

Amphibian Monitoring Report 2011

Klondike Gold Rush National Historical Park

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ON THE COVER

Clockwise from top right, adult female boreal toad at core breeding site TR01, newly metamorphosed boreal toad at TR01, Skagway Recreation Center's Career Day, adult female boreal toad profile, Columbia spotted frog found in the White Pass Unit of KLGO, biotech Jaime Welfelt holding a recaptured PIT tagged boreal toad.

ABSTRACT

Amphibian monitoring has been conducted annually in Klondike Gold Rush National Historical Park (KLGO) since 2004. KLGO has two confirmed amphibian species, boreal toads (*Bufo boreas*) and Columbia Spotted Frogs (*Rana luteiventris*). Boreal toads, also called western toads are the primary focus of monitoring efforts due to their relative abundance in the Taiya River watershed. The primary goal of the project is to monitor long-term changes in amphibian distribution, abundance, reproduction, and survival rates at core breeding sites in lower Taiya River Watershed. The 2011 monitoring season spanned a five-month period between April 24 and September 30. 176 routine amphibian surveys were conducted at nine core breeding sites in Dyea, four non-core sites, and five extensive sites along the Chilkoot Trail corridor. Columbia Spotted frog surveys were conducted at 153 sites in the White Pass Unit. *B. boreas* were observed at eight core sites with breeding activity observed at 4 of the core sites, all of which exhibited a fully successful breeding cycle. A total of 43 adult boreal toads, 18 of which were in amplexus, 110 juvenile, 23 egg masses, ~71, 000 tadpoles, and ~11,500 metamorphs were detected during the 2011 monitoring season. For the first time since 2008 a PIT tagged adult boreal toad was recaptured, initially tagged in 2006. Two adult *R. luteiventris* were counted in the White Pass survey but no evidence of breeding was detected. Testing for chytrid fungus (*Batrachochytrium dendrobatidis*) was not conducted in the 2011 season.

Key Words: Amphibian monitoring, Klondike Gold Rush, Chytrid fungus, habitat assessment, boreal toad, *Bufo boreas*, Columbia Spotted Frog, *Rana luteiventris*

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INTRODUCTION

National Park managers use many indicators to understand and help maintain the integrity of park natural resources. Amphibians are considered good indicators of ecosystem health because of their sensitivity to environmental change. The rapid decline of amphibian populations in Klondike Gold Rush National Historical Park (KLGO) and Southeast Alaska reflects a larger, global decline in amphibians that may have alarming implications for the world's environment. Many factors are contributing to the dramatic declines, including habitat destruction, environmental contaminants, climate change, introduced species, and disease (Carstensen et al. 2003). Because of the pristine nature of Southeast Alaska, it may seem that wildlife populations are immune to the declines seen in other parts of the world. However, amphibian surveys completed between 2004 and 2010 and historical observations indicate a precipitous decline in local abundance and distribution of amphibians in the park and nearby wildlands.

Efforts to monitor amphibian populations in Klondike Gold Rush National Historical Park are part a worldwide push in the last 20 years to study and protect amphibian biodiversity (Anderson, 2004). In 2000, the National Park Service in Alaska prioritized amphibians as a taxonomic group to be inventoried. An Amphibian Monitoring Program was established in KLGO in 2004 and initially began by surveying wetlands and assessing the presence or absence of species. Since then, it has evolved from a purely inventory-based research strategy to a mid-level monitoring effort based on the USGS Amphibian Research and Monitoring Initiative (ARMI).

Two amphibian species have been confirmed in the park: boreal toad (*Bufo boreas*) and the Columbia spotted frog (*Rana luteiventris*). Prior to 2007, with the discovery of *R. luteiventris* in the White Pass Unit of KLGO, *B. boreas* was the only confirmed amphibian species within park boundaries. Although not yet confirmed, KLGO falls within the expected range of three additional amphibian species, the northwestern salamander (*Ambystoma gracile*), rough-skinned newt (*Taricha granulose*), and wood frog (*Rana sylvatica*) (Alaska National Heritage Program, 2001).

In recent years, emerging diseases have been detrimental to global amphibian populations. Chytrid fungus (*Batrachochytrium 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 (Berger et al., 1998). Although thought to have been spread throughout the world in just the last century, its extent and current distribution are unclear. 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. Sampling for chytrid in 2005 confirmed its presence in KLGO. Additional sampling was done in 2006, 2007, 2009, and 2010. In 2010 a dead boreal toad was sent to the National Wildlife Health Center for testing, the results confirmed the cause of death as chytridiomycosis (Surdyk, 2010). With multiple years of positive test results, chytrid testing was not conducted in 2011.

Boreal toads, due to their relative abundance in the Taiya River watershed are the primary focus of amphibian monitoring efforts in KLGO. This species, historically widespread throughout the western United States and Canada, has shown precipitous declines in abundance and distribution through large portions of their range in the last several decades (Hallock 2005). *B. boreas* is

classified 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 et al. 2003). 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 and adjacent wildlands.

The amphibian monitoring strategy at KLGO is organized into *intensive* and *extensive* components of the project in order to focus efforts appropriately given the density of amphibians in each particular area. Therefore, the lower Taiya River watershed, with its multiple *B. boreas* breeding sites has been considered the intensive component. In this area, core sites (those with present or previous breeding occupancy) will continue to be visited multiple times throughout each season (approximately mid-April through mid-September) to monitor toad presence and development. The extensive component was given a stratified design in which the greater areas of White Pass, the remaining sections of the Upper Skagway River watershed, select areas of the lower Taiya River watershed and the entire upper Taiya River watershed, were divided into Panels 1-4, one to two of which will be monitored per given season. Unlike the intensive component, each individual site within a panel of the extensive component will be visited only once per season (SOP 1. Routine Amphibian Survey Field Methods, 1.1.2 Seasonal Monitoring Schedule).

2011 Monitoring Objectives

The 2011 monitoring season was dedicated to implementing the long-term Amphibian Monitoring Protocol developed for KLGO in 2009 based on USGS Amphibian Research and Monitoring Initiative (ARMI) mid-level Monitoring Protocol. Thus the focus of park resources and staff was on monitoring species composition and abundance rather conducting inventories on presence-absence data. The objectives of amphibian monitoring in Klondike Gold Rush National Historical Park are:

1. Monitor long-term changes in amphibian distribution, abundance, reproduction, and survival rates at core breeding sites in Dyea.
2. Collect phenological and morphological data as part of the long-term monitoring effort for *B. boreas* populations at designated core breeding sites.
3. Record changes and disturbances at core breeding sites.
4. Collaborate with and provide data to other initiatives and efforts for monitoring amphibians, with an emphasis on Southeast Alaska.

In addition to the broader monitoring objectives, the 2011 monitoring season had a strong emphasis on education and outreach. Natural Resources staff participated in the Skagway Recreation Center's Summer Camp Career Day (Figure 1), NPS sponsored Junior Ranger Day (Appendix I) and Guide Lecture Series (Appendix II), community observation poster and forms, and a publication for the NPS Alaska Region AK2day website (Appendix III).



Figure1. Local students participated in the Skagway Recreation Center's Career Day on June 23, 2011 where they learned about amphibian monitoring efforts in KLGO.

SURVEY METHODS

One seasonal biological technician managed the amphibian monitoring program according to the Amphibian Monitoring Protocol and Standard Operating Procedures (SOPs) for routine amphibian surveys and adult and juvenile toad measurements. The SOPs can be located in T:/NRM/Amphibians/Amphibian Monitoring Protocol. Additional field support was provided by a part time Amphibian Biotech, a student intern, volunteers, and available Natural Resources staff.

The 2011 amphibian monitoring season focused on the core western toad breeding sites in Dyea. These sites were visited at least once a week between April 25 and September 29. During active breeding times, sites were visited more often; sometimes daily if needed and if resources allowed. A total of 176 routine amphibian surveys of the 9 intensive monitoring core sites were conducted during the 2011 season. Less frequent visits were made to four non-core breeding sites. Extensive sites located on West Creek, along the Chilkoot Trail Corridor, and White Pass all received a single site visit. White Pass monitoring was performed within hydrologically delineated basins (Basins 1A and 1B) extending south from White Pass and mostly west of the railroad, with a goal of surveying every lentic water body (mainly lakes) greater than 20 m², within each basin, for the presence of amphibians.

