



Amphibian Surveys at Klondike Gold Rush NHP

2019 Summary

Natural Resource Report NPS/KLGO/NRR—2022/2428



ON THE COVER

Boreal Toad (*Anaxyrus boreas boreas*) core breeding site DY14, located in Dyea, June 12, 2019 (NPS/ KATLYN FUENTES)

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Abstract

Amphibian monitoring has been conducted annually at Klondike Gold Rush National Historical Park (KLGO) since 2004 with the primary goal of monitoring long-term changes in amphibian distribution, abundance, reproduction, and survival at core breeding sites. The Park has two confirmed amphibian species, the Boreal Toad (*Anaxyrus boreas*, formerly *Bufo boreas*) and the Columbia Spotted Frog (*Rana luteiventris*); however, Boreal Toads are the primary focus of monitoring efforts due to their relative abundance in the Taiya River watershed. In 2018, a Focused Condition Assessment (FCA) of the KLGO Amphibian Monitoring Program was initiated, which resulted in a set of recommendations to maximize the efficiency and statistical value of data collected by the program. However, the FCA was not published until December 2019. Using a draft of the FCA and in consultation with an author, the 2019 season became a transitional year that partially implemented the FCA recommendations.

Boreal Toad monitoring in 2019 started on 11 June and ended on 21 August. Data were collected through Visual Encounter Surveys (VES) that combined FCA and KLGO traditional methods and data. Monitoring adopted the FCA recommendation for multiple surveys during a single site visit, and for time windows targeted to larval (aquatic tadpole) and metamorph (tiny emergent terrestrial toadlet) detection. Monitoring methods also retained much of the detailed data traditionally collected by KLGO. A total of 51 routine VES were conducted, of which 23 surveys detected toads. Breeding activity was found through larval and metamorph detection at four of the eight core sites. Larvae, but not metamorphs, were detected at one additional site. A small number of skin and buccal (mouth) swabs from eight toads, juvenile and adult, were collected and sent to Colorado State University in Fort Collins, CO to test for the presence of chytrid disease fungus. Chytrid was detected in five of the eight samples that were processed. Lastly, casual observations from interested staff, residents or visitors provided additional insight into general toad distribution and behavior, particularly migration corridors and the use of leaf piles as summer habitat and possible over-wintering hibernacula.

Recommendations are presented for future Boreal Toad monitoring, including considerations for full implementation of the Focus Condition Assessment.

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Thank you to Blake Hassock, co-author of the Focus Condition Assessment, who gave advice on executing a transitional field season and provided a transitional data sheet. Thanks also to Daryl Trumbo of Colorado State University who gave guidance on swabbing toads to detect chytrid disease fungus.

We would also like to acknowledge all the former biologists and 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, the Harvard Biologist said, “We ourselves could not have devised a better early-warning device for general environmental deterioration than the frog,” (Wilson 2002).

Worldwide, one third of the 6300 known amphibian species are now extinct or threatened with extinction (Ceballos et al. 2020). Sixty-five threatened species are also currently classified as on the brink of extinction (fewer than 1,000 individuals) with more than 70% of those with fewer than 250 individuals (Ceballos et al. 2020). Amphibians are more threatened and declining more rapidly than either mammals or birds (Stuart et al. 2004).

A study published by United States Geological Survey (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 (NPS) lands (Adams et al. 2013). Primary hypotheses to explain global amphibian declines include habitat loss and degradation, climate change, contaminants, and disease as well as other unknown stressors (Adams et al. 2013). Increasing concentrations of mercury and the acidification of limnic systems caused by air pollution are two possible factors contributing to amphibian declines in national parks (Eagles-Smith et al. 2020, Sullivan et al. 2011). Chytrid fungus (*Batrachochytrium dendrobatidis*) is a pathogen responsible for amphibian declines around the globe and was first confirmed in Klondike Gold Rush National Historic Park (KLGO) in 2005. Globally, more than 200 species of amphibians have experienced die-offs or extinctions caused by the introduction of chytrid fungus (Wake and Vrendenburg 2008).

Two amphibian species have been confirmed in KLGO: the Boreal Toad, also known as the Western Toad, *Anaxyrus boreas boreas* (formerly *Bufo boreas*)¹; 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 Boreal Toad was the only confirmed amphibian species within Park boundaries. KLGO also falls within the expected range of the wood frog, *Lithobates sylvatica* (formerly *Rana sylvatica*) (Lenz et al. 2002); however, its presence has not yet been confirmed.

¹ In the 6th edition of “Scientific and Standard English names of Amphibians and Reptiles of North America, North of Mexico, with comments regarding confidence in our understanding”(Crother et al. 2008), the Society for the Study of Amphibians and Reptiles recognized two nominal subspecies Western Toad (*Anaxyrus boreas*): Boreal Toad (*A. b. boreas*), and Southern California Toad (*A. b. halophilus*). However, in the 7th ed. (Boundy et al. 2012), it was speculated that the species *A. boreas* may be a taxonomically erroneous, containing in fact a complex of distinct species. Adhering to the species account published Amphibian Declines the Conservation Status of United States Species (Lannoo 2005), Western Toads documented in KLGO as part of the Amphibian Monitoring Program have been recognized as the subspecies Boreal Toads (*A. b. boreas*), and will be referred to as such in this report.

History of Amphibian Monitoring at KLGO

Monitoring amphibian populations in KLGO is part of 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. Between 2001–2003, a state-wide effort to document opportunistic observations of amphibians in Alaska parks was led by the NPS Inventory and Monitoring Program (I&M) of the Southeast Alaska Network (SEAN) (Anderson 2004). The project confirmed the presence of amphibians in 10 of Alaska's 16 parks, and the presence of five species in the state (Anderson 2004). KLGO contributed 22 observation records to the I&M project, and the Park was identified as an important Boreal Toad² breeding area in the I&M project report (Anderson 2004).

Boreal Toads, due to their abundance relative to any other amphibian in the Taiya and Skagway watersheds, have been 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 (Lannoo 2005). In 2003, Boreal Toads were classified as a species of concern for southeast Alaska by the Alaska Department of Fish and Game, however the state has revised their ranking system since that time and no longer uses the “species of concern” classification for any species (Carstensen 2003). Also in 2003, Boreal Toads were recognized as a rare and uncommon species in Alaska by the Alaska Natural Heritage Program (AKNHP) and The Nature Conservancy. As of 2013, the Boreal Toad conservation status was classified as “IX. Blue, low status and low biological vulnerability and action need” by the AKNHP Alaska Species Ranking System (Walton, Gotthardt, and Field 2013).

Incomplete information on Boreal Toad distribution, population size, and habitat range in southeast Alaska prompted the development of a long-term monitoring protocol for KLGO and adjacent lands (Carstensen 2003). A formalized Boreal Toad monitoring program was established at KLGO in 2004, which began by surveying wetlands to assess the presence or absence of species (Payne 2004). The following year, KLGO partnered with the U.S. Geological Survey's (USGS) Amphibian Research and Monitoring Initiative (ARMI) to implement a mark-recapture study at Boreal Toad breeding sites in Dyce (Payne 2005). In 2006, KLGO continued the mark-recapture study and became an ARMI Apex-level monitoring site. According to the ARMI program design, apex-level monitoring sites involve population estimates, demographic studies, detailed environmental data, and long-term research (Muths et al. 2006). Due to low recapture rates, the mark-recapture study was discontinued in 2007, and KLGO was reclassified as an ARMI mid-level monitoring site (Fairchild 2007). The objective of mid-level sites are to collect data on occupancy, species richness, basic environmental data, and to document possible causes of amphibian decline (Muths et al. 2006).

In 2008, KLGO reviewed the Boreal Toad monitoring program, expanded it into an amphibian monitoring program to include the Columbia Spotted Frog, and identified three program objectives:

² Reported as Western Toad (Anderson 2004)

- monitor long-term changes in amphibian abundance, reproduction, and survival at core breeding sites in Dyea,
- determine the presence and distribution of chytrid fungus disease,
- and assess upland habitat use.

