National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

2009 Klondike Gold Rush National Historical Park Amphibian Monitoring Report

Natural Resource Report NPS/KLGO/NRDS—2014/626



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

2009 Klondike Gold Rush National Historical Park Amphibian Monitoring Report

Natural Resource Report NPS/KLGO/NRDS—2014/626

Heather Wetherbee

National Park Service
Klondike Gold Rush National Historical Park
PO Box 517
Skagway, Alaska 99840

February 2014

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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Please cite this publication as:

Wetherbee, H., 2014. 2009. 2009 Klondike Gold Rush National Historical Park amphibian monitoring report. Natural Resource Report NPS/KLGO/NRDS—2014/626. National Park Service, Fort Collins, Colorado.

NPS 461/123944, February 2014

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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.

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
- Development of long-term monitoring Standard Operating Procedures and Protocols (Appendix 1)
- Intensive monitoring of core breeding sites in Dyea and non-core sites around Dyea
- Extensive monitoring along the Chilkoot Trail Corridor (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.

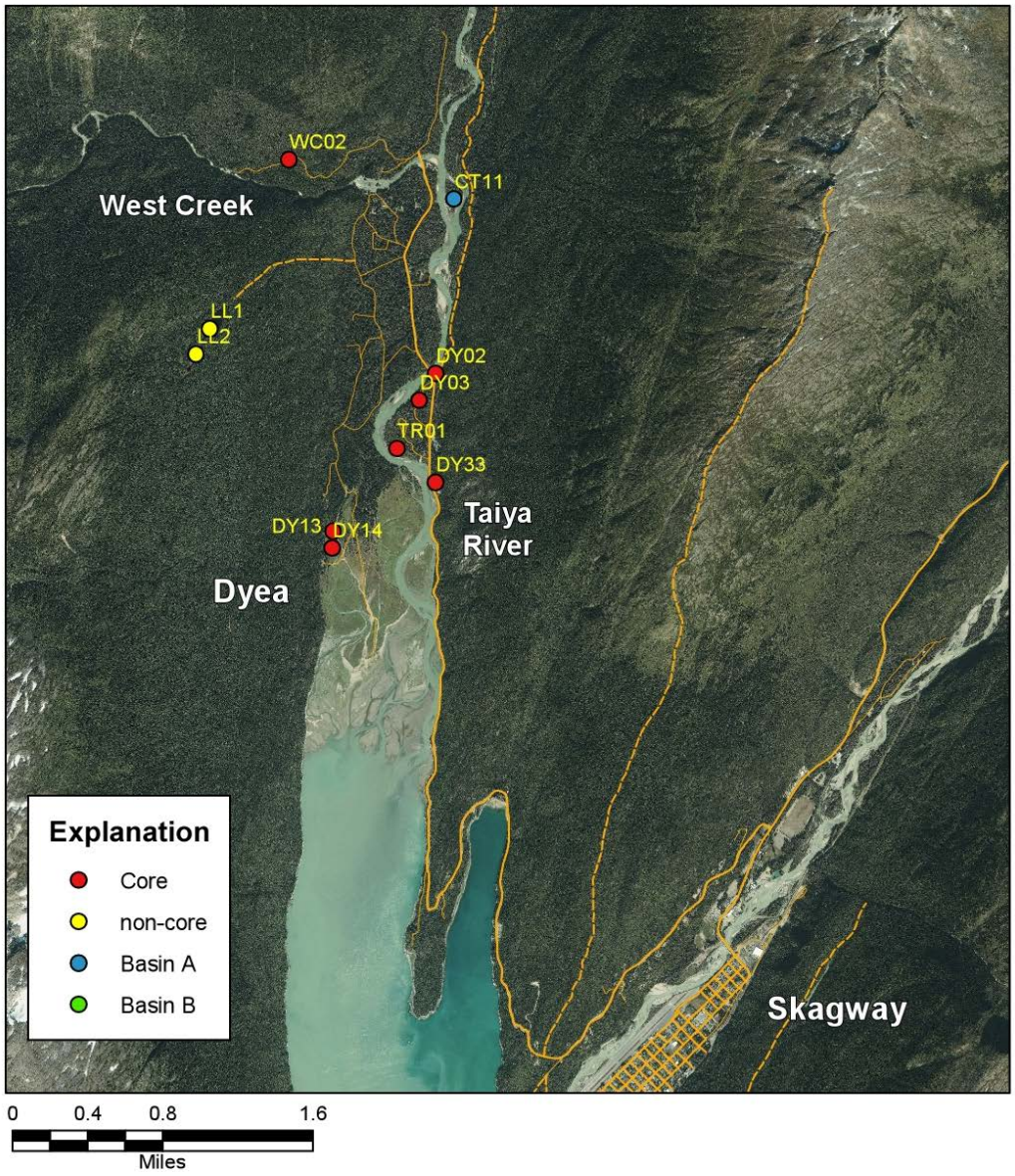


Figure 1. Location of Sample Sites in Dyea/West Creek Area

2009 high-intensity monitoring focused on the core western toad breeding sites in Dyea (figure 1). 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.

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.

