

SOAPBERRY (*SAPINDUS* L.) IN ARIZONA

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ABSTRACT

Physical characteristics of western soapberry, *Sapindus saponaria* var. *drummondii*, are illustrated to facilitate their identification and conservation in Arizona. Larger thickets, composed of hundreds to thousands of tightly clustered trees, usually occur in riparian or riparian-adjacent areas, though soapberry trees and shrubs occur in a variety of habitats. We illustrate soapberry thickets using a combination of ground-based and aerial photography from three primary study sites in southern Arizona.

Soapberry trees and shrubs (*Sapindus* spp.) have a wide distribution (Figs. 1–2) and are important for indigenous peoples in the Americas, Pacific Islands, and elsewhere (Vestal & Schultes 1939; Carlson & Jones 1940; Whitehead & Flynn 2017; BRIT 2020; GBIF 2020). The widespread use and cultural importance of the genus *Sapindus* may be reflected in the variety of names applied to it, including but not limited to abolillo, amole, amolillo, att-dtok-ko-ai-od-la, boliche, cherioni, chirrión, guayul, jaboncillo, mata muchacho, palo blanco, soapnut, and wingleaf soapberry (SEINet 2020; BRIT 2020; GBIF 2020). The smooth black seeds of soapberry (Fig. 3) can be polished and used to make beads. The seeds also contain high concentrations of saponins, detergent-like chemicals used to make soap. Medical applications of the chemicals found in soapberry for a range of skin and other conditions have been the subject of several recent studies (Albiero et al 2002; Tsuzuki et al. 2007; García et al. 2012; Rodríguez-Hernandez et al 2016). In southeastern Arizona, the use of soapberry wood by native Americans for crafting arrows was described by European observers in the early twentieth century (Castetter & Underhill 1935). Soapberry has been utilized as a landscaping plant with notably few problems (Hodel 2012; Silva et al. 2018), though some issues with an introduced species of soapberry borer (*Agrilus prionurus*) have been reported in Texas (Billings et al. 2014).

Only *Sapindus saponaria* var. *drummondii* is known to occur Arizona, the northwest extent of the native range of *Sapindus* in the Americas (Figs. 1–2). The closely related and possibly intergrading taxon, *S. saponaria* var. *saponaria* reaches its northernmost extent in Sonora (Fig. 1). However, there are different taxonomic interpretations of the variation within the American Southwest (Kearney & Peebles 1960; Shreve & Wiggins 1964; Felger et al. 2001; Felger & Rutman 2016).

Leaves of soapberry (Figs. 3–4) might be confused with other native and naturalized trees and shrubs with compound leaves, including chinaberry (*Melia azedarach*), smooth sumac (*Rhus glabra*), tree-of-heaven (*Ailanthus altissima*), walnut (*Juglans major*), and ash (*Fraxinus* spp.). The fruits of soapberry are particularly similar in size and color to the fruits of chinaberry, a fairly widespread, non-native tree in Arizona that is both naturalized and widely cultivated. Both *Melia* (Meliaceae) and *Sapindus* (Sapindaceae) belong to the order Sapindales and have compound leaves and paniced

inflorescences. Confusingly, both *Melia* and *Sapindus* have been called by the common name “chinaberry.” A helpful point of distinction between the two species is that the tissue of soapberry fruits becomes translucent with age (Fig. 3), while the mature fruits of chinaberry remain opaque.

Soapberry thickets are ecologically important in Arizona, as they provide habitat for a variety of plants and animals. In particular, *Sapindus saponaria* var. *drummondii* is the only known host species for the soapberry hairstreak butterfly, *Phaeostrymon alcestis*. This butterfly is the only member of its genus and is endemic to northern Mexico, Arizona, New Mexico, Texas, and Oklahoma, with a distribution closely overlapping that of its host plant (Fig. 5). The miniscule green caterpillars of the soapberry hairstreak and similar species are well camouflaged against the leaves of their host plant, with nearly identical bright green coloration and hair textures (Warren et al. 2012). Other members of the hairstreak subfamily (Theclinae) such as the commonly observed grey hairstreak, *Strymon melinus*, also utilize soapberry (Fig. 6).