Standard Operating Protocols (SOPs) for the Amphibian Monitoring Program (AMP) were developed which have guided the program from 2009 to the present. Due to the extreme difference in distribution and abundance between the Boreal Toad and the Columbia Spotted Frog at KLGO, the remote location where the Columbia Spotted Frog was found, and the pace of public and private construction with associated habitat loss in the Dyea area, the bulk of the Amphibian Monitoring Program continues to be concentrated on the Boreal Toad.

A deficiency in information to understand upland habitat use by toads was identified in 2011. KLGO had monitored Boreal Toad occupancy and development at known breeding sites since 2004; however, effective conservation requires an understanding of habitat use across all seasons and life stages. Toads use shallow water for breeding, but depend mostly on terrestrial habitats to feed and hibernate (Lannoo 2005). 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 (Lannoo 2005). Information on the spatial behavior and movement patterns of individual adults would help complete understanding of the species' ecology and could be obtained using radiotelemetry.

In 2012, KLGO added Boreal Toad radio-tracking to the amphibian monitoring program. The aim of the radio-tracking component was to provide information about the use of upland habitat by Boreal 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 could be used to inform the planning process for any infrastructure development or enhancement proposals for Dyea. Procedures for conducting the radio-tracking component are found in KLGO Amphibian Monitoring Protocol SOP No. 8: Amphibian Radio Tagging Methods (available at: <https://irma.nps.gov/DataStore/Reference/Profile/2253258>). Boreal Toads were radio-belted and tracked during the 2012–2015 field seasons, but have not been tracked since the 2016 season due to limited staff-time availability. No toads were radio-tracked during the 2019 field season.

Boreal Toad Focused Condition Assessment

In 2018, KLGO obtained funding to conduct a Focused Condition Assessment (FCA) on the existing monitoring program for Boreal Toads. The FCA research team was spearheaded by Blake Hossack, Research Zoologist, USGS Northern Rocky Mountain Science Center, through an Interagency Agreement (Chambert, Belt and Hossack 2019). The team analyzed data from 2005–2018, to assess occupancy trends and develop simulations to determine how much effort to expend at what locations to focus the effort for future research. The FCA found that Boreal Toad occupancy across 62 monitoring sites in KLGO and surrounding areas has been stable since 2005 (when the first routinized monitoring began), with an apparent, but not statistically significant, appearance of a slight (3.7%) upward trend. They also found that within the eight core Boreal Toad breeding sites in

Dyea, there was a breeding success rate (based on the number of sites where tadpoles successfully developed into metamorphs) of 72%, which has remained stable overtime.

Based on the results of their analyses, Chambert, Belt and Hossack made specific recommendations for a sampling design that modified the Visual Encounter Surveys (VES) to collect presence/absence data on toad larvae (tadpoles) in order to be able to detect a large, significant decline of 40% or more in their population over a 10-year period. The goal could be achieved using a similar amount of staff time as has been used by the program in past years by performing 2 VES targeted for larvae presence per season at the Dyea core sites plus at 30 previously identified breeding wetlands outside of Dyea. The Dyea core sites would be sampled every year, the other sites would consist of panels of 30 breeding wetlands on a 3-year rotation. All VES would be performed during the window of highest probability of larval detection: 01 June to 31 August, with adjustment for earlier development at lower elevation—in Dyea the window would be 01 June to 31 July—and to adapt to annual weather conditions if needed. By having two observers per visit and using methods to retain independence of data collection, 2 VES could be accomplished in one site visit.

In addition, the FCA suggested that the Dyea core sites serve as sentinels for trends and breeding success by receiving additional VES for metamorph detection each season. Ideally, 5 additional VES targeted for metamorph presence would occur between 1 July to 31 August, which could be adjusted to adapt to annual weather conditions.

The FCA also looked at chytrid disease infection as it relates to sex, size, habitat, and other variables relating to amphibians in KLGO and surrounding areas, and made recommendations about continued need and sampling design for chytrid disease testing. That portion of the FCA on amphibian chytrid disease has been published as a stand-alone research note (Hossack et al. 2020). The report found a decreasing trend in the presence of chytrid on Boreal Toads in the KLGO area over a 10-year period of chytrid sampling (2005–2015). The authors postulate that this decline may be due to a reduction in Boreal Toad (host) density due to die-offs, or due to increased population resistance to the disease (Hossack et al. 2020). Given the continued uncertainty about the distribution and impacts of this pathogenic fungus, there is a need for continued chytrid monitoring among the Boreal Toads in southeast Alaska, including in the KLGO area.

2019 Objectives

Boreal Toads are an important regional indicator species, serving as a signal for wetland health at Klondike Gold Rush National Historical Park (KLGO) and throughout southeast Alaska (NPS 2010). Park managers must understand the status and population trends of Boreal Toads in order to incorporate toad habitat conservation into implementation of the Dyea Area Plan. Quantitative information about the status and role of toad breeding areas on non-park land within KLGO and surrounding areas is needed to complete population assessments, and will also inform collaborative conservation efforts among a diversity of landowners.

Objectives for the 2019 season were to monitor the Dyea core breeding wetlands incorporating methods based upon the data analysis design described in the draft Focused Condition Assessment (FCA). At the same time, data similar to previous years would be collected to assure continuity during the transition period and until an overall evaluation of KLGO goals for Boreal Toad monitoring can meld the FCA recommendations with the traditional monitoring program can be performed.

Methods

Year 2019 amphibian monitoring consisted of Boreal Toad Visual Encounter Surveys (VES) and chytrid disease fungus sampling at 8 core Boreal Toad breeding wetlands in Dyea (Figure 1). No toads were radio-tracked during the 2019 field season. No Columbia Spotted Frog or general amphibian surveying was included in 2019.