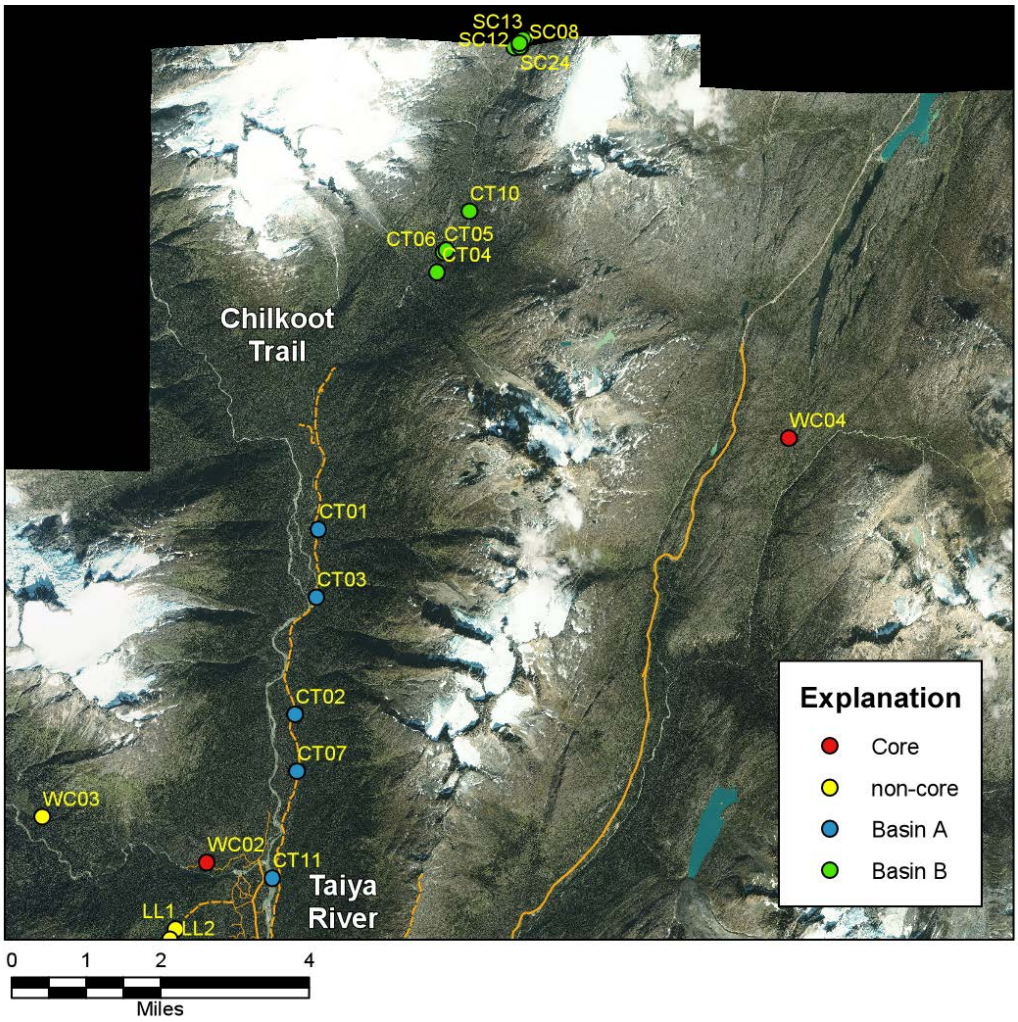


Figure 2. Location of monitoring sites in Basin A and B, along the Chilkoot Trail.

Extensive site monitoring in 2009 was confined to Panel 3: Chilkoot Trail corridor (Figure 2). 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.

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 1).

Table 1. 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	----------	----------

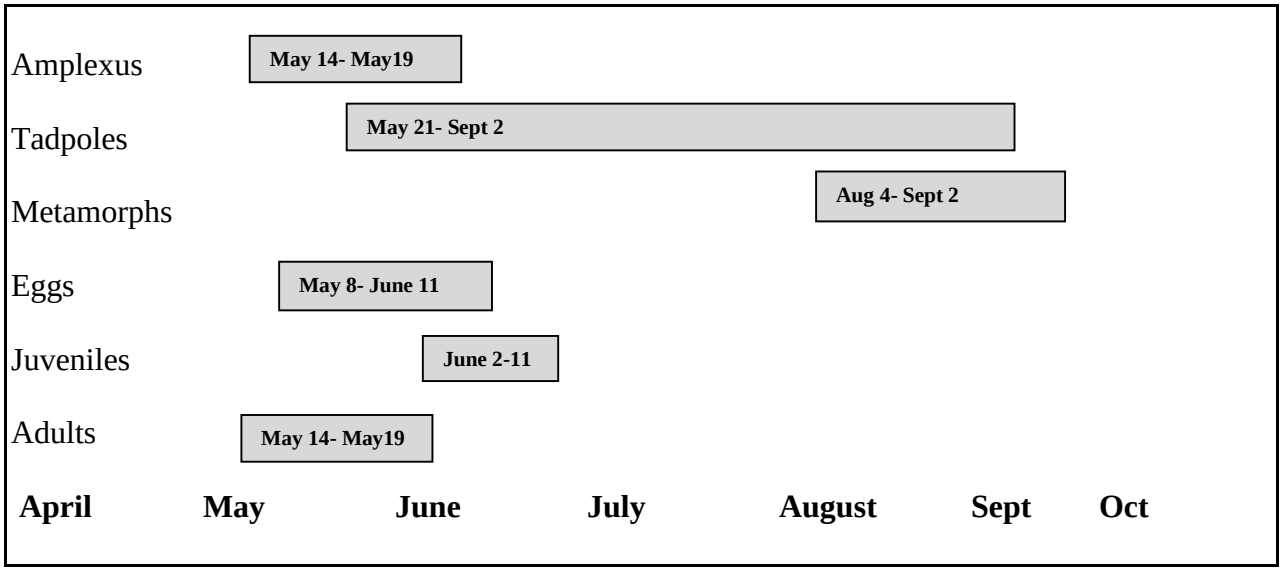


Figure 3. Western toad phenology date ranges observed at core sites in KLGO in 2009

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.

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.