METHODS

For this study, we relied heavily on data hosted by the Southwest Environmental Information Network (SEINet 2020) and the Global Biodiversity Information Facility (GBIF 2020). We referred to aerial imagery associated with known localities to try to identify larger soapberry thickets, especially from the National Agriculture Imagery Program (USDA 2020). We visited approximately 20 different soapberry populations across Arizona in Gila, Mohave, Pima, Pinal, Maricopa, Santa Cruz, and Yavapai counties (Fig. 2) from 2018 to 2020 to take photographs and make general observations. Photographs were taken with a variety of sensors and lenses (including iPhone, Nikon DSLR, and DJI Mavic). Photos were processed in Adobe Lightroom and Photoshop. Cartography layouts were created in QGIS. Drone flights were performed at study sites 1–3. Drone flights within Buenos Aires National Wildlife Refuge (study site 2) were performed under federal permit #2019-013.

We follow Shreve and Wiggins (1964) in recognizing two varieties of soapberry, *Sapindus saponaria* var. *saponaria* and *S. saponaria* var. *drummondii*, with the caveat that the latter “narrow-leaved form grades into the blunter larger leaflet of the typical plants” (Shreve & Wiggins 1964). Because of this apparent gradation and poorly understood taxonomic boundary, Salywon (1999) proposed discarding the varieties and recognizing one morphologically variable species, *Sapindus saponaria*, with a distribution stretching from Argentina to Kansas. In contrast, Felger et al. (2001) recognized both *S. saponaria* and *S. drummondii* at the rank of species, with distinctions noted in leaf morphology, habit, and cold tolerance, stating that “*S. saponaria* differs from *S. drummondii* in nearly always having a much larger well-developed trunk, having much larger and drought deciduous (rather than winter-deciduous) leaves with conspicuously winged leafstalks, slightly larger fruits, and being frost sensitive” (Felger et al. 2001). Felger et al. noted that the “northern range of *S. saponaria* is undoubtedly limited by winter cold; [since] in cultivation it perishes with moderate freezing.”

STUDY SITES AND ILLUSTRATIONS

Soapberry has been found between approximately 520 to 2400 meters elevation in Arizona, though the majority of known populations occur between 700 to 1800 meters (SEINet 2020; GBIF 2020). Soapberry habitat varies greatly but generally includes washes and rocky places. In some situations, soapberry thickets may indicate the presence of persistent groundwater (Whitehead & Flynn 2017).

Soapberry tends to occur in clusters spreading outward by rhizomes, evidenced by the commonly observed phenomenon of younger stems arising along the edges of these thickets.

Soapberry thickets that contain several thousand stems and form canopies that tend to be associated with mesquite bosques dominated by velvet mesquite (*Prosopis velutina*) and occasional netleaf hackberry (*Celtis reticulata*). Within these mesquite bosques, soapberry canopy is visually distinct with lighter green foliage.

Flowering in soapberry thickets typically occurs June through August. Fruits form in the fall and often persist through the winter. Older soapberry stems within a clonal thicket seem to produce the most flowers and fruits, while younger individuals often produce no flowers. This phenomenon is evident in Figures 17 and 18.

Western Yellow-billed Cuckoo, a U.S. federally protected species that is listed as threatened, has been observed utilizing habitats within and adjacent to study sites 1 and 2.

