2009 Amphibian Monitoring Report

Klondike Gold Rush National Historical Park

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ON THE COVER
Conducting routine amphibian surveys at West Creek 03 in July, 2009.

Abstract

Amphibian monitoring has been conducted in Klondike Gold Rush National Historical Park since 2004. The 2009 monitoring season spanned a four-month period between April 14 and August 19. Routine amphibian surveys were conducted at eight western toad (*Bufo boreas*) core breeding sites in Dyea, three non-core sites at Lost Lake and West Creek, and 13 extensive sites along the Chilkoot Trail corridor. Western toad breeding activity was observed at five of the core sites. Only two sites exhibited a fully successful breeding cycle, meaning eggs laid during the 2009 spring breeding season reached maturity and migrated to their upland winter sites. Biotechs observed 22 adult western toads in Dyea and 2 adult western toads along the Chilkoot trail, for a total of 24 adult toad observations. An estimated 10,000 to 15,000 tadpoles in the Nelson Slough area (monitoring sites DY13 and DY14) survived long enough to reach metamorph stage. Hundreds of metamorphs were observed at upland forest sites around the Dyea townsite in late August and early September. No other amphibian species were detected in the park in 2009.

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Introduction and Background

Amphibian monitoring at Klondike Gold Rush National Historical Park was conducted for the sixth consecutive year in 2009. Monitoring was conducted in Dyea, along West Creek, and along the Chilkoot Trail corridor.

Amphibian populations have been monitored in Klondike Gold Rush National Historical Park (KLGO) since 2004. Two amphibian species have been confirmed in the park: western toad (*Bufo boreas*) and the Columbia spotted frog (*Rana luteiventris*). Western toad populations in Alaska represent the northern extent of the species' range (Carstensen 2003). It is classified by KLGO as a species of concern for Southeast Alaska and by the National Heritage Network and The Nature Conservancy as a rare and uncommon species in Alaska (Carstensen 2003). Western toads have shown precipitous declines in abundance and distribution through large portions of their range in the last several decades, which extends south to New Mexico (Hallock 2005). The rapid decline of local and Southeast Alaskan western toad populations reflects a larger, global decline in amphibians that may have alarming implications for many of our National Parks. Incomplete information in western toad distribution, population size, and habitat range in Southeast Alaska prompted the development of a long-term monitoring protocol for KLGO.

One of the biggest threats to western toad populations is emerging diseases. The chytrid fungus (*Batrochochytrium dendrobatitis*) is a disease agent responsible for chytridiomycosis in amphibians. The disease was originally described in 1998 and is one of the main factors attributed to the loss of amphibian biodiversity worldwide. Although thought to have been spread throughout the world in just the last century, its extent and current distribution are unclear. Dispersal of the fungus is assumed to be through infected frogs, contaminated water, or an unknown host (Oevermann 2004). Amphibians exposed to the fungus may die soon after their skin is infected and can quickly spread the fungus through an area, causing a rapid collapse of the entire population at the site.

The western toad population in KLGO continues to decline, as evidenced by monitoring data collected between 2004 and 2009. In 2004, an initial amphibian survey and habitat assessment was initiated in KLGO. The first year of surveying focused on determining the presence or absence of amphibian species park-wide. This effort included a survey and characterization of wetland habitat within the park. Physical and biological characteristics of wetland sites were recorded and evaluated for their potential as amphibian habitat and as valuable sites for long-term, repeat monitoring.

In 2005, 125 surveys were conducted in 39 wetland sites within KLGO between April and August. Wetland sites were identified from the 2003 LIDAR image of the park and from the National Wetland Inventory GIS layer (Payne 2005). Six of the 39 wetland sites were identified as breeding sites of the western toad (*Bufo boreas*) and 12 of the sites were found to have adult, juvenile, or tadpole western toads. During the 2005 surveys, 15 adult western toads were captured and tagged using electronic "PIT" tags. Chytrid fungus (*Batrochytrium dendrobatitis*) was also identified as an important monitoring subject and swab samples taken from adult western toads confirmed its presence in the toad population of KLGO. In 2006, several more samples were collected to monitor the distribution of chytrid fungus.