Temporal, climatic, physical, and vegetative habitat data metrics were collected on hard copy data forms (Appendix IV) during the visual encounter survey (VES) for amphibians present. The VES was performed by visually scanning the shoreline and all wadeable habitat of the site, estimating the relative abundance when large numbers of amphibians were present or making actual counts when feasible. Adults were captured by dipnet or by hand in order to measure SVL (Snout Vent Length), determine sex (presence of nuptial pads or emission of release calls for males), check for recapture (PIT tag), and photograph with the goal of building a library of individual identifications according to the pattern of bumps on the backs of toads which remains consistent from year to year (Carstensen et al., 2003). Age class was defined according to Carstensen et al. (2003) with some minor changes as follows: metamorph- according to presence

and timing at known tadpole locations; juvenile- <55mm SVL; and adult- >55mm. All attributes for amphibians observed were recorded on the species data form (Appendix IV). Counts for amplexing pairs, adults, and juveniles are “memory-less,” meaning it was assumed that the same individual was never detected twice and that there were no recaptures, as recommended by Nate Chelgren from USGS ARMI in 2005. Numbers for tadpoles and metamorphs are sums from the single survey counts with the greatest observations.

A strict hygiene protocol is followed to reduce the transmission of infectious diseases between study sites. All footwear and field gear is disinfected using a diluted bleach solution. The exact procedure is outlined in the Hygiene SOP 3 of the Amphibian Monitoring Protocol.

RESULTS

The 2011 season produced 4 active *B. boreas* breeding sites, all of which successfully reached metamorphosis. Additional *B. boreas* activity was observed at 9 total known monitoring sites (Table 1). Eighteen adult toads (9 pairs) in amplexus, 43 lone adults, 110 juveniles, 23 egg masses, an estimated 71,000 tadpoles, and an estimated 11,500 metamorphs were detected in total. The 23 egg masses recorded in the 2011 season marks the greatest number of egg masses ever recorded at KLGO. All 2011 egg masses were found at core breeding sites with previously documented breeding history. Table 2 shows dates of first observed egg mass, tadpoles, and metamorphs for the 2011 season and since the monitoring program began in 2004. Adult and juvenile *B. boreas* were detected throughout the duration of the monitoring season. Tadpoles were still present at TR01 and DY14 at the end of the monitoring season in late September (Table 3).

For the first time since 2008, a PIT tagged *B. boreas* was recaptured (Figure 2). On May 26 and again on May 28, 2011 biotech’s recaptured a PIT tagged adult male boreal toad. In 2005 and 2006 captured toads were outfitted with passive integrated transponders, also known as PIT tags, as means of identifying individual toads in the breeding population. The mark-recapture study was abandoned in 2007 due to low numbers of recapture. This toad was initially captured at the same breeding pond in July 2006 and is estimated to be at least 9 years of age in 2011.



Figure 2. A PIT tagged boreal toad recaptured at TR01 on May 26, initially tagged in 2006, this individual is estimated to be at least 9 years old in 2011.

Site ID	2004					2005					2006					2007					2008					2009					2010					2011				
	Life Stages Observed					Life Stages Observed					Life Stages Observed					Life Stages Observed					Life Stages Observed					Life Stages Observed					Life Stages Observed					Life Stages Observed				
	Egg Mass	Tadpole	Metamorph	Juvenile	Adult	Egg Mass	Tadpole	Metamorph	Juvenile	Adult	Egg Mass	Tadpole	Metamorph	Juvenile	Adult	Egg Mass	Tadpole	Metamorph	Juvenile	Adult	Egg Mass	Tadpole	Metamorph	Juvenile	Adult	Egg Mass	Tadpole	Metamorph	Juvenile	Adult	Egg Mass	Tadpole	Metamorph	Juvenile	Adult					
DY02									X					X																										
DY03		X	X			X	X		X	X	X	X	X	X	X	X	X				X						X	X	X					X	X	X	X	X		
DY12				X																																				
DY13				X				X						X									X				X	X	X	X	X			X				X		
DY14		X		X		X	X				X	X	X	X		X	X	X	X		X	X	X	X		X	X	X	X	X	X	X	X	X	X			X		
DY19						X			X			X		X																								X		
DY33		X				X					X	X			X																								X	
TR01						X	X		X	X	X	X	X	X	X	X	X	X		X	X	X			X	X	X	X		X	X	X	X	X	X	X	X	X		
WC02						X	X		X	X	X	X	X	X	X						X																			
WC03														X	X																									
WC04																		X	X			X	X	X			X	X	X		X	X	X	X	X	X	X	X		

Table 1. Detected site occupancy during the summer season for each life stage from 2004-2011. "X" indicates positive detection, blank indicates no detection, and "--" indicates that the site was not surveyed.

	Egg Mass	Tadpole	Metamorph
2004	May 19	late May	July 1
2005	April 21	May 9	July 6
2006	mid -May	May 30	July 26
2007	May 14	June 5	Aug 15
2008	May 20	June 5	July 31
2009	May 8	May 21	Aug 4
2010	May 3	May 19	June 28
2011	May 11	May 16	July 14

Table 2. Date of first observed *B. boreas* life stages for each year of KLGO Amphibian Monitoring Program.

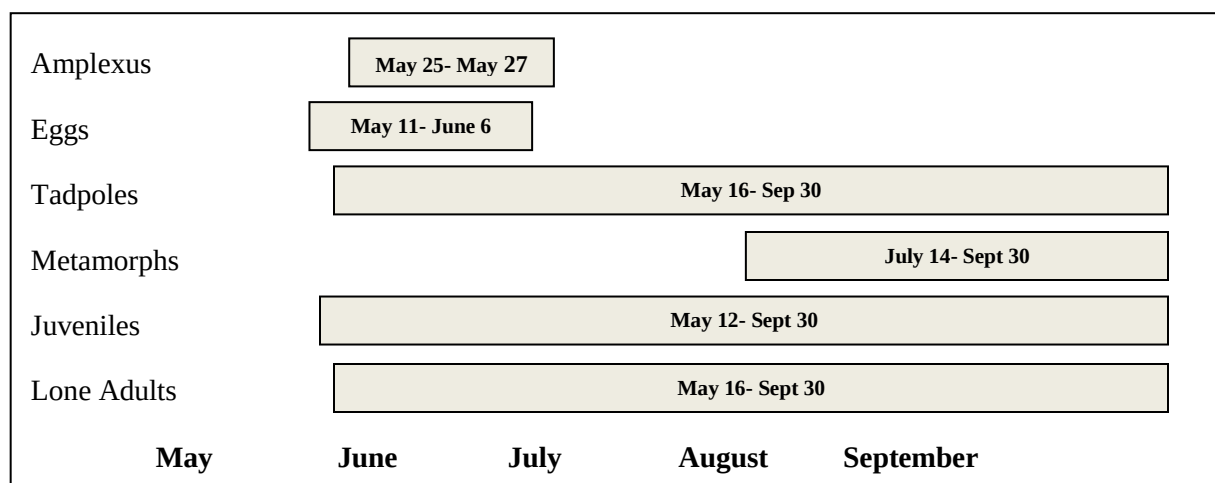


Table 3. Boreal toad phonology date ranges observed at core sites in KLGO in 2011.

Individual Site Results

For each core breeding site and extensive site surveyed, a general habitat description for the 2011 season, summary of quantitative site data, and qualitative timeline in amphibian activity and significant morphology events are provided.

Lower Taiya River Watershed: Core sites

Taiya River 01 (TR01)

Discovered in 2005, this productive breeding site is a wetland within bankfull of the Taiya River, approximately 50 m west of the NPS Dyea campground. This series of 3 primary side channels intermittently receives flow from the Taiya River causing water levels to fluctuate widely and rapidly throughout the summer in response to temperature and the amount of recent precipitation. Such a regime produces 3 ‘lobes’ (East, Middle, and South) that typically maintain some water throughout the season supporting extensive areas of *Equisetum*, with the pond margins dominated by *Salix* and *Alnus* spp. These aquatic and riparian plants, along with a several others, increase significantly in size, density, and coverage as the summer season progresses. In addition to hydrological disturbances, this site is especially prone to disturbances by people, their pets, hares, otters, bears, and predation from shore birds.