Study site 1

The 7B Ranch soapberry thicket study site (Figs. 2, 7–10) is situated along the floodplains of the Lower San Pedro River basin, near Mammoth, Arizona, at approximately 725 m elevation with a center point estimated at 32.70897° N, 110.62100° W. The 7B soapberry thicket itself occupies an area of approximately 1,000 m² and contains an estimated 5,200 live soapberry stems. The thicket occurs within an old-growth mesquite bosque. The oldest soapberry tree here is taller than other canopy dominant species (*Prosopis velutina* and *Celtis reticulata*) with an approximate height of 20 m and a DBH (diameter at breast height) of 47 cm. Figure 10 shows the trunk of this individual. Study site 1 may represent the largest soapberry thicket currently known to occur in Arizona, based on what has been recorded in herbarium records and other published records examined.

The understory and adjacent mesquite bosque at study site 1 support a relatively large population of Mexican passionflower (*Passiflora mexicana* Juss.), a species with a fairly limited range and number of known occurrences in the USA (southern Arizona only) and Mexico (SEINet 2020; GBIF 2020).

Study site 2

The Las Guijas soapberry thicket (Figs. 2, 11–14) is situated along Las Guijas Wash in the Beunos Aires National Wildlife Refuge near the USA–Mexico border at approximately 1,020 m elevation with a center point estimated at 31.68459° N, 111.40765° W. The Las Guijas thicket occupies an area of approximately 1,500 m² and contains an estimated 3,000 live soapberry stems. The Las Guijas thicket has an approximate maximum canopy height of 6 m, with larger individual trunks up to 20 cm DBH. The soapberry canopy appears slightly shorter than surrounding mesquite and netleaf hackberry canopies. Study site 2 may represent the second largest soapberry population cluster currently known to occur in Arizona, based on what has been recorded in available sources.

Study site 3

The Gardner Canyon soapberry thickets (Figs. 2, 4–5, 15–18) are dispersed in lower Gardner Canyon in the Coronado National Forest at approximately 1,400 m (4,870 ft) elevation with a center point estimated at 31.72697° N, 110.70113° W. This site was not fully surveyed but contains an estimated 2,000 live soapberry stems. Maximum canopy height is approximately 6 m. Common trees in the immediate vicinity include velvet mesquite (*Prosopis velutina*), desert willow (*Chilopsis linearis*), Arizona walnut (*Juglans major*), and Emory oak (*Quercus emoryi*).