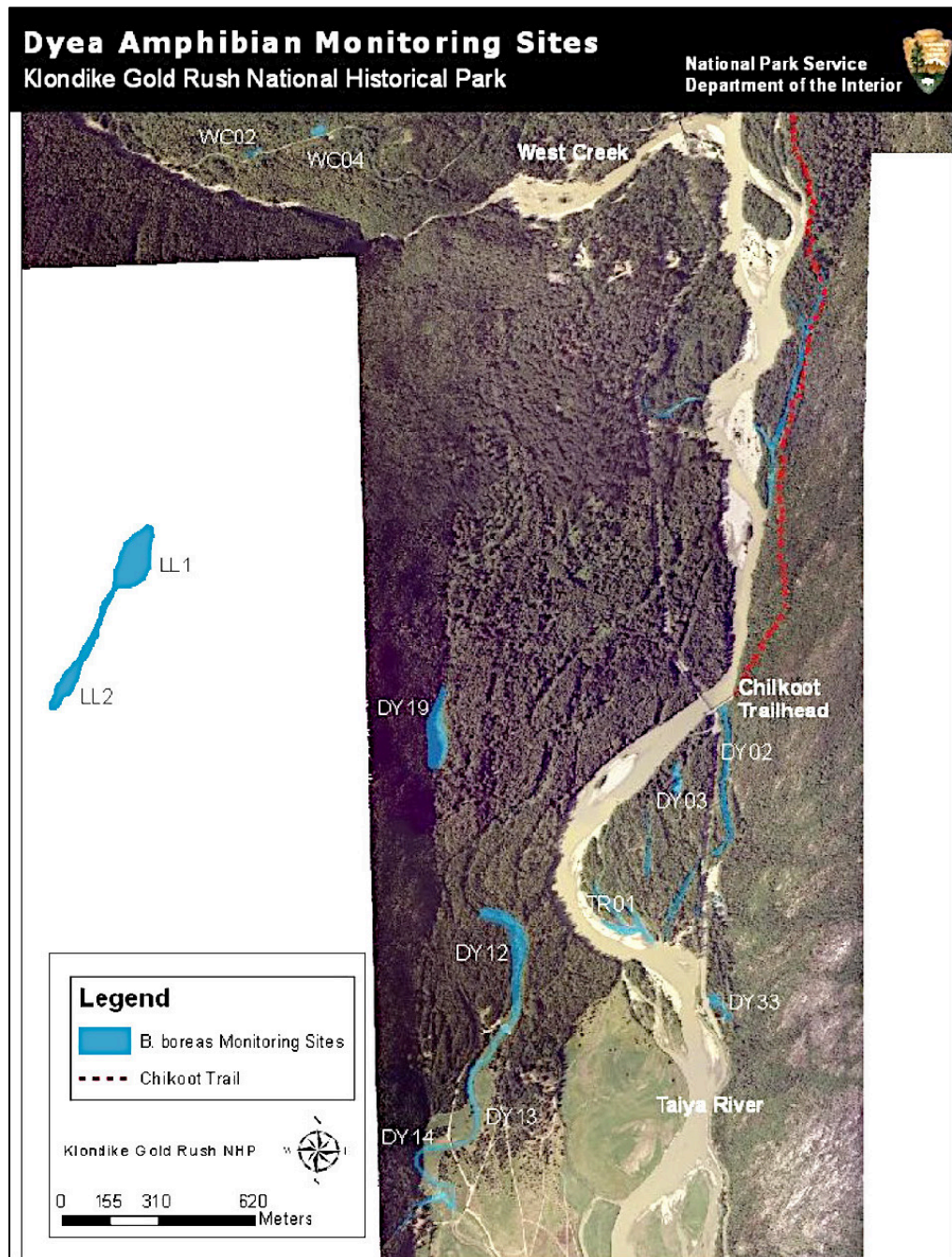


Figure 1. Locations of the 8 core sites monitored during the 2019 season, located around Dyea, Alaska. (Note: Sites LL1, LL2, DY02, and DY12 are not core sites. Map is from Welfelt 2012.).

Visual Encounter Surveys (VES)

The Focused Condition Assessment (FCA) of 2019 had not been published when KLGO staff planned the summer monitoring season. One of the FCA authors, Blake Hossack (Research Zoologist, USGS Northern Rocky Mountain Science Center), gave specific advice on interim data collection methods and provided a prototype datasheet that incorporated elements recommended in the FCA into the existing KLGO datasheet for use in 2019 (Hossack & Furbish, 2022).

Monitoring efforts in 2019 focused exclusively on the eight core breeding sites in Dyea (Table 1). During the 2019 season, VES data were collected at each core site by two observers per visit. Each observer performed an independent survey of the breeding wetland during the site visit, as recommended in the FCA. This method of independent, replicate surveys was designed to produce two survey events during a single site visit, allowing for twice the number of VES to be conducted during the same number of site visits (Gould et al., 2012).

Table 1. Core sites visited during the 2019 monitoring season. Coordinates are in UTM Zone8 NAD83.

Site Number	Easting (meters)	Northing (meters)
Dyea 03 (DY03)	0480267	6596890
Dyea 13 (DY13)	0479529	6595772
Dyea 14 (DY14)	0479518	6595625
Dyea 19 (DY19)	0479496	6597047
Dyea 33 (DY33)	0480408	6596190
Taiya River 01 (TR01)	0480075	6596476
West Creek 02 (WC02)	0479147	6598956
West Creek 04 (WC04)	0491745	6608133

A VES was performed by visually scanning the shoreline and shallow water areas, counting or estimating the number of Boreal Toads amphibians present, and recording growth and development attributes. Tadpoles and metamorphs were counted using a combination of ocular estimation and individual counts. Habitat and amphibian data were recorded in the field on printed datasheets (Appendix A).

All 2019 VES datasheets were entered into the KLGO amphibian monitoring database and checked for Quality Assurance/Quality Control in 2021. The database is stored on the KLGO computer network in the resources dedicated network T: drive, in the amphibian folders area, file name: "KLGOtoads v4.7F_2010.mdb". Original field datasheets are stored in paper and digital form in the KLGO park archives. Because a new datasheet was adopted in 2019 but data were entered into the database in 2021, a note on data entry procedures that explains how the new data were handled in the existing database fields is provided in Appendix B.

Chytrid Disease Detection

During the 2019 season, eight (8) Boreal Toads were captured and swabbed for chytrid fungus. Following guidance provided by Daryl Trumbo (PhD, Postdoctoral Researcher, Department of Biology, Colorado State University, Fort Collins, CO), buccal swabs were a new addition to KLGO methods—both skin and buccal swabs were collected from adult and juvenile Boreal Toads. To reduce the transmission of chytrid fungus or other diseases among study sites, a strict hygiene protocol was followed. All footwear and field gear were disinfected using a diluted bleach solution between sites. The exact procedure is outlined in the Hygiene SOP 3 of the Amphibian Monitoring Protocol (IRMA reference: <https://irma.nps.gov/DataStore/Reference/Profile/225325>).

Casual Observations

Casual toad observations are often submitted by interested Park staff, local residents or park visitors. In 2019, five (5) toad observations were presented to KLGO; 3 from along the Chilkoot Trail and 2 from the Dyea town area.

Dyea Core Sites – Individual Site Descriptions

For each site included in the 2019 monitoring efforts (Table 1), a general habitat description and brief summary of amphibian activity detected at the site prior to 2019 follow. Due to a combination of processes including succession, habitat loss, restoration, fluvial fluctuation, climate change, and isostatic rebound, many of the sites have changed dramatically during the 15 years of the monitoring program. Sites on the low, level Dyea flats are particularly affected by post-glacial rebound, as the Skagway-Dyea area rises an average of 14–16 mm per year, one of the fastest rates found anywhere in the world (Larsen et al. 2005).

Dyea 03 (DY03)

This shallow, anthropogenic wetland is frequently cited by locals as a well-known historic toad breeding area. When amphibian monitoring was first conducted at it by the NPS personnel in 2004, it was directly connected to a dirt road and frequently driven through. The 2004 report stated that despite high levels of disturbance “it had been used as a breeding area for several years.” Outside of anthropogenic impacts, DY03 is susceptible to radical changes in water depth and often floods over the old roadbed 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 fills a depression to the West decommissioned road. A fourth pond, on the east side of the road is the deepest at approximately 1.5 meters during high water and leaf litter, canopy cover, and depth make it less suitable breeding habitat, but it could be used as a migration area. Breeding was not detected at the site between 2014–2016. A single egg mass was detected at the site in 2017. No breeding was detected in 2018.

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 is considered Dyea 14 (DY14). 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. Visibility and amphibian detection are low due to dense vegetation cover. Water levels fluctuate from being entirely dry to having complete connectivity with both DY14 and DY12. Egg masses were detected at this site in 2009, 2010, and 2014. Tadpoles probably move freely between DY13 and DY14 during high water, and juveniles use Nelson Slough (including DY14, DY13, DY12) as a migration corridor.

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. Bears, shorebirds, river otters, salmon and other fish share this dynamic environment. It remains the most productive breeding site currently monitored at KLGO, and breeding has been detected every year since the monitoring program began.

Dyea 19 (DY19)

This site can be accessed by parking at the Slide Cemetery, off the road to the Dyea Townsite. Following a faint path west from the end of the cemetery toward the rocky cliff bands will lead to an open wetland. This large bog, dominated by emergent buckbean (*Menyanthes trifoliata*) and a fringe of sweet gale (*Myrica gale*) maintains some water throughout most of the summer, but often becomes dry by mid-August, except for the main channels running through the site. Dyea 19 is part of the same watershed as DY12, DY13, and DY14, and it is possible that it is part of a larger juvenile migration corridor. Evidence of toad breeding at DY19 was observed in 2005 and 2006, but no amphibians were detected at the site in 2007 or 2008. The site was not surveyed in 2009. Juveniles were found in high abundance in 2010 and 2011, indicating either undetected breeding activity in the area, or use of the wetland as a migration corridor. No amphibians of any life stage were detected at the site between 2012–2015. The site received a single survey in 2016, during which 172 juveniles were detected; no other life stages were observed. In 2017, the site received three visits, and only a single adult toad was detected. The site was not surveyed in 2018.