The productivity of this site is ever dependent of the fluctuating hydrology of the Taiya River. In some previous years the old river braids used as breeding ponds have dried completely, resulting in 100% desiccation of eggs and larva. Reversely, high water levels have also caused the river to reshape and expand, ultimately overwhelming the site with turbid glacial runoff and washing away any amphibians inhabiting the site. This year both scenarios played out. In May, one egg mass in the southwest pool failed to develop due to desiccation. In late August, due to several days of precipitation the Taiya River reached the National Weather Service’s moderate stage flooding level with a max gauge height of 17.2 on August 21, 2011(Figure 3). It is suspected that many of the newly metamorphosed toadlets were washed downstream.

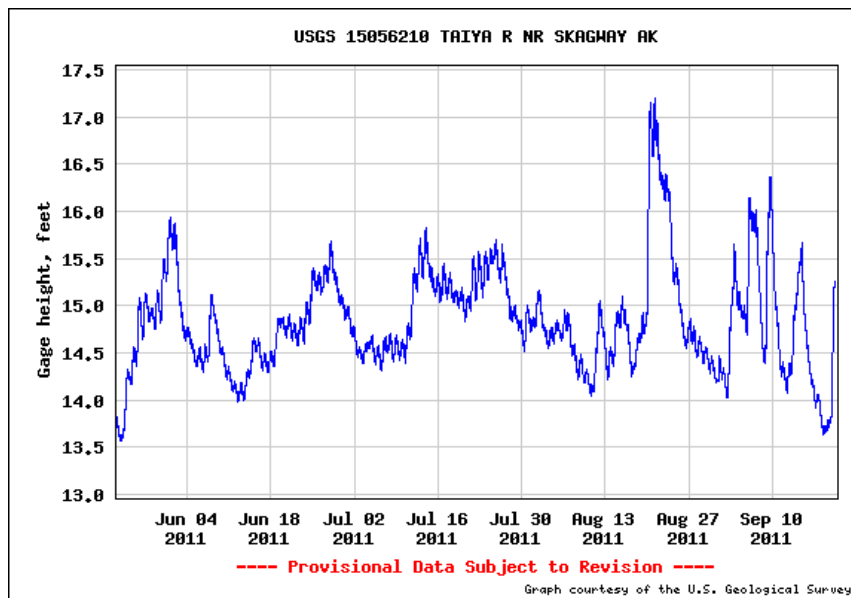


Figure 3. USGS Taiya River gage height (ft) graph showing the moderate flooding event on August 21, 2011.

During the 2011 monitoring season, TR01 received a total of 31 visual encounter surveys, 28 (90%) of which resulted in positive amphibian detection. Biotechs observed 10 egg masses (nine surviving to produce hatchlings and tadpoles), ~30,000 tadpoles, ~10,000 metamorphs, 4 adults in amplexus, and 21 lone adults.

One PIT tagged adult male was recaptured on May 26 and again on May 28 in the same location. PIT tag number 465734443E, was initially captured at TR01 on July 11, 2006. When captured in 2006, 465734443E had a SVL of 66 mm and a mass of 34 g. In 2011, SVL had increased to 71 mm and a mass of 52 g.



Figure 4. The south lobe of site TR01 during average water levels (left) and flooding on August 22, 2011 (right).

Dyea 02 (DY02)

This shallow, detritus-laden wetland is dominated by *Carex*, *Equisetum*, and several species of grass in the aquatic zone, with Sitka alder and cottonwood around the perimeter. Water levels fluctuate from completely dry to nearly two feet of depth during high water. Physical evidence of *B. boreas* breeding (egg masses or tadpoles) has never been observed at DY02. However, it appears to be important habitat for juvenile and adult boreal toads. Juvenile toads were observed at this site in 2005, 2006, 2009, 2010, and in the 2011 season. Lone adult toads were seen in the 2007 and 2010 seasons.

During the 2011 Monitoring season, DY02 received a total of 11 visual encounter surveys, 7 (64%) of which resulted in positive amphibian detection. A total of 54 juvenile toads were observed at DY02 in 2011. A majority of the surveys were cut short due to the abundant number of juveniles and the high probability of stepping on them.

Dyea 03 (DY03)

This shallow, anthropogenic wetland is susceptible to radical changes in water depth and may flood over an old road bed or dry out after *B. boreas* breeding initiation. At average water levels this site is composed of four distinct ponds. The northern-most pond has a thick layer of leaf debris along the shore but relatively little leaf debris on the bottom of the pond itself and no emergent or submergent vegetation. The north-center pond is the shallowest and thus the most vulnerable to water fluctuations. At high water, the north and center pond merge into one, and become water connected to the south-center pond, which expands over the decommissioned road leading into the site. The southernmost pond is the deepest, approximately 1.5 meters deep in the

center. Leaf litter, canopy cover, and depth make this pond less suitable breeding habitat but it could be used as a migration area for metamorphs and adults. While water levels fluctuate throughout the season, there are no inlets or outlets to the site and the water remains stagnant and warm. In the early season and at low water levels, there are few aquatic emergent plants present. As the season progresses, plants grow and water levels rise, a larger portion of the pond supports emergent vegetation. Sitka alder comprises a majority of the riparian vegetation.

During the 2011 Monitoring season, DY03 received a total of 22 visual encounter surveys, 17 (77%) of which resulted in positive amphibian detection. Biotechs observed 4 egg masses, ~ 1,000 tadpoles, ~ 500 metamorphs, 4 adults (2 pairs) in amplexus, and 7 lone adults. One of the egg masses laid in the south-center pond developed green algae or water mold and only 20 percent developed into hatchlings (Figure 5). The only egg mass laid in the north-center pond on May 31 died due to desiccation. Low water levels mid-season caused 100 or more tadpoles to be stranded along the shore in shallow depressions. Biotechs relocated several tadpoles into the deeper water but many more died due to desiccation (Figure 5). In previous years water fluctuations have caused complete failure or abandonment of DY03 as a breeding site.



Figure 5. Adults in amplexus at DY03 (left), desiccated tadpoles along the shore of DY03 as water levels receded in mid-June(center), green water mold or algae found on egg masses at DY03 resulting in approximately 50% egg mass mortality (right).

Dyea 12 (DY12)

This section of Nelson Creek above the Nelson Slough foot bridge is a slow-moving stream and is well filled with emergent vegetation. The channel becomes increasingly shaded as it moves north. The deepest parts of the channel are centrally located and can reach a maximum depth of ~.8m. The northern end of this wetland maintains water on a regular basis while the southern portion typically dries out. Physical evidence of *B. boreas* breeding (egg masses or tadpoles) has never been observed at DY12.

In 2011, DY12 received 2 visual encounter surveys. No amphibians were detected at this site. Water fluctuations and dense canopy cover make DY12 a less desirable breeding site for *B. boreas*. However, it should continue to be periodically searched throughout the breeding season. Lone toads have been seen at this site in the past.

Dyea 13 (DY13)

This is the section of Nelson Slough (West Branch of the Taiya River) between the old Dyea town site trail footbridge and the vehicle bridge, south of which it is considered Dyea 14. This slow moving channel is almost entirely filled (75%) with emergent *Carex spp.* with one narrow area of open water near the center of the channel. Changes in the hydrology of the Nelson Slough are related to fluctuating water levels and post-glacial rebound, or the slow uplift of land after the recession of a glacier. The Dyea flats rise an average 14 to 16 mm per year, one of the fastest rates found anywhere (Larsen et al. 2005). In 2011, water levels fluctuated between being entirely dry to full connection with DY14. Visibility and amphibian detection is very low at this site due to dense vegetation cover.

During the 2011 Monitoring season, DY13 received a total of 19 visual encounter surveys, 2 (11%) of which resulted in positive amphibian detection. No egg masses were observed at this site. However, over 100 tadpoles were observed and one adult male *B. boreas* was captured on June 6, 2011 (Figure 6). The ~100 tadpoles observed were actually from the productive breeding that took place in DY14, since no egg masses were ever observed here and tadpole detection did not take place at this site until water connected DY13 to DY14, a highly active breeding site.



Figure 6. Natural Resources SCA intern, Sara Cohen holds the only adult boreal toad observed at DY13 on June 16, 2011.