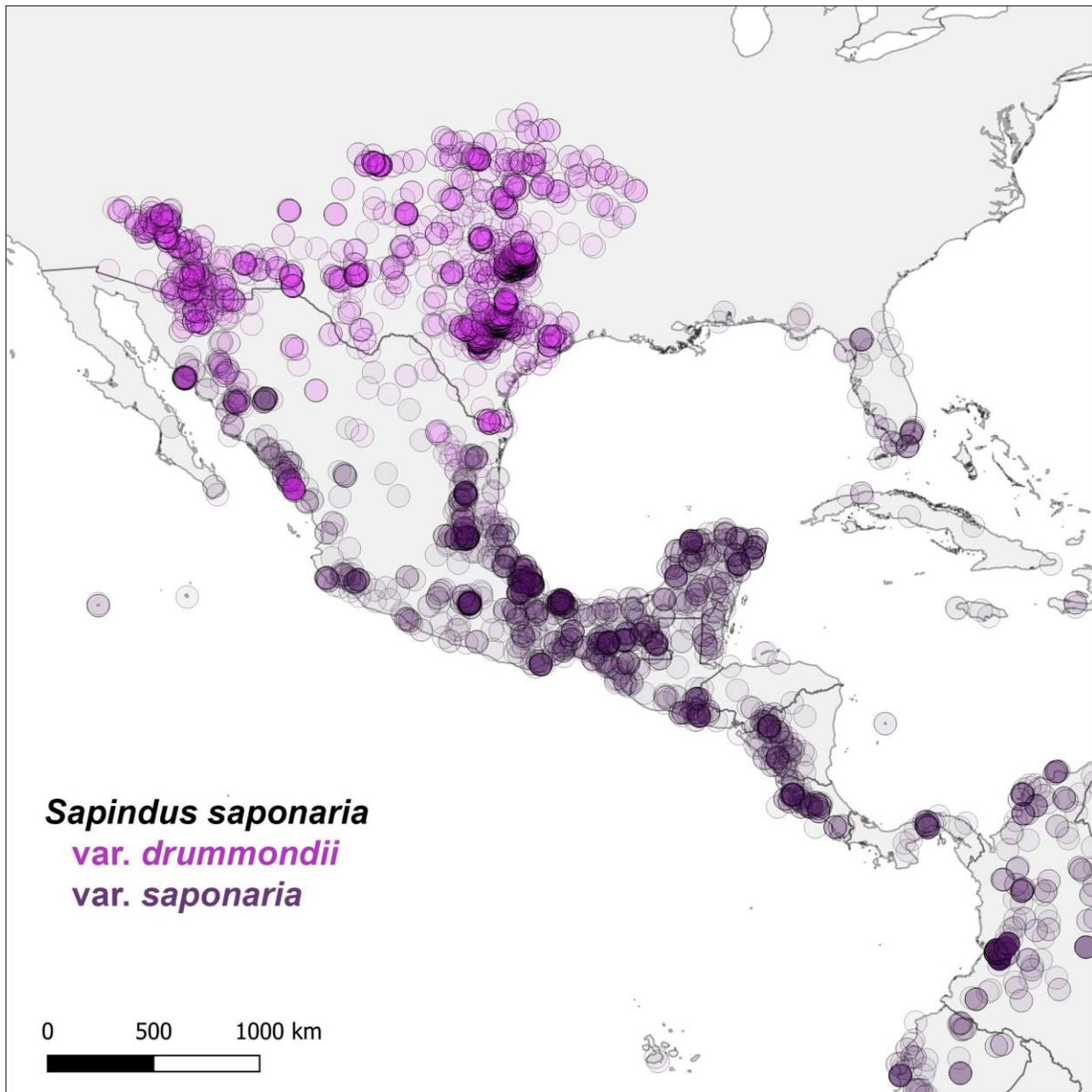


Figure 1. Approximate distribution of the genus *Sapindus* in North America and Central America indicated with semi-transparent circles using data from GBIF (2020) and SEINet (2020). The lighter, violet colored locations represent our interpretation of *Sapindus saponaria* var. *drummondii* distribution, while the darker, purple locations represent our interpretation of *S. saponaria* var. *saponaria* distribution. *Sapindus marginatus* (primarily of Florida) is mapped along with *S. saponaria* var. *saponaria* for the purpose of this visualization.

