



2014 Amphibian Surveys at Klondike Gold Rush National Historical Park

Natural Resource Data Series NPS/KLGO/NRDS—2015/784



ON THE COVER

Western toad (*Bufo boreas*) caught and radio-tracked in Dyea

2014 Amphibian Surveys at Klondike Gold Rush National Historical Park

Natural Resource Data Series NPS/KLGO/NRDS—2015/784

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Abstract

Amphibian monitoring has been conducted annually at Klondike Gold Rush National Historical Park since 2004 with the primary goal to monitor long-term changes in amphibian distribution, abundance, reproduction, and survival at core breeding sites. The Park has two confirmed amphibian species, the western toad (*Bufo boreas*) and the Columbia spotted frog (*Rana luteiventris*); however, toads are the primary focus of monitoring efforts due to their relative abundance in the Taiya River watershed. The monitoring season spanned a four month period from May 22 to September 22. A total of 59 routine visual encounter surveys were conducted at six core breeding sites in Dyea, three non-core sites, and extensive sites at Lost Lake, West Creek, and the White Pass. Breeding activity was observed at three of the core sites and one extensive site. A total of eight adult western toads, two egg masses, ~59,000 tadpoles, more than 60 juveniles, and hundreds of metamorphs were observed. One adult Columbia spotted frog was detected during the White Pass survey, but no evidence of breeding was observed. Four western toads were also fitted with radio-transmitters and tracked to identify upland habitat use, hibernation sites, and migration corridors.



Figure 1. Juvenile western toad

Acknowledgments

Special thanks to SCA Intern Jade Cook as this project would not have been possible without her assistance. Additional thanks to Jonathan Fiely and Jessica Wilbarger for their help. I would also like to acknowledge all of the former wildlife technicians who initiated, expanded, and improved the amphibian monitoring program at Klondike Gold Rush NHP and whose research and data are reflected in this report.

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. E.O. Wilson, a Harvard biologist said, “We ourselves could not have devised a better early-warning device for general environmental deterioration than the frog.” Worldwide, 32% of amphibian species are now threatened with extinction while 43% exhibit some form of population decrease (Stuart et al. 2004). Amphibians are far more threatened and declining more rapidly than either mammals or birds, with many amphibians on the brink of extinction (Stuart et al. 2004). A recent study published by USGS scientists and collaborators found that amphibians in the United States are disappearing at a rate of 3.7% each year with the greatest declines observed on National Park Service Lands (Adams et al. 2013). Primary hypotheses to explain global amphibian declines include habitat degradation, climate change, contaminants, and disease as well as other unknown stressors (Adams et al. 2013). Chytrid fungus (*B. dendrobatitis*) is an invasive pathogen responsible for amphibian declines around the globe and was first confirmed in Klondike Gold Rush National Historic Park (KLGO) in 2005.

Efforts to monitor amphibian populations in KLGO are part a worldwide effort over the last twenty 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 and monitored. A program was established at KLGO in 2004 and began by surveying wetlands to assess the presence and 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). The current objectives are to monitor long-term changes in amphibian abundance, reproduction, and survival at core breeding sites in Dyea, determine the presence and distribution of chytrid fungus, and assess upland habitat use.

Two amphibian species have been confirmed in the Park, the western toad, *Bufo boreas*, and the Columbia spotted frog, *Rana luteiventris*. Prior to 2007, with the discovery of Columbia spotted frogs in the White Pass Unit of KLGO, the western toad was the only confirmed amphibian species within Park boundaries. KLGO also falls within the expected range of three additional amphibian species, the northwestern salamander, *Ambystoma gracile*, rough-skinned newt, *Taricha granulosa*, and wood frog, *Rana sylvatica* (Alaska National Heritage Program 2001); however, their presence has not yet been confirmed.

Western toads, due to their relative abundance in the Taiya River watershed, are the primary focus of amphibian monitoring efforts at KLGO. This species, historically widespread throughout the western United States and Canada, has shown abrupt declines in abundance and distribution through large portions of its range over the last several decades (Hallock and McAllister 2005). Western toads are classified as a species of concern for Southeast Alaska and as a rare and uncommon species in Alaska by the Natural Heritage Network and The Nature Conservancy (Carstensen et al. 2003). Incomplete information on western toad distribution, population size, and habitat range in Southeast Alaska prompted the development of a long-term monitoring protocol for KLGO and adjacent lands.

Since 2004, KLGO has monitored western toad occupancy and development at known breeding sites; however, effective conservation requires an understanding of habitat use across all seasons and life stages. Toads use shallow water for breeding, but depend on terrestrial habitats to feed and hibernate. Outside of their brief breeding period in late spring and early summer, adults are very difficult to detect as they spend most of the time in upland habitats. Information on the spatial behavior and movement patterns of individuals is necessary for a complete understanding of the species' ecology and can be obtained using radio-telemetry.

