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Red Cliffs National Conservation Area

Cottonwood Trail Fire Tortoise Mortality Survey Report



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ON THE COVER (counterclockwise from top image): (1) Photo taken by Melissa Buchmann (NCA Park Ranger) on July 23, 2020, from a location within the Red Cliffs National Conservation Area near Cottonwood Trail looking north within the recent burn area; (2) Adult female tortoise killed by fire; (3) Adult female fire-injured live tortoise; (4) Live immature tortoise within the burn area. Photos 2–4 by John Kellam.

TABLE OF CONTENTS

INTRODUCTION 1

MATERIALS AND METHODS..... 1

 Field Effort..... 1

 Survey Methods 3

 Statistical Analysis..... 3

RESULTS 3

 Area Surveyed..... 3

 Tortoise Remains Found 3

 Tortoise Burrows Found 5

 Live Tortoises..... 5

 Fire-Injured Live Tortoise 6

DISCUSSION 6

LITERATURE CITED 7

LIST OF TABLES

Table 1. Tortoise remains (*n* = 25) found during the Cottonwood Trail Fire surveys including date, age class, sex, carapace length (mm), file number, cause of death, and time since death, July 31, 2020 to September 05, 2020. Dash represents no file number observed. The CL of fragmented shells were estimated using regressions based on scute size (Berry and Woodman 1984). 5

LIST OF FIGURES

Figure 1. Map of tortoise mortality survey area 2

Figure 2. Map of tortoise remains, burrows, and live tortoises in survey area 4

INTRODUCTION

The Mojave desert tortoise (*Gopherus agassizii*; hereafter desert tortoise or tortoise) is a burrowing reptile in the family Testudinoidea that occurs in the Mojave and Sonoran deserts of California, Nevada, Arizona, and southwestern Utah (USFWS 1990, 1994). The U.S. Fish and Wildlife Service (USFWS) listed the desert tortoise as a threatened species in 1990 (USFWS 1990). Declines in desert tortoise populations are primarily attributed to habitat degradation and loss, disease, predation, and stochastic events including drought and wildfires (USFWS 1994). In 1994, USFWS designated 6,446,200 acres of critical habitat throughout the species range in 6 recovery units, including the 54,600-acre Upper Virgin River Recovery Unit (UVRRU) in Washington County, Utah (USFWS 1994, 2011). Most of the critical habitat in the UVRRU is in the Red Cliffs National Conservation Area (NCA), managed by the Bureau of Land Management's (BLM) St. George Field Office (SGFO).

On July 12, 2020, a wildfire named the "Cottonwood Trail Fire" was started by a vehicle tire blow-out on Interstate 15 (I-15) and burned approximately 1,414 acres of public lands in the Red Cliffs NCA. Eighty-two acres owned by the State of Utah's Institutional Trust Lands Administration (SITLA), and small areas of Utah Department of Transportation's I-15 right-of-way and private lands were also damaged by this fire, resulting in a total fire size of approximately 1,631 acres (Figure 1).

This wind-driven fire moved rapidly north and west from the ignition point on I-15, damaging or destroying approximately 1,001 acres of desert tortoise critical habitat (Figure 1).

Once the Cottonwood Trail Fire was declared 100% contained on July 22, 2020, the NCA biologist, assisted by Utah Department of Wildlife Resources (UDWR) biologist and a survey team, systematically searched for fire-killed or injured desert tortoises on public land within the burn area to assess direct tortoise mortality and injury.

MATERIALS AND METHODS

Field Effort – The survey effort focused on desert tortoise critical habitat and the area eastwards to Leeds Creek within the fire perimeter (Figure 1). Prior surveys have concluded the area east of Leeds Creek is unoccupied potential tortoise habitat (Figure 1). Although the initial goal was to survey 100% of the critical habitat on public land within the Cottonwood Trail Fire burn area, surveyor availability constraints and agency data request deadlines precluded accomplishing this goal. The target survey area was redefined to encompass approximately 50% of the critical habitat on public land within the fire perimeter. The survey team consisted of: John Kellam (NCA biologist), Stephanie Root-Taylor (SGFO biologist), Ann McLuckie (UDWR tortoise biologist), and two American Conservation Experience Resource Associates (Emily Hartwig and Toulia Demetria Papadopoulos), who are participating in a long-term internship program under the direction of the NCA Biologist. In addition, Dawna Ferris-Rowley (NCA Manager), who is tortoise survey trained and experienced, assisted on 2 surveys.