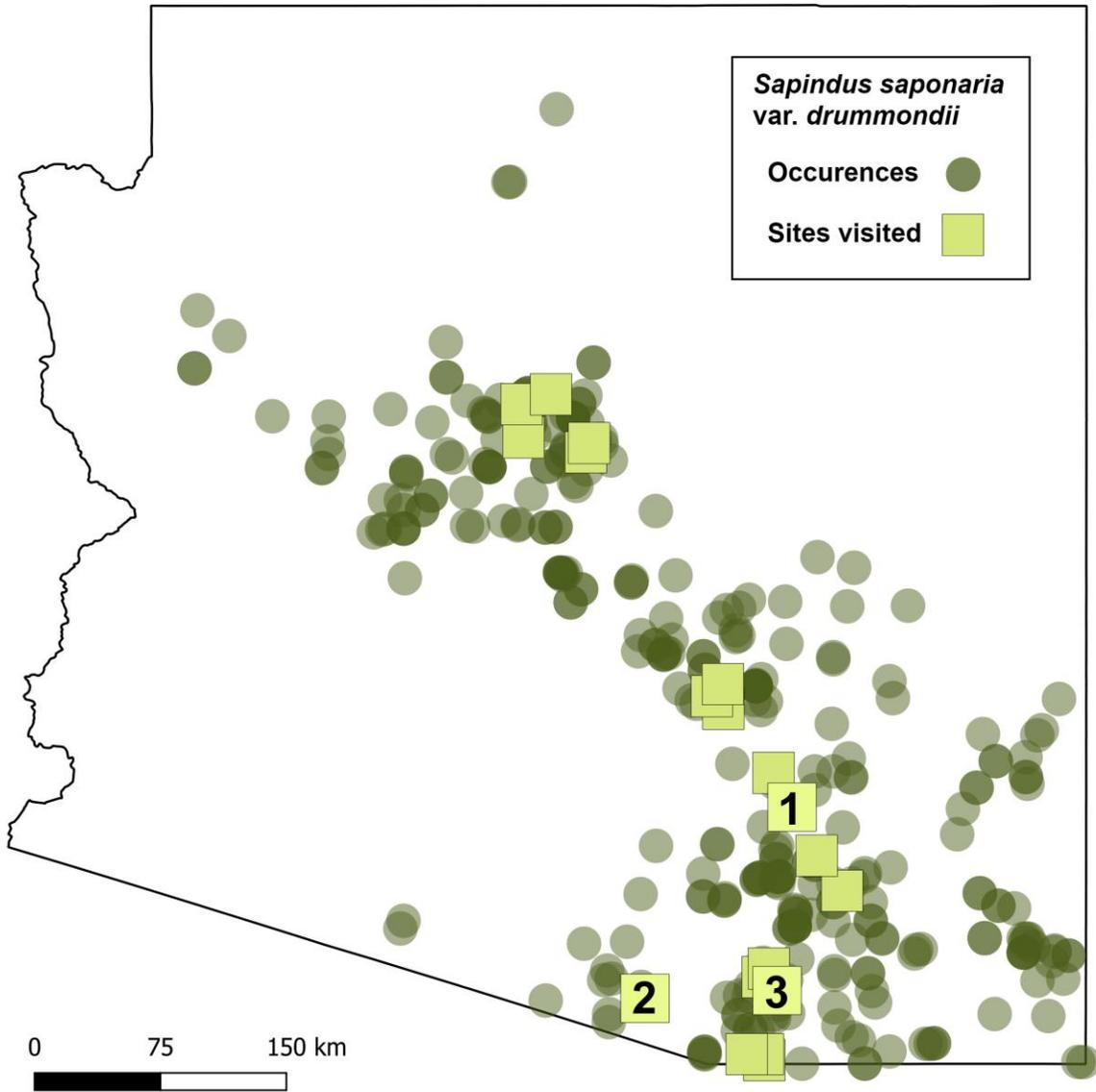


Figure 2. *Sapindus saponaria* var. *drummondii* occurrences in Arizona from the Southwest Environmental Information Network (SEINet 2020), indicated with green semi-transparent circles. All sites visited for this study are indicated with yellow-green squares. Primary study sites 1–3 are indicated.