Initiated in 2012, the radio-tracking study at KLGO aims to provide information about the use of upland habitat by western toads and locate key habitat elements such as hibernacula, movement corridors and additional breeding locations that are required to facilitate the conservation of the species. Data on upland habitat use can be used to inform the planning process for any infrastructure development or enhancement proposals for Dyea.

Klondike Gold Rush National Historical Park

Skagway, Alaska

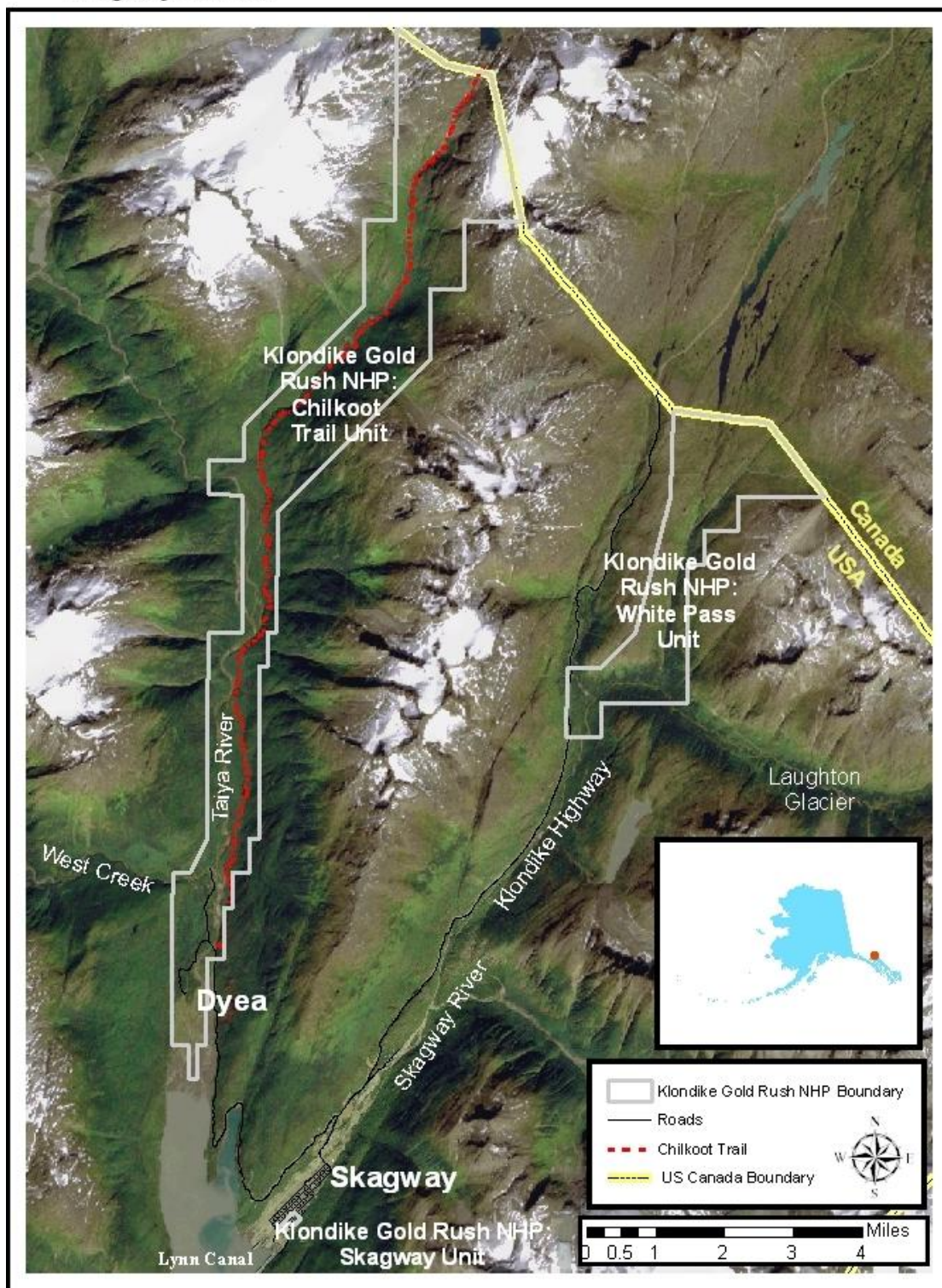


Figure 2. Area map of Klondike Gold Rush National Historic Park and extensive monitoring sites.

Methods

Visual Encounter Surveys

The amphibian monitoring program at KLGO is organized into intensive and extensive components to focus efforts appropriately given the relative abundance of amphibians. The lower Taiya River watershed, with its multiple western toad breeding sites, has been considered the intensive component (Figure 3). In this area, core sites (those with current or recent breeding activity) are visited multiple times throughout each season to monitor toad presence and tadpole development, while non-core sites (those with historic or potential activity) are surveyed less frequently. Over the years, several core sites have been reclassified as non-core as they no longer appear to support breeding activity. 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 are monitored per given season (Figure 2). Unlike the intensive component sites, each site within a panel of the extensive component is visited only once per season (SOP 1. Routine Amphibian Survey Field Methods, 1.1.2 Seasonal Monitoring Schedule).