In 2007, a stratified monitoring approach was established to continue monitoring western toads at known breeding sites, and to search suitable habitat sites for other amphibian species. 156 surveys were conducted; 19 at previously identified wetlands and 35 newly identified pond sites. As a result, a new amphibian species, the Columbia spotted frog (*Rana luteiventris*), was discovered within the White Pass Unit of the park (Fairchild 2007). Four of the 54 surveyed wetlands were identified as breeding sites of the western toad in 2007. No new efforts to tag individual toads were made in 2007 and KLGO was also identified as a "mid-level amphibian monitoring site" by the Amphibian Research and Monitoring Initiative (ARMI) of the United States Geological Survey (USGS). Under the ARMI framework, a monitoring protocol was established to collect data on site-occupancy at established western toad breeding sites.

In 2008, monitoring of western toads and Columbia spotted frogs was continued using a draft Amphibian Monitoring Protocol that focused on Visual Encounter Surveys at known breeding sites ("core" sites), Adult and Juvenile toad measurements, and stratified monitoring of potential amphibian breeding habitat. Multiple visits were made to the 7 core breeding sites around the Dyea area, and single visits were made to 7 non-core sites within the park. The rough sampling design was tested and refined, culminating in the 2009 DRAFT Amphibian Monitoring Plan for KLGO.

2009 Monitoring Objectives

Much of the 2009 season was devoted to developing Standard Operating Procedures and a draft Protocol following NPS Inventory and Monitoring Standards for the long-term amphibian monitoring program. These are based on the USGS Amphibian Research and Monitoring Initiative (ARMI) mid-level monitoring structure. The objectives of amphibian monitoring in Klondike Gold Rush National Historical Park are:

> Monitor long-term changes in amphibian distribution, abundance, and reproduction.
>
> Monitor the presence and distribution of chytrid fungus in amphibian populations within KLGO and surrounding wetlands.
>
> Collaborate with and provide data to other initiatives and efforts for monitoring amphibians in Southeast Alaska.

In addition to the broader monitoring objectives, 2009 resources were focused on developing the long-term monitoring plan and conducting routine amphibian surveys at habitat sites in Dyea and along the Chilkoot Trail. 2009 accomplishments included:

- Creation of an amphibian site bulletin (Appendix 1)
- Development of long-term monitoring Standard Operating Procedures and Protocols
- Intensive monitoring of core breeding sites in Dyea and non-core sites around Dyea
- Extensive monitoring along the Chilkoot Trail Cooridor (Monitoring Panel 3)
- Chytrid fungus sampling of all captured adult and juvenile toads detected
- Partnering with Parks Canada to conduct chytrid fungus monitoring

Sampling methods

One seasonal biological technician managed the amphibian monitoring according to Standard Operating Procedures (SOPs) for routine amphibian surveys, chytrid fungus sampling, and adult and juvenile toad measurements. The SOPs were under development throughout the season and were refined as field work progressed.

2009 high-intensity monitoring focused on the core western toad breeding sites in Dyea. These sites were visited at least twice a week between April 14 and August 18. During active breeding times, sites were visited more often; sometimes daily if needed and if resources allowed.

Table 1. Core sites visited in Dyea during the 2009 monitoring season. Coordinates are in UTM Zone8 NAD83.

Site Number	**Easting (meters)**	**Northing (meters)**
Dyea 33 (DY33)	480408	6596190
Taiya River 01 (TR01)	480075	6596476
Dyea 02 (DY02)	480408	6597121
Dyea 03 (DY03)	480267	6596890
Dyea 13 (DY13)	479529	6595772
Dyea 14 (DY14)	479518	6595625
West Creek 02 (WC02)	479147	6598956
West Creek 04 (WC04)	491745	6608133

Three non-core sites were also visited once each during the 2009 season.

Table 2. Non-core sites visited in Dyea during the 2009 monitoring season. Coordinates are in UTM Zone8 NAD83.

Site Number	**Easting (meters)**	**Northing (meters)**
West Creek 03 (WC03)	475585	6599939
Lost Lake 1 (LL1)	478471	6597508
Lost Lake 2 (LL2).	478352	6597289

Non-core sites were evaluated for their potential as monitoring habitats. West Creek 03 (WC03) will be included in the monitoring program as a non-core intensive site to be visited twice per season, and the Lost Lake sites will be considered extensive sites to be visited once per year during the amphibian monitoring program. They were deemed to be generally unsuitable toad habitat, reinforced by the consistent lack of toad observations at the sites.