Dyea 14 (DY14)

DY14 encompasses the section of Nelson Slough extending southwest from the vehicle bridge to its confluence with Nelson Creek on the western bank. This slow-moving channel starts out with a dense cover of *Carex spp.*, except in the thalweg and has a substrate comprised of unconsolidated silt (Figure 7). As it nears a large bend, aquatic vegetation disappears almost entirely as depth increases and a large open pool forms with a substrate that is consistent with the upstream portion. Moving downstream from the pool, the channel becomes increasingly covered with *Carex spp.* as the average depth decreases over a primary substrate of fine gravel. This site is part of the larger Taiya River estuary and thus it is a slightly brackish environment. Water levels

at DY14 are affected by tidal movement as well as glacial melt and rainfall. During high water events, DY14 is connected with DY13 to the north and Nelson Creek to the south. Brown bears, black bears, great blue herons, river otters, salmon and other fish share this dynamic environment with the boreal toad population that has been positively detected at the site every year since the monitoring program began in 2004. DY14 is consistently the most productive *B. boreas* breeding site currently monitored at KLGO.

In 2011 DY14 received a total of 27 visual encounter surveys, 18 (67%) of which resulted in positive amphibian detection. Biotechs observed 6 adults (3 pairs) in amplexus, 7 egg masses, ~30,000 tadpoles, ~10,000 metamorphs, and 11 lone adults. No juvenile *B. boreas* were detected during the 2011 season. The first adult of the 2011 season was detected at DY14 on May 16 (Figure 7).



Figure 7. DY14 looking west off the vehicle bridge over Nelson Slough (left). The first observed adult boreal toad of the 2011 season found at DY14 on May 16 (right).

Dyea 19 (DY19)

This large bog, dominated by emergent buckbean (*Menyanthes trifoliata*) and a fringe of sweet gale (*Myrica gale*), maintained some water throughout most of the summer, but became nearly dry by mid-August, except for the main channels running through the site. This site is located behind Slide Cemetery, accessed using a conspicuous trail located along the north side of the cemetery fence. Evidence of *B. boreas* breeding was observed here in 2005 and 2006 and was not surveyed in 2009. Juveniles were found in high abundance in 2010 and 2011, indicating undetected breeding activity in the area.

During the 2011 monitoring season, DY19 received a total of 10 visual encounter surveys, 2 (20%) of which resulted in positive amphibian detection. No breeding activity was detected at this site in 2011, but a total of 14 juveniles were observed.

Dyea 33 (DY33)

This anthropogenic wetland, owned by the Municipality of Skagway, becomes 2 distinct areas when during high water events. A relatively deep (< 2 m), circular pond, created by excavation, lies at the southern end of the site and maintains water throughout the summer. The larger portion to the north is less convex, with ephemeral water only. In 2009, gravel piles were placed in this site for road maintenance and the shallow depressions that previously supported breeding activity and egg masses were filled in. The majority of the deep pond substrate is gravel, but the

western edge is dominated by plants typically associated with wet meadows and the perimeter of the pond is comprised mainly of Sitka alder. A productive breeding site in 2004, 2005 and 2006, evidence of *B. boreas* has not been detected since then. Vehicles regularly move through this area and it does not appear to be suitable *B. boreas* breeding habitat but should continue to be periodically monitored for activity as conditions change.

In 2011, DY33 received a total of 11 visual encounter surveys, 1 of which resulted in positive amphibian detection. Unfortunately, the only amphibian detected at this site was killed by a vehicle and found flattened on the gravel (Figure 8).



Figure 8. Adult male boreal toad found dead on the road leading into DY33.
One of three toads found this season killed by vehicles.

West Creek 02 (WC02)

Adjacent to West Creek Road, just west of the KLGO boundary in the Municipality of Skagway's jurisdiction, this small wetland, approximately 100 m², is a series of small ponds dominated by cotton grass, *Eriophorum spp.*, and sedge, *Carex spp.*, as well as sphagnum moss. After its initial discovery from aerial photographs in 2005, it was identified as an important breeding site in 2005, 2006, and 2007. One adult *B. boreas* was detected in 2009 but breeding activity has not been recorded at WC02 since the creation of an adjacent road-side ditch, WC04 in 2008. Shading and lower water temperatures make WC02 less suitable for *B. boreas* breeding and it is assumed that the breeding population now using WC04 is the same population once utilizing WC02.

During the 2011 Monitoring season, WC02 received a total of 8 visual encounter surveys, none of which resulted in positive amphibian detection.

West Creek 04 (WC04)

Discovered in 2008 as a *B. boreas* breeding site after conducting a survey of WC02, this anthropogenic pool (approximately 50 m²) is part of the drainage ditch adjacent to the north side of West Creek Road, created when the road was 'improved' during the spring of 2007 (Figure 9). The site has a shoreline substrate mainly comprised of fine gravel and large rocks with grass, sedge, and rush spp. as the dominant vegetation. The bed surface consists of relatively deep (20-

50 mm), dark detritus, providing substantial cover for tadpoles, as did an increasingly abundant cover of algae. WC04 has little or no shading and consistently warm temperatures making it more suitable breeding habitat for *B. boreas*. Unlike the other core sites, WC04 is not directly dependent on the hydrology of the Taiya River and is less prone to abrupt shifts in water levels.

Although WC04 was a highly successful *B. boreas* breeding site in 2011 it was also marked by predation, loss of water, human and animal disturbances. On June 2, 2011 ATV tracks were observed running through the west end of the pond (Figure 9). The egg mass at that end had already hatched, reducing overall mortality. Water slowly dried up and became nearly completely dry by mid-July. Approximately 200 tadpoles were stranded and died due to desiccation. Human, bear, great blue heron, spotted sandpiper and other bird, canine, hare, and other small mammal tracks were observed at the site becoming more pronounced as the water levels receded. One metamorph less than 1 cm long was observed ~3 meters from the edge of the water crossing the road.

During the 2011 Monitoring season, WC04 received a total of 27 visual encounter surveys, 27 (100%) of which resulted in positive amphibian detection. Biotechs observed 2 egg masses, ~10,000 tadpoles, ~1,000 metamorphs, and 27 juvenile *B. boreas*. No adult toads were detected at this site in 2011. The first egg mass of the 2011 season was detected at WC04, one week earlier than other sites.



Figure 9. ATV tracks in the foreground leading into WC04 during high water (left), WC04 at the end of July with only two small pools of stranded tadpoles (center), great blue heron tracks along the shore of WC04, a common occurrence at this site (right).

Lower Taiya River Watershed: Non-Core Sites

West Creek 03 (WC03)

This is an area of extensive wetlands, up the West Creek drainage, that can be reached by hiking approximately 2.5 km up the trail at the end of West Creek Road. The area surveyed in 2011 includes a Small Complex (WC03-SC; approximately 150m x 70m in area) that is separated from the much larger Main Complex (WC03-MC; approximately 750m x 300m) (Figure 10) by a thin band of forest to the northwest. The majority of the water surface area for each site, while

relatively exposed in early summer, becomes increasingly enshrouded with a dense cover of buckbean (*Menyanthes trifoliata*) with the margins dominated by various grasses, sedges, alder, and willow. Such vegetative phenology makes the detection of amphibian egg and larval stages progressively difficult, especially in the vast expanse of the Main Complex where approximately 70-80% of the area is covered by lentic bodies of water. Evidence of *B. boreas* breeding has been observed at this site in the past, in 2006 juveniles and an adult was located and in 2009 tadpoles were found.

During the 2011 Monitoring season, WC03 received just one visual encounter survey, during which no amphibians were detected. Conducting a full search of the small complex and a partial search of the large complex took a team of 4 people 240 minutes.



Figure 10. The largest and deepest pool of the WC03-MC complex.

Lost Lake (LL1)

Lost Lake is a bedrock controlled lake with steep sides and very few shallow areas. The southern end of Lost Lake is fairly shallow with an area of buckbean that is similar to Dyea 19. Lost Lake was surveyed once during the summer on June 15, 2011. No amphibians were detected during the survey.



Figure 11. The view of Lost Lake from the north looking south.

Lost Lost Lake (LL2)

Lost Lost Lake can be found by continuing down a little used trail at the southern end of Lost Lake. The vegetation community in and surrounding Lost Lost Lake is similar to the lakes and ponds of Canada that host western toad, spotted frog (*Rana pretosia*), and wood frog (*Rana sylvatica*) breeding populations. However, the main body of water considered Lost Lost Lake has steep banks creating a deep shoreline, potentially not favorable for western toad breeding. On the other hand, a number of distinct pools lie in the meadow surrounding the north end of the lake which have much shallower water and appear to be ideal for breeding. Lost Lost Lake was surveyed once during the summer on June 15, 2011. No amphibians were detected.



Figure 12. The view of Lost Lost Lake from the north looking south.