Dyea 33 (DY33)

Located along the east side of the Dyea road, approximately ¼ mile south of the campground entrance road and directly across from the large pullout that is used as a staging area for commercial rafting trips on the Taiya river. This wetland area is used as a staging-area for large amounts of gravel fill and is managed by the Municipality of Skagway. The site becomes two distinct pond areas when not inundated by high water. A relatively deep (approx. 2 m), circular pond, created by excavation, lies at the southern end of the site, and is fed throughout the summer by underground and spring seepage near the rock cliffs. The larger portion to the north is less convex, with ephemeral water only and changes in size and shape as gravel piles are removed or added. 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. The lack of shallow areas may make the “deep pond” seem unsuitable for boreal toad breeding habitat. DY33 was documented as a productive Boreal Toad breeding site in 2004, 2005 and 2006, but evidence of breeding was not detected between 2007–2017. 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. In 2010, the gravel piles were removed, and the shallow zones held water for part of the season, but no amphibians were detected. In 2014–2015, the site was used as a staging area for boulders and heavy machinery used in the Dyea Road improvement project. No amphibians were detected at the site between 2016–2017. The site was not surveyed in 2018.

Taiya River 01 (TR01)

Discovered in 2005, this productive breeding site is a wetland adjacent to the Taiya River, approximately 50 m southwest 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 three ‘lobes’ (north, 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. 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. Breeding has been detected at this site every year since the monitoring program began.

West Creek 02 (WC02)

Located alongside the West Creek Road, just west of the KLGO boundary (approximately one mile up the 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. A small stream outlet drains from this site to a culvert on the West Creek road, at the south end of WC04.

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. When first constructed, this site had 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. Over the following year, the alders at the site grew rapidly and began to shade the pool, especially

the southern shoreline. During the first VES in 2015, it was clear that extensive brush-cutting had occurred that spring along the West Creek road and WC04 was no longer shaded by alders. Concerned about the impact that future road improvements might have on the productivity of the breeding site, NPS staff met with the Municipality of Skagway's borough manager and the director of Public Works. The director agreed to avoid brush cutting along that length of road, and to limit road work in that area particularly in the fall when metamorphs disperse from the natal pond. As of the 2019 season, small alder shrubs also dominated the shoreline, shading the drainage ditch. Breeding has been detected at this site every year between 2008–2018.

Results

Visual Encounter Surveys

During the 2019 field season, 51 Visual Encounter Surveys (VES) were conducted at 8 Boreal Toad core breeding sites in Dyea between June 11th and August 20th. Dates of first observed toad life stages during the 2019 monitoring season are reflected in Table 2. No egg masses were detected in 2019, probably due to the late date of the first survey (June 11th, 2019). Boreal Toad larvae were detected at 5 of the 8 core sites surveyed and recent metamorphs were also detected at 5 of the 8 core sites, as shown in Table 3. However, of the 5 sites where larvae were detected, recent metamorphs were only detected at 4 sites (80%, n=5). Metamorphs were detected at WC04 during 2 surveys in August 2019, although no larvae were detected at the site during prior surveys in the season. The metamorphs may have migrated over from the nearby site WC02, where larvae were detected on June 12th.

A single toad abnormality was detected near DY33. The adult appeared to be sick, underweight, and had opaque/filmy eyes (see the individual results narrative for Dyea 33 (DY33), below). This was the only recorded abnormality observed in 2019.

Table 2. Date of first observed Boreal 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 ^a	July 31
2015	May 14	May 20	July 13
2016	—	May 24 ^a	June 30

^a The first survey of the 2014 season was conducted on May 22, the first survey of the 2016 season was conducted May 24, the first survey of the 2017 season was conducted on May 31, and the first survey of the 2019 season was conducted on June 11. Tadpoles were already present at multiple sites for all three years.

^b In 2017, no survey was conducted at WC04 (where metamorphs are typically first detected) between July 6th and Aug 8th. In 2018, no surveys were conducted after July 17th.

Table 2 (continued). Date of first observed Boreal Toad life stage for each year of monitoring at KLGO.

Year	Egg Mass	Tadpole	Metamorph
2017	–	May 31 ^a	Aug 8 ^b
2018	May 9	May 22	July 17 ^b
2019	–	June 11	July 17

^a The first survey of the 2014 season was conducted on May 22, the first survey of the 2016 season was conducted May 24, the first survey of the 2017 season was conducted on May 31, and the first survey of the 2019 season was conducted on June 11. Tadpoles were already present at multiple sites for all three years.

^b In 2017, no survey was conducted at WC04 (where metamorphs are typically first detected) between July 6th and Aug 8th. In 2018, no surveys were conducted after July 17th.

Table 3. Boreal Toads life stages detected at monitoring sites in 2019.

Site Number	No. of surveys	Egg masses	Larvae	Metamorphs	Juveniles/Adults (JA)
DY03	7	N	Y	N	0
DY13	7	N	Y	Y	2
DY14	6	N	Y	Y	1
DY19	6	N	N	N	33
DY33	7	N	N	N	0
TR01	6	N	Y	Y	5
WC02	6	N	Y	Y	0
WC04	6	N	N	Y	0
Totals	51 surveys	No sites	5 sites	5 sites	41 J/A

Chytrid Disease Testing

Buccal and skin chytrid swabs were collected from 8 juvenile and adult Boreal Toads and sent to Daryl Trumbo at Colorado State University in Fort Collins, CO to test for the presence of chytrid fungus. Individual sample data are provided in Appendix C. Results were provided by Chris Funk from Colorado State University in July 2020 (Table 4). Chytrid was detected on 5 of the 8 samples that were processed.

Table 4. Results from chytrid sampling on adult and juvenile Boreal Toads in KLGO during the 2019 season.

Source	Source ID #	Pisces #	Sample Form/Condition	Tested For	Total B.d. Target Copies in Original Sample
CDOW/HC	TR01.01.19.19	153032	Swab/EtOH	B. dendrobatidis	0.00E+00
CDOW/HC	TR01.02.19.03	153033	Swab/EtOH	B. dendrobatidis	0.00E+00
CDOW/HC	TR01.03.19.07	153034	Swab/EtOH	B. dendrobatidis	0.00E+00
CDOW/HC	DY13.01.19.19	153035	Swab/EtOH	B. dendrobatidis	5.85E+03
CDOW/HC	DY19.01.19.11	153036	Swab/EtOH	B. dendrobatidis	5.20E+03
CDOW/HC	DY19.02.19.13	153037	Swab/EtOH	B. dendrobatidis	4.63E+02
CDOW/HC	DY19.03.19.15	153038	Swab/EtOH	B. dendrobatidis	6.82E+01
CDOW/HC	DY19.04.19.17	153039	Swab/EtOH	B. dendrobatidis	3.05E+03

Casual Observations

Six (6) casual Boreal Toad observations were reported to KLGO in 2019 (Appendix D). Three (3) separate observations of an adult toad were made along the Chilkoot Trail throughout the summer. On 7 July, a Dyea resident photographed many adult boreal toads (8 counted) burrowed into a leaf litter pile on his property. Four (4) adult toads were observed on 6 August, south of the NPS campground near the Taiya River. On 7 August, a ‘handfuls of toadlets’ were seen near Boreal Toad core breeding site DY13 while checking on a bat acoustic box in Nelson Slough near the historic townsite.

Dyea Core Sites – Individual Results Narratives

Dyea 03 (DY03)

Seven (7) VES were conducted at DY03 in 2019. The first 2 surveys were conducted on 11 June, during which no amphibians were detected. Tadpoles were detected at each of the surveys on 17 and 31 July, and 16 August. The tadpoles that were observed during the last survey on 16 August did not yet have budding legs. No metamorphs were detected at the site in 2019.

Dyea 13 (DY13)

Seven (7) VES were conducted at DY13 in 2019. Tadpoles were detected during the first 2 surveys on 12 June, and the following 2 surveys on 17 July. Recent metamorphs were detected during the last 3 surveys on 1 and 20 August. Two (2) juveniles/adults were detected during a survey on 1 August, one of which was swabbed for chytrid fungus.

