the 1930s and again in the early 1960s, the Pacific Treefrog (*Pseudacris regilla*) was introduced to areas in the northern portion of the archipelago and has now become widespread throughout Graham Island and the northern portion of Moresby Island (Reimchen 1991). In 2002, a second frog species, the Red-legged Frog (*Rana Aurora*), was identified in several locations near Port Clements and Juskatla on Graham Island (Golumbia et al. In press). The effects of these introduced frogs on toads and the native ecosystems of Haida Gwaii are not well understood. They may compete with toads either directly or indirectly (Golumbia et al. In press), and adult treefrogs may be predators of Western Toad eggs (Wind and Dupuis 2002). There is also evidence that adult toads are being heavily predated within Gwaii Haanas by raccoons (*Procyon lotor*), another introduced species (Reimchen 1992).

Background

Throughout the year, Western Toads occupy three different types of seasonal habitat: aquatic breeding sites in the spring (ponds, wetlands and shallow margins of lakes or streams), moist upland feeding habitat in the summer, and terrestrial hibernacula in the winter. Locating hibernacula is notoriously difficult. And because they are relatively resistant to water loss, Western Toads use a broad range of habitat types during the summer, including all biogeoclimatic zones found in Gwaii Haanas. Breeding sites are therefore obvious focal points to assess the status and trends of toad populations.

The demographics of most pond-breeding anurans, including Western Toads, are highly variable at local scales, with fluctuating abundances and periods of absence or local extinctions (Trenham et al. 2003). This means that intensive monitoring of individual breeding sites, such as measuring abundance of the different life history stages, can be problematic. At a larger geographic scale, however, the occupancy rates of breeding sites are relatively stable over time (Blaustein et al. 1994). The most promising long term monitoring approach for Western Toads, therefore, is to monitor breeding site occupancy at as many sites as possible over as large a geographic area as possible.

Objectives

The objectives of this project were:

- to assess the distribution of Western Toads and non-native frogs in Gwaii Haanas
- to locate as many Western Toad breeding sites as possible throughout Gwaii Haanas
- to investigate the presence of infectious disease (chytrid fungus, chytridiomycosis) and document malformations
- to document the extent of raccoon predation on toads at breeding sites
- to develop a long term monitoring strategy for Western toads and non-native amphibians for Gwaii Haanas

Methods

At the outset of this project we conducted a literature review to collate the little information available about amphibians on Haida Gwaii.

In 2005 we conducted a pilot study at field sites near Queen Charlotte City to assess the effectiveness of various survey techniques including visual encounter surveys, dipnetting and funnel traps. We also visited low elevation and subalpine sites in Gwaii Haanas to determine the timing of breeding, egg laying and larval emergence.

Between May and August 2006 we surveyed 13 low elevation (< 100 m) lakes, ponds and wetlands along the east coast of Gwaii Haanas. This represents virtually all of the potential breeding sites that appear on a 1:20,000 topographic map and can be reasonably accessed during a day trip via patrol boat. We also surveyed several potential breeding sites in the subalpine area above Island Bay (Mt. Yatza area), and with helicopter access, we surveyed a series of lakes/ponds in the high alpine between Bigsby and Sunday Inlets. Access issues prevented our surveying additional high elevation sites or any west coast sites.

At each site we conducted a two or three person Visual Encounter Survey. Wearing chest waders, surveyors walked as much of the perimeter of each breeding site as possible, visually scanning the shallows, the shoreline and nearby terrestrial habitat (~10 m from the water margin) for evidence of breeding (adult breeding congregations, egg masses, larvae/tadpoles and emerging toadlets). Individuals were captured by hand or dip-net and maximum snout-vent length (SVL) was measured for each toad/toadlet and total length (TL) for a sample of tadpoles at each site. Each individual was screened for clinical signs of disease (e.g. abnormal behavior such as lack of flee response, abnormal posture, or abnormal appearance such as thickened epidermis, sloughing of skin or abnormal mouthparts) and abnormalities such as deformities or missing limbs. Habitat characteristics were recorded for each site including elevation, water temperature, substrate type, amount of emergent vegetation, dominant riparian vegetation and presence of fish. All signs of raccoon predation (inverted toad skins) were recorded. Toads have poison glands in there skin that protects them from most predators. The raccoon's dexterity enables it to prey on toads by peeling the skin and leaving the toxic portion behind. We also surveyed each site for evidence of non-native frogs. Frog eggs are deposited in clusters, readily distinguishable from clutches of toad eggs that form long

strings. Toad tadpoles are uniformly dark in color with eyes positioned dorsally relatively high on the head. Frog tadpoles are less uniform in color and have lateral eyes that break the silhouette of the body. Unlike breeding toads, frogs are highly vocal throughout the breeding season, making their presence readily detectable.