Extensive site monitoring in 2009 was confined to Panel 3: Chilkoot Trail corridor. Panel 3 is divided into Basin A (Lower Taiya River) and Basin B (Chilkoot Pass). Both basins were surveyed once during the 2009 field season.

Table 3. Chilkoot Trail Panel 3: Basin A (Lower Taiya River) sites monitored in 2009. Coordinates are in UTM Zone8 NAD83.

Site Number	Easting (meters)	Northing (meters)
Chilkoot Trail 07 (CT07)	481095	6600925
Chilkoot Trail 02 (CT02)	481054	6602154
Chilkoot Trail 03 (CT03)	481521	6604689
Chilkoot Trail 01 (CT01)	481566	6606160
Chilkoot Trail 11 (CT11)	480567	6598617

Table 4. Chilkoot Trail Panel 3: Basin B (Chilkoot Pass) sites monitored in 2009. Coordinates are in UTM Zone8 NAD83.

Site Number	Easting (meters)	Northing (meters)
Chilkoot Trail 04 (CT04)	484131	6611732
Chilkoot Trail 05 (CT05)	484272	6612159
Chilkoot Trail 06 (CT06)	484329	6612206
Chilkoot Trail 10 (CT10)	484830	6613044
The Scales 06 (SC06)	485804	6616595
The Scales 08 (SC08)	485936	6616612
The Scales 10 (SC10)	486063	6616781
The Scales 12 (SC12)	485922	6616615
The Scales 13 (SC13)	485991	6616765
The Scales 24 (SC24)	485908	6616678

Basin A was surveyed during a two-day, one-night trip between the Chilkoot Trail trailhead and Canyon City on June 29 and 30. Basin B monitoring sites were surveyed over a separate two-day period on August 13 and 14, with Sheep Camp as a logistical base station.

Field data was checked for quality assurance and entered into the current amphibian monitoring database: KLGOtoadsv4.7F_2009.

Results

Routine Amphibian Surveys

Phenology

Biologists conducted 158 Routine Amphibian Surveys between the first survey on April 14 and the last survey on August 18. Life stage development of western toads observed during the 2009 monitoring season fell within the same range of phenology dates that have been observed since monitoring began in 2004 (Table 5).

Table 5. Dates of first observed life stages at each core monitoring site in Dyea in 2009.

site	eggs	larvae	juveniles	adults	metamorphs
TR01	5/8/2009	6/3/2009	----------.	5/14/2009	----------
DY03	5/8/2009	----------	----------	---------	----------
DY14	5/13/2009	6/3/2009	----------	5/14/2009	8/4/2009
WC04	5/15/2009	5/21/2009	6/2/2009	----------	----------
WC02	----------	----------	---------	5/19/2009	---------
DY13	----------	----------	----------	----------	8/4/2009
DY02	----------	----------	6/11/2009	----------	----------