Dyea 14 (DY14)

Six (6) VES were conducted at DY14 in 2019. Tadpoles were detected during the first 4 surveys on 12 June and 17 July (Figure 2). Metamorphs were also detected during both surveys on 17 July, as well as during both surveys on 1 and 20 August. A single juvenile/adult was detected on 20 August.



Figure 2. Boreal Toad larvae detected at core breeding site DY14 in Dyea on June 12th, 2019 (NPS/KATLYN FUENTES).

Dyea 19 (DY19)

Six (6) VES were conducted at DY19 in 2019. Juveniles were detected at each of the surveys on 11 and 31 June, and 17 July (Figure 3). No amphibians were detected during the last survey on 20 August. No larvae or metamorphs were detected in 2019. On 17 July, surveyor Mary Hake reportedly heard one adult “calling in the distance.”



Figure 3. A juvenile Boreal Toad detected at core breeding site DY19 in Dyea on July 17th, 2019 (NPS/KATLYN FUENTES).

Dyea 33 (DY33)

Seven (7) VES were conducted at DY33 in 2019, between 11 June and 16 August. No amphibians were detected during any VES. On 17 July, while walking from the parking lot to site DY33, a single adult Boreal Toad was observed. The adult appeared to be sick, underweight, and had opaque/filmy eyes (Figure 4). This was the only recorded abnormality observed in 2019.



Figure 4. A sick adult Boreal Toad observed just outside of core breeding site DY33 in Dyea on July 17th, 2019 (NPS/KATLYN FUENTES).

Taiya River 01 (TR01)

Six (6) VES were conducted at TR01 in 2019. Approximately 1000–2000 tadpoles were detected during the 2 surveys on 11 June. During 2 surveys on 17 July, thousands of metamorphs were detected, along with 2 adult Boreal Toads (Figure 5). During a single survey on 31 July, metamorphs were detected, as well as 3 adult Boreal Toads that were captured, swabbed for chytrid, and released. Metamorphs were detected during the final survey on 16 August.



Figure 5. An adult Boreal Toad detected during a VES at core breeding site TR01 in Dyea on July 17th, 2019 (NPS/KATLYN FUENTES).

West Creek 02 (WC02)

Six (6) VES were conducted at WC02 in 2019, between 12 June and 21 August. Tadpoles were detected during both surveys on June 12th. No amphibians were detected during a single survey on 17 July. Four (4) metamorphs were detected during one of 2 surveys on 1 and 8 August, metamorphs were detected during the last survey on 21 August.

West Creek 04 (WC04)

Six (6) VES were conducted at WC04 in 2019, between 12 June and 21 August. No amphibians were detected during surveys conducted on 12 June or 17 July (2 surveys on each date). Although no tadpoles were detected at the site, a single metamorph was detected during a survey on 1 August, and a single metamorph was detected during the final survey on 21 August. It is possible that the metamorphs migrated over from WC02, where tadpoles were detected in June.

Discussion

Oral history accounts and anecdotal evidence suggest 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 due to all of the black egg masses and tadpoles (Kalen 2010, Albecker 2010, Fairbanks 2010). The small, isolated toad population in Dyea today may be a small fraction of a once abundant species. Similar population crashes of Boreal Toads were documented in Juneau, Ketchikan, and Haines between 1970 and 1990 (Carstensen et al. 2003).

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 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. The Dyea valley also experienced a major flooding event in 2003 when the West Creek glacial moraine gave out. Results from the chytrid analyses carried out in Focused Condition Assessment may support the hypothesis that Boreal Toads at KLGO have already experienced a mass mortality event and decline in population due to the introduction of chytrid fungus (Chambert, Belt, and Hossack 2019).

Visual Encounter Surveys

Twenty-three (23) out of 51 routine Visual Encounter Surveys (VES) detected toads. Breeding activity was found through larval (aquatic tadpole) and metamorph (tiny terrestrial toadlet) detection at 4 of the 8 core sites. Larvae, but not metamorphs, were detected at one additional site. Therefore, there continue to be consistent signs of breeding Boreal Toads in core Dyea wetlands overall. However, visitation and human activity levels in Dyea increase every year (excepting COVID-19 years) making continued annual monitoring for breeding activity at core Dyea wetlands necessary to detect rapid changes at these important wetlands.

Chytrid Disease Detection

Chytrid fungus was detected on 5 of 8 samples from Dyea toads. The impact to the Dyea Boreal Toad population is unquantified, but it is established as firmly present. Human movements among wetlands without measures to reduce chytrid fungus spread (such as cleaning/sanitizing footwear between wetlands) is likely to spread the pathogen.

Casual Amphibian Observations

Observations of adult toads on the Chilkoot Trail indicate active toad populations along the trail. Photo-documentation of adult toads in a leaf pile at a Dyea residence indicates that human-generated organic mounds (leaf, compost, brush, etc) are summer habitat and possible overwintering hibernation sites for Boreal Toads. The observation of dispersing metamorphs at Nelson Slough near the historic townsite points to the slough and connected upstream sites being used as a migration corridor by recent metamorphs and juvenile toads.

Transition to FCA methods

The 2019 field season for the Amphibian Monitoring Program at KLGO represented a transitional year, during which revisions to the program were made following advice from one of the authors of the Focused Condition Assessment (FCA). In particular, the 2019 methods adopted the method of 2 observers performing independent, replicate surveys (Chambert, Belt, and Hossack 2019; Gould et al. 2012). Each of the 8 core sites received the recommended number of VES during the monitoring season (6–7 visits per site) to achieve the needed statistical power for a planned occupancy analysis in the future.

However, field methods and the data sheet layout used in 2019 did not clearly discriminate the different types of data: FCA vs. traditional. Also, data intended for analysis following the FCA may have been affected by insufficient information on details of methodology that led to compromised independence of observers. Possible contributing factors are:

- 1) Surveyors recorded observations on data sheets that had adjacent data blocks for their observations. If both surveyors wrote down their own observations, the second surveyor would see the first surveyor's data unless additional steps were taken to hide the information. If both surveyors wrote down observations for each other, the first scribe would know the first surveyor's data before executing their own independent survey.
- 2) During independent visual surveys, surveyors might simultaneously collect other data wherein they acted as a pair. For example, interrupting a VES to capture adult or juvenile toads for biometrics or chytrid swabs, then resuming the VES. The interaction of surveyors could lead to unintentionally sharing visual information.
- 3) The small size of most KLGO core sites meant to surveyors were close enough to see and hear each other even when on opposite sides of a site. The surveyors did not speak to each other about what they saw, but other cues might occur, and interruptions in the VES to work together (such as adult toad capture for swabs) could increase opportunity for inadvertent communication.
- 4) The FCA methods included the possibility of having the second surveyor start 15 minutes after the first surveyor and following the same direction around the pond for larger wetlands. FCA methods for smaller wetlands directed that one surveyor should fully complete their survey, then after a 15-minute rest period, the second surveyor performs their survey. However, discriminating larger from smaller wetlands was not defined.

These factors should be considered when preparing data for future occupancy analyses. It might be necessary to treat replicate surveys that were conducted in 2019 as single, combined survey, so as not to violate the assumptions of independence in the statistical analyses.

Conclusions & Recommendations

Visual Encounter Surveys (VES) as well as chytrid disease sampling should continue in order to monitor long-term changes in Boreal Toad population status and health. When the Focused Condition Assessment (FCA) methodology is fully implemented, the KLGO Amphibian Monitoring Program will have the statistical power to detect a large (40%) decline in Boreal Toad populations over a 10-year monitoring period (Chambert, Belt, and Hossack 2019). The 2019 field season represented a transitional year for implementing those changes by incorporating the VES methods described in the FCA into the traditional KLGO toad monitoring VES protocol. Based on the experience and results from the 2019 season, recommendations are provided for consideration to improve the Amphibian Monitoring Program in future years.