Upper Taiya Watershed: Panel 3 Sites Surveyed

Chilkoot Trail 04 (CT04)

CT4 is located between Pleasant Camp and Sheep Camp. This large 450m² pond is bordered by a *Tsuga* spp. overstory with a primarily *Vaccinium* spp. understory. Yellow pond-lily (*Nuphar polysepalum*) was the dominant aquatic vegetation. Most of the water input comes from hillside runoff and there does not appear to be a significant outlet. CT04 appears to be ideal amphibian habitat with shallow vegetated margins along the shore and a relatively open canopy. However, amphibians have never been detected at this site.

This site can be difficult to locate given that GPS accuracy is limited under the dense canopy. The site is located on a bench, approximately 30 meters above elevation the Chilkoot Trail. Based on descriptions from past years, it appears that in some years the actual site was not found and surveys took place at much shallower water bodies in the same general area.



Figure 13. CT04 looking north on June 30, 2011.

Chilkoot Trail 05 (CT05)

In previous years, the archaeology zip line was used to cross the Taiya River to the historic Sheep Camp. The archaeology zip line was no longer in-use for the 2011 season. Sites CT05, CT06, and CT10 must now be accessed by crossing the Taiya River on foot. A safe crossing was located at an area where the river is broken into several smaller channels. We located a crossing approximately 1 mile south of Sheep Camp, an area where an old foot bridge and trail remnants are visible from the current trail. The river was safe to cross at a USGS gauge height of 15 feet and a discharge of 2,100 cfs. Checking the height of the river before the trip would be very useful in determining if the river will be crossable. A river crossing should not be attempted if the water is much higher. Trekking poles and appropriate river shoes were very useful for the river crossing and should not be attempted without a partner.

After crossing the river, travel south along the river to a large open muskeg area on a shelf above the river. CT 5 is a 4x10m pond that is completely open to the sun and surrounded by a dense mat of crowberry (*Empetrum nigrum*). The only emergent vegetation includes yellow pond-lily and buckbean. Several small shore pine (*Pinus contorta* var. *contorta*) dot the area within 50m of the pond. A small area of water seepage indicates that the pond may be spring fed. Although this area is similar to ponds in Canada where wood frogs, spotted frogs, and boreal toads have been seen, no amphibians have ever been detected at this site. Surveys of this area should continue.

Chilkoot Trail 06 (CT06)

CT 6 is ~85m northwest of CT 5. While larger than CT 5, CT 6 is similar in all other aspects. Surveys of this area should be completed along with surveys of CT 5. No amphibians were detected.



Figure 14. Volunteer, Bryan Frazier scans the perimeter of CT06 on June 30, 2011.

Chilkoot Trail 07 (CT07)

This large series of beaver ponds is located on the Chilkoot Trail at mile three. There are several dead trees standing in the middle of the pond, and the entire pond is surrounded by closed forest. The sides of the pond are fairly steep, the water appears to be at least 1m deep, lacks emergent vegetation, and requires the use of chest waders to effectively survey.

An adult was found at CT07 by the trail crew in 2007 and 2010. Two adults were reported in 2011, one by the vegetation mapping crew and another reported by a Chilkat River guide. Evidence of breeding has never been detected at this location. However, the large size and complexity of the beaver ponds makes detection very difficult. No amphibians were detected during the visual encounter surveys conducted on June 1 and 2.

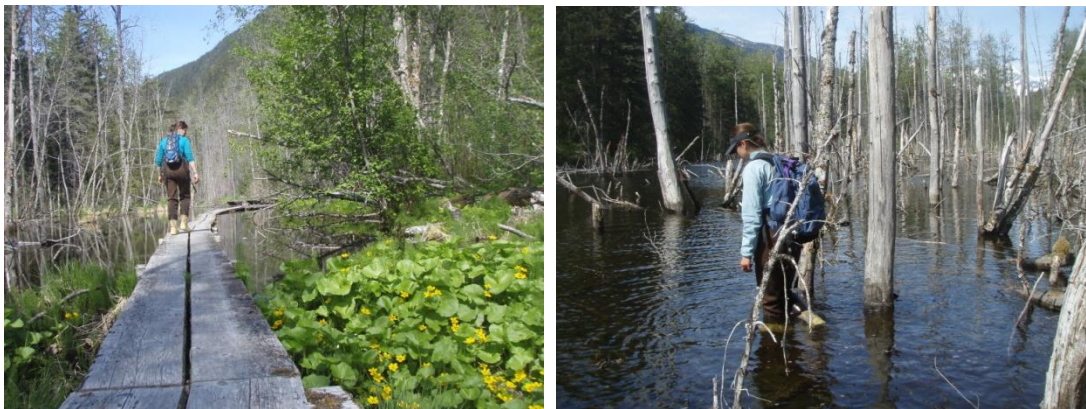


Figure 15. Biological technicians Selby Surdyk (left) and Jaime Welfelt (right) conduct a routine amphibian survey at CT07 on June 1, 2011.

Chilkoot Trail 11 (CT11)

CT11 is a wide open sand flat which is an old river braid that can receive river water flow during periods of high water. The lack of cover for much of the shore, the regular presence of spotted sandpipers, a density of spotted sandpiper footprints at the pond's shoreline, and the sand substrate on this uplift pond is reminiscent of TR01, a consistently productive breeding site in

Dyea. CT11 can be reached with a short bushwhack from the raft put-in spot, 1.6 miles down the Chilkoot Trail. The bank starts to undercut downstream of the put-in spot so wading just offshore is not an option. When traveling North on the trail, after descending the first hill, Saintly Hill, there is a spot where the trail opens up to the river bank is just after a bridge. This spot is a viewpoint used by raft guides for interpretation, and affords a view of the site. No amphibians were found here during the search on June 21, 2011.

Extended Chilkoot Survey

Reports from multiple hike and float guides of boreal toads found on the Chilkoot Trail between the trailhead and the rafters put-in prompted a survey of the area to try and locate additional breeding sites along this corridor. While no new breeding sites were identified, an adult and multiple yearling toads were located on a sandbar adjacent to the stream flowing out of the beaver ponds (Figure 16). Multiple sightings of juvenile boreal toads have been reported along the second wooden bridge on the Chilkoot Trail heading north (Figure 17). Evidence of breeding was not found but additional juveniles were located using this stream corridor. An incidental *B. boreas* was sighted by Natural Resources staff a quarter mile north of Finnegan's Point on September 4, 2011. The high number of sightings and distance from known breeding locations suggests that there are additional undiscovered breeding sites located in the upper Skagway River Valley.



Figure 16. Juvenile (left) and adult (right) *B. boreas* found along the Chilkoot Trail on June 21, 2011.