Cottonwood Trail Fire

St. George Field Office 9/14/2020

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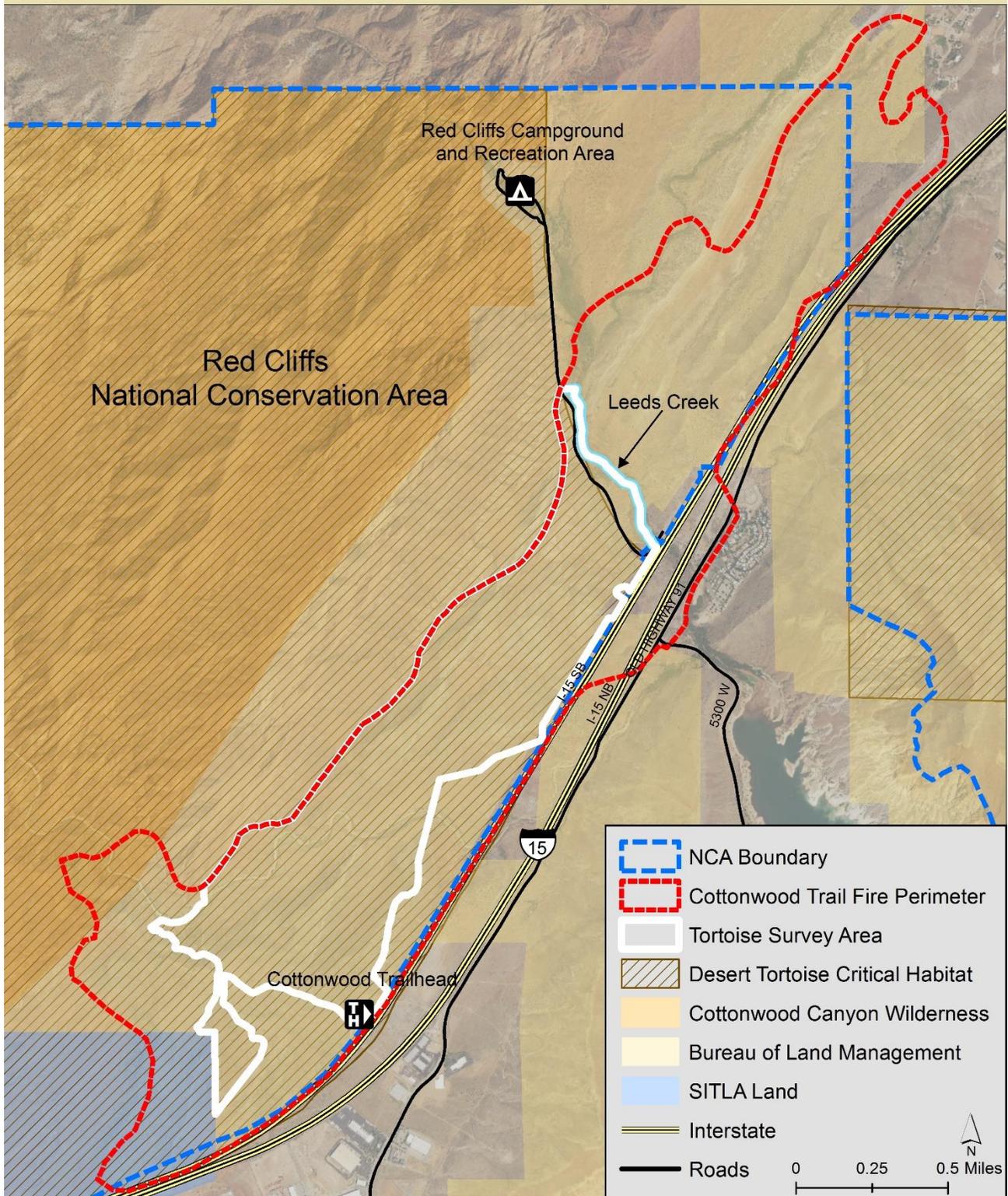


Figure 1. Map of tortoise mortality survey area.