Results

Distribution

Adult Western Toads are found throughout both Graham and Moresby Islands from the north to south and east to west. They have been observed in forested and open areas, from sea level to the subalpine (Burles et al. 2004 and this study). There are no records of toads on any of the smaller, more remote islands of Haida Gwaii. During this study, surveys were focused on the portion of Moresby Island within Gwaii Haanas and at only one site on an offshore Island. We found no evidence of toads on Lyell Island.

It appears as though the non-native amphibians found further north in Haida Gwaii have not yet colonized Gwaii Haanas. In 1982s, there was a single reliable observation of a Pacific Treefrog at the stream mouth in Anna Inlet at the northern end of Gwaii Haanas (Reimchen 1992). No signs of introduced frogs were recorded in this area or at any other sites surveyed in Gwaii Haanas during this project.

Breeding Sites

During this project a total of 16 potential breeding sites were surveyed and evidence of Western Toad breeding was observed at 5 of these sites: Poque Lake, Dead Toad Lake, Tadpole Lake, Post Lake and Lutea Lake. Toad tadpoles have been reported at a sixth site within Gwaii Haanas, Upper Victoria Lake (Reimchen 1994). We were unable to access this site during the course of this project, but assume it continues to be used as a breeding site.

Throughout their range, Western Toads are known to lay eggs in a variety of different aquatic habitats including ponds, stream edges, shallow lake margins and even roadside ditches. To date, however, all breeding sites recorded within Gwaii Haanas are in permanent lakes greater than 1 ha in size. Other consistent habitat attributes found among breeding sites include the presence of a least some emergent vegetation and the presence of fish. Toads were observed breeding in lakes with varying types of substrate and riparian vegetation, both clear and stained water, varying water depths, and temperatures between 13°C and 17°C (see Appendix 1).

Although adult and subadult toads have been observed from sea level to areas well above 500 m, all the known breeding sites recorded in Gwaii Haanas are below 100 m in elevation. It is not known how far toads range in search of food, breeding sites or hibernacula, but movements of 1 to 3 km have been documented (Burles et al. 2004). It is therefore possible that the toads seen at higher elevations, such as around Mt. Yatza, have traveled upland to feed from distant breeding sites (e.g. Upper Victoria Lake). A recent amphibian study in Southeast Alaska noted that toad breeding sites were widely separated from each other. They speculate that with declining toad populations, mating adults from