Dyea Amphibian Monitoring Sites

Klondike Gold Rush National Historical Park

National Park Service
Department of the Interior

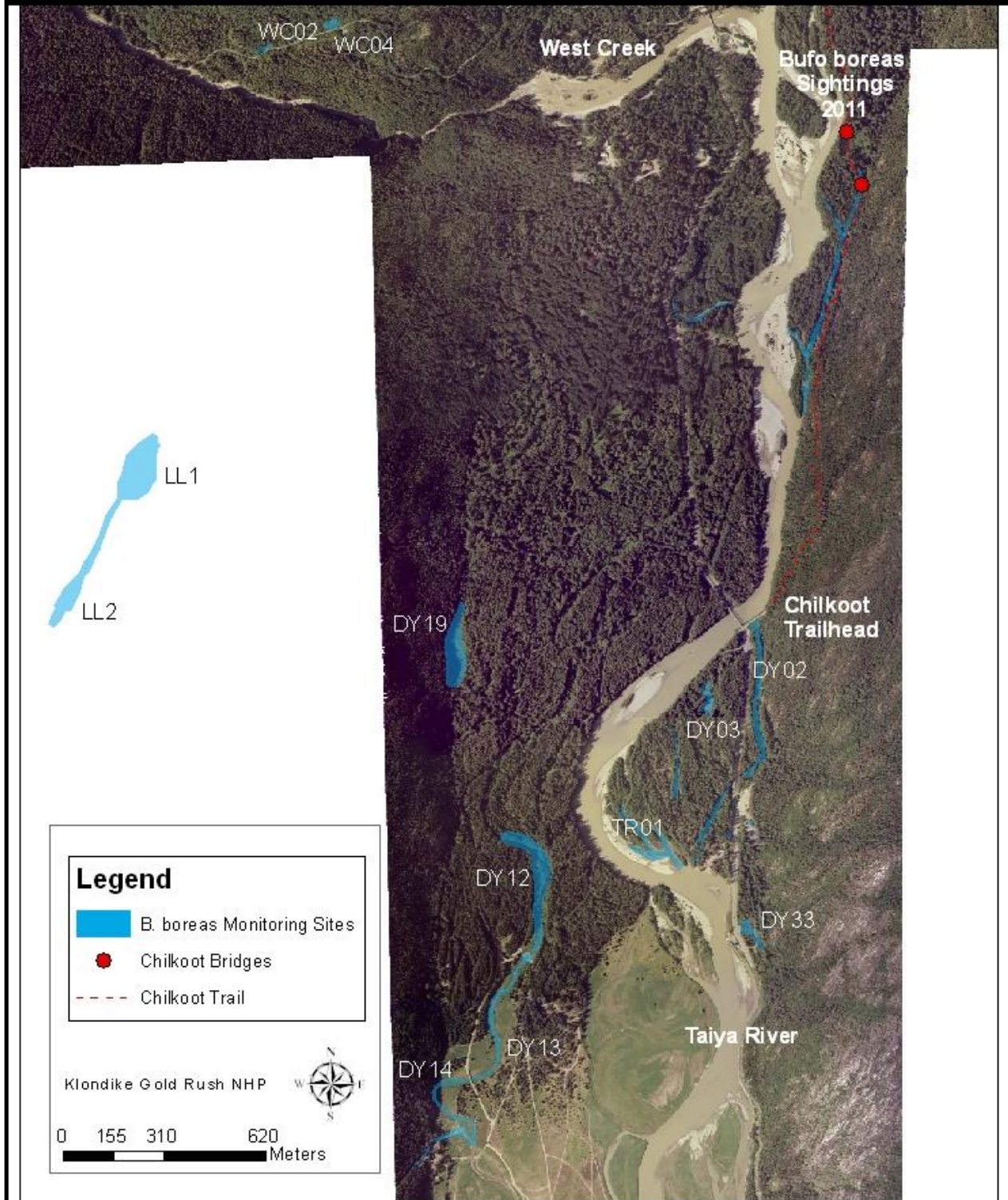


Figure 17. The 2011 *B. boreas* sightings location along the Chilkoot Trail.

Skagway River Watershed:

White Pass Unit Panel 1, Basins 1A and 1B

In early August 2004, a White Pass & Yukon Route employee spotted a large amphibian sunning on a rock near White Pass (J. Mcdermott, pers. comm. 2004). This prompted the survey of Pumphouse Lake (WP01), immediately to the south of the pass, in which a single western toad adult was found that same year. Subsequent surveys in 2005 and 2006 of this same site did not reveal any amphibians, but in 2007 an additional 9 lake sites (WP02A-C, WP04, WP04B, WP05-WP08) were visited, up to 2 km south of WP01. This effort produced a single Columbia spotted frog sighting, the range of which, prior to this discovery, was only documented to extend within 4 km north of the Canadian Border at White Pass.

Previously documented observations of two amphibian species in the White Pass area provided a sufficient impetus in 2008 to survey this zone far more extensively than in the previous 4 years to determine if breeding populations exist. In order to establish a survey goal that included the locales of previous sightings, encompassed nearly all similar habitat beyond these, and existed mainly within the KLGO boundaries, target basins were delineated following the primary guidelines of the Hydrologic Unit Code (HUC) established by the U.S.G.S. (Figure 19). Because the smallest unit created under this system is still far too large to effectively survey by a single technician in one season, this procedure was slightly modified to yield a manageable basin area of approximately 1-4 km². The 4 basins were divided into 2 panels (Panel 1 and 2) each containing Basins A and B (Figure 20), with the monitoring strategy being to survey 1 panel per year.

With monitoring boundaries determined in 2008, the data collection strategy was then to locate and survey, by searching in a grid-like fashion, every lentic water body encountered utilizing the same protocol as in previous surveys. An area of 20 m² was adopted as the minimum for a site in order to focus on those which are likely to sustain water long enough to be suitable breeding habitat. Four additional Columbia spotted frogs were found during the 2008 season.

Extensive surveys of the White Pass Unit resumed in 2011 with a survey of Panel 1, Basins A and B (Figure 20). A total of 153 sites were searched resulting in the detection of two Columbia spotted frogs. The first was found at WP2A and the second at WP01. Both sites have previously documented Columbia spotted frog observations. No evidence of breeding was observed.



Figure 18. SCA intern, Zachary Goodrich stands at the southern end of the White Pass Panel 1 survey unit on August 4, 2011.

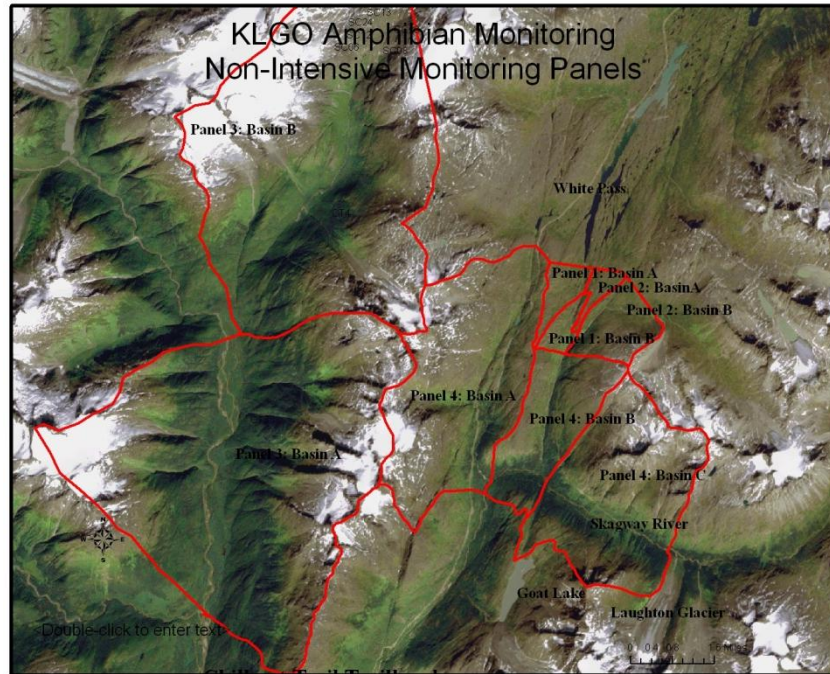


Figure 19. Extensive Monitoring Panels

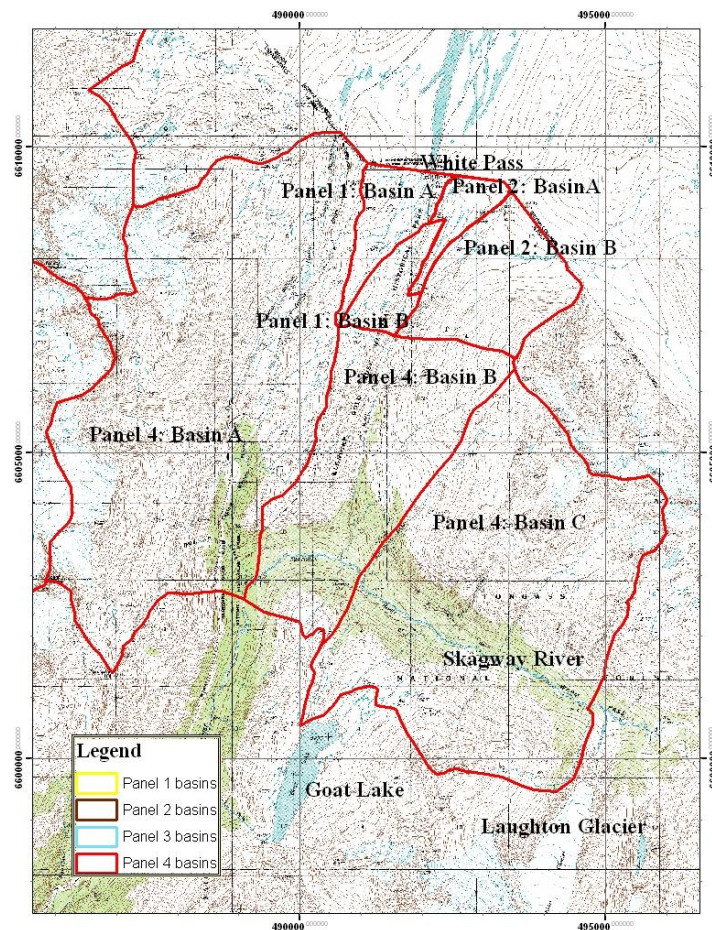


Figure 20. Extensive White Pass Survey Unit, Panel 1: Basins A and B were surveyed in 2011.