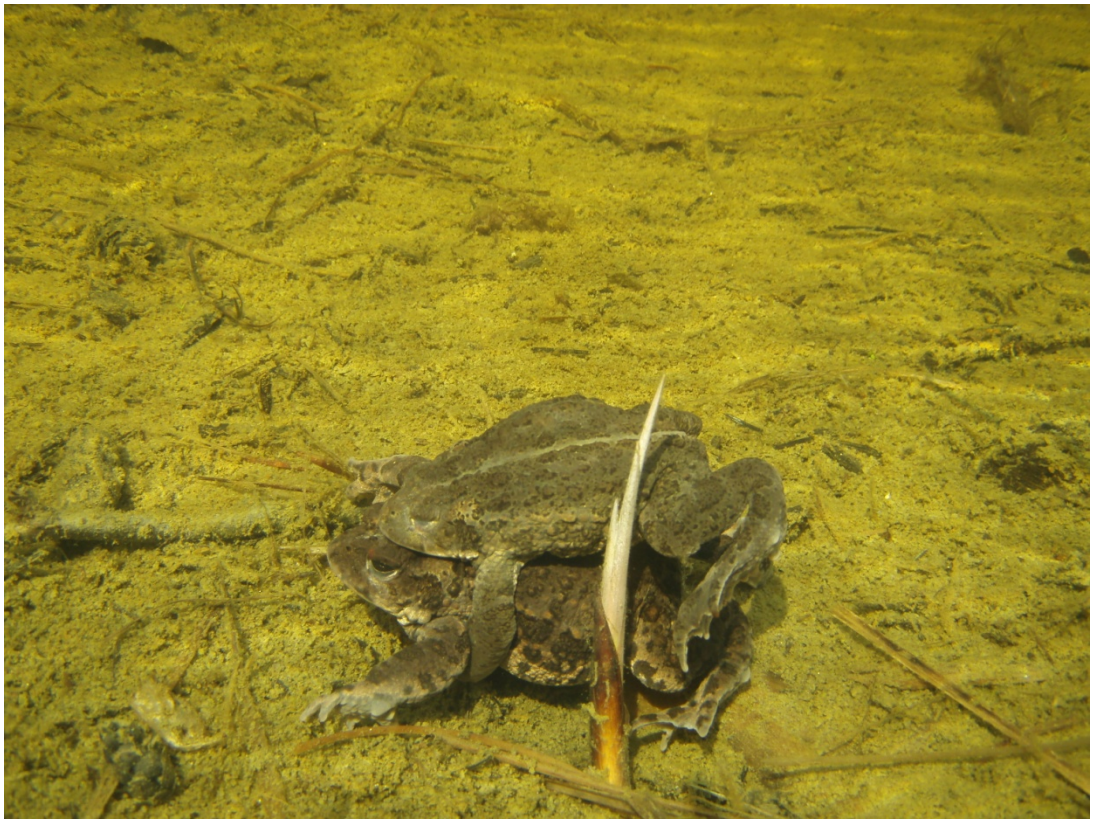


Figure 4. Biologists observed 16 pairs of toads in amplexus at DY14 and TR01.

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 2. 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 3. 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 5. 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 6. 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 7. 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 8). Holmes hypothesizes that geographical barriers between the populations may create effects such as reduced genetic diversity, unique extinction and re-colonization 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).

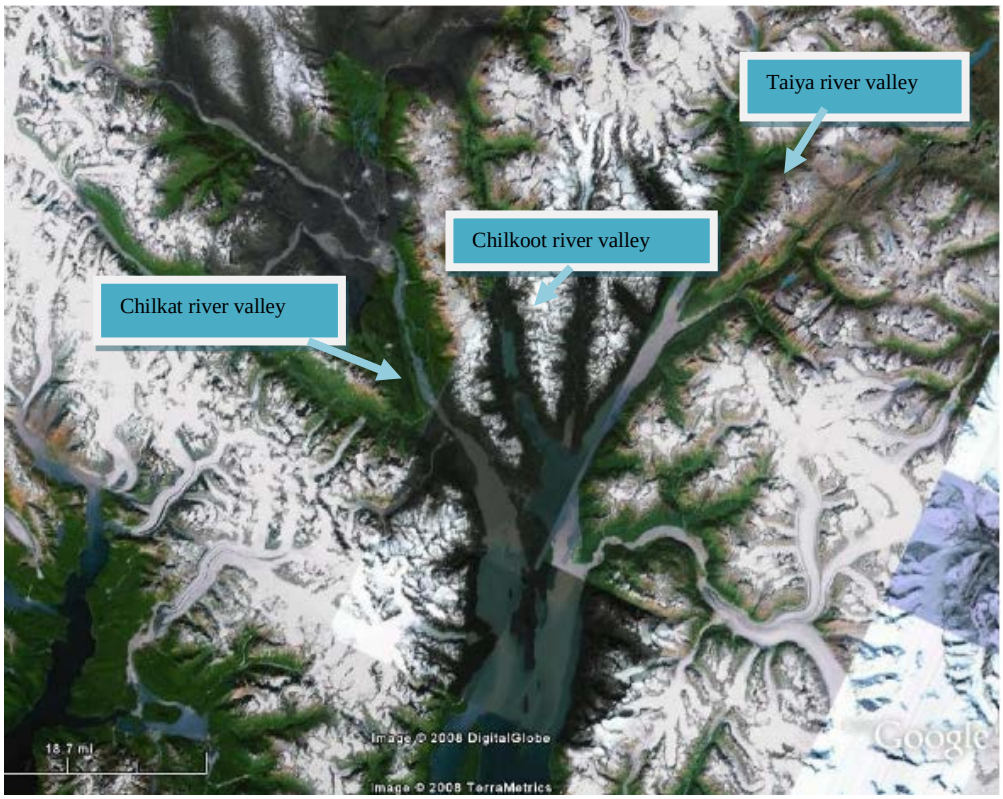


Figure 8. GIS image of the Upper Lynn Canal. Samples were collected in the Taiya, Chilkoot, and Chilkat valleys for genetic testing.

Conclusions

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), changes in wetland hydrology caused by local isostatic rebound, and natural fluctuations in seasonal water levels.

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 A Amphibian Monitoring Protocol for Klondike Gold Rush National Historical Park

Standard Operating Procedure (SOP) No. 1

Routine Amphibian Survey Field Methods

Version 1.0 (August 2009)

Revision History Log

Previous Version #	Revision Date	Author	Changes Made	Reasons for Change	New Version #

1.1 Routine Amphibian Survey

Routine Amphibian Surveys are the main structural component of the Amphibian Monitoring Program at Klondike Gold Rush National Historical Park. Survey methods described in the SOP pertain to all field monitoring efforts at "core" and "non-core" sites within the monitoring strategy. Routine amphibian surveys include visual encounter surveys and individual measurements of adults and juveniles.

