

Postfire breeding behavior in Couch's spadefoot toad (*Scaphiopus couchii*) along the San Pedro River, Arizona

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ABSTRACT.—Fire is an important ecosystem process that can impact local amphibian communities and breeding behaviors. Riparian gallery forests of the American Southwest are an important habitat for amphibians that breed in river channels, wetlands, and pools within the floodplain. High-intensity fires are rare in these riparian forests, and there is no information on how amphibians respond to fire in this system. We documented the presence and reproductive attempts of Couch's spadefoot (*Scaphiopus couchii*) in the San Pedro River following a high-intensity wildfire in riparian gallery forest. These observations are the first recorded breeding events of Couch's spadefoot in recently burned habitat and one of the first documented breeding events of this species in a perennial river. Our findings suggest that Couch's spadefoot can breed in burned habitat and may also suggest that the species selects perennial streams for breeding following wildfire.

RESUMEN.—Los incendios son procesos importantes para los ecosistemas, que pueden afectar las comunidades locales de anfibios y sus conductas reproductivas. Los bosques de galería ribereños del sudoeste de los Estados Unidos son un hábitat importante para los anfibios que se reproducen en canales de ríos, humedales y estanques dentro de llanuras aluviales. Aunque, los incendios intensos son raros en estos bosques ribereños, poco se sabe acerca de la respuesta de las comunidades de anfibios a incendios en sistemas ribereños. En el presente estudio, documentamos la presencia y los intentos reproductivos del sapo cavador (*Scaphiopus couchii*) en el río San Pedro, posterior a un gran incendio forestal ocurrido en el bosque de galería ribereño. Estas observaciones, son los primeros registros de eventos reproductivos del sapo cavador, en un hábitat recientemente incendiado y uno de los primeros casos de reproducción de esta especie en un río perenne. Nuestros resultados, indican que el sapo cavador puede reproducirse en hábitats quemados y sugieren que esta especie puede elegir arroyos perennes para reproducirse después de un incendio forestal.

Wildfire is a major ecological process that influences succession, regulates habitat structure, and impacts local plant and animal diversity (Fontaine and Kennedy 2012). However, wildfire can pose a threat to local amphibian populations as fire intensity and frequency increases (Hossack and Pilliod 2011, Westgate et al. 2018). Amphibian responses to fire are dependent on their natural history and habitat requirements, and may be affected by intensity, frequency, and timing of a fire (Pilliod et al. 2003, Schurbon and Fauth 2003, Hossack and Corn 2007). Pond-breeding amphibians are considered to be fire adapted and may benefit from fire maintaining breeding habitat (Pilliod et al. 2003). For example, the year after a high-intensity fire burned numerous wetlands in Glacier National Park, the pond-breeding

anuran *Anaxyrus boreas* was found reproducing in 7 burned wetlands from which they had not bred in the 3 years prior (Hossack and Corn 2007). Despite the role of fire in western North American forests, little information exists on the short-term effects of fire for the majority of western amphibians (Pilliod et al. 2003, Bury 2004). Herein we report the first observations, to our knowledge, of postfire behavior and breeding habitat use of the frog *Scaphiopus couchii* following a high-intensity fire in riparian gallery forest along a perennial river in southeastern Arizona.

The lower San Pedro River, located in Pinal County, Arizona, USA (32.931478, -110.743143, elevation 611 m), is a deciduous riparian gallery forest typical in the American Southwest that has historically experienced low fire incidence

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(Busch 1995). Riparian forests in this region contain various pools and wetlands that provide important breeding habitat for amphibians (Bateman et al. 2008) and are dominated by cottonwood (*Populus* spp.) and willow (*Salix* spp.), but nonnative saltcedar (*Tamarix* spp.) is also present. Historically, fire along the San Pedro River was not considered part of the disturbance regime because of the dominance of native non-fire-resistant tree species and the high water content of riparian forests (Smith and Finch 2017). However, the expansion of the fire-tolerant saltcedar along the floodplain (Drus 2013) increased fire frequency in this aridland riparian system (Busch and Smith 1995, Stromberg et al. 2009).