Lower Skagway River Valley

For the first time since monitoring efforts began in 2004, two adult boreal toads were reported in the lower Skagway Valley. Historically, boreal toads were found in abundance in both the Skagway and Taiya River Valleys but recent reports have been confined to the Loughton Glacier Valley. One life-long Skagway resident recalled breeding ponds adjacent to the mouth of the Skagway River, the current location of the Skagway Airport and in Icy and Lower Dewey Lake (Kalen 2010, Albecker 2010).

In 2011, the first toad was reported in early June, near Liarsville by a local Skagway resident. The second adult toad was found by Shelby Surdyk, an amphibian biotech in 2010 and 2011. She found a dead adult toad on the 7-Pastures Road near the disc golf course, hole 8 on August 2, 2011.

Mortality and Disease Observations

Mortality

Three dead adult *B. boreas* were reported by park staff during the 2011 season (Table 4). All three mortalities were caused by vehicles. All scanned negative for PIT tags.

Date Observed	Location	Type	Cause of Death	Collected
07/06/2011	Road into DY33	Adult	Vehicle	No
07/15/2011	NPS Campground	Adult	Vehicle	No
08/02/2011	Seven Pastures Road	Adult	Vehicle	Yes

Table 4. Amphibian mortalities reported during the 2011 monitoring season.

Egg mass Infection and Mortality

Several of the egg masses detected during the 2011 monitoring season did not survive to produce hatchlings. A variety of biotic and abiotic factors are reported to damage or act as stressors on *B. boreas* egg masses including UV-B radiation, non-optimal temperatures, changes in pH, pollution, physical disturbances, and water-borne pathogens such as water-molds or fungi (Kiesecker, 1995). The reason for detected egg mass mortality in KLGO is not known, but white mold was found on eggs at DY14 (Figure 21). Green algae were observed on egg masses at DY03 and TR01. In the Oregon Cascades, *B. boreas* egg masses have seen 50-100% mortality due to a pathogenic fungus, *Saprolegnia ferax* (Kiesecker, 1995).



Figure 21. White water mold or fungus detected on several egg masses at DY14. Approximately 25% of egg masses at this site failed to develop due to water mold or fungal infections.

DISCUSSION

Oral history accounts and anecdotal evidence indicates that boreal toads were once abundant in both the Skagway and Taiya River Valleys. Elders from both communities have commented that the bottom of ponds were not visible in the spring from all of the black egg masses and tadpoles (Kalen 2010, Albecker 2010, Fairbanks 2010). The small, isolated *B. boreas* population in Dyea today is a small fraction of this once abundant species.

While greatly reduced from historic accounts, strong numbers from the 2010 and 2011 monitoring seasons indicate an increase in breeding activity. In 2011, 23 *B. boreas* egg masses were recorded; the greatest number at KLGO since monitoring efforts began in 2004. Rather than continued precipitous decline, the remnant KLGO population appears to be relatively stable.

Similar population crashes of *B. boreas* are documented in Juneau, Ketchikan and Haines between 1970 – 1990 (Carstensen et al. 2003). Anecdotal evidence suggests that amphibians in southeast Alaska may have already experienced a mass mortality event (Green 2010) and now continue to be subject to variation in breeding site occupancy and breeding productivity due to natural metapopulation dynamics (Shmetherling 2009).

A wide-spread amphibian die-off in the Dyea and Skagway valleys could have been triggered by many possible causes. The reasons for abrupt population crashes in Southeast Alaska are most likely a combination of factors. Habitat loss, climate change, increased UV-B radiation, introduction of predators (such as stocked fish in the Skagway valley) or the pathogenic chytrid fungus, are all suspected causes. The presence of chytrid in KLGO with confirmed mortality seems to be a major contributor. However, even with multiple years of positive chytrid tests results, the remnant Dyea population is currently persisting.

Human activities, while mostly unintentional, have a major impact on current *B. boreas* survival in KLGO. Each season multiple toads are killed by vehicles. Unknowing visitor's spread pathogens on their footwear and step on the tiny newly metamorphosed toads. Community and visitor education should remain an integral part of the KLGO amphibian monitoring program to mitigate these impacts. Amphibian observations from visitors, community members and local

guides have been instrumental in piecing together the extensive distribution of amphibians in the area.

The discovery of two toads in the lower Skagway Valley is encouraging. While evidence of breeding was not detected, the discovery of boreal toads several miles from known breeding sites along the Chilkoot Trail and lower Skagway indicates that toads are dispersing and suggests the possibility of undiscovered breeding locations. A movement study is proposed for the 2012 season, using radio tracking to located additional breeding locations and identify important terrestrial upland habitat used for foraging and hibernation.

RECOMENDATIONS

Education and Outreach

In 2010 amphibian biotech, Selby Surdyk created amphibian observation forms for KLGO. In 2011 she made an additional amphibian monitoring educational poster with observation forms and distributed them to local guide and excursion services. Nine amphibian observation forms were returned with many more in-person reports. These observations are fundamental to piecing together the entire picture of amphibian distribution throughout the area. Education efforts are essential in reducing the spread of chytrid and mitigating human impacts on sensitive breeding sites. Education efforts should continue to be a focus of the KLGO amphibian monitoring program. Outlines of the 2011 education efforts are included in the appendix.

Individual Toad Identification

The recapture of a PIT tagged boreal toad in the 2011 was a highlight of the season. Finding a marked individual boreal toad allows insight into the movement patterns, growth rate and life span of this elusive species. Being able to track individuals over time would also provide data on the effects of chytrid and local survival rates. The most common methods for marking amphibians are toe clipping or PIT tagging, both of which are invasive and have the potential to harm the study species. In 2011, Shelby Surdyk contacted Tom Morrison from Dartmouth University. He is working on a photo identification software that can be used to identify toads based on the unique marking patterns on their backs. The implementation of an automated digital amphibian identification program would greatly improve the usefulness of the data collected by giving an estimation of recapture rates, population numbers, movement patterns and site fidelity, and life span of individual toads.

Movement Study Using Radio Tracking

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 area 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 V). Another option is the Holohil BD-2 or PD-2, which can be fitted with a belt harness and cost \$180 each (www.holohil.com)

(Appendix V). Toads that are captured during the summer breeding season should be fitted with radio tags and tracked through the fall to determine habitat use and movement patterns.

Careful research into the appropriate size and material of the radio transmitter and belt should be done before initiation of the tracking project. Radio transmitters and the belt have been known to have adverse impacts on the study species. The belt material can cause skin irritation and lesions, there is also the possibility of becoming snagged on vegetation or loss of signal (Bartelt et al., 2000). Studies indicate that the impacts on *B. boreas* are minimal but research and consistent monitoring is necessary to minimize negative impacts (Browne et al., 2010, Pimentel, 1955).

Columbia Spotted Frog Surveys

The detection of two additional Columbia spotted frogs in the White Pass Unit of KLGO in 2011 merits the continuation of extensive surveys. In order to observe breeding activity surveys should be conducted in mid-July rather than August. Testing for chytrid on *R. luteiventris* in the White Pass Unit would also be advised in order to detect the distribution of chytrid within the entire range of the park.

ACKOWLEGDMENTS

Thank you to Biological Science Technician Shelby Surdyk for her much needed orientation, training, field support, and educational outreach efforts. Thank you to student volunteer, Maya Heubner for her field assistance, keen observation skills and much enjoyed company. Additional thanks to Ellen Bagwell and Bryan Frazier for their volunteer time on the amphibian monitoring project. I would also like to acknowledge all of the former biotech's who initiated, grew, and contributed to the Amphibian Monitoring Program, and whose work and data is reflected in this report. Lastly, thank you to Dave Schirokauer for his support and guidance and most importantly, for the opportunity to work in Alaska.