Survey Methods – Field surveys were conducted 1 to 45 days after the fire was contained. Surveys began at 0730 each day and continued until approximately noon, when daily ambient temperatures generally exceeded 90 °F. Survey observers walked on 10-m wide belt transects and were spaced consecutively, walking at the same rate to provide 100% coverage (Esque 2003; USFWS 2017).

Tortoise remains were examined to determine cause of death. For example, remains with charred scutes and bones or limbs with burn marks were assumed to be indicative of a tortoise that sustained lethal injuries during the fire (Esque 2003; McLuckie et al. 2007a). Time since death was confirmed using deterioration rates of tortoise shell and skeletal remains (Berry and Woodman 1984; McLuckie et al. 2007a). Midline carapace length (CL) was measured using calipers and a ruler, and sex was determined for subadult and adult carcasses (CL ~180 mm). The CL of deteriorated or fragmented shell remains was estimated using regressions based on scute size (Berry and Woodman 1984; McLuckie et al. 2007a).

The location of active and good condition tortoise burrows (Condition Class 1 and 2; USFWS 2009) were recorded during surveys.

Signal mirrors were used to search for live tortoises within deep tortoise burrows and shelters. Live tortoises were photographed and aged. Adult tortoises were measured and sexed. Midline carapace length for immature and juvenile live tortoises were estimated using photogrammetric analysis of individual tortoises photographed with a 15 cm ruler placed next to the shell.

Location data for dead and live tortoises and burrows were recorded using handheld Garmin GPS-map 76CS GPS units (< 10 m accuracy typical; Garmin International, Inc., Olathe, Kansas—Wing 2008).

Statistical Analyses – Summary statistics are reported means ($\pm 1 SD$).

RESULTS

Area Surveyed – A total of 618 acres (2.5 km²) was surveyed from July 22, 2020 to September 08, 2020, which constitutes 59% of the critical habitat ($n = 1,001$ acres) and 44% of the public land ($n = 1,414$ acres) within the Cottonwood Trail Fire burn area ($n = 1,631$ acres; Figure 1).

Tortoise Remains Found – A total of 25 tortoise remains were observed from July 31, 2020 to September 05, 2020, during surveys (Table 1; Figure 2). Tortoise remains ($n = 25$) included eight Adult (mean CL = 237.5 ± 21.0 mm; range 206-278), 14 Immature (mean CL = 119.1 ± 17.3 mm; range 98-151), and three Juvenile (mean CL = 62 ± 2.8 mm; range 60-66; Table 1). Sex of all tortoise remains ($n = 25$) was three males, five females, and 17 unknown. Sex could not be accurately determined for shell remains < 180 mm and for heavily burned remains. Of the total tortoise remains ($n = 25$), 14 remains were directly attributed to fire (Table 1; Figure 2), including five Adult (mean CL = 236.6 ± 26.1 mm; range 206-278), seven Immature (mean CL = 119.3 ± 17.3 mm; range 101-151), and two Juvenile (mean CL = 63 ± 3 mm; range 60-66; Table 1). Sex of fire attributed remains ($n = 14$) was two males, three females, and nine unknown. Tortoise remains were found under burned bushes, by burrow entrances, in open areas, and on rocky hillsides.