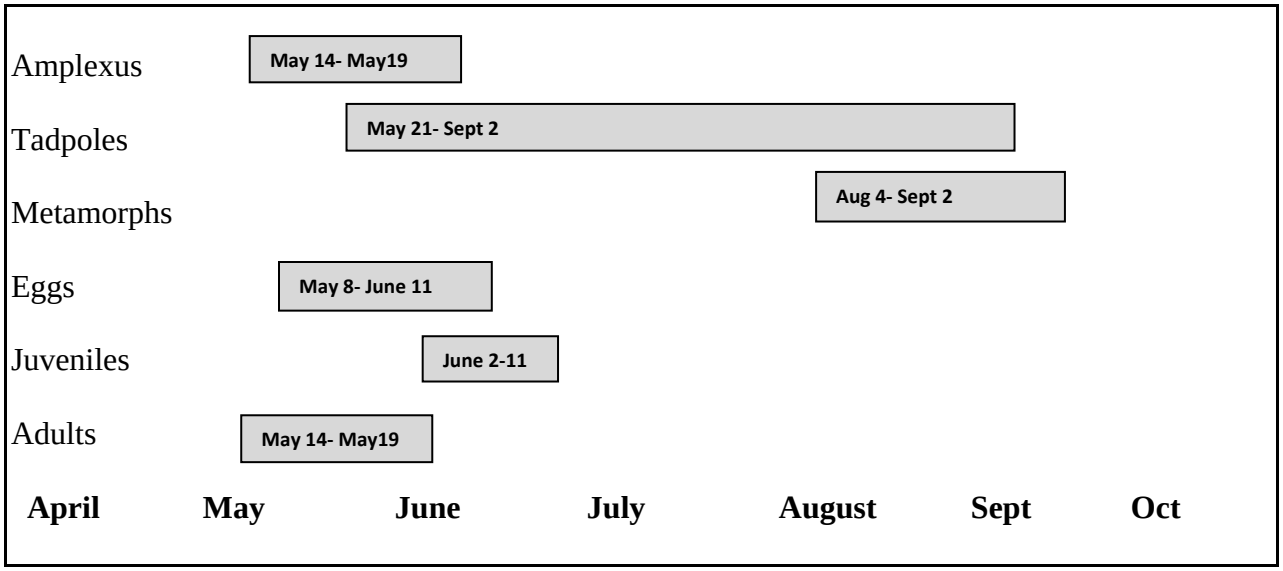

Figure 1. Western toad phenology date ranges observed at core sites in KLGO in 2009

Habitat conditions

Water levels at the monitoring sites fluctuated greatly throughout the season. During the peak of breeding activity in mid-May and continuing through late July, water levels remained very low at the sites. Initial snowmelt filled the ponds in early May and slowly evaporated until only small puddles were left at each site by July. Rising river levels due to rapid snowmelt and rain later in the summer eventually re-filled the ponds. One egg mass at site TR01 survived, despite being in very shallow water during the dry period, because of later river overflow, but water came too late for recovery of the desiccated egg mass at site DY03. This water level pattern is characteristic of the Dyea monitoring sites, which are influenced by the groundwater and river levels of the Taiya river system. Water sources for the monitoring sites located in the West Creek watershed are more consistent, as they depend on creek flows and groundwater sources that are not influenced by the Taiya River. Although the West Creek sites followed a similar pattern of drying in mid-summer, the water levels exhibited slower responses to rainfall and snowmelt fluctuations.

Observations

Over the course of the 2009 field season, a total of 22 adult western toads were observed at the core monitoring sites in Dyea. Of the 22 observed, 16 were in amplexus at the time of observation and two were observed by a biologist conducting bird surveys. Therefore, only 4 of the adults were captured for measurements. In addition to the toad sightings in Dyea, Park staff observed two adult western toads along the Chilkoot trail, but not in designated monitoring sites. One was observed at Sheep Camp by Resource Management Staff, and the other was observed by a hiker and a trail crew member at the Beaver Ponds at the south end of the trail. Biologists also observed four juvenile toads at the core monitoring sites in Dyea. Three of the toads appeared to be hatchlings from 2008 and the other juvenile was older.