1.1.1 Time Commitment

Time commitment for each monitoring site survey varies, depending on the breeding activity at the site, the number of adult toads to be captured, chytrid fungus sampling schedules, and the site location. Approximate time commitments for each activity of a routine amphibian survey:

Equipment preparation: 30 minutes

Driving to Dyea monitoring sites from office: 30-40 minutes

Walking to sites from vehicle parking: 5-10 minutes

Equipment disinfecting between sites: 10-20 minutes

Amphibian survey at site: 1-2 hours

Driving to office from Dyea monitoring sites: 20-25 minutes

Data entry and editing: 30-60 minutes

Data management: 60-90 minutes

Typically four to five core site visits can be completed in a nine or ten-hour monitoring day. Core sampling can be completed by one person, but may be easier with two people if there are many individuals to be captured. For extensive non-core monitoring sites, extra time is needed for travel to the sites. Chilkoot Trail sites can be logistically divided into two monitoring expeditions. A two-day, one-night trip is suitable to cover the five monitoring sites between the trailhead and Canyon City. A longer three-day, two-night trip may be necessary to visit sites between Pleasant Camp and Chilkoot Pass. See Appendix C for site descriptions and maps.

Equipment should be assembled into backpacks and vehicles for the day. An equipment list is included in SOP 2: Field Preparation and Equipment. Navigation to the survey site can be accomplished using site maps (Appendix B). Upon arriving at each monitoring site, data recording begins using the Routine Amphibian Survey Form (Figure 1). If data is being collected with the PDA, the appropriate Pendragon Form is used (See SOP 9: Using Pendragon Forms).

1.1.2 Seasonal monitoring schedule

Core sites are visited once a week from late April to early May, or until toads start gathering at the sites for breeding. Additional searches specifically targeting adult toads are made once the period of breeding and egg lying starts, at sites with prior records of breeding. Core monitoring sites are visited at least twice-weekly, and daily if needed during the egg-laying period because toads will be concentrated at the ponds during this time. Ideally two or more full visual encounter searches occur at each core site per week, in each of the egg period, larval period, and metamorphosis period for western toads (Chelgren 2005). When several weeks have passed without new detection of adult or juvenile toads, monitoring can be reduced to once-weekly visits to the sites, with continued monitoring of larvae development. Monitoring activities end for the season when new toadlets start leaving the breeding ponds for upland forest sites.

Non-core sites within the high intensity stratum are visited at least twice in the season, at times when detection is predicted to be higher such as time of breeding or metamorphosis. Late June is an appropriate time to visit sites within the Chilkoot Trail Monitoring Panel and early July can be a suitable time to search sites monitoring panels in the White Pass area.

1.2 Survey Procedures

1.2.2 Visual Encounter Survey

Upon arrival at the site, a Routine Amphibian Survey is initiated. All Routine Amphibian Survey data is recorded on the Routine Amphibian Survey Form (Appendix 1) and is organized into the following categories:

General site information: observer, date, arrival time, start time, end time, and pond ID.

Routine Amphibian Survey Form		Observer(s)
Date	Time Start	Time at Site Arrive:
Pond ID	Time End	Leave:

Fields in the general site information category are defined as follows (see Routine Amphibian Survey Field Reference Sheet):

Observer(s)- the three-letter initials of individuals conducting the survey at the site

Date- date the survey is being conducted. Use MM-DD-YY format (e.g. 4/09/09 for April 9 of 2009)

Pond ID- the site number, name (e.g. "Dyea3), or 4-digit code (DY03) assigned to the pond site. If the site was not pre-assigned a number, document it as a new site and assign it a four-digit code based.

Time Start- start time of Visual Encounter Survey

Time End- end time of Visual Encounter Survey. Time between start and end is meant to represent time spent searching and net sweeping the site for amphibians, excluding time spent taking habit, weather, or amphibian measurements and recording data. Make a note or adjust end time to account for other activities. Record in 24-hour format (e.g. 16:35 for 4:35 pm)

Time at Site Arrive: time of arrival at the monitoring site recorded in 24-hour format (e.g. 16:35 for 4:35pm)

Time at Site Leave: time of departure from the monitoring site

Weather*:* Air temperature, precipitation, wind, cloud cover, surface glare, and ripples are recorded.

Air Temp.	Ripples none some significant
Precip dry lt rain heavy rain snow/sleet	Wind calm light mod heavy
Clouds clear partially cloudy overcast	Surface Glare none some significant
Precip last 2 days? none, fog, light rain, medium rain, heavy rain, snow	

Fields in the weather category are defined as follows:

Air Temp- air temperature in the shade, approximately 1 meter off the ground, in Celcius

Ripples- circle “none” if the surface of the water is perfectly flat and smooth. Circle “some” if there is some disturbance in the surface, but there is still good visibility beneath the water. Circle “significant” if visibility below the surface is significantly affected by ripples or surface disturbance.

Precip- circle “dry” if no precipitation falls during all or most of the survey. Circle “lt rain” if there is light rain falling during all or most of the survey. Circle “heavy rain” if a heavy rain is falling during all or most of the survey. Circle “snow/sleet” if snow or sleet is falling during all or most of the survey.

Wind- circle “calm” if there is no wind. Circle “light” if the wind is 0-10 knots (0-12mph, 0-19kph, Beaufort 1-3). Circle “mod” when the wind speed is 10-20 knots (13-24mph, 20-38kph, Beaufort 4-5), circle “heavy” if the wind speed is over 20 knots (>24mph, >38kph, >Beaufort 5).

Clouds- circle “clear” when cloud cover is 0-35%, “partially cloudy” when cloud cover is 35-70%, “overcast” when cloud cover is >70%

Surface Glare- circle “none” if there is no visible glare off the surface of the water, “some” if there is noticeable glare but still some visibility below the surface, or “significant” if below-surface visibility is significantly affected by glare. Polarized glasses should be used during field surveys and when recording surface glare data.

Precip last 2 days?- circle the condition most dominant in the past two days. Selected precipitation rating should represent conditions for a minimum of ½ day during the past two days.