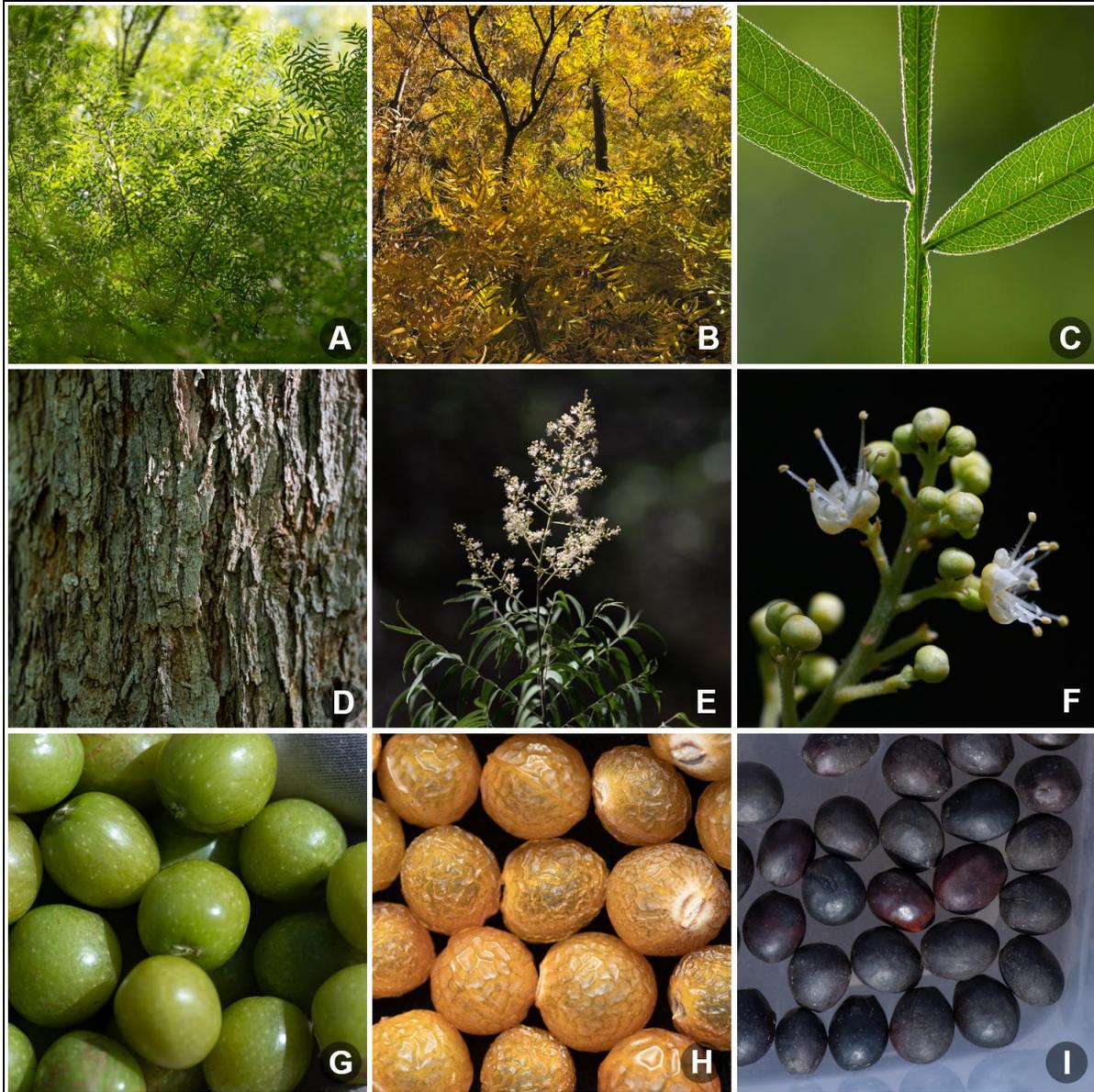


Figure 3. *Sapindus saponaria* var. *drummondii* in Arizona. **A.** Summer leaf colors, looking up into a thicket canopy. **B.** Typical fall leaf colors. **C.** Close-up of winged leaf rachis, present but not as pronounced as others in the genus (note: some leaves lack a winged rachis). **D.** Typical bark of older trees. **E.** Flowers and leaves. **F.** Close-up of flowers with petals measuring approximately 2 mm long. **G.** Opaque (immature) green fruits approximately 1–1.5 cm long. **H.** Translucent (mature) amber-colored fruits approximately 1 cm long. **I.** Reddish-black seeds approximately 0.75 cm long.



Figure 4. *Sapindus saponaria* var. *drummondii* in bloom, 25 June 2020, at study site 3, Coronado National Forest, Arizona.