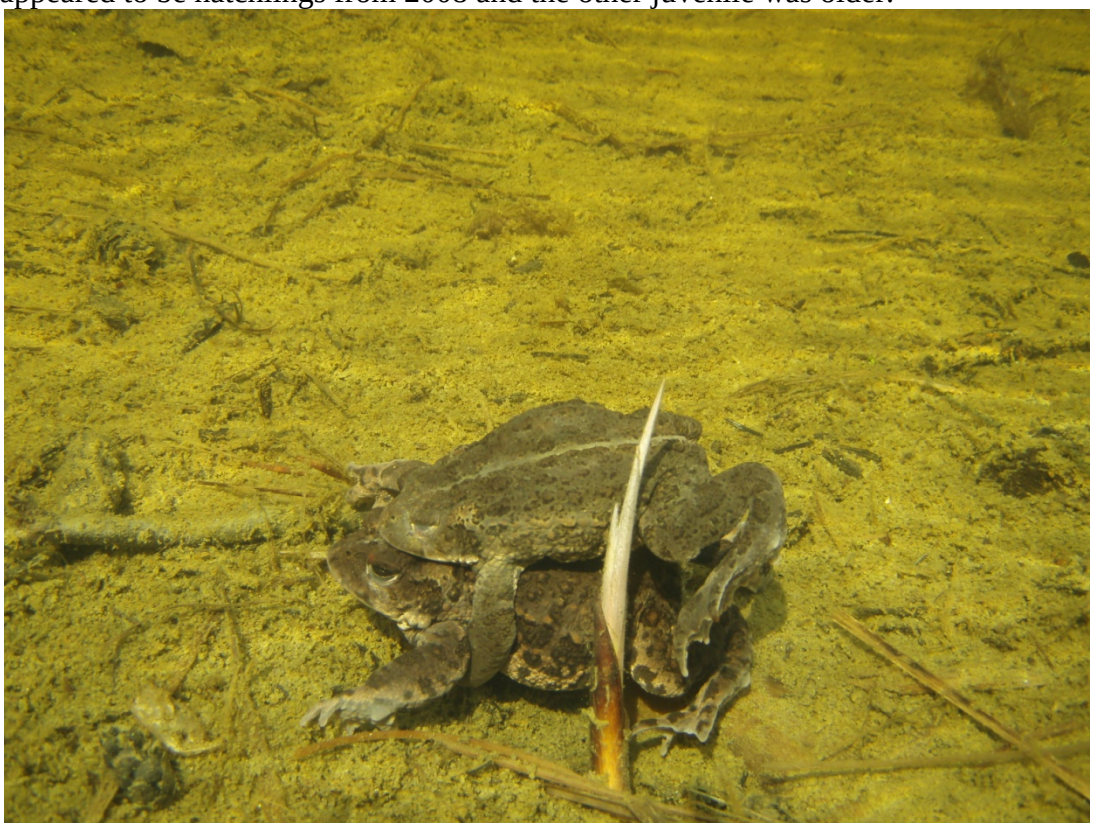

Figure 2. Biologists observed 16 pairs of toads in amplexus at DY14 and TR01.

It is estimated that between 12,000 and 15,000 tadpoles survived long enough to reach the metamorph stage at Nelson Slough breeding sites (DY13 and DY14). Thousands of new metamorphs were observed moving from the breeding ponds to uplands sites in late August. No other amphibian species were detected in 2009.

Chytrid fungus sampling

As part of the continued monitoring of chytrid fungus in the park, 7 swab samples were taken from 3 adult and 4 juvenile western toads. Swabs were sent to Iris Holmes at the Cornell Department of Ecological and Evolutionary Biology in Ithaca, NY for analysis. Results of the chytrid tests will likely be reported back in late 2009 or early 2010.

Table 6. Chytrid swab samples collected during the 2009 monitoring season.

date	site	type	gender	swab ID
5/13/2009	DY14	adult	male	DY14May13A1
5/13/2009	DY14	adult	male	DY14May13A2
6/2/2009	WC04	juvenile	unknown	WC04June02J1
6/2/2009	WC04	juvenile	unknown	WC04June02J1
6/2/2009	WC04	juvenile	unknown	WC04June02J1
6/3/2009	WC02	adult	female	WC02June3A1
6/11/2009	DY02	juvenile	unknown	DY02June11J1

Table 7. Summary of chytrid swab samples collected by Parks Canada during the 2009 monitoring season, by species.

Species	Toal # swabs
Rana sylvatica	15
Bufo boreas	52
Rana luteiventris	9
*Unknown species**	3
Total	**79**

***unknown species*- two samples are species information on the datasheet, and one sample is from an individual awaiting positive identification.

Individual site results

Dyea 33 (DY33)

This site was visited regularly, but no breeding activity or toad presence was detected here. As with the other habitat sites this year, water levels fluctuated greatly throughout the season. This site is located on land owned by the city of Skagway and has seen some anthropogenic change this year. Several large gravel piles were moved to and around the site during the summer, changing the landscape drastically. The northwest lobe of the site is no longer a depression that collects water, but contains several mounds of gravel.

Taiya River 01 (TR01)

The three lobes of this site were distinct for most of the breeding season, but as the Taiya river level increased, they became a single, large pond and flooded the entire site. During the toad breeding season, two separate egg masses were detected in shallow water; one at the end of the middle lobe and one at the east end of the south lobe. The water quickly dried up and the egg masses appeared to be dessicated. After water levels increased later in the season, about three dozen larvae were found to have survived. The larvae were not observed to maturity because of flooding and increased turbidity. They were probably washed away by late season flooding before reaching metamorph stage.