Habitat information: Water level, clarity, turbidity, iron floc, sheen, vegetation, and water temperatures are recorded.

Habitat	Water level high average low dry	
Clarity clear stained	Turbidity clear cloudy	iron floc absent present severe
Sheen none organic petro	Pictures? Yes No Picture #'s:	
%Shallow	% surface area w/ emergent vegetation	
% bottom cover by submergent veg	% surface area w/ floating vegetation	
% shoreline covered by snow	% surface area covered by snow	
Water Temp	loc'n	Temp Logger deployed collected
Water Temp	loc'n	Under water? Yes No Light?
Water Temp	loc'n	Temp Time
Water Temp	loc'n	
Water Temp	loc'n	
Water Temp	loc'n	

Fields in the Habitat Information category are defined as follows:

Water level- circle the best description of the water level relative to the water level at the site throughout the season. For an initial rating, refer to pictures from the previous year

Clarity- select the true color of the water, represented by the materials dissolved in the water and not by pond floor material

Turbidity- how cloudy the water is, represented by the mixture of dissolved or suspended sediments in the water column

Iron floc- iron flocculent is formed when highly mineralized, iron-rich groundwater surfaces, comes into contact with air and oxidizes, forming an orange scum that coats rocks and vegetation (Hocker 2003). Record the presence of rusty orange to red color in the water or on the bottom of the pond.



Figure 1.1 Iron flock forms a rusty-orange colored scum on rocks and vegetation in wetlands.

Sheen- sheen is a shiny, rainbow-colored smear across the surface of stagnant water. To test whether the sheen is organic or inorganic, stir through it with a finger or a stick. If it swirls, it is likely inorganic and petroleum-based, such as oil or gas. If it breaks apart into plates, it's most likely organic in origin (Hocker 2003). Note whether or not sheen is detected on the surface of the water and whether the source is petroleum or organic.

Pictures- Indicate if pictures are taken of the site and record photo numbers assigned to the image by the digital camera. Do not include pictures taken of individual amphibians in this field.

%Shallow- record the percentage of the site area that is covered in water less than 0.5 meters deep

%Shoreline w/ emergent vegetation- record the percentage of the site area that is covered by emergent vegetation

%Bottom covered by submergent vegetation- record the percentage of the site area that is covered by submerged vegetation

%Shoreline covered by snow- record the percentage of the shoreline that is covered by snow

%Surface area covered by snow- record the percentage of the pond and site surface area that is covered by snow

Water temperature- collect water temperatures in different locations of the pond site. Submerge thermometer until temperature reading stabilizes and record the number in Celsius.

Location- describe the location of water temperature measurements taken at the site in relation to general compass direction and the depth (e.g. NW edge of pond, at surface)

Amphibian Search: The entire perimeter of the wetland is scanned for embryos and larvae by having one person wading and the other walking along the shoreline. Polarized sunglasses must be worn to reduce glare and increase visibility below the surface of the water. Early in the season, eggs and tadpoles can be very small and difficult to see. Care is taken to closely examine the path ahead to ensure eggs and larvae are not trampled. If moveable cover items are present, they can be moved to see if larvae are hiding beneath them. Vegetated areas and other habitats likely to harbor embryos and larvae should also be searched. Record each species-stage detected and total numbers of each life-stage of each species encountered are recorded on the datasheet. If toadlets (metamorphs) or adult amphibians are found, they are captured using a dipnet and are placed in individual containers if there are too many to keep track of at the site (see SOP No. 7: Amphibian handling guidelines).

Amphibian Search	Full? Yes No	% Shore Searched
Connection inlet outlet both neither		Recent disturbances?
% bottom visible	Fish Present? Yes No	
Fish Species		Other Predators?
Survey Method visual hand ID boards traps net sweep	hand ID boards traps net sweep	
Amphibian Species Seen (if any seen, complete back of form also)		Where?

Fields in the amphibian search data are defined as follows:

Full?- indicates whether the entire length of the shoreline is searched (yes or no)

%Shore searched- percentage of shoreline searched

Connection- indicates whether the water body is visibly connected to the water source (inlet) or outlet. Bubbles in the substrate may indicate underground inlets.

Recent disturbances?- note any human disturbances such as trash, foot prints, vehicle tracks, natural disturbances such as flooding, landslides, windfall, or any significant changes to the pond/site structure

%Bottom visible- percent of the bottom up to 2m depth that is visible, excluding areas that are covered with vegetation, obscured by stained or turbid water, or other obstructed by anything

Fish present?- were any fish observed during the survey?

Fish species- record fish species observed, if known

Other predators?- note signs or presence of other predators. Common predators are predaceous diving beetles, damselfly or dragonfly nymphs, other aquatic beetles and insects, domestic dogs, coyotes, foxes, weasels, minks, martens, badgers, black bears, owls, magpies, ravens, crows, jays, shrikes, mallards, and spotted sandpipers.

Survey method- circle methods used to search for amphibians at the site during the survey

Amphibian Species Seen- For each species record the first two letters of the scientific genus and species names (e.g. BUBO for Bufo boreas)

Where?- describe where amphibians were generally found at the site (e.g. E shore of pond in emergent veg <1m water depth)

Egg Masses and Larvae: If egg masses are distinct, they are counted. If egg masses cannot be counted, their number is estimated based on the average size of isolated egg masses. For larvae, ocular estimation is used to determine total numbers (*e.g.*, a crew member counts all the larvae found within a small area and then counts the number of those size areas which have the same density). Median body length of larvae is determined by measuring the largest, smallest, and a few in the middle range (Appendix B. Body Measurement of Tadpoles). Median Gosner stage development should be determined with the least amount of disturbance to larvae or larval mass (Appendix C. Gosner Developmental Stages). Care is taken to search the area in a manner that prevents double-counting individuals.