REFERENCES

- Alaska National Heritage Program, University of Alaska, Expected Species List, 2001.
- Albecker, Betsy. Skagway, AK. Personal Interview with Shelby Surdyk. August 22nd, 2010.
- Anderson, B. 2004. "Glacier Toads and Frozen Frogs: Alaska's Surprising Amphibian Diversity." *Alaska Park Science*. Vol. 3(2): pp10-15.
- Beebee, T. J. 1995. "Amphibian breeding and climate." *Nature*. Vol. 374: pp219-220.
- Berger, L., Speare, R., Daszak, P., Green, D. E., Cunningham, A. A., Goggin, C. L., Slocombe, R., Ragan, M. A., Hyatt, A. D., McDonald, K. R., Hines, H. B., Lips, K. R., Marantelli, G., and Parkes, H. 1998. Chytridiomycosis causes amphibian mortality associated with population declines in the rain forests of Australia and Central America. *Proceedings of the National Academy of Sciences of the United States of America* 95: 9031-9036.
- Blaustein, A. 2001. "Amphibian Breeding and Climate Change." *Conservation Biology*. Vol. 15(6): pp1804-1809.
- Browne, C. L., and C. A. Paszkowski. 2010. Hibernation sites of western toads (*Anaxyrus boreas*): Characterization and management implications. *Herpetological Conservation and Biology* 5(1):49-63.
- Bull, Evelyn L. 2005. Ecology of the Columbia Spotted Frog in Northeastern Oregon. Gen. Tech. Rep. PNW-GRT-640. Portland, OR: U.S. Dept. of Agriculture, Forest Service, Pacific Northwest Research Station. 46 p.
- Carstensen, R., M. Willson, and R. Armstrong. 2003. Habitat use of amphibians in northern southeast Alaska. Report to the Alaska Department of Fish and Game. Discovery Southeast. Juneau, Alaska.
- Carey, C., Cohen, N., and Rollins-Smith, L. 1999. Amphibian declines: An immunological perspective. *Developmental & Comparative Immunology* 23: 459-472.
- Corn, P. 2003. "Amphibian Breeding and Climate Change: Importance of Snow in the Mountains." *Conservation Biology*. Vol. 17(2): pp622-625.
- Fairbanks, Judy. Skagway, AK. Personal Interview with Shelby Surdyk. May, 2010.
- Funk, W. C., A. E. Greene, P. S. Corn, and F. W. Allendorf. 2005. High dispersal in a frog species suggests that it is vulnerable to habitat fragmentation. *Biology Letters* 1: 13-16.
- Garcia, T.S. 2006. "Survival of three species of anuran metamorphs exposed to UV-B radiation and the pathogenic fungus *Batrachochytrium dendrobatidis*." *Diseases of Aquatic Organisms*. Vol. 72: pp163-169.

- Green, David E. Veterinary Medical Office. National Wildlife Health Center. Madison, WI. Personal Correspondence with Shelby Surdyk. June, 2010.
- Johnson, M. 2005. "Possible modes of dissemination of the amphibian chytrid *Batrachochytrium dendrobatidis* in the environment." *Diseases of Aquatic Organisms*. Vol. 65: pp181-186.
- Johnson, M.L., and R. Speare. 2003. "Survival of *Batrachochytrium dendrobatidis* in water: quarantine and disease control implications." *Emerging Infectious Diseases*. Vol. 9: pp922-925.
- Kalen, Barbara. Skagway, AK. Personal Interview with Shelby Surdyk. August 22nd, 2010.
- Keinath, D. 2011. "Wyoming Toad Monitoring on Safe Harbor Reintroduction Sites: 2010." *Wyoming Natural Diversity Database*. 31 January 2011.
- Kiesecker, J. and A.R. Blaustein. 1995 "Synergism between UV-B radiation and a pathogen magnifies amphibian embryo mortality in nature." *Proc. Natl. Acad. Sci. USA*. Vol. 92: pp11049-11052.
- Kirshtein, J. 2007. "Quantitative PCR detection of *Batrachochytrium dendrobatidis* DNA from sediments and water." *Diseases of Aquatic Organisms*. Vol. 77: pp11-15.
- Larsen, C. F., R. J. Motyka, J. T. Freymuller, K. A. Echelmeyer, and E. R. Ivins. 2005. Rapid viscoelastic uplift in southeast Alaska caused by post-Little Ice Age glacial retreat. *Earth and Planetary Science Letters* 237:548-560.
- Pimentel, R. A. 1955. Habitat distribution and movements of *Bufo b. boreas*, Baird and Girard. *Herpetologica* 11:72.
- Reading, C. J. 1998. "The effect of winter temperatures on the time of breeding activity in the common toad *Bufo bufo*." *Oecologia*. Vol. 117: pp469-475.
- Reading, C. J. 2007. "Linking global warming to amphibian declines through its effects on female body condition and survivorship." *Oecologia*. Vol. 151: pp125-131.
- Rodder, D. 2008. "Environmental gradients explaining the prevalence and intensity of infection with the amphibian chytrid fungus: the host's perspective." *Animal Conservation*. Vol. 11(6): pp513-517
- Surdyk, S. 2010. Klondike Gold Rush National Historical Park Annual Amphibian Monitoring Report. Final Report, Klondike Gold Rush National Historical Park, Skagway, Alaska. 40 pp.

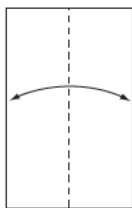
Appendix I. KLGO Junior Ranger Day July 22, 2011

Natural Resources staff made origami toads with participants of the KLGO Jr. Ranger Day while using the opportunity to talk about the amphibian monitoring efforts at the park. Instructions for the origami toads are located below.



Origami Jumping Frog

origami-fun
www.origami-fun.com



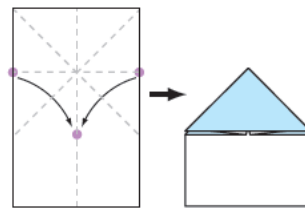
1. Start with a rectangular sheet of paper, white side up. Fold it in half, and open out again.



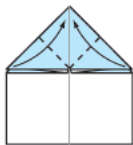
2. Fold both top corners to the opposite edge of the paper. Your creases should look like this.



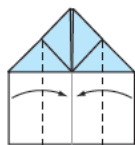
3. Where the diagonal creases meet in the middle, fold the paper backwards, crease well and open.



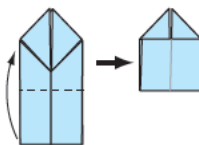
4. Hold the paper at the sides, bring these points down to the centre line, then flatten. The creases should do most of the work here!



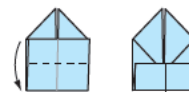
5. Fold the uppermost triangles up to the top point.



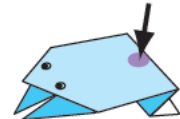
6. Fold sides in to the centre line.



7. Fold bottom of model upwards so the end sits in the centre of the top diamond.



8. Now fold the same part downwards, in half.



9. Turn over and your frog is finished! To make him jump, press down on his back as shown.

Appendix II. AK2day Amphibian Bulletin

Old Toad Found in Klondike Gold Rush National Historical Park

By Jamie Welfelt

On May 26, 2011 biologists at Klondike Gold Rush National Historical Park recaptured a PIT tagged male boreal toad (*Bufo boreas*), also known as the western toad. In 2005 and 2006 captured toads were outfitted with passive integrated transponders, also known as PIT tags, as means of identifying individual toads in the breeding population. Finding a marked toad allows insight into the movement patterns, growth rate, and life span of this elusive amphibian. This toad was initially captured at the same breeding pond in July 2006 and is estimated to be at least 9 years of age in 2011.

Klondike Gold Rush National Historical Park has been monitoring boreal toads annually since 2004. Boreal toads were historically widespread in the western United States and Canada. Recent dramatic population decline in boreal toads is linked in part to the introduction of the pathogenic chytrid fungus (*Batrachochytrium dendrobatidis*), first discovered on toads in Alaska at Klondike Gold Rush NHP in 2006.



A male boreal toad recaptured at Klondike Gold Rush National Historical Park.

GUIDE SERIES

Klondike Gold Rush NHP



Amphibian Research at Klondike Gold Rush NHP

Join us for a discussion on amphibian monitoring at Klondike Gold Rush National Historical Park. Learn about current amphibian monitoring projects, amphibian ecology and local and global amphibian declines.

Friday, August 19 @ 6 pm
National Park Service Auditorium
2nd and Broadway



Presented by Klondike Gold Rush NHP
Wildlife Biological Technician Jaime Welfelt

Appendix IV. Routine Amphibian Survey Data Form

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		
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)						

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