Dyea 02 (DY02)

Regular visits were made to DY02, but no breeding activity was detected here. One juvenile toad was detected and measured on June 11.


Figure 3. One juvenile toad was found at DY02 on June 11.

Dyea 03 (DY03)
One egg mass was found in a shallow pond at the southern end of the site early in the breeding season. The pond water completely dried up soon after the egg mass was laid, and no larvae appeared to have survived the desiccation. No other egg masses or individuals were detected at the site.

Dyea 13 (DY13)
A group of newly-hatched larvae were detected at this site on June 3, just north of the Nelson Slough vehicle bridge. The breeding event and subsequent egg mass that produced them were undetected, but the number of larvae at the same Gosner development stage at one time suggested that they developed from one egg mass near their detection location and were laid around May 13, when other egg masses at Dyea 14 were also produced.

Dyea 14 (DY14)
Dyea 14 continues to be the most productive breeding site in the Park. Multiple adults, egg masses, and breeding events were detected at the site beginning on May 8. Several thousand tadpoles developed and reached the metamorph stage by the end of August.


Figure 4. Thousands of tadpoles were found in DY13 and DY14.

West Creek 02 (WC02)

One adult female toad was found at WC02 on June 3, but no breeding activity was detected here.


Figure 5. One large, adult female toad was observed at WC02

West Creek 04 (WC04)

One egg mass was detected and an estimated 550 larvae developed into large tadpoles before the pond dried up in late June. The larvae were not detected again once the pond dried up, but three small juveniles were found at the site in early June. Chytrid sampling swabs were taken from the three individuals for testing. In late August, after the pond had partially re-filled with rain water, several off-road vehicle tracks were found crossing through the site, creating many "troughs" through the site that will probably pose as obstacles to future breeding success at the site.

West Creek 03

West Creek 03 was visited once during the monitoring season in early June. Eight KLGO employees and one visiting college researcher traveled to the site for a full day of amphibian surveys. No breeding activity or individual amphibians were detected. The site was also evaluated for its value as a routine monitoring site. It was determined that the far northern reaches of the site are not likely amphibian habitat because of the dense willow and alder brush, and deep ponds with no shallow shorelines. Future monitoring efforts should be focused on the small pond areas at the southern end of the site.

Lost Lake Sites 1 and 2

Lost Lake 1 and 2 were visited once during the monitoring season, in late June. No signs of amphibians were found, and have never been found at these sites. The sites have been re-classified as non-core monitoring sites because of their lack of suitable toad habitat.

Chilkoot Trail sites

All Chilkoot Trail monitoring sites in extensive monitoring panel 3 were visited once during the 2009 season. Basin A sites were visited in late June and Basin B sites were visited in early August. All of the pond sites at the Scales had very low water levels, compared to pictures taken in previous monitoring years. Sites SC13, SC14, SC12, and SC08 were completely dry. One western toad was detected during the surveys, but not at a designated survey site. The toad was sighted at the Sheep Camp Ranger station, near the helicopter pad.

Genetic Research

Iris Holmes, a graduate student from Cornell University and a native of Haines, Alaska, is conducting research on the genetic diversity and connectivity of three distinct populations of western toads in Southeast Alaska. Larvae samples were collected from the core breeding sites in Dyea in 2008 and again in early June of 2009 to compare with samples collected from two other valleys in the vicinity. The focus of the research is on three geographically isolated populations of western toads: Chilkat River valley, Chilkoot River valley, and the Taiya River corridor (Figure 6). Holmes hypothesizes that geographical barriers between the populations may create effects such as reduced genetic diversity, unique extinction and recolonization patterns, and adaptations to range limit conditions that are unique to the populations at the edge of the species' range. Using microsatellite loci DNA isolation and Bayesian clustering algorithms, Iris is processing two field seasons' worth of data. Preliminary results from the population connectivity study indicate that the three populations are genetically distinct, with the Chilkoot population appearing to be exactly between the other two genetically which reflects its relative geographical location (Holmes 2009).