Egg Masses and Larvae							
Location within Site:							
Individual ID (EM1, L1)							
Estimated # in egg mass							
Estimated total # larvae							
Tot. Length							
Body Length							
Gosner stage							

If egg masses and/or larvae are encountered, data is recorded based on the following definitions:

Location within site- description of where egg masses and larvae were found at the survey site

Individual ID- assigned alpha-numerical identification number for the day and site of capture (e.g. EM1 for the first egg mass identified at the site that day, or L3 for the third larvae measured).

Estimated # in egg mass- estimate number of individual eggs within an egg mass

Estimated total # of larvae- visually estimate total number of tadpoles, counting by 10's or 100's

Tot. Length- average total length of tadpoles at the site. Measure the length from the tip of the snout, not including any fleshy projections from the oral disk, to the end of the tail.

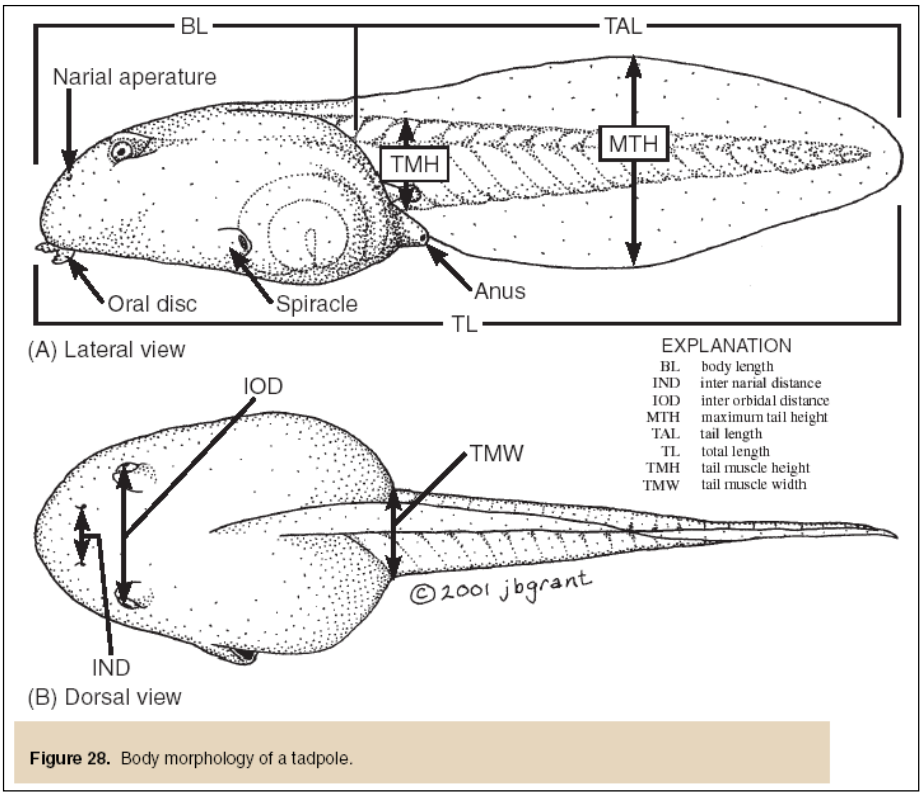


Figure 1.2 Body length (BL) and Total Length (TAL) measurement locations for tadpoles.

Body Length- average body length of tadpoles at the site. Measure the length from the tip of the snout, not including any fleshy projections from the oral disk, to the junction of the posterior body wall with the axis of the tail myotomes. The axis is defined by an imaginary line connecting the apices of the tail myotemes (Altig 2005). Measure 6 tadpoles at the site to calculate an average length and length range.

Gosner stage- record the average Gosner stage of larvae at the site

1.2.3 Adult and Juvenile toad measurements.

Capturing adult and juvenile toads is conducted according to the handling considerations and instructions outlined in SOP 7: Amphibian Handling Guidelines. A net may used to facilitate capture at monitoring sites.

Measurements are collected and recorded for each captured adult amphibian: SVL, Gape, Forearm, Weight, Nuptial pads, Calling, Location within site, and Individual ID (Appendix 2. Field Reference Sheet)

Location within Site:							
Individual ID (e.g. A1,J2)							
SVL (mm)							
Gape (mm)							
Forearm (mm)							
Weight (g)							
Nuptial pads?							
Calling?							
Tag? (Y/N)							
Swab?(Y/N)							

If juvenile or adult toads are captured during the Visual Encounter Survey, measurement data is recorded according to the following definitions:

Location within site- general area where the amphibian was found at the site (e.g. SE shore of pond in submerged veg <0.5 m water depth)

Individual ID- assigned alpha-numerical identification number for the day and site of capture (e.g. A1 for adult 1 observed and/or captured at the site that day, or J3 for the juvenile observed and/or captured at the site that day)

SVL (mm)- snout-to-vent length of the amphibian

Gape (mm)- head width at the point of jaw articulation

Forearm (mm)- length of the right forearm from the end of the bent elbow (including the elbow) to the tip of the longest toe. Straighten the limb gently so the elbow is at 90 degrees before measuring.

Weight (g)- weight of toad after subtracting empty weight of the bag

Nuptial pads?- note the presence or absence of darkened nuptial pads on the thumbs and first 2 fingers (Figure)

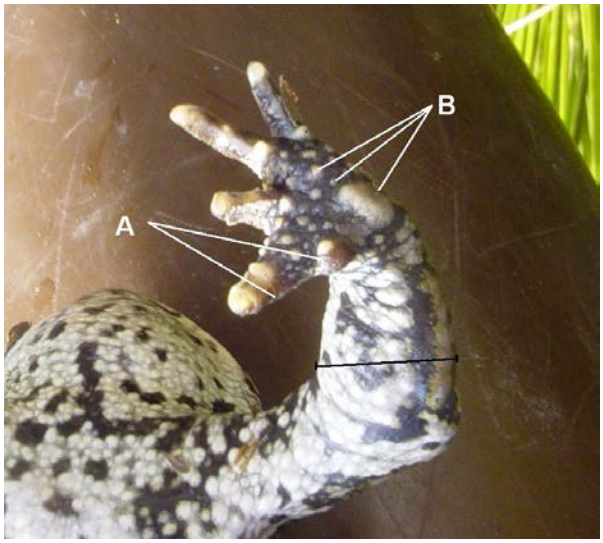


Figure 1.3 Tubercles (B, light in color) are present on all toads. Darkened nuptial pads (A), effectively calluses, are present only on males and are most developed during the breeding season.