The 2014 amphibian monitoring season focused on six core and three non-core sites in Dyea that were visited an average of once per week from May 22 through September. During active breeding times, sites were visited more often in an effort to detect egg laying and hatching. A total of 59 routine amphibian surveys were conducted at the nine intensive sites and single surveys were conducted at extensive sites located in West Creek, Lost Lake, and the White Pass Unit.

During Visual Encounter Surveys (VES), habitat and amphibian data were collected on hard copy data forms (Appendix A). The VES was performed by visually scanning the shoreline and all wadeable areas, counting or estimating the number of amphibians present, and recording growth and development attributes. 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- <45mm SVL; and adult- >45mm. 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 are sums from the single survey counts with the greatest estimates. Although metamorphs have been counted in previous years, this season it was determined that the numbers could not be accurately estimated due to poor visibility and increased mobility over the course of development.

To reduce the transmission of chytrid fungus or other diseases between study sites, a strict hygiene protocol was followed. All footwear and field gear were disinfected using a diluted bleach solution. The exact procedure is outlined in the Hygiene SOP 3 of the Amphibian Monitoring Protocol.

Dyea Amphibian Monitoring Sites

Klondike Gold Rush National Historical Park

Department of the Interior
National Park Service



Figure 3. Map of intensive monitoring sites located in Dyea.

Radio-tracking Study

Western toad movements and habitat use were investigated by radio-tracking four adult toads during their active period (late July through September) after breeding activity had concluded. Radio transmitters (Model BD-2, Holohil Systems, Ltd.; Carp, Ontario, Canada) were attached using adjustable plastic belts (Burow et al. 2012) and toads were tracked using a Telonics radio receiver and antenna at least once per week. Anatomical data including snout-vent length, weight and sex were recorded. Detailed belt instructions and telemetry methods are outlined in SOP 8 Amphibian Radio-Tagging Methods.

Habitat data were collected on the Amphibian Movement Study Datasheet (Appendix B) and GPS coordinates were recorded for each location. The habitat was classified as either large woody debris, human made structure, rock formation, moss, bare ground, leaf litter, grass, shrubs, water or other, and the visibility of the toad was recorded. Belts were examined for condition and the toads were released in their exact capture locations.

Results

Visual Encounter Surveys

Five active western toad breeding sites were identified and at least three produced tadpoles that successfully reached metamorphosis (Table 1). A total of eight adult toads, two egg masses, ~59,000 tadpoles, more than 60 juveniles, and hundreds of metamorphs were observed. Table 2 shows the dates of the first observed egg mass, tadpoles, and metamorphs for the 2014 season and for all years since the monitoring program began in 2004.

Table 1. Life stages of western toads detected at each site from 2004-2014. “X” indicates positive detection and “—” indicates that the site was not surveyed.

Site ID	2004					2005					2006					2007					2008					2009					2010					2011					2012					2013					2014				
	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	Egg Mass	Tadpole	Metamorph	Juvenile	Adult															
DY02									X					X																																									
DY03		X	X			X	X		X		X	X	X	X	X	X	X				X						X																												
DY12				X																X																																			
DY13				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																									
DY19	—	—	—	—	—		X		X			X		X							—	—	—	—	—																														
DY33		X				X					X	X			X																																								
TR01	—	—	—	—	—		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																									

Table 2. Date of first observed western toad life stage for each year of monitoring at KLGO.

Year	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
2012	May 14	May 21	July 30
2013	May 9	May 20	July 17
2014	----	May 22*	July 31

*The first survey of the season was conducted on May 22 and tadpoles were already present at multiple sites.

For each site surveyed, a general habitat description and summary of amphibian activity follow.

Core Sites

Taiya River 01 (TR01)

Discovered in 2005, this productive breeding site is a wetland adjacent to the Taiya River, approximately 50 m west of the National Park Service campground in Dyea. The series of three 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 precipitation. Such a regime produces 3 ‘lobes’ (east, middle, and south) that typically maintain some water throughout the season and support 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 progresses. In addition to hydrological disturbances, this site is especially prone to disturbances by people, pets, bears, and shorebirds.

The productivity of this site is ever dependent on the fluctuating hydrology of the Taiya River. In previous years, the old river braids used as breeding ponds have dried completely, resulting in complete desiccation of eggs and tadpoles. High water levels have also caused the river to flood and expand, ultimately overwhelming the site with turbid glacial runoff and washing away any amphibians inhabiting the site. In 2013, ten egg masses, ~2,000 tadpoles, ~200 metamorphs, 8 adults in amplexus, and 9 lone adults were detected. Five egg masses failed to develop due to desiccation and fluctuating water levels.

In 2014, ~4,000 tadpoles were observed during the first routine visit while others were already desiccated. The site slowly refilled and in late July several hundred hatchling tadpoles were found while radio-tracking adults; however, few remained after the Taiya River flooded in early August.