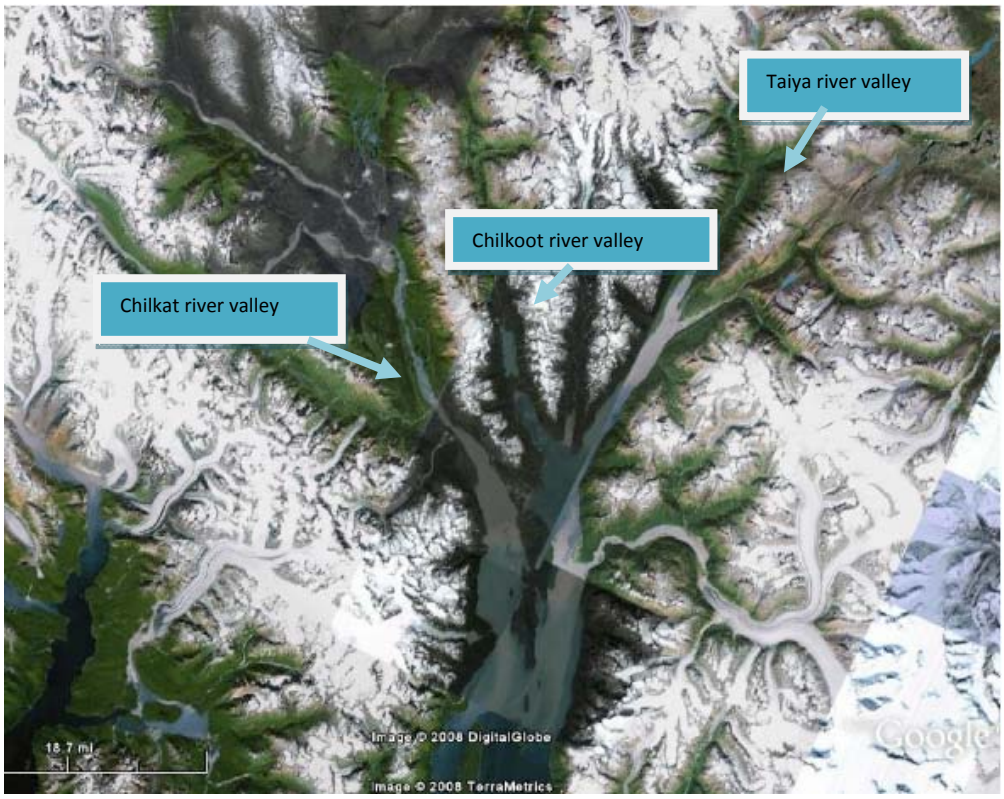

Figure 6: GIS image of the Upper Lynn Canal. Samples were collected in the Taiya, Chilkoot, and Chilkat valleys for genetic testing.

Discussion

Western toad populations in Dyea appear to continue their decline. A contraction in breeding site distribution is evidenced by the lack of breeding activity at several sites that have traditionally seen heavy use in the past five years of amphibian monitoring (Figure 5). Sites that were historically recorded as breeding sites, but did not host breeding activity this year are: Dyea33, Dyea2, Dyea19, WestCreek03 and WestCreek02. Sites that had breeding activity, but failed to reach maturity because of desiccation or flooding in 2009 are: WestCreek04, Dyea03, and TaiyaRiver01. Dyea13 and Dyea14 appear to be the only fully successful breeding sites in 2009.

Upon maturity, new toad metamorphs migrate from the Dyea13 and Dyea14 breeding sites to upland forest sites around the Dyea townsite and Nelson Slough area. Although breeding has yet to be detected or observed along the Chilkoot Trail corridor, several adult toads have been found there, suggesting that undetected breeding does occur, or that toads migrate along the Taiya river wetlands systems from breeding sites in Dyea or across the Canadian border.

Several factors are contributing to the decline in western toad populations in Southeast Alaska. The presence of chytrid fungus is considered the greatest variable, along with climate change, habitat destruction, species range limit, and unknown factors. Variation in breeding site occupancy and breeding productivity between years in the Dyea area may also be influenced by the bi-annual breeding cycles of western toads (Schmetterling 2009) and changes in wetland hydrology caused by local isostatic rebound.