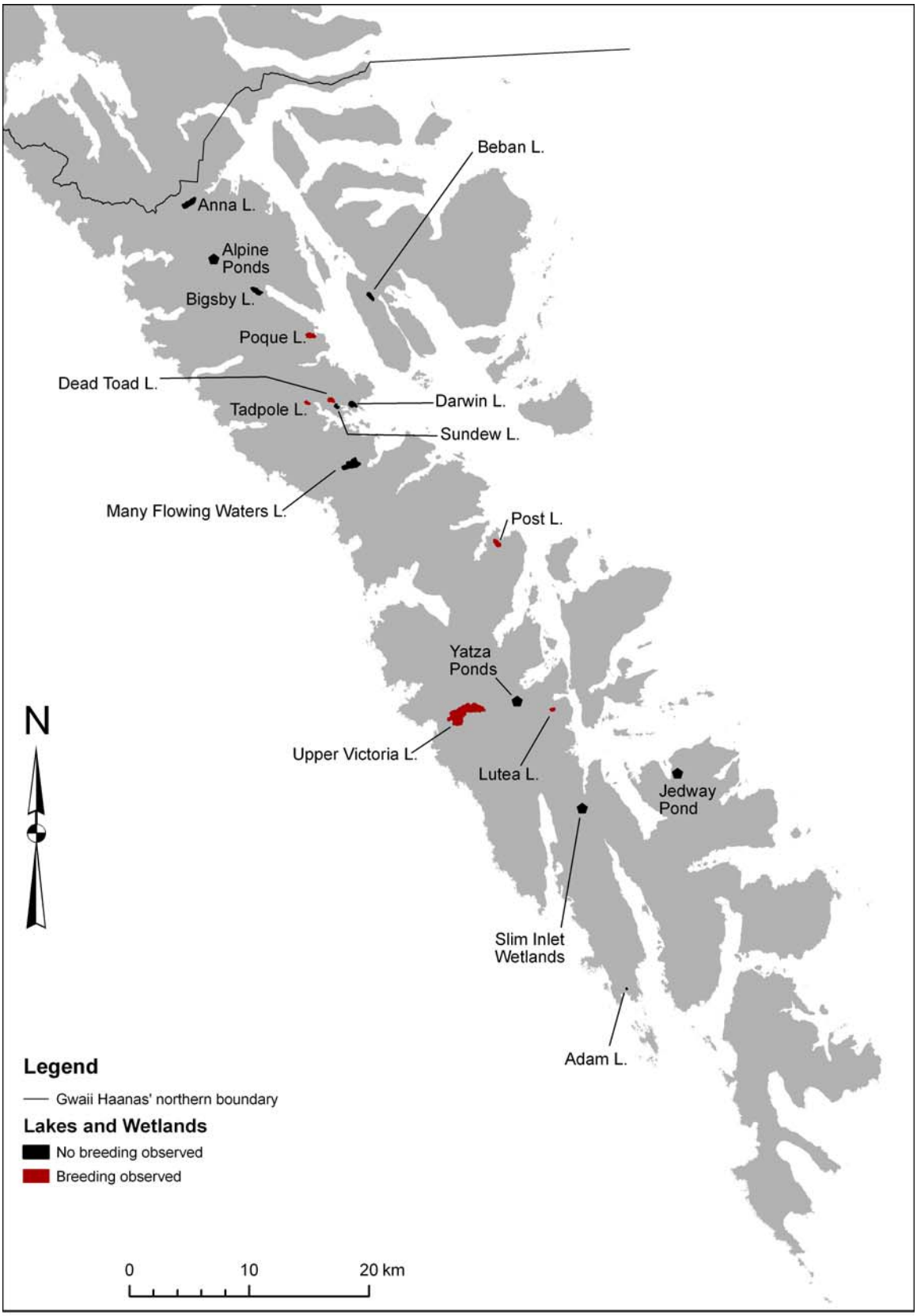

Figure 1. Location of Western Toad breeding sites within Gwaii Haanas. Sites surveyed in 2005-2006 with no evidence of toad breeding are also indicated.

wide areas are drawn together into single spawning clusters in spring, making it unlikely for two nearby ponds to contain tadpoles unless the mating congregations converged at different times (Carstensen et al. 2003).

Hundreds to thousands of tadpoles were observed at the breeding sites in Gwaii Haanas. However, because an individual female toad can lay thousands of eggs, it is not possible to estimate the size of breeding population at any of these sites.

Phenology

In spring, adult toads congregate at traditional breeding sites to find mates. Unlike most anurans, male Western Toads do not attract females with a loud call. Throughout much of their range, male Western Toads do not vocalize at all, while in other areas males have been described as emitting a soft chirp (Wind and Dupuis 2002). In May 2005, we observed males vocalizing at a breeding congregation at Post Lake and heard vocalizations at Lutea Lake. Although they were not loud, we believe the vocalizations were advertising calls because they were routinely made by lone individuals, and therefore could not be described as warning or release calls made by one male to deter another male from mounting.

Breeding pairs releases eggs and sperm simultaneously into the water, and eggs are fertilized externally. The eggs are laid in long gelatinous strings of thousands of eggs per spawn, often entangled in submerged vegetation. An individual female toad may carry thousands of eggs. After approximately 1 week the eggs hatch into large schools of tadpoles. Depending on water temperature, the tadpoles metamorphose into terrestrial toadlets in approximately 6-8 weeks (Green and Campbell 1984).