Dyea 03 (DY03)

This shallow, anthropogenic wetland is susceptible to radical changes in water depth and often floods over an old road bed or dries after breeding initiation. At average water levels, this site is composed of four distinct ponds. The northern pond has a thick layer of leaf debris along the shore, but relatively little on the bottom of the pond itself and no emergent or submergent vegetation. The 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 pond, which expands over the decommissioned road leading into the site. The south pond is the deepest at approximately 1.5 meters and leaf litter, canopy cover, and depth make it less suitable breeding habitat, but it could be used as a migration area. 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 ponds support emergent vegetation. In 2014, no evidence of breeding was detected, but four juveniles were observed during a routine visit and sub-adults were regularly encountered while searching for adults to transmitter.

Dyea 13 (DY13)

This is the section of Nelson Slough (west branch of the Taiya River) between the old Dyea town site 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 along the center of the channel. Changes in the hydrology of Nelson Slough are related to fluctuating water levels and post-glacial rebound. The Dyea flats rise an average of 14-16 mm per year, one of the fastest rates found anywhere (Larsen et al. 2005). Water levels fluctuate from being entirely dry to having complete connectivity with DY14, and visibility and amphibian detection are low due to dense vegetation cover.

In 2014, two egg masses containing approximately 4,500 eggs were observed followed by ~1,500 tadpoles (Figure 4). During high water levels, larger and more developed tadpoles appeared, likely resulting from connectivity with DY14. Six juveniles and two adults, including one that was missing part of the largest hind digit, were detected.

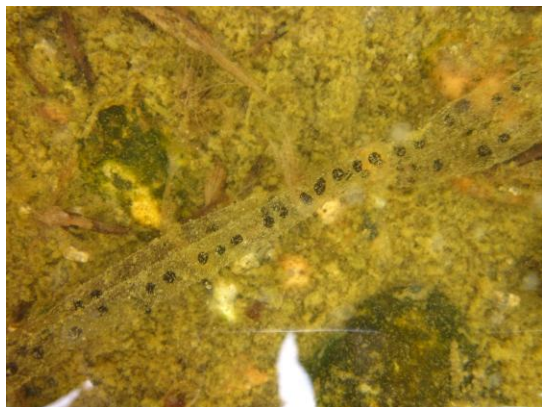


Figure 4. Egg masses observed at DY13 on June 5, 2014.

Dyea 14 (DY14)

This is 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* and has a substrate comprised of unconsolidated silt. As it nears a large bend, aquatic vegetation disappears almost entirely and a large open pool forms with a substrate consistent with the upstream portion. Moving downstream from the pool, the channel becomes increasingly covered with *Carex spp* as the average depth decreases over fine gravel. This site is part of the larger Taiya River estuary and thus it is a slightly brackish environment. Water levels 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. Bears, shorebirds, river otters, salmon and other fish share this dynamic environment with the toad population that has been positively detected at the site every year since the monitoring program began. It remains the most productive breeding site currently monitored at KLGO.

In 2013, five adults, 19 egg masses, ~5,000 tadpoles, and ~700 metamorphs were observed; however no juveniles were detected. Approximately half of the egg masses failed to develop. A variety of biotic and abiotic factors are reported to damage or stress 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 reasons for egg mass mortality in KLGO are unknown, but in the Oregon Cascades western toad egg masses have seen 50-100% mortality due to the pathogenic fungus *Saprolegnia ferax* (Kiesecker 1995).

In 2014, ~50,000 tadpoles, >40 juveniles, hundreds of metamorphs, and three adults were detected. One adult had an abrasion on its forearm, one juvenile had “hollow eye,” and several juveniles had abnormal skin patches potentially indicative of chytrid fungus (Figures 5 and 6). The tadpoles were largely concentrated at the north end of the main water body near the creek inlet and in the shallow, vegetated gravel area below the cabin at the southern end.

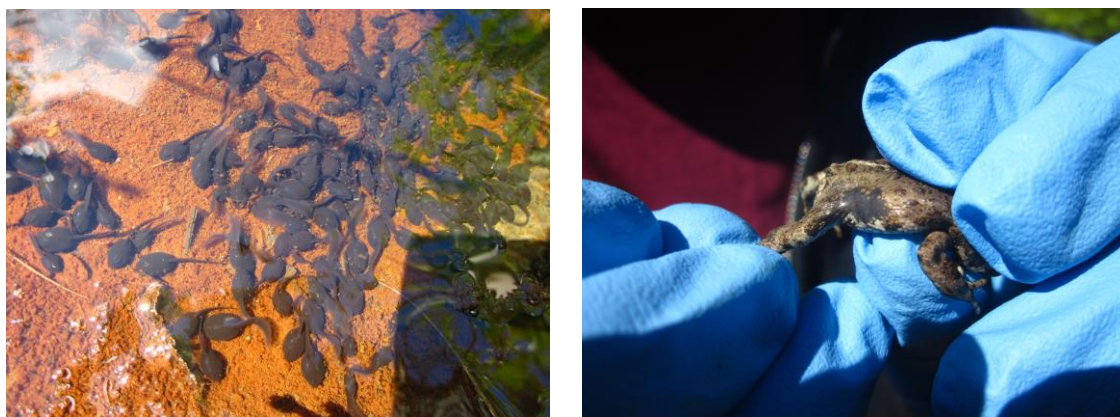


Figure 5. Tadpoles observed at DY14 (left) and example of abnormal skin patches found on many juveniles (right).