- 1. KLGO Amphibian Monitoring Program should evaluate program objectives and identify goals for future monitoring.**

This transitional year melded the established KLGO Boreal Toad monitoring with recommendations from the FCA, applied only to the subset of toad wetlands that are the Dyea core sites. Full implementation of the FCA will include previously identified toad habitat within the broader Skagway Borough in order to achieve an estimate of overall population status. However, much more detailed information about breeding and non-breeding toad habitat in Dyea is needed to evaluate impacts to the toads from increasing human activity and potential construction projects. Goals for the more detailed information should be described and associated data should be clearly identified.

- 2. KLGO Amphibian Monitoring Program Standard Operating Procedures and database should be updated.**

The KLGO Amphibian Monitoring Program Standard Operation Procedures (SOPs) should be revised to reflect the new methods used during VES, chytrid swab collection, chytrid hygiene practices, and data entry. Field data sheets and the Boreal Toad Monitoring database should be updated to accommodate the data. Specific guidance regarding use of the new VES datasheet, and methods for conducting independent, replicate surveys (if this method continues to be used at KLGO in future years). The SOP on chytrid swab collection should include specific guidance on collecting buccal swabs (a new method used in 2019) and outline general requirements for safe handling of amphibians to prevent the spread of chytrid.

- 3. Traditional VES field season could be extended for Dyea core sites.**

For Dyea core sites, toad monitoring could begin at the start of the breeding season in April when toads can be found in amplexus (mating) and eggs are present. Egg masses are not part of the FCA data, but can often be more easily detected than mobile tadpoles and an early start to monitoring could provide enhanced detections of breeding activity at these specific sites. Similarly, metamorphs could be detected through September, particularly at sites where tadpoles were found earlier in the season, but had not yet metamorphosed by August.

4. FCA recommended intensive sampling for "sentinel" core breeding sites may provide detailed information for Dyea.

From 2008–2019, the Amphibian Monitoring Program at KLGO was organized into intensive and extensive components to focus efforts appropriately given the relative abundance of amphibians. The lower Taiya River and West Creek watersheds, with their multiple Boreal Toad breeding sites, have been considered the intensive component. In this area, core sites were those where breeding had been documented in the past, and were traditionally visited multiple times throughout each season to monitor toad presence and tadpole development. Non-core sites, those with potential activity, were surveyed less frequently, perhaps once in a season or with multiple-year gaps between surveys. Over the years, some non-core sites had been reclassified to core sites as breeding activity has been detected.

The FCA recommends that KLGO identify and select 8–12 “sentinel” Boreal Toad breeding sites in the Dyea area to be surveyed intensively every year (Chambert, Belt, and Hossack 2019). The FCA stated, “Each core site must be visited (at least) twice between approximately June 01 and July 31 (larvae sampling window) and five times between 01 July and 31 August (metamorph sampling window), for a total of 7 repeated surveys per site, per year” (Chambert, Belt, and Hossack 2019). The data acquired through this type of survey should be evaluated to determine if the Park management information needs would be fully met with only the presence/absence data of the FCA surveys.

5. Re-examine existing core sites and candidates to become core sites.

Eight (8) sentinel core sites were selected and monitored in 2019: DY03, DY13, DY14, DY19, DY33, TR01, WC02, WC04. Given the extreme proximity of WC02 and WC04 (within a few meters of each other), consider treating those 2 sites as a single site in future years, to prevent the assumption in occupancy analyses that metamorphs would not migrate between sites. For the same reason, it might be worth treating DY13 and DY14 as a single site for future occupancy analyses. Lastly, DY02 and DY12 should be evaluated as potential ‘sentinel’ sites given their relative closeness to other Boreal Toad core breeding sites in the Dyea area.

6. Ninety (90) non-core sites to be selected for FCA rotating panel surveys.

Regarding selection of non-core sites, the FCA recommends that 90 non-core sites be randomly selected and divided into 3 panels (30 sites each) to be surveyed on a 3-year rotating basis (1 panel per year), with 2 VES performed for each site in a given panel during the year that the panel is selected. This extensive portion of the Amphibian Monitoring Program should be developed as soon as possible, preferably with guidance from a herpetologist with knowledge of the KLGO program and park landscape. The FCA states, “252 non-core sites had been surveyed [in KLGO and surrounding areas] since the beginning of the monitoring program. Among these, 208 sites were actually visited only once, in 2008. The other 44 non-core sites were visited between 2 and 10 times since 2007.”

It is important to note that in 2008, a large comprehensive survey in the White Pass was conducted, and most of the sites identified and surveyed were small (<2 m²), ephemeral alpine ponds not suitable for either Boreal Toad or Columbia Spotted frog breeding habitat. Rather than randomly selecting 90 of the 252 previously identified non-core sites, it might be valuable to

review and eliminate small, ephemeral alpine sites in the White Pass area from the site selection list. Alternatively, it might be valuable to repeat the wetland identification process that was first conducted when the Amphibian Monitoring Program at KLGO was launched in 2004, using National Wetland Inventory Data and park LIDAR imagery (Weatherbee 2009), and randomly select 90 of the sites identified through that process. Three (3) panel areas might be initially selected (e.g., Dyea and West Creek area, Chilkoot Trail, White Pass Unit). The area around White Pass City might be prioritized for amphibian surveys, as there has been discussion in recent years at the Park about developing a public access trail in that area.

7. Chytrid sampling should continue, other signs of disease should be documented.

Chytrid sampling should remain as part of the long-term monitoring program at the park. Since 2010, chytrid sampling has been conducted approximately every other year. This rotation is logistically achievable and should be continued. A single amphibian abnormality was observed in 2019. Abnormalities may indicate environmental contaminants or pathogens. Toads at all life stages should continue to be examined for malformations or other indicators of disease. Water quality testing should be considered for environmental DNA testing to indicate pathogens, and for traditional environmental contaminants testing.

8. Radio-tracking should be resumed.

Radio-tracking of adult Boreal Toads provides valuable information on upland habitat use and requirements that could be valuable in better understanding the movement patterns of Boreal Toads as well as the potential impacts of habitat loss due to development and recreational activities. No toads were radio-tracked between 2017–2019. Due to the established need for upland habitat information, the radio-tracking portion of the KLGO Amphibian Monitoring Program should be resumed, perhaps on an alternating year, rotating basis. Also, it could be prioritized annually at sites that are near potential development projects or implemented during years when the Dyea panel of extensive sites is selected.

9. Community outreach and interaction should continue.

Community observations provide valuable information that contributes to understanding current and historic amphibian distributions throughout the area. In 2017, longtime Dyea resident Wayne Greenstreet reported once discovering a large number (~20) adult Boreal Toads hibernating in the well on his property in Dyea. In 2019, resident John McDermott reported finding 8 adult Boreal Toads burrowed in a leaf litter pile on his property. Future technicians should talk with local residents to target areas for radio-belted toads and identifying locations of hibernacula.

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. Facebook groups such as “Skagway Naturally!” (maintained by longtime Dyea resident John McDermott) should be checked for community observations of amphibians, and it might be a good platform for sharing information and results from the Amphibian Monitoring Program at KLGO. An annual public presentation at the Park auditorium would be a great way to engage the community in the research, and possibly recruit volunteers.

Human activities may have a major impact on current Boreal Toad survival in KLGO as toads are routinely found crushed by vehicles. When moving to and from breeding wetlands, toads must navigate roads, parking lots, campgrounds, trails, Park facilities and private residences which makes them vulnerable to vehicle mortality. In addition, places where humans and their pets congregate increase potential exposure of toads to contaminants or pathogens attached to vehicles, gear, or footwear or animal paws. Non-motorized vehicles, pedestrian and pet traffic increases the potential for accidental trampling of newly metamorphosed and adult toads. To mitigate such impacts, community and visitor education should remain an integral part of the amphibian monitoring program.