The timing of congregations and the subsequent breeding chronology can vary greatly between years depending on temperature and water levels (Gregory 1999). In the warm spring of 2005, we observed toads breeding at Post and Lutea Lakes during the first week in May. In 2006, spring was much colder and we found no toads, eggs or tadpoles at Lutea Lake when we visited during the second week in May. When we returned on June 16, we found very recently hatched tadpoles with egg cases still present. Between years, timing of breeding activities varied by approximately one month. Also of note, when we surveyed Dead Toad Lake on June 22, 2006, we noted two distinct size classes of tadpoles (~16 mm and ~25 mm). This suggests that there may have been two separate breeding events.

Based on our limited surveys, toads in Gwaii Haanas appear to be slightly smaller than what is typically reported for the species' various life stages (Carstensen et al. 2003). Tadpoles are within the expected range of 5-40 mm TL. We did not encounter any recent metamorphs (terrestrial form in the late summer of their first year) because of the timing of our surveys (May-June). We did, however, encounter many small toadlets in the 20-25 mm SVL range. These are likely yearlings (small toadlets in their second summer), but are on the small size of the range reported for this stage (20-45 mm SVL). Subadults are usually classified as individuals 45-65 mm SVL, with adults being those >65 mm SVL. We only encountered one individual that would classify as an adult by these standards

(79 mm SVL on Mount Yatza). Individuals that we assume to be breeding adults due to their proximity to breeding ponds tended to be 50-60 mm SVL.

Disease and Abnormalities

We found no evidence of abnormalities (malformations or deformations) during our surveys. We also found no clinical signs of disease.

Predation

We found a few (up to 12) inverted toad skins, indicating raccoon predation, at three of the five breeding sites in Gwaii Haanas: Lutea, Post and Tadpole Lakes. Predation signs were observed at Lutea Lake in both 2005 and 2006. This suggests that the raccoons in this area are cuing in to toad breeding congregations each spring. While this suggests that toads may be particularly vulnerable to predation when they congregate in large number to breed, the amount of predation we observed does not seem unsustainable. In 1992, however, Reimchen reported, "at a lake in de la Beche Inlet, a 50 m stretch of shore contained several hundred everted toad skins". This level of mortality could reflect a substantial proportion of the breeding population at this site.

Although we did not find evidence of successful breeding (eggs or tadpoles), we found toad skins at Jedway pond in both 2005 and 2006.

Recommendations

Long Term Monitoring

To date, the most promising inventory and monitoring method for pond-breeding amphibians is to estimate site occupancy rates over a large geographic scale using presence/absence data, accounting for detection error (Proportion of Area Occupied, PAO, Mackenzie et al. 2002). This involves multiple visits to sites during the appropriate season when evidence of breeding activity (breeding congregations, eggs or tadpoles) may be detectable. Unfortunately, documenting statistically significant shifts in PAO through time requires a minimum sample size much larger than the total number of breeding sites known in Gwaii Haanas (~n=50). Despite this limitation, we are still faced with the need to monitor Western Toad populations in Gwaii Haanas because it is a listed species threatened by non-native predators and competitors. Biologically meaningful trends in breeding site occupancy can still be gained by periodically (every 5 years) surveying the known and potential breeding sites accessible along the east coast of Gwaii Haanas (n=9). To be able to interpret our findings, we must first determine the annual variability in the occupancy rates at these sites by visiting each site every year for a minimum of 3 years.

Raccoon Predation

We should continue to monitor the level of raccoon predation during breeding site surveys. If mortality is observed at levels that could reflect a significant proportion of the local population, we should consider taking management action to eliminate or reduce the number of raccoons at the site during the spring, when breeding adults congregate and are particularly vulnerable to predation. Although we have no estimate of the size of breeding

populations at our sites in Gwaii Haanas, Reimchen's (2002) observation of several hundred toad carcasses at one site suggests that the populations were historically quite large. To err on the side of caution, evidence of predation on 50 or more toads at one site should trigger management action.

Non-native Amphibians

We should continue monitoring for evidence of non-native frogs during our surveys at toad breeding sites. We should also visit Anna Inlet and McEchran Cove at the northern end of Gwaii Haanas, where frogs are first likely to colonize. Two to three hours should be spent in each area listening for frog breeding vocalizations and looking for eggs or tadpoles in wetlands.