Figure 6. Adult with injured forearm (left) and juvenile with “hollow eye” (right) found at DY14.

West Creek 02 (WC02)

Adjacent to West Creek Road, 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 western toad was detected in 2009, but breeding activity has not been recorded since the construction of an adjacent road-side ditch, WC04, in 2008. Shading and cooler water temperatures make this site less suitable for breeding such that the population now using WC04 may be the same once utilizing WC02. In 2014, only one juvenile toad was detected.

West Creek 04 (WC04)

Discovered as a breeding site in 2008 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 constructed in 2007. This site has a shoreline substrate mainly comprised of fine gravel and large rocks with grass, sedge, and rush species as the dominant vegetation. The bed surface consists of relatively thick (20-50 mm) detritus and algae that provide substantial cover for tadpoles. 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. When first constructed, WC04 had little or no shading and consistently warm temperatures that possibly made it more suitable as breeding habitat; however, the alders at the site are growing rapidly and beginning to shade the pool, especially the southern shoreline. In 2013, two egg masses, ~200 tadpoles, ~100 metamorphs, 4 juvenile, and 7 adults were observed.

In 2014, ~3,000 tadpoles and eleven juveniles were detected during routine site visits. One sub-adult was found during telemetry surveys, but no adults were detected. The number of tadpoles became more difficult to estimate as development progressed due to poor visibility and increased mobility; however, at least several hundred appeared to reach metamorphosis (Figure 7). Many of the juveniles had abnormal skin patches similar to those observed at DY14.



Figure 7. Metamorphs observed at WC04.

Non-Core Sites

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 along the edges. Water levels fluctuate from completely dry to nearly two feet of depth during high water. No physical evidence of western toad breeding has ever been observed; however, it appears to be important habitat for juveniles and adults. Juvenile toads were observed in 2005, 2006, 2009, 2010, and 2011, and lone adult toads were seen in 2007, 2010 and 2012. Site visits have been limited due to high numbers of juveniles in the grass in previous seasons, but no amphibians were detected in 2014.

Dyea 12 (DY12)

This section of Nelson Creek north of the Nelson Slough foot bridge is a slow-moving stream filled with emergent vegetation and becomes increasingly shaded towards the northern end. The deepest parts of the channel are centrally located and can reach a maximum depth of ~.8m. The northern end maintains water on a regular basis while the southern portion typically dries out. Physical evidence of toad breeding has never been observed, but lone adult toads have been seen at this site in the past. Water fluctuations and dense canopy cover make it a less desirable breeding site; however, it should continue to be periodically searched throughout the breeding season. In 2014, no amphibians were detected.

Dyea 19 (DY19)

This large bog is located behind Slide Cemetery and accessed using a conspicuous trail located along the north side of the cemetery fence. It is dominated by emergent buckbean (*Menyanthes trifoliata*) and a fringe of sweet gale (*Myrica gale*). Evidence of toad breeding was observed in 2005 and 2006, but the site was not surveyed in 2009. Juveniles were found in high abundance in 2010 and 2011, indicating undetected breeding activity in the area. In 2014, no amphibians were detected.

Extensive 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 along the trail at the end of West Creek Road. The site 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) by a thin band of forest to the northwest (Figure 8). The majority of the water surface area, while relatively exposed in early summer, becomes increasingly enclosed with a dense cover of buckbean (*Menyanthes trifoliata*) with the edges 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 western toad breeding has been observed at this site in the past. Several juveniles, an adult and tadpoles were found in the small complex in 2009 and 1,000 tadpoles were found in 2012.

WC03 was surveyed on July 3, 2014 and a single, hatchling-sized tadpole was found at the northeast end of the small complex. It is likely that more tadpoles were present, but not detected due to poor visibility from thick vegetation and high turbidity.



Figure 8. The main complex (left) of West Creek 03 and the small complex (right) where a tadpole was found on July 3, 2014.

Lost Lake (LL1)

This is a bedrock controlled lake with steep sides and very few shallow areas. The southern end is shallow with an area of buckbean similar to DY19 (Figure 9). Amphibians have never been detected at this site, but it should continue to be searched annually. LL1 was surveyed once on June 12, 2014 and no amphibians were detected.



Figure 9. View of Lost Lake with shallow area in foreground.

Lost Lost Lake (LL2)

Lost Lost Lake can be found by continuing down the trail at the southern end of Lost Lake. The vegetative community in and around Lost Lost Lake is similar to the lakes and ponds of Canada that support western toad, spotted frog, and wood frog populations. However, the main body of water considered LL2 has steep banks that create a deep shoreline making it potentially unfavorable for western toads. Still, a number of distinct pools lie in the meadow surrounding the north end of the lake and have much shallower water that could support breeding. Lost Lost Lake was surveyed once along with Lost Lake on June 12, 2014. No amphibians were detected.