Cottonwood Trail Fire

St. George Field Office 9/10/2020

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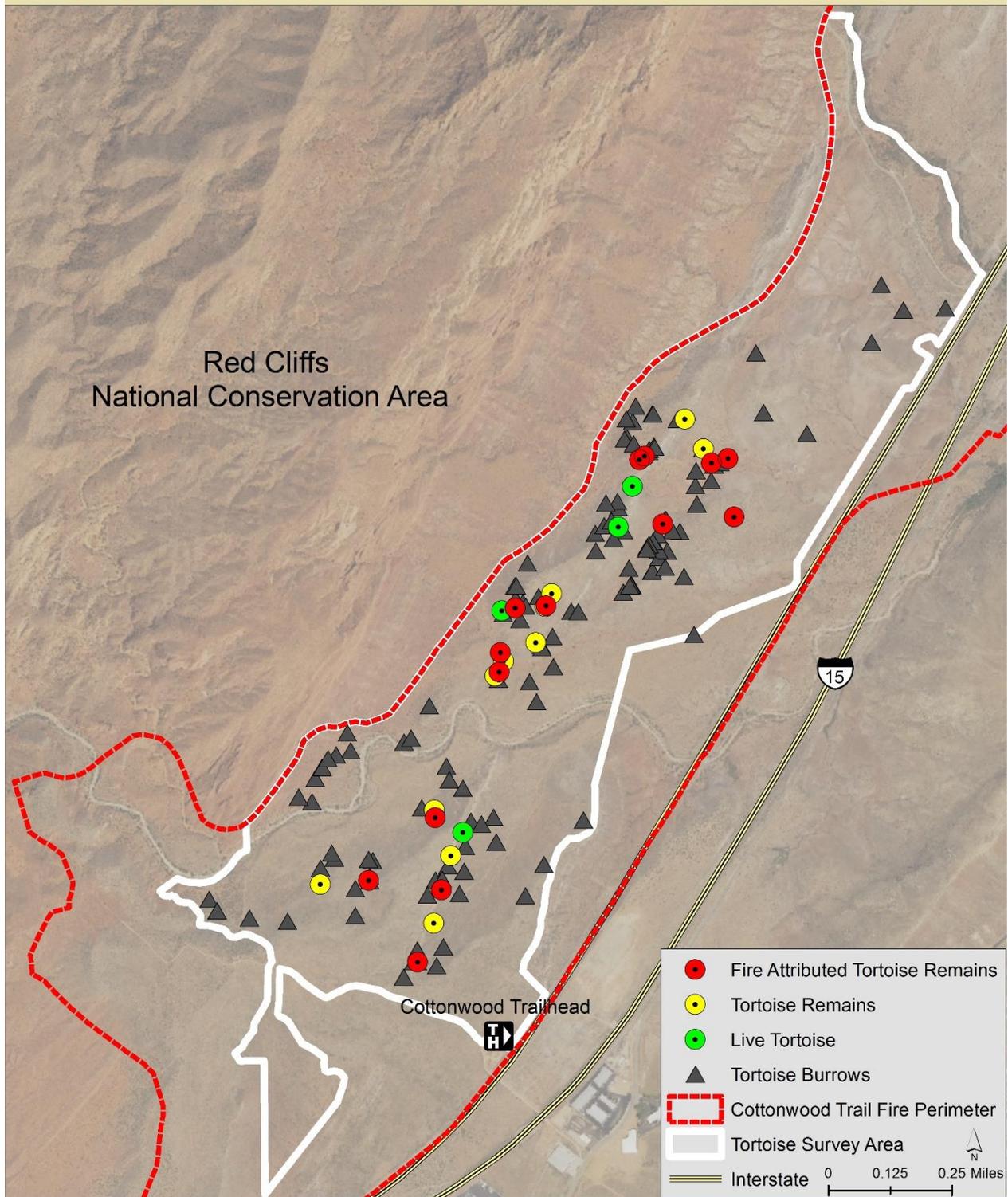


Figure 2. Map of tortoise remains, burrows, and live tortoises in survey area.

Table 1. Tortoise remains ($n = 25$) found during the Cottonwood Trail Fire surveys including date, age class, sex, carapace length (mm), file number, cause of death, and time since death, July 31, 2020 to September 05, 2020. Dash represents no file number observed. The CL of fragmented shells were estimated using regressions based on scute size (Berry and Woodman 1984).