Calling?- note whether a chirp-like release call is made by the individual when handled

Tag?- Is a PIT tag detected? Any adult toad >45 mm SVL that is encountered in the study area is scanned for an existing PIT tag. If a PIT tag is identified, the toad is considered a "recapture."



Figure 1.4 PIT tag reader scanning an adult toad for a tag number.

Swab?- was a swab taken to test for chytrid fungus? If sampling is being conducted for chytrid fungus (*Batrachochytrium dendrobatidis*), a swab is collected for each adult amphibian and the swab number is recorded (see SOP No.4 Chytrid Fungus Testing Protocol).

During Visual Encounter Surveys, amphibian pairs in amplexus should not be separated, but should be captured after they separate naturally. Sites of known amplexing pairs are frequented throughout the day to check on their status. Amphibians are released as close to the spot of capture as possible. While conducting adult and juvenile measurements, it is helpful to keep individuals in plastic containers (see SOP 7: Amphibian Handling Guidelines) to avoid recapture and repeat sampling until the site survey is completed.

1.2.4 Completion of Routine Amphibian Surveys

Comments and notes pertaining to the habitat, amphibians, data collected or general activities are recorded on the amphibian survey form or in a separate field notebook. At the end of each site survey the “end time” and “site leave time” must be recorded.

1.3 Cleaning Field Equipment

All field equipment that has come in contact with stream water, including all footwear, must be cleaned and disinfected between any sites that are not “water-connected”, or that amphibians don’t freely move between. At the end of each sampling day all field equipment must be thoroughly cleaned and sterilized. Procedures for cleaning field equipment exposed to stream water during sampling are found in SOP No.3: Hygiene Protocol.

1.4 References

Altig, R. 2006. "Comments on the descriptions and evaluations of tadpole mouthpart anomalies." Herpetological Conservation and Biology 2(1): 1-4.

Chelgren, N. 2005. Some Thoughts on Toad Monitoring. B. Kevin Payne, KLGO. Skagway, Alaska: 10.

Hocker, K., T. Schwarz. 2003. Streamwalker's Companion. Juneau, Discovery Southeast.

Appendix A. Routine Amphibian Survey Form and Field Reference Guide

Routine Amphibian Survey Form		Observer(s)
Date	Time Start	Time at Site Arrive:
Pond ID	Time End	Leave:

Air Temp.	**Ripples** none some significant
Precip dry lt rain heavy rain snow/sleet	**Wind** calm light mod heavy
Clouds clear partially cloudy overcast	Surface Glare none some significant
Precip last 2 days? none, fog, light rain, medium rain, heavy rain, snow	

Habitat	**Water level** high average low dry	
Clarity clear stained	**Turbidity** clear cloudy	iron floc absent present severe
Sheen none organic petro	Pictures? Yes No	**Picture #'s**:
%Shallow	% surface area w/ emergent vegetation	
% bottom cover by submergent veg	% surface area w/ floating vegetation	
% shoreline covered by snow	% surface area covered by snow	

Water Temp	loc'n	Temp Logger deployed collected
Water Temp	loc'n	Under water? Yes No Light?
Water Temp	loc'n	Temp Time
Water Temp	loc'n	
Water Temp	loc'n	
Water Temp	loc'n	

Amphibian Search	Full? Yes No	% Shore Searched
Connection inlet outlet both neither	Recent disturbances?	
% bottom visible	Fish Present? Yes No	
Fish Species	Other Predators?	
Survey Method visual hand ID boards traps net sweep		
Amphibian Species Seen (if any seen, complete back of form also)	Where?	

Comments:

Routine Amphibian Survey Form		Observer(s)
Date	Time Start	Time at Site Arrive:
Pond ID	Time End	Leave:

Air Temp. _____	**Ripples** none some significant
Precip dry lt rain heavy rain snow/sleet	**Wind** calm light mod heavy
Clouds clear partially cloudy overcast	Surface Glare none some significant
Precip last 2 days? none, fog, light rain, medium rain, heavy rain, snow	

Habitat	**Water level** high average low dry	
Clarity clear stained	**Turbidity** clear cloudy	iron floc absent present severe
Sheen none organic petro	Pictures? Yes No	**Picture #'s**:
%Shallow	% surface area w/ emergent vegetation	
% bottom cover by submergent veg	% surface area w/ floating vegetation	
% shoreline covered by snow	% surface area covered by snow	

Water Temp	loc'n	Temp Logger deployed collected
Water Temp	loc'n	Under water? Yes No Light?
Water Temp	loc'n	Temp Time
Water Temp	loc'n	
Water Temp	loc'n	
Water Temp	loc'n	

Amphibian Search	Full? Yes No	% Shore Searched
Connection inlet outlet both neither	Recent disturbances?	
% bottom visible	Fish Present? Yes No	
Fish Species	Other Predators?	
Survey Method visual hand ID boards traps net sweep		
Amphibian Species Seen (if any seen, complete back of form also)	Where?	