White Pass Unit

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). This prompted the survey of Pumphouse Lake (WP01), immediately to the south of the Pass, in which a single western toad adult was found the same year. Subsequent surveys in 2005 and 2006 did not reveal any amphibians, but in 2007 an additional nine lake sites (WP02A-C, WP04, WP04B, WP05-WP08) up to 2 km south of WP01 were surveyed. This effort resulted in a single sighting of a Columbia spotted frog, a species whose range had previously only been documented to extend within 4 km north of the Canadian border at White Pass. Additional Columbia spotted frogs were found in surveys conducted in 2009 and 2011. Nine Columbia spotted frogs and one western toad were found in 2012; chytrid tests collected from two frogs and the toad produced negative results. In 2013, frogs were found in areas near the railroad tracks, but no evidence of breeding was detected.

In 2014, the White Pass survey was conducted on August 3rd and again focused on areas adjacent to the railroad tracks and with previous amphibian detections. Only one Columbia spotted frog was found at Pumphouse Lake, but was not successfully caught.

Radio-tracking Study

Radio-transmitters were attached to four adult western toads in Dyea and individuals were tracked between July 27 and September 23, 2014 (Table 3). No skin sores or irritation were detected from the belt attachment and the belts did not noticeably hinder movement or alter behavior. The main issues encountered were escapement and transmitters flipping to the underside of a toad.

One toad lost the belt within days and another was found dead on the vehicle bridge over Nelson Slough just three days after being fitted with a transmitter. The remaining two toads were both captured and tagged at TR01; however their movement patterns were quite different. Toad 169321 moved ~200 meters northwest along the bank of the Taiya River while toad 169322 traveled ~225 meters northeast through the forest and was last found just 90 meters from the Dyea road (Figure 11).



Figure 10. Radio-transmitter belt attached to a toad at TR01 (left) and radio-tagged toad found dead on the vehicle bridge over Nelson Slough at DY14 (right).

Table 3. Western toads radio-tracked in Dyea.

Capture Date	Location	Transmitter Serial #	Sex	Weight (g)	Release Date	Notes
27 Jul 14	TR01	169321*	M	63	4 Aug 14	Belt slipped off
4 Aug 14	TR01	169321	M	42	27 Aug 14	Belt slipped off
4 Aug 14	TR01	169322	M	58	23 Sept 14	Removed belt for winter
11 Aug 14	DY14	169325	M	59	14 Aug 14	Found toad dead on vehicle bridge over Nelson Slough

*Transmitter was recovered and reused.