We monitored herpetofauna along the lower San Pedro River in the summer months from 2016 to 2018 in a study designed to compare herpetofaunal assemblages and habitat across riparian forests dominated by native and non-native vegetation (Bateman and Riddle 2020). On 7 July 2017, a human-caused fire known as the Roach Fire burned 136 ha (335 acres) of riparian gallery forest along the lower San Pedro River. On 18 July 2017, 11 d postburn, we were allowed access to the burned portions of our study site, and we conducted time-constrained visual encounter surveys in 150-m transects placed in unburned and burned areas (Fig. 1) that were roughly 250 m apart. From 16 July to 18 July 2017, 6.5 mm of precipitation was recorded in an on-site rain gauge. During the surveys, we observed calling by *S. couchii* in both burned and unburned areas and observed an amplexant pair in the heavily burned section of the gallery forest in the channel of the San Pedro river at 05:15 (Fig. 2); calling occurred in both burned and unburned areas until 07:15. We saw an additional 6 individuals in the burned location and 8 exhibiting breeding behaviors along the river channel. *Scaphiopus couchii* is fossorial much of the year and emerges after rainfall events to breed in temporary pools (Degenhardt et al. 1996). The source of the frogs in the recently burned forest and river channel is unknown, and they may have colonized the pool from the unburned area or survived the fire in underground burrows (Degenhardt et al. 1996, Westgate et al. 2012).

Fires that coincide with amphibian breeding events may cause direct mortality or delay breeding (Pilliod et al. 2003), but there are

exceptions. For instance, *Pseudacris crucifer* was found breeding 1 d after a burn at a pond surrounded by smoldering ash in a fire-prone Florida prairie (Vogl 1973), but the Florida prairie is a fire-adapted community, and contrasts greatly with our low-fire-regime gallery forest community. Congeners of *S. couchii* have been observed utilizing postburn habitat in fire-adapted systems of the southeastern United States, but to our knowledge, this is the first report of postfire breeding behavior and habitat use for *S. couchii* (e.g., Bury 2004). This observation is exceptional because it occurred within 11 d of a high-intensity wildfire in a non-fire-adapted southwestern riparian system, in a species not known to be adapted to fires. Greenberg and Tanner (2004) found that *Scaphiopus holbrookii* in Florida is highly adapted to the breeding conditions created by frequent fire events in the sandhill region which arrest forest succession; similarly, Brown et al. (2011) reported increased capture rates of juvenile *Scaphiopus hurterii* from 29 d to 35 d following one low-intensity and 2 high-intensity burns in loblolly pine (*Pinus taeda*) forests in Texas. *Scaphiopus hurterii* has also been found to exhibit an increase in movement rates 4 months after a wildfire in burned areas (Brown et al. 2014), and our observations of *S. couchii* suggest that it may also utilize burned riparian areas as breeding habitat. Additionally, this observation is exceptional because it may be the first documentation of *S. couchii* breeding in an active channel of a perennial stream or river. *Scaphiopus couchii*, which inhabits riparian areas, is not known to breed directly in river channels, instead preferring side-channels and temporary rain pools in the floodplain (Lazaroff et al. 2006).

The Roach Fire along the San Pedro River burned at such intensity that high levels of native riparian tree mortality were reported 9 months postburn along with dramatic changes in lizard abundance (Bateman and Riddle 2020); yet, within days of the burn, *S. couchii* was breeding in the wildfire footprint. Although eastern *Scaphiopus* congeners appear to be fire adapted, this first report of the postfire response in *S. couchii* provides evidence that *S. couchii* adults can tolerate aboveground fire disturbances. This information will be valuable for researchers seeking to predict how native wildlife will respond to increased prevalence