Comments:

Location within Site:							
Individual ID (e.g. A1,J2)							
SVL (mm)							
Gape (mm)							
Forearm (mm)							
Weight (g)							
Nuptial pads?							
Calling?							
Tag? (Y/N)							
Swab?(Y/N)							

Location within Site:							
Individual ID (e.g. A1,J2)							
SVL (mm)							
Gape (mm)							
Forearm (mm)							
Weight (g)							
Nuptial pads?							
Calling?							
Tag? (Y/N)							
Swab?(Y/N)							

Egg Masses and Larvae

Location within Site:							
Individual ID (EM1, L1)							
Estimated # in egg mass							
Estimated total # larvae							
Tot. Length							
Body Length							
Gosner stage							

Egg Masses and Larvae

Location within Site:							
Individual ID (EM1, L1)							
Estimated # in egg mass							
Estimated total # larvae							
Tot. Length							
Body Length							
Gosner stage							

Recaptures

Individual ID	Tag #	Swab ID

Recaptures

Individual ID	Tag #	Swab ID

KLGO Routine Amphibian Survey Field Reference Sheet

General site data

Observers- initials of individuals

Date- MM-DD-YY

Pond ID- site number (e.g. Dyea3)

Time Start- start time of amphib. search

Time End- end time of amphib. search

Arrive- time of arrival at site

Leave- time of departure from site

Weather data

Air Temp- deg C in shade, 1 m off ground

Ripples-none-water is flat and smooth
some- some disturbance in the surface, but still good visibility beneath the water.
significant- visibility below the surface is affected by ripples

Precip- dry- no precipitation during survey
lt rain- light rain falling during survey
heavy rain- heavy rain falling
snow/sleet- snow or sleet falling

Wind- calm- no wind.
light- wind 0-10 knots (0-12mph, 0-19kph, Beaufort 1-3).
mod- wind 10-20 knots (13-24mph, 20-38kph, Beaufort 4-5),
heavy- wind over 20 knots (>24mph, >38kph, >Beaufort 5).

Clouds- clear- cloud cover 0-35%,
partially cloudy- cloud cover 35-70%,
overcast- cloud cover >70%

Surface Glare- (when polarized sunglasses are used) **none-** no visible glare off water
some- noticeable glare but still some visibility below the surface,
significant-below-surface visibility affected by glare.

Precip last 2 days?- condition most dominant in the past two days

Habitat data

Water level- relative to water level at the site throughout the season

Clarity- true color of the water (not pond floor)

Turbidity- how cloudy the water is from the mixture of dissolved or suspended sediments in the water column

Iron floc- presence of rusty orange to red color in the water or on the bottom of the pond.

Sheen- shiny, rainbow-colored smear across the surface of stagnant water. If it swirls when stirred with a stick, it is likely inorganic and petroleum-based, such as oil or gas. If it breaks apart into plates, it's most likely organic in origin.

Pictures- photo numbers assigned to the image by the digital camera.

%Shallow- % of site covered in water <0.5 meters deep

%Shoreline w/ emergent vegetation- % of shoreline covered by emergent vegetation

%Bottom covered by submergent vegetation- % of site covered by submerged vegetation

%Shoreline covered by snow- % of shoreline covered by snow

%Surface area covered by snow- % of site covered by snow

Water temp (C)- from different locations in pond. Submerge thermometer until temperature reading stabilizes

Location- compass direction and depth of water temps (e.g. NW edge at surface)

Temp Logger- condition of temp logger
Under water?- is the logger under water?
Light?- is the light on?
Temp- record temp reading with thermometer w/in 1 inch of temp logger
Time- time of water temp reading

Amphibian Search Data

Full?- all of the shoreline searched?

%Shore searched- % shoreline searched

Connection- how water body is visibly connected to the water source (inlet) or outlet.

KLGO Routine Amphibian Survey Field Reference Sheet

Recent disturbances?- any human or natural disturbances (i.e trash, foot prints, vehicle tracks, landslides, flood)

%Bottom visible- % of bottom < 2m depth that is visible, excluding areas that are obstructed, covered with vegetation, or obscured by stained or turbid water

Fish present?- fish observed during the survey?

Fish species- fish species observed

Other predators?- signs or presence of predators: predaceous diving beetles, damselfly or dragonfly nymphs, other aquatic beetles and insects, domestic dogs, coyotes, foxes, weasels, minks, martens, badgers, black bears, owls, magpies, ravens, crows, jays, shrikes, mallards, and spotted sandpipers.

Survey method- methods used to search for amphibs at the site

Amphibian Species Seen- first two letters of the scientific genus and species names

BUFO- Western toad
RALU- Columbia spotted frog
UNID- Unidentified

Where?- where amphibians were generally found at site (e.g. E shore of pond in emergent veg <1m water depth)

Amphibian Capture Data

Location within site- general area where amphibian was found at the site (e.g. SE shore of pond in submerged veg <0.5 m water depth)

Individual ID- assign an alpha-numeric ID # (eg. A1, A2 or J1, J2) A=adult, J=juvenile.

SVL (mm)- snout-to-vent length

Gape (mm)- head width at point of jaw articulation

Forearm (mm)- right forearm length from the end of the bent elbow to the tip of the longest toe

Weight (g)- weight of toad after subtracting empty weight of bag

Nuptial pads?- presence or absence of darkened nuptial pads on the thumbs and first 2 fingers

Calling?- a chirp-like release call is made by the individual when handled

Tag?- is a PIT tag detected

Swab?- was a swab taken to test for chytrid fungus?

Egg Masses and Larvae Data

Location within site- where egg masses and larvae were found at the survey site (eg. NW edge under logs)

Individual ID- assign an alpha-numeric ID# (eg. EM1, EM2 or L1) EM=egg mass, L=larva

Estimated # in egg mass- estimate number of individual eggs within an egg mass

Estimated total # of larvae- estimate total number of tadpoles, counting by 10's or 100's

Tot. Length- average total length of tadpoles at the site from the tip of the snout (excluding fleshy projections from the oral disk) to the end of the tail

Body Length- average body length of tadpoles at the site from the tip of the snout (excluding fleshy projections from the oral disk) to the junction of the posterior body wall with the axis of the tail myotomes.

Gosner stage- average Gosner stage of larvae at the site

Recaptures

Individual ID- assigned alpha numeric #

Tag #- tag number identified by the PIT tag scanner

Swab ID- swab number taken from the individual for chytrid fungus testing

Appendix 2 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

Biotrack Ltd, 52 Furzebrook Road, Wareham, Dorset, BH20 5AX
Tel: +44 (0)1929 552992, Fax +44 (0)1929 554948

Biotrack is now part of Lotek Wireless.
Together we offer a greatly expanded range of telemetry equipment and expertise.

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Appendix 3 Site Locations for Toad Monitoring

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

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

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

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NPS 461/123944, February 2014

National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

www.nature.nps.gov