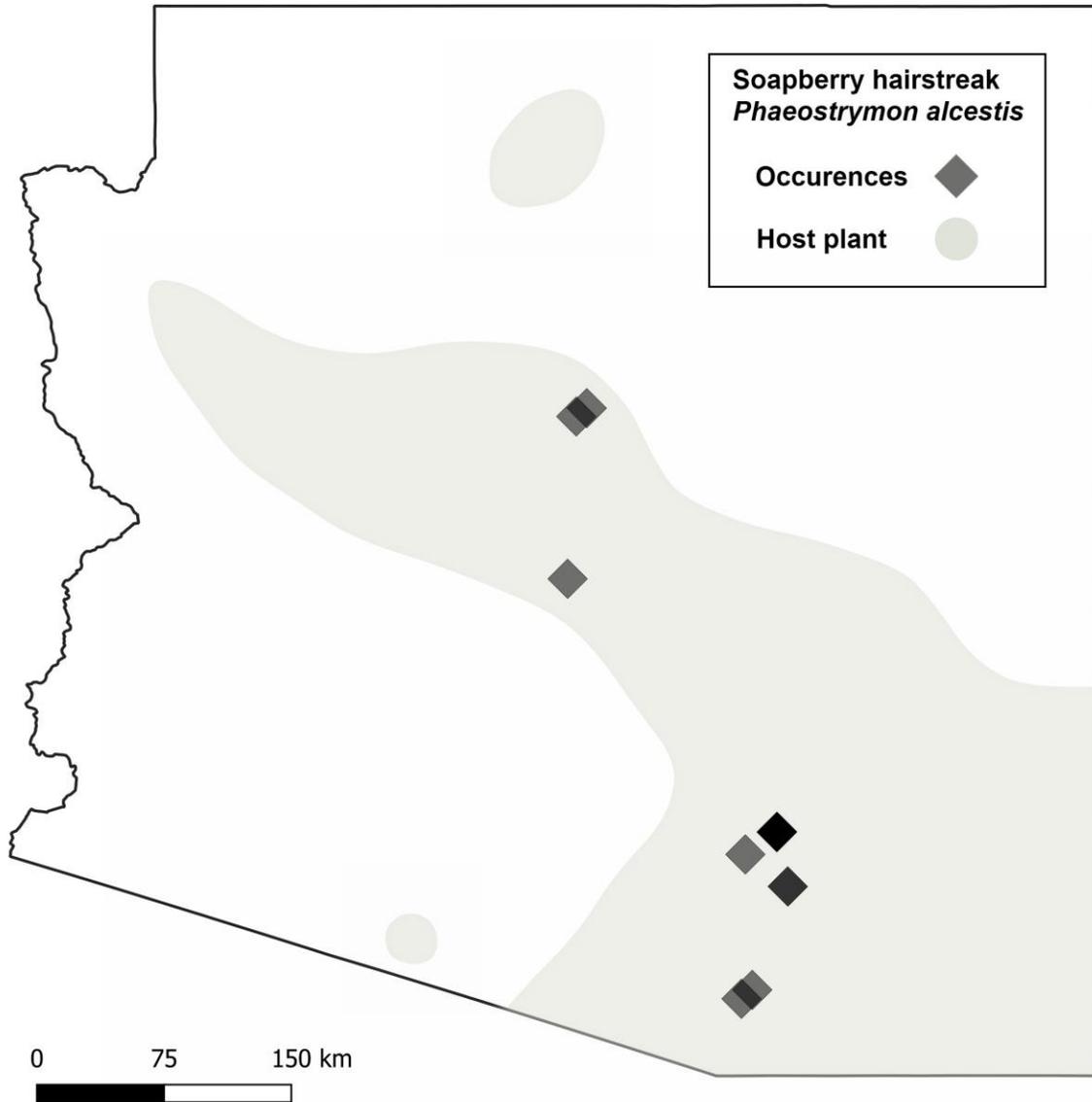


Figure 5. Occurrences of the soapberry hairstreak butterfly (*Phaeostrymon alcestis*) in Arizona (GBIF 2020) with approximate range of its obligate host plant, *Sapindus saponaria* var. *drummondii*.