Recommendations

Routine Amphibian Surveys

Amphibian monitoring for the 2010 field season should follow the Standard Operating Procedures for routine amphibian surveys and adult and juvenile toad measurements in the Draft Amphibian Monitoring Protocol. Core monitoring sites should be visited regularly beginning around April 21 and ending when the majority of hatchlings are in their metamorph stage and begin to disperse- around the beginning of September.

Extensive monitoring for 2010 should focus on Panel 4: the Skagway River basin. The Panel is divided into three basins: Basin A, Basin B, and Basin C, which will help coordinate logistics and field work. Wetlands sites that are visited should be geo-referenced with a GPS unit and entered into the geodatabase as a GIS shapefile. The Amphibian Monitoring Protocol should be updated with the monitoring site locations to facilitate monitoring consistency in future years.

Chytrid fungus testing

Chytrid fungus sampling is conducted every other year, in odd-numbered years. The next sampling iteration will be in 2011.

Site occupancy, detectability, and population size estimates

A western toad site occupancy rate of 0.25 was calculated by ARMI for wetlands in KLGO, based on amphibian monitoring data collected in past years. Site occupancy estimates the

abundance and distribution pattern of western toads in the park, expressed as a probability of finding an individual of the species at any given wetland site within the Park. There are several site occupancy models in use by other agencies and researchers that use repeat observation data from monitoring sites to determine wildlife detectability, which can then be expressed as a mathematical model to predict site occupancy of a defined area (Bailey 2005). A software package, developed largely from funding by the Amphibian Research and Monitoring Initiative (ARMI) is available to conduct occupancy analyses: PRESENCE (http://www.mbr-pwrc.usgs.gov/software.html). Monitoring data collected at Klondike Gold Rush NHP in the past few years or from a single season can be used to run the model. The PRESENCE model has options for using single-season data or multiple-season data and is available for free download from the USGS website above.

Amphibian Monitoring Protocol and Standard Operating Procedures

The Amphibian Monitoring Protocol and Standard Operating Procedures for Klondike Gold Rush National Historical Park need to be completed and refined. Updates such as the site occupancy model and radio tracking study should be included in the new version.

Western toad non-breeding habitat use study

An important project that should be initiated is a radio tracking study of western toads in the park. Little is known about the life cycles, ranges, and habitat use of toads in the park outside of breeding activity. Knowledge of habitat use is especially important for the successful management of the toad population in Dyea, as development and changes to the Dyea townsite may impact the western toad populations during non-breeding times when their presence is likely to go undetected. An option for radio monitoring equipment is the Biotrack Company (part of Lotek Wireless) 90-day radio waist collar (www.biotrack.co.uk or www.lotek.com). The company offers several options for radio waist collars that vary in weight and longevity, but the lightest tag is the 'Pip3 Ag393', which cost $185 each (Appendix II). Another option is the Sirtrack single stage transmitter, which can be fitted with a belt harness (www.sirtrack.com) (Appendix II). Toads that are captured during the summer breeding season should be fitted with radio collars and tracked through the fall and winter to determine habitat use and movement patterns.

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Appendix II. Amphibian radio collar options

Dear Heather,

Thank you for your enquiry to Lotek. Lotek and Biotrack are now working together and Biotrack have sold a range of tags for toads, hence your reply from me.

Many tags that we have supplied for toads have been for waist bands. Some of our customers have provided their own waistband material, but one method that has been successful, and that we can supply the waist band materials for, is an elasticated plastic waistband.

With this, the tag sits on the back of the toad and a tube built in to the tag has another tube fed through it, the same width as the toads hips (this stops the harness being tight round the sides of the toad). Through this second tube is then thread a type of elasticated plastic which is knotted at the back, securing the tag at the right elasticity. Does this sound like it could work for your study species?

Our lightest tag that will last 90 days is our Pip3 Ag393 tag. This weighs about 1.7g. Would this be a suitable weight for your study species?

These tags are 185 US Dollars each. All prices exclude taxes and shipping.

How many toads would you like to track and when would you like to start your study?

Please feel free to ask any questions.

Best wishes,

Sarah

Sarah Walley
Technical Sales Advisor

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