10. Dorsal pattern photos of adult and juvenile toads should be systematically collected and identified.

A recent study found that Wyoming Toads (*Anaxyrus baxteri*) can be individually identified by their dorsal spot pattern with the human eye with incredibly high success (their study reported 100% of the time) (Morrison et al. 2016). Following the photo methods published by that study (Morrison et al. 2016), photo-documentation of dorsal spot patterns of juvenile and adult toads should become a systematic step in data collection when individual Boreal Toads are captured during Visual Encounter Surveys at KLGO. Photos should be geotagged, and named systematically; such as:

format – “AmphibianSurvey_Site_IndivID_Date_ObserverName”

example – “Amphibian Survey_TR01_A3_04June2017_SSurdyk”.

Prior to commencing photo data collection, an SOP should be developed for storing and managing digital photos and associated data. Outreach materials could also be developed for promoting citizen science submissions of Boreal Toads.

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Appendix A. Notes on 2019 Data Entry

2019 Data Entry into Amphibian Database, Prepared by Jen Larsen and Shelby Surdyk, July 2021

Due to staff limitations in 2019, data entry was not completed until 2021.

The 2019 season included the first year of toad surveys that utilized the new data sheet recommended by T. Chambert, J. Belt, and B. Hossack from the “Boreal Toad (*Anaxyrus boreas*) Monitoring Program in Klondike Gold Rush National Historical Park: Survey design recommendations and trends in wetland occupancy and amphibian chytrid”.

Because this new datasheet focuses on collecting less detailed data and rather focusing on the absence/presence of boreal toads, when compared to the previous data sheet used by KLGO staff, there are some discrepancies when entering data into the database.

Some things to consider:

Multiple datasheets per visit:

In 2019, multiple VES datasheets were often collected during a single site visit. This was especially true for sites TR01 and DY03, which each have multiple distinct ponds. For example, TR01 includes three “lobes” or “fingers” (long, narrow ponds, parallel to the Taiya River) which are separated from each other by a few meters of wet shrubland. During surveys of TR01 in 2019, surveys of each “lobe” were recorded on separate datasheets, although all lobes belong to the same site. Each datasheet was entered into the database separately. Therefore, there are more 2019 entries in the database than there are surveys that were conducted in 2019. This must be taken into consideration when data are exported from the database for future occupancy analyses.

Independent replicate surveys:

In 2019, surveyors used ‘independent, replicate’ survey methods, meaning that two surveyors visited a site at the same time, and surveyed the site independently from each other. The new VES datasheet that was adopted in 2019 included space for recording data from replicate surveys. Each independent, replicate survey was entered into the database as a separate survey event, although they share the same datasheet. In some cases, surveyors noted that independent surveys were not possible due to the size of the area surveyed or other reasons, and so no replicate survey was conducted. In other cases, surveyors began conducting two replicate surveys in one part of a site (for example, Lobe 1 and Lobe 2 at TR01), but then reportedly surveyed another part together (for example, surveyed Lobe 3 together, not independently), in which case the entire survey of TR01 on that date was treated as a single survey, not two independent, replicate surveys.

Weather/Environmental Entries:

Cloud Cover: data sheet options include: 0–10%, 11–80, >80. To stay consistent with entries historically made into the database, 0–10% was noted in the database as “clear”, 11–80% was noted in the database as partially cloudy, >80% was noted in the database as overcast.

Precipitation: data sheet options include: none, rain, frozen. To stay consistent with entries historically made into the database, none was noted in the database as “Dry/clear”, rain was noted in the database as “rain”, and frozen would have been noted as “frozen” if the need arose.

Wind: data sheet options include: none-light, moderate, strong. To stay consistent with entries historically made into the database, none/light was noted in the database as “calm”, moderate was noted in the database as “medium”, and strong was noted as “hard”.

Percentage of Site Emergence:

The Amphibian database will not take a range of percentages as the new data sheet requires. For percentage ranges selected in the new database, the lowest number in the range was used for the numeric value expressing how much vegetation was emergent at a site. Ex. A site with 76–100% emergent vegetation on the datasheet was listed as 76% within the database.

Percentage of Perimeter Searched:

The Amphibian database has a column for percentage of survey completed. The datasheet provides the options of 1–25, 26–50, 51–75, 76–99, and 100. The Amphibian database historically received single numeric values representing the percentage of a survey completed. As the column representing this value in the database will accept a range of values, entries for the 2019 season copied exactly what was written on the datasheet into the database. Ex. On the datasheet, if percentage of perimeter was selected as 76–99%, “76–99%” was listed as the value in the database.

Life Stage History Codes:

All life stages observed while completing surveys was noted in the notes section for each entry in the Amphibian database.

Appendix B. 2019 Chytrid Sample Collection

Table B-1. Boreal Toad Chytrid / Genomic Sampling. (PCR assay for chytrid & RADseq for genomics.)
Site: Klondike Gold Rush National Historical Park, Skagway, AK. County: Skagway-Hoonah-Angoon
County. Observers: Katlyn Fuentes. Sampling date(s): 07/31/2019–08/01/2019.

Site code / Sample number	Sex/stage M/F/J/ YOY/T	SVL (mm)	Mass (g)	PIT tag #	Return?	Sample collected: Chytrid skin swab, 2 mouth swabs, toe, whole animal? Ventral photo number? Other comments
TR01.01-19-01	Unknown sex	82mm	—	—	—	CHYTRID SKIN SWAB (1 of 2); Same individual as sample vial TR01.01-19-02; 07/31/2019
TR01.01-19-02	Unknown sex	82mm	—	—	—	CHYTRID SKIN SWAB (2 of 2); Same individual as sample vial TR01.01-19-01; 07/31/2019
TR01.02-19-03	Unknown sex	93mm	—	—	—	CHYTRID SKIN SWAB (1 of 2); Same individual as sample vials TR01.01-19-04 to 06; 07/31/2019
TR01.02-19-04	Unknown sex	93mm	—	—	—	CHYTRID SKIN SWAB (2 of 2); Same individual as sample vials TR01.01-19-03 to 06; 07/31/2019
TR01.02-19-05	Unknown sex	93mm	—	—	—	BUCCAL SWAB (1 of 2); Same individual as sample vials TR01.01-19-03 to 06; 07/31/2019
TR01.02-19-06	Unknown sex	93mm	—	—	—	BUCCAL SWAB (2 of 2); Same individual as sample vials TR01.01-19-03 to 06; 07/31/2019
TR01.03-19-07	Unknown sex	—	—	—	—	CHYTRID SKIN SWAB (1 of 2); Same individual as sample vials TR01.01-19-07 to 10; 07/31/2019
TR01.03-19-08	Unknown sex	—	—	—	—	CHYTRID SKIN SWAB (2 of 2); Same individual as sample vials TR01.01-19-07 to 10; 07/31/2019
TR01.03-19-09	Unknown sex	—	—	—	—	BUCCAL SWAB (1 of 2); Same individual as sample vials TR01.01-19-07 to 10
TR01.03-19-10	Unknown sex	—	—	—	—	BUCCAL SWAB (2 of 2); Same individual as sample vials TR01.01-19-07 to 10; 07/31/2019
DY19.01-19-11	Unknown sex	33mm	—	—	—	CHYTRID SKIN SWAB (1 of 2); Same individual as sample vial DY19.01-19-12; 07/31/2019

Table B-1 (continued). Boreal Toad Chytrid / Genomic Sampling. (PCR assay for chytrid & RADseq for genomics). Site: Klondike Gold Rush National Historical Park, Skagway, AK. County: Skagway-Hoonah-Angoon County. Observers: Katlyn Fuentes. Sampling date(s): 07/31/2019–08/01/2019.