Date	Age Class	Sex	CL	File Number	Cause of Death	Time Since Death
7/31/2020	Immature	U	103	-	Fire	< 1 yr
7/31/2020	Juvenile	U	60	-	Fire	< 1 yr
8/3/2020	Juvenile	U	66	-	Fire	< 1 yr
8/3/2020	Adult	F	246	-	Unknown	1-2 yrs
8/3/2020	Adult	M	253	-	Fire	< 1 yr
8/3/2020	Immature	U	105*	-	Unknown	1-2 yrs
8/4/2020	Juvenile	U	60	-	Unknown	< 1 yr
8/6/2020	Immature	U	151	-	Fire	< 1 yr
8/11/2020	Adult	M	278	-	Fire	< 1 yr
8/23/2020	Adult	F	232*	-	Unknown	2-4 yrs
8/23/2020	Immature	U	107*	-	Fire	< 1 yr
8/23/2020	Immature	U	114*	-	Unknown	2-4 yrs
8/26/2020	Immature	U	124	-	Fire	< 1 yr
8/26/2020	Adult	M	239	-	Unknown	2-4 yrs
8/29/2020	Adult	F	206	-	Fire	< 1 yr
8/29/2020	Immature	U	136*	-	Fire	< 1 yr
8/30/2020	Immature	U	118	-	Unknown	1-2 yrs
8/30/2020	Immature	U	101	-	Fire	< 1 yr
9/1/2020	Immature	U	145*	-	Unknown	1-2 yrs
9/1/2020	Immature	U	98*	-	Unknown	1-2 yrs
9/2/2020	Adult	F	231	-	Fire	< 1 yr
9/2/2020	Immature	U	144*	-	Unknown	2-4 yrs
9/5/2020	Immature	U	113	-	Fire	< 1 yr
9/5/2020	Immature	U	108	-	Unknown	1-2 yrs
9/5/2020	Adult	F	215	__45**	Fire	< 1 yr

*CL estimated using regression formula.

**Incomplete file number due to rear marginal scavenger chew marks.

Tortoise Burrows Found – A total of 133 active or good condition tortoise burrows (USFWS Condition Class 1 and 2) were recorded during surveys (Figure 2).

Live Tortoises – A total of four live tortoises were observed from July 31, 2020 to September 05, 2020, during surveys (Figure 2). Live tortoises processed included two Adult (mean CL = 268.5 ± 15.5 mm; range 253-284). Carapace length was estimated for one Immature (CL = 118 mm) and one Juvenile (CL = 76 mm) live tortoise. Sex of the two adult tortoises was one male and one female and sex could not be determined for the immature and juvenile tortoises. No live tortoises were found in burrows.

Fire-Injured Live Tortoise – On August 05, 2020, an adult female desert tortoise (CL = 253 mm) was located with moderate burn injuries on its front legs, face, and shell. The tortoise was in stable condition and was left at a burrow site. The NCA Biologist and/or Resource Associates began monitoring the condition of this tortoise on a daily basis. On August 15, 2020, the tortoise’s burned leg tissue was observed to be starting to slough and within a week, the tortoise’s condition had noticeably worsened. After coordination with the UDWR Biologist and consultation with the USFWS, the decision was made that the NCA Biologist remove this injured tortoise from the wild for medical treatment. It is currently under the care of UDWR and, when deemed fit to be released, will be relocated to unburned habitat near its burrow site.