Radiotracked Toad Movements

Klondike Gold Rush National Historical Park

Department of the Interior
National Park Service

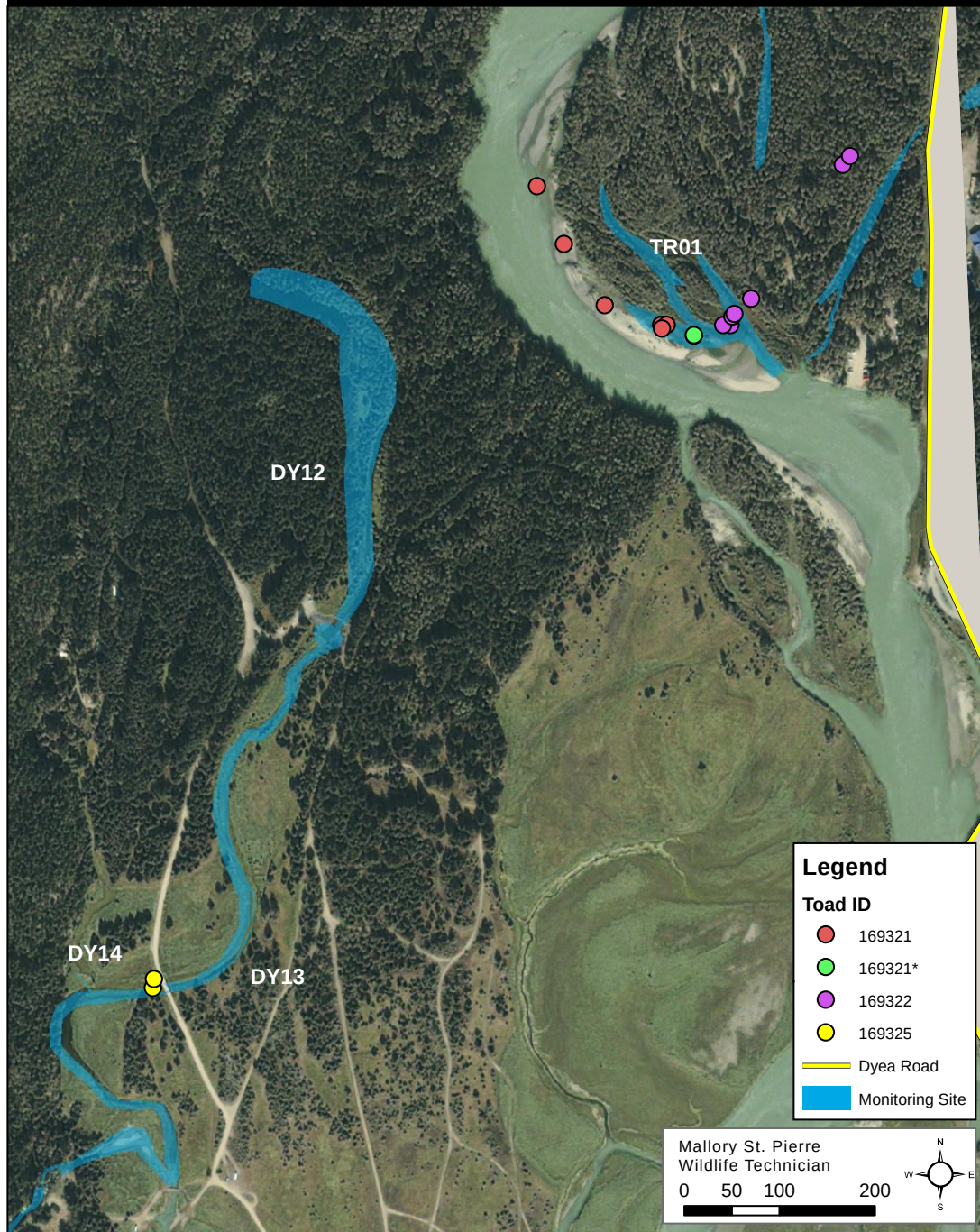


Figure 11. Map of movements by toads with radio-transmitter belts.

Discussion

Visual Encounter Surveys

Oral history accounts and anecdotal evidence suggest that western 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 due to all of the black egg masses and tadpoles (Kalen 2010, Albecker 2010, Fairbanks 2010). The small, isolated western toad population in Dyea today may be a small fraction of a once abundant species.

Similar population crashes of western toads were documented in Juneau, Ketchikan and Haines between 1970 and 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 productivity due to natural metapopulation dynamics (Shmetterling 2009). A wide-spread amphibian die-off in the Dyea and Skagway valleys could have been triggered by many possible factors. The reasons for abrupt population crashes in Southeast Alaska are most likely a combination of habitat loss, climate change, increased UV-B radiation, introduction of predators (such as stocked fish in the Skagway Valley) and the pathogenic chytrid fungus.

Evidence of amphibian disease and deformities were detected during the 2014 monitoring season and natural phenomena such as dramatic changes in water levels were observed. Toads and metamorphs should continue to be examined for malformations or other indicators of disease and water quality testing could be conducted to assess environmental contaminants that might be responsible. Human activities may have a major impact on current western toad survival in KLGO as toads are killed by vehicles while crossing roads and visitors potentially spread pathogens on their footwear or trample newly metamorphosed toads. To mitigate such impacts, community and visitor education should remain an integral part of the amphibian monitoring program.

Radio-tracking Study

The protection of habitat and prevention of disease are both essential factors in conserving the remaining western toad populations in Dyea and Skagway. However, very little is known about habitat requirements of the toads outside of the short spring breeding season. Knowledge of habitat use is especially important for successful management in Dyea as development and changes to the area may impact the populations during non-breeding times when their presence is often undetected.

Results from the radio-tracking study suggest that toads are dependent on a variety of habitat features. All toads were initially captured in grassy or open areas in close proximity to known breeding sites. They maintained small summer home ranges and often remained in nearly the same location for several weeks. However; as fall approached, the toads traveled away from wetland breeding sites and up into forested areas. Previous studies found that female toads tend to travel further from breeding ponds and utilize terrestrial habitats more than males (Schmetterling et al. 2008, Bartelt et al 2004). Unfortunately no female toads were found this season, so a comparison of movement patterns between the sexes was not possible.

Adult toads were still active when tracking concluded in late September, but at least one potential hibernation site was identified. The belt and transmitter of toad 169321 was found at the end of a large log along the Taiya River in TR01, similar to a location identified during the 2013 season. In several cases, tracking a toad also led to the discovery of additional toads using the same habitat, providing support that western toads use communal hibernation sites. Browne and Paszkowski (2010) found twenty-nine western toads in one hibernation site in Alberta, Canada. Since toads are known to hibernate communally, the disturbance of one site has the potential to severely impact the remaining population in Dyea.

Results from the tracking study also indicate that habitat fragmentation can have a significant impact on western toads. One toad was found dead on the vehicle bridge and another was last observed traveling toward the Dyea road. Because they are so slow moving, toads may be more susceptible to vehicle collision. The multiple habitat requirements of western toads (shallow breeding ponds and upland hibernation sites) make the impacts of fragmentation more severe. Proposed development in the Dyea and West Creek areas would likely further impact the toad population.