Screening for Chytrid Fungus

There are recent reports of chytrid fungus infecting amphibians in the Pacific Northwest, including British Columbia (Hayes 2006). Although there is not likely a vector to carry the disease to Haida Gwaii, it would be prudent to test local populations for the presence of the disease. Even in infected populations, individuals are rarely found that are displaying clinical symptoms. Since the fungus usually infects juvenile toads, we recommend opportunistically collecting a toe clipping from juvenile toads found during future breeding site surveys to send in for analysis (Bradley Anholt, University of Victoria). A single toe should be clipped and stored in ethanol with a record of the sampling date and location. If an animal is found showing clinical signs of infection, skin samples should be collected for analysis.

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Appendix 1 – Details from the Gwaii HaanasWestern Toad breeding survey sites, 2005-2006.

Date	Site Name	Breeding Evidence?	Predation Sign?	% Edge Searched	Wetland Size (ha)	Max. Depth (m)	Elevation (m)	Primary Substrate	Fish Present?	Water Color	% of Margin with Emergent Veg.	Water Temp. (°C)
May 5, 2005	Jedway Pond	no	yes	100	0.5-1	1-2	5	cobble	no	stained	1-25	
May 6, 2005	Lutea Lake	yes	yes	50	>1	1-2	25	silt/mud	yes	stained	>50	
May 6, 2005	Post Lake	yes	no	25	>1	>2	41	silt/mud	yes	clear	1-25	
May 7, 2005	Anna Lake	no	no	<5	>1	>2	170	boulder/bedrock	no	clear	1-25	
July 21, 2005	Mt. Yatza Ponds	no	no	100	0.5-1	1-2	550	silt/mud	no	stained	1-25	
May 9, 2006	Lutea Lake	no	no	80	>1	1-2	25	silt/mud	yes	stained	1-25	8.5
June 16, 2006	Lutea Lake	yes	yes	100	>1	1-2	25	silt/mud	yes	stained	>50	13.0
June 16, 2006	Jedway Pond	no	yes	100	0.5-1	1-2	5	cobble	no	stained	1-25	18.5
June 17, 2006	Darwin Lake	no	no	<5	>1	>2	10	silt/mud	yes	stained	0	16.0
June 17, 2006	Post Lake	yes	yes	100	>1	>2	41	silt/mud	yes	clear	1-25	16.5
June 19, 2006	Adam Lake	no	no	85	0.5-1	>2	32	silt/mud	no	stained	>50	17.5
June 20, 2006	Slim Wetlands	no	no	100	<0.5	<1	20	silt/mud	no	stained	1-25	
June 20, 2006	Jedway Pond	no	yes	100	0.5-1	1-2	5	cobble	no	stained	1-25	18.5
June 21, 2006	Poque Lake	yes	no	1	>1	>2	20	boulder/bedrock	yes	clear	1-25	13.0
June 21, 2006	Tadpole Lake	yes	yes	100	>1	>2	25	silt/mud	yes	clear	25-50	11.0
June 22, 2006	Many Flowing Waters	no	no	10	>1	>2	80	boulder/bedrock	yes	clear	0	17.0
June 22, 2006	Sundew Lake	no	no	75	0.5-1	1-2	25	boulder/bedrock	yes	stained	1-25	16.0
June 22, 2006	Dead Toad Lake	yes	no	<10	>1	>2	50	boulder/bedrock	yes	clear	1-25	17.0
June 23, 2006	Bigsby Lake	no	no	<5	>1	>2	25	boulder/bedrock	yes	clear	0	
June 29, 2006	Mt. Yatza Ponds	no	no	100	0.5-1	1-2	550	silt/mud	no	stained	1-25	14.0
July 5, 2006	Beban Lake	no	no	20	>1	>2	20	silt/mud	yes	stained	1-25	14.0
August 3, 2006	Alpine Camp 1 Lake	no	no	90	0.5-1	>2	725	boulder/bedrock	no	clear	0	11.5
August 3, 2006	Alpine Camp 2 Lake	no	no	100	0.5-1	>2	735	boulder/bedrock	no	clear	0	10.0
August 3, 2006	Alpine Camp 3 Lake	no	no	100	0.5-1	>2	730	boulder/bedrock	no	clear	1-25	13.5
August 5, 2006	Alpine Bench Pond	no	no	100	0.5-1	1-2	842	boulder/bedrock	no	clear	0	13.0
August 6, 2006	Lower Alpine 1 Lake	no	no	20	>1	>2	576	boulder/bedrock	no	clear	0	13.5
August 6, 2006	Lower Alpine 2 Lake	no	no	75	>1	>2	618	boulder/bedrock	no	clear	0	14.5