DISCUSSION

The Cottonwood Trail Fire resulted in the direct mortality of a significant number of tortoises including adults and immatures and juveniles. Tortoise deaths were attributed to direct impacts including incineration and injuries from exposure to high temperatures (Esque et al. 2003; Huff and Kapler Smith 2000; Lyon et al. 2000). Losses of individuals in long-lived species with low reproductive capacity, such as tortoises, lead to population-level effects (Esque 2003; Hailey 2000). For example, in the summer of 2005, approximately 14,634 acres burned within the Red Cliffs NCA, of which approximately 7,885 acres were in tortoise habitat (McLuckie et al. 2007a). McLuckie et al. (2007a) estimated that 15% (12-18%) of adult tortoises within the Red Cliffs NCA died due to the 2005 fires. Subsequent biannual tortoise population monitoring by UDWR between 2006 and 2019 indicates the tortoise population has never recovered to pre-fire levels (McLuckie et al. 2007b; McLuckie et al. 2020). The approximately 1,631-acre Cottonwood Trail Fire and 11,995-acre Turkey Farm Fire that burned during the summer of 2020, largely within the footprint of the 2005 Red Cliffs NCA fires (McLuckie et al. 2007a), will likely have significant population-level effects on tortoises within their respective burn areas.

Direct wildlife mortality in wildland fires is common, but highly variable (Esque et al. 2003; Huff and Kapler Smith 2000; Lyon et al. 2000). Wildfires in tortoise habitat, depending upon the time of year, time of day, population density and weather conditions can have extremely variable impacts on tortoise populations (McLuckie et al. 2007a). Although desert tortoises spend a majority of their lives underground (Nagy and Medica 1986), during peak activity periods in the spring (May to June) and fall (August to September) they are often active and above ground (McLuckie et al. 2007a; USFWS 1990). During the Cottonwood Trail Fire, tortoises were likely active and above ground based on fire-killed tortoise remains observed in open areas away from burrow sites.

Topography and micro sites that trap animals likely influence survival rates (Esque 2003; Whelan 1995). Within the Cottonwood Trail Fire burn area, the majority of direct tortoise mortality occurred in small washes and open areas containing a high density of nonnative cheatgrass (*Bromus tectorum*) and red brome (*Bromus rubens*). Fire-killed tortoises observed in front of burrows within small brome-

lined washes and burrows adjacent to mature burned creosote bush (*Larrea tridentata*) likely exited their burrows due to high temperatures and subsequently died from fire-caused injuries.

Juvenile and immature tortoise mortality is believed to have been underestimated as their shells were more likely to suffer greater damage in the fire, deteriorate rapidly (Turner and Berry 1984), or be scavenged by animals (Esque et al. 2003; McLuckie et al. 2007a). For example: (1) areas of the Cottonwood Trail Fire burned extremely hot and the fire may have completely incinerated juvenile and immature tortoise remains; (2) fire-killed juvenile and immature tortoise shells showed signs of scavenging; and (3) the remains of a fire-killed juvenile tortoise discovered on July 31, 2020, was no longer present at the mortality site on September 04, 2020, likely due to scavenging. Some moribund tortoises with injuries may have retreated and died in deep soil burrows or caves and were undetected during surveys (Esque 2003; McLuckie et al. 2007a). Of the 133 active or good condition tortoise burrows documented in the burn area, many were deep burrows which precluded our ability to detect tortoise occupancy. The observation of a moderately fire-injured adult tortoise within the burn area suggests other tortoises may have been severely injured by fire and died undetected in burrows. Therefore, it is likely that direct mortality was underestimated.

The relatively large number of tortoise remains observed within the 618-acre Cottonwood Trail Fire survey area is due, in part, to initiating mortality surveys immediately (1-45 days) post fire, use of 10-m wide belt transect survey techniques to provide 100% coverage, and use of experienced tortoise observers. Surveys not conducted immediately after a fire and use of inexperienced observers might severely underrepresent direct tortoise mortality.

The goal of this survey effort was to assess direct tortoise mortality and injury. However, indirect effects of fire can be significant and include habitat changes, such as altered nutrient availability and quality, loss of cover from predators, loss of thermal refugia, and faunal community shifts or changes in behavior (Esque et al. 2003; McLuckie et al. 2007a). Tortoise populations within the Cottonwood Trail Fire burn area will continue to be affected by the lack of quality forage (Brooks and Esque 2002) and shelter sites and other indirect impacts from the fire. Monitoring is required to quantify the long-term tortoise population impacts from the Cottonwood Trail Fire.

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