Site code / Sample number	Sex/stage M/F/J/ YOY/T	SVL (mm)	Mass (g)	PIT tag #	Return?	Sample collected: Chytrid skin swab, 2 mouth swabs, toe, whole animal? Ventral photo number? Other comments
DY19.01-19-12	Unknown sex	33mm	–	–	–	CHYTRID SKIN SWAB (2 of 2); Same individual as sample vial DY19.01-19-11; 07/31/2019
DY19.02-19-13	Unknown sex	41mm	–	–	–	CHYTRID SKIN SWAB (1 of 2); Same individual as sample vial DY19.02-19-14
DY19.02-19-14	Unknown sex	41mm	–	–	–	CHYTRID SKIN SWAB (2 of 2); Same individual as sample vial DY19.02-19-13; 07/31/2019
DY19.03-19-15	Unknown sex	41mm	–	–	–	CHYTRID SKIN SWAB (1 of 2); Same individual as sample vial DY19.03-19-16; 07/31/2019
DY19.03-19-16	Unknown sex	41mm	–	–	–	CHYTRID SKIN SWAB (2 of 2); Same individual as sample vial DY19.03-19-15; 07/31/2019
DY19.04-19-17	Unknown sex	36mm	–	–	–	CHYTRID SKIN SWAB (1 of 2); Same individual as sample vial DY19.04-19-18; 07/31/2019; has deformed foot
DY19.04-19-18	Unknown sex	36mm	–	–	–	CHYTRID SKIN SWAB (2 of 2); Same individual as sample vial DY19.04-19-17; 07/31/2019; has deformed foot
DY13.01-19-19	Unknown sex	37mm	–	–	–	CHYTRID SKIN SWAB (1 of 2); Same individual as sample vial DY13.01-19-19; 08/01/2019
DY13.01-19-20	Unknown sex	37mm	–	–	–	CHYTRID SKIN SWAB (2 of 2); Same individual as sample vial DY13.01-19-19; 08/01/2019

SITE CODE LOCALITY INFORMATION: Coordinates are in UTM Zone8 NAD83

DYEA 13 (DY13):

- **COORDINATES:** Easting (meters) 0479529, Northing (meters) 6595772
- **DESCRIPTION:** 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 is considered Dyea 14 (DY14). 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. Visibility and amphibian detection are low due to dense vegetation cover. Water levels fluctuate from being entirely dry to having complete connectivity with both DY14 and DY12. Egg masses were detected at this site in 2009, 2010, and 2014. Tadpoles probably move freely between DY13 and DY14 during high water, and juveniles use Nelson Slough (including DY14, DY13, and DY12) as a migration corridor.

DYEA 19 (DY19):

- **COORDINATES:** Easting (meters) 0479496, Northing (meters) 6597047
- **DESCRIPTION:** 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 no amphibians were detected in 2007 or 2008. The site was not surveyed in 2009. Juveniles were found in high abundance in 2010 and 2011, indicating either undetected breeding activity in the area, or use of the wetland as a migration corridor. No amphibians or any life stage were detected at the site between 2012–2015.

TAIYA 01 (TR01):

- **COORDINATES:** Easting (meters) 0480075, Northing (meters) 6596476
- **DESCRIPTION:** Discovered in 2005, this productive breeding site is a wetland adjacent to the Taiya River, approximately 50 m southwest 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 three ‘lobes’ (north, 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. 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. Breeding has been detected at this site every year since the monitoring program began.

Appendix C. 2019 Casual Amphibian Observations

Sterling Graham, Trail Crew – CHILKOOT TRAIL

CANYON CITY: 31May2019 11:16am

1 adult boreal toad (sex unknown) spotted near Canyon City camp (USA portion of the Chilkoot Trail), near steps to National Park Service cabin



Boreal toad near canyon city camp.



Boreal toad near canyon city camp.

LINDEMAN CITY: 30May2019 08:59am

1 adult boreal toad (sex unknown) spotted before lakes near Lindeman City camp (Canada side of Chilkoot Trail)



Adult boreal toad (sex unknown) spotted before lakes near Lindeman City camp.

John McDermott, Civilian – Private Property in Dyea

DYEA – PRIVATE PROPERTY: 07 July 2019

Adult boreal toads ($n \geq 8$; approximately 1 ½-2 inch in total length) spotted in leaf litter pile on private property of McDermott residence in Dyea. Toads were seen both on the leaf-litter pile and within holes/burrows made by the toads. Possible over-wintering site? John McDermott (owner of property) posted pictures to Facebook, the post was then forwarded to NPS staff/intern Mary Hake and Katlyn Fuentes by Elaine Furbish, an independent contractor working with KLGO NPS officials.



Adult boreal toads spotted in leaf litter pile on private property of McDermott residence in Dyea



Adult boreal toads spotted in leaf litter pile on private property of McDermott residence in Dyea

8/6/2019 – Mary Hake and Elaine Furbish

Taiya River 01 (TR01)

Observed four adult toads, two each at two of the eastern ponds along the old ATV trail. All four toads were on land, adjacent to the pond when first observed. Two jumped in the water when we approached. Small tadpoles observed in the southernmost pond. Water levels were higher than they were two weeks ago.



Photo of Adult Boreal Toad in TR01 on 8/6/2019 (M.Hake)

8/7/2019, Jen Larsen

Nelson Slough, DY13

When in the field doing routine bat box equipment monitoring, handfuls of toadlets were observed on the ground crawling through the grass when taking steps to the bat box. In four years of checking battery charges at the Nelson Slough bat box site, never have I observed toadlets nor that many actively habituating the area close to the bat box.

9/18/2019, anonymous

Helipad at Canyon City

Large adult toad seen 2 nights in a row under trail cabin helipad.

CHILKOOT-KLONDIKE NATURAL HISTORY OBSERVATION CARD

REQUIRED - PLEASE COMPLETE

WHAT: TOAD 1
(ROCK, PLANT, ANIMAL, TERRAIN FEATURE, EVENT, ETC. - GIVE SCIENTIFIC NAME, IF KNOWN)

WHEN: 6 AM 18 Sept 2019
(TIME) (DAY) (MONTH) (YEAR)

WHERE: ☐ Dyea Flats ☐ Dyea townsite ☐ Chilkoot Pass to Happy Camp
☐ trailhead to Finnegan's Point ☐ Happy Camp to Deep Lake
☐ Finnegan's Point to Canyon City ☐ Deep Lake to Lindeman Camp
☒ Canyon City to Pleasant Camp ☐ Lindeman Camp to Bare Loon Lake
☐ Pleasant Camp to Sheep Camp ☐ Bare Loon Lake to Bennett Lake
☐ Sheep Camp to Chilkoot Pass ☐ other

please describe location in more detail, if possible: under helipad @ trail cabin, 2 nights in a row!

CONFIDENCE: ☒ positive (expert level, completely certain) ☐ fairly confident (intermediate level, species may be uncertain) ☐ somewhat confident (just beginning to learn to identify this)

OPTIONAL - complete as much as possible

CHECK ALL BOXES THAT APPLY

Terrain	Habitat	Plants-Fungi	Animals	
☐ tidal flat	☐ still water	☐ budding	☐ feeding	_____ animal total #
☐ floodplain	☐ moving water	☐ leafing out	☐ roosting	_____ # adult female
☐ river/stream	☐ peat bog	☐ flowering	☐ bedding	_____ # adult male
☐ pond	☐ runoff fen	☐ fruiting	☐ flying	☒ # adult ? sex
☐ wetland	☐ shrub thicket	☐ autumn colors	☐ fleeing	_____ # juvenile
☐ sideslope	☐ woodland	☐ leaf drop	☐ swimming	
☐ ridgetop	☐ alpine meadow	☐ mushroom, etc	☐ dead	
☒ rock face	☐ dead snag	☐ lichen	☐ track or sign	
☐ talus	☐ downed log	☐ disease sign	☐ breeding site	
☐ avalanche chute	☐ artifact	☐ damaged (by)	☐ communal area or roost	

describe more here: HE WAS BIG!

May we contact you for more information? If yes, give name and address, phone or e-mail: _____

Environment

_____ °F or °C
temperature

_____ precipitation

_____ percent cloud cover

_____ aspect of slope

_____ feet or m
elevation

Scan of field observation form.

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 461/182820, July 2022

National Park Service
U.S. Department of the Interior



[Natural Resource Stewardship and Science](#)

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