Appendix 2 – Field data sheet

Toad Breeding Site Survey

Survey Information

Date	Start Time	End Time	Crew

Start UTM East North	End UTM East North

Survey Length (m)	Survey area (m^2)	% Edge Searched

Survey Conditions

Weather: clear/few clouds overcast light rain heavy rain	Wind: calm light breeze strong wind gusts	Air Temp (ºC)	Water Temp (ºC)

Site Characteristics

Site	Location	Site Photo

Wetland Class: pond/lake wetland	Wetland Size (ha): <½ ½-1 >1	Max Depth (m): <1 1-2 >2	Elevation (m)

Permanence: Permanent semi-permanent temporary	Dominant Riparian Vegetation: trees shrubs herbs grasses

Primary Substrate: clay silt/mud sand/gravel cobble boulder/bedrock leaf litter

Fish Present? yes no unknown	Water Color: clear stained	% of Margin With Emergent Vegetation: 0 1-25 25-50 >50

Toad Information

Breeding Evidence? Yes No	Tadpoles? Yes No	# tadpoles	Eggs? Yes No	# eggs

Breeding Congreg.? Yes No	# of Toads at Congregation	UTM East North

Toads Observed?	# adults (>65mm)	# sub-adults / yearlings (25-64mm)	# metamorphs (9-24mm)

Raccoon Predation? Yes No	# of Depredations	Introduced Frogs? Yes No

Sign of Infection? Yes No	Photos? Yes No	Samples? Yes No	Sign of Malformations? Yes No	Photos? Yes No

Comments:

Appendix 3 – Western toad and non-native amphibian monitoring protocol

Frequency: every 5 years

Timing: mid June (consider earlier in warm years)

Survey Locations:
- all known Western Toad breeding sites accessible along the east coast of Gwaii Haanas (see Figure 1)

1. Lutea Lake (south of Bag Harbour)
2. Post Lake (back of Newberry Cove)
3. Poque Lake (lowest lake off the small inlet between Kostan and Bigsby Inlets)
4. Tadpole Lake (back end of De la Beche Inlet proper)
5. Dead Toad Lake (2nd lake at back of Skittagetan Lagoon)

- potential breeding sites (readily searchable sites where no breeding evidence was found during 2005-2006 surveys) (see Figure 1)

6. Jedway Pond (entrance to Harriet Harbour)
7. Sundew Lake (1st lake at back of Skittagetan Lagoon)
8. Many Flowing Waters Lake (back of Haswell Inlet)
9. Adam Lake (Louscoone Point)

- the northern boundary of Gwaii Haanas

10. Anna Inlet and McEchran Cove

Survey Method:
At toad breeding sites, conduct a two person Visual Encounter Survey. Wearing chest waders, surveyors walk as much of the perimeter of each breeding site as possible, visually scanning the shallows, the shoreline and nearby terrestrial habitat (~10 m from the water margin) for evidence of breeding toads, (adult breeding congregations, egg masses, larvae / tadpoles and emerging toadlets), non-native amphibians and raccoon predation (inverted toad skins).
At Anna Inlet and McEchran Cove, spend 2-3 hours in each area listening for frog breeding vocalizations and looking for eggs or tadpoles in wetlands.

Record:
- Western toad breeding evidence (breeding congregation, eggs, tadpoles)
- Evidence of non-native amphibians (vocalizations, adult frogs, tadpoles or eggs)
- Evidence of raccoon predation (inverted toad skins)
- Abnormalities (e.g. deformities or missing limbs) or clinical signs of disease (e.g. abnormal behavior such as lack of flee response, abnormal posture, or abnormal appearance such as thickened epidermis, sloughing of skin, abnormal mouthparts)

Collect:
- Photographs of any abnormalities
- skin samples from individuals showing clinical sings of disease (store in ethanol)