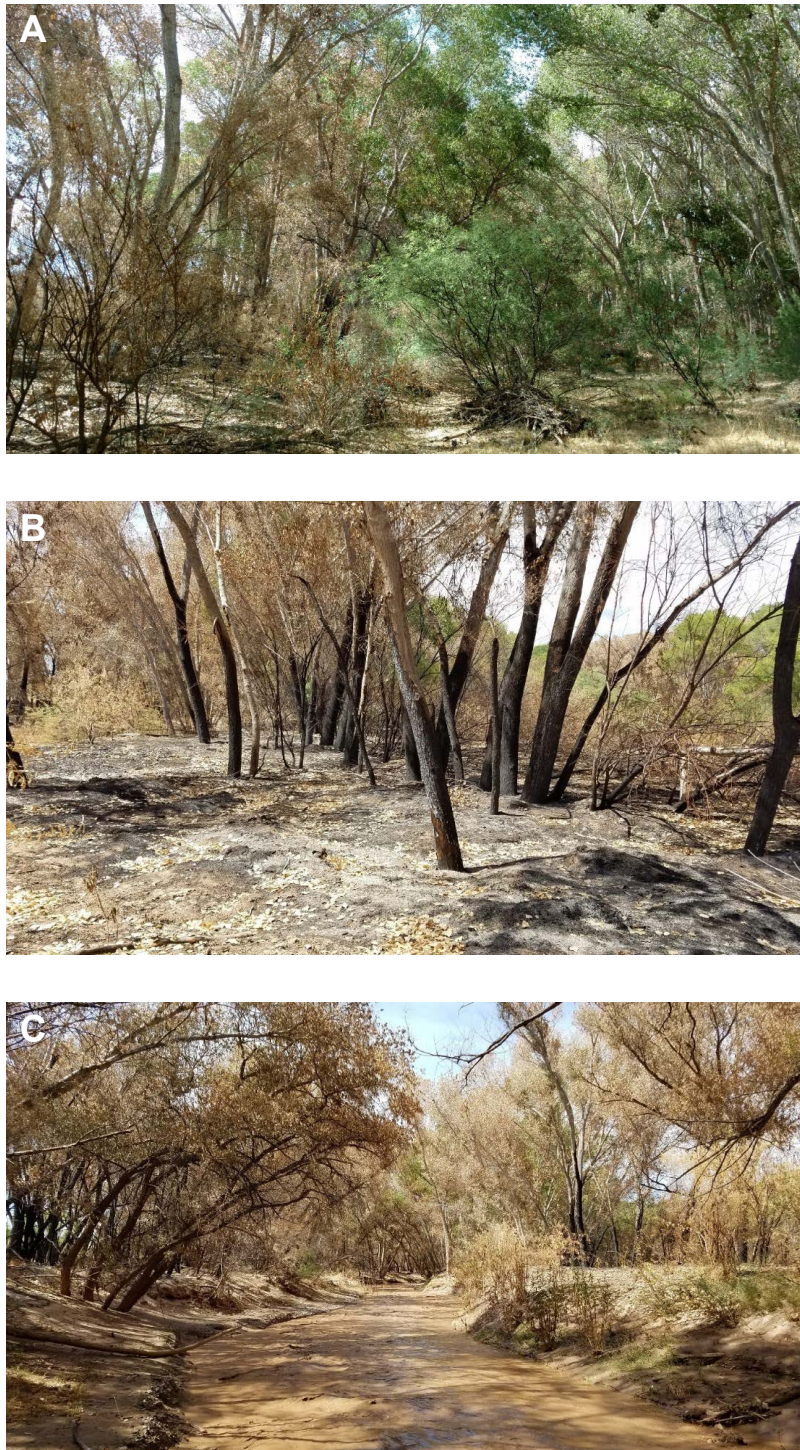


Fig. 1. Environs of the lower San Pedro River, Pinal Co., Arizona, 17 July 2017. **A**, Edge of burned area abutting unburned riparian gallery forest. **B**, Burned riparian gallery forest. **C**, Burned vegetation along the lower San Pedro River.



Fig. 2. *Scaphiopus couchii* in amplexus in the burned area along the bank of the lower San Pedro River, Pinal County, Arizona, 18 July 2017.

of fire in riparian ecosystems of arid southwestern North America.

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