Conclusions

Surveys should continue in order to monitor long-term changes in amphibian distribution, abundance, reproduction, and survival. Monitoring should begin at the start of the breeding season in April when toads can be found in amplexus and eggs are present. Egg masses can often be more easily detected than mobile tadpoles and an early start to monitoring could provide more accurate detections of breeding activity. This might be useful for extensive sites where the probability of detecting toad activity is important given that only single surveys are conducted. The use of a dip net while surveying would also help to enhance tadpole or metamorph detection, especially at sites with poor visibility.

Radio-tracking of toads provides valuable information on upland habitat use and requirements that could be valuable in better understanding the movement patterns of western toads as well as the potential impacts of development. As toads were still active in late September when the study ended, tracking should continue into October if possible in order to locate potential hibernation sites.

Community observations are fundamental to understanding current and historic amphibian distributions throughout the area. Education efforts are also essential in reducing the spread of chytrid or other diseases and mitigating human impacts at sensitive breeding sites. Increased outreach efforts at KLGO should focus on local guide companies, school groups, and visitors.

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

Individual ID	Tag #	Recaptures	Swab ID

Appendix B Amphibian Movement Study Datasheet

Amphibian Movement Study Datasheet	
Observer(s):	
Date:	
Start Time:	
End Time:	
Animal Identification Information	
Animal ID (Transmitter Serial #) :	
Radio Frequency:	
Attachment Date:	Total Days:
Weight (g):	Sex: Male Female Unknown
Belt/skin Condition: (Skin sores present?)	
Chytrid Swab?	
Location	
GPS Coordinates:	
Last Location:	
Habitat Pick one that best describes the animals location	
Large Woody Debris	Cut Bank/Soil
Human Made Structure	Leaf Litter
Rock Formation	Grass
Moss	Shrubs
Bare Ground	Water
Other _____	
% Covered When Located: (0% = fully visible, 100% = not visible at all)	
Closest Known Breeding Site:	
Other Toads Present?: Yes No	How many?
Possible Hibernation Site? : Yes No	

Appendix C State of Alaska Department of Fish and Game Fish Resource Permit



STATE OF ALASKA
DEPARTMENT OF FISH AND GAME
333 Raspberry Road
ANCHORAGE, ALASKA 99518

Permit No. **SF2014-228**

Expires: **9/30/2014**

FISH RESOURCE PERMIT
(For Scientific/Collection Purposes)

This permit authorizes:

Theresa Thibault

(whose signature is required on page 2 for permit validation)

Of

Klondike Gold Rush National Historic Park

Box 517, Skagway, AK 99840

(907) 983-9244

theresa.thibault@nps.gov

to conduct the following activities from **June 1, 2014** to **September 30, 2014** in accordance with AS 16.05.930 and AS 16.05.340(b).

Purpose: To monitor amphibian populations in Klondike Gold Rush National Historic Park

Location: Skagway Borough/Dyea

Species: Boreal Toad, Columbia Spotted Frog, and other local amphibians

Method of Capture: Hand

Final Disposition: ≤60 adults of each species per discrete population may be measured, sampled for chytrid fungus, and then released alive.
The lesser of ≤2 Boreal Toad individuals or 25% of the observed population at a site, for a total of 10 individuals, may be captured, radio-tagged then released alive at core breeding sites (see **Stipulation #5**).
Frogs found dead may be collected for pathological testing and preserved as voucher specimens.

COLLECTION REPORT DUE October 31, 2014 and RESEARCH REPORT DUE March 2015; see Stipulations #2 and #3 for more information. Data from such reports are considered public information. Reports must be submitted to the Alaska Department of Fish and Game, Division of Sport Fish-HQ, 333 Raspberry Rd, Anchorage, AK 99518, attention: Scott Ayers (267-2517; scott.ayers@alaska.gov). A report is required whether or not collecting activities were undertaken.

GENERAL CONDITIONS, EXCEPTIONS, AND RESTRICTIONS

1. This permit must be carried by person(s) specified during approved activities who shall show it on request to persons authorized to enforce Alaska's fish and game laws. This permit is nontransferable and will be revoked or renewal denied by the Commissioner of Fish and Game if the permittee violates any of its conditions, exceptions, or restrictions. No redelegation of authority may be allowed under this permit unless specifically noted.
2. No specimens taken under authority hereof may be sold, bartered, or consumed. All specimens must be deposited in a public museum or a public scientific or educational institution unless otherwise stated herein. Subpermittees shall not retain possession of live animals or other specimens.
3. The permittee shall keep records of all activities conducted under authority of this permit, available for inspection at all reasonable hours upon request of any authorized state enforcement officer.
4. Permits will not be renewed until detailed reports, as specified in the Stipulations section, have been received by the department.
5. UNLESS SPECIFICALLY STATED HEREIN, this permit does not authorize the exportation of specimens or the taking of specimens outside of existing regulations.


Fish Resource Permit Coordinator
Division of Sport Fish


Director
Division of Sport Fish

5/30/14
Date

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 461/128464, April 2015

National Park Service
U.S. Department of the Interior



Natural Resource Stewardship and Science
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www.nature.nps.gov