Figure 6. Floral visitors on *Sapindus saponaria* var. *drummondii* in Arizona, 25 June 2020, at study site 3, Coronado National Forest, Arizona. Floral visitors visible in this photograph include several grey hairstreak butterflies (*Strymon melinus*) and a number of different beetle, bee, and wasp species.



Figure 7. *Sapindus saponaria* var. *drummondii* at study site 1, the 7B Ranch soapberry thicket in Arizona, with an arrow indicating the lighter green signature of the soapberry canopy, at approximately 32.70897° N, 110.62100° W. Imagery is from National Agriculture Imagery Program (NAIP), acquired 19 October 2019 (USDA 2020), displayed in natural color.



Figure 8. *Sapindus saponaria* var. *drummondii* at study site 1, the 7B Ranch Soapberry thicket in Arizona, 12 July 2019, from a drone. Arrows indicate the relatively lighter, yellow-green soapberry canopy appearance during summer months compared with the surrounding bluer mesquite canopy.



Figure 9. *Sapindus saponaria* var. *drummondii* at study site 1, the 7B Ranch soapberry thicket in Arizona, using a telephoto lens from the cliffs along South River Road, 10 May 2019. An arrow indicates the soapberry canopy, which is concentrated in the center of this image and rises above the surrounding canopy to a height of approximately 20 m. The surrounding canopy is composed primarily of velvet mesquite (*Prosopis velutina*), which dominates the foreground of the image.



Figure 10. *Sapindus saponaria* var. *drummondii* at study site 1, the 7B Ranch soapberry thicket in Arizona, 21 February 2019, illustrating the winter deciduous habit of soapberry thickets. All leaves and stems visible in this photograph are soapberry.



Figure 11. *Sapindus saponaria* var. *drummondii* at study site 2, the Las Guijas Wash Soapberry thicket in Buenos Aires National Wildlife Refuge, Arizona, at approximately 31.68459° N, 111.40765° W. Imagery is from National Agriculture Imagery Program (NAIP), acquired 19 October 2019 (USDA 2020), displayed in natural color. An arrow indicates the soapberry canopy, which is difficult to distinguish from the surrounding mesquite canopy when viewed at this scale.



Figure 12. *Sapindus saponaria* var. *drummondii* at study site 2, the Las Guijas Wash Soapberry thicket in Arizona, 13 July 2019, from a drone. Arrows indicate the yellow-green soapberry canopy signature in contrast with the surrounding blue-green mesquite canopy.



Figure 13. *Sapindus saponaria* var. *drummondii* at study site 2, the Las Guijas Wash soapberry thicket in Arizona, 13 July 2019, from a drone. Arrows indicate the soapberry thicket, which is a lighter, yellowish green compared to the surrounding canopy and is concentrated in the foreground, rising to a canopy height of approximately 6 m.



Figure 14. *Sapindus saponaria* var. *drummondii* at study site 2, the Las Guijas Wash soapberry thicket in Arizona, 31 January 2019. The image illustrates the winter deciduous habit of soapberry thickets. All stems and leaves visible in this photograph are soapberry.



Figure 15. *Sapindus saponaria* var. *drummondii* at study site 3, the Gardner Canyon soapberry thicket within the Coronado National Forest, Arizona, at approximately 31.72697° N, 110.70113° W. Imagery is from National Agriculture Imagery Program (NAIP), acquired 19 October 2019 (USDA 2020), displayed in natural color. Arrows indicate the soapberry canopy.



Figure 16. *Sapindus saponaria* var. *drummondii* at study site 3, the Gardner Canyon soapberry thicket in Arizona, from a drone, 25 June 2020. Arrows indicate the soapberry canopy.



Figure 17. *Sapindus saponaria* var. *drummondii* at study site 3, the Gardner Canyon soapberry thicket in Arizona, from a drone, 25 June 2020. Arrows indicate the soapberry canopy. Flowering is mostly restricted to older individuals within the thickets.



Figure 18. *Sapindus saponaria* var. *drummondii* at study site 3, the Gardner Canyon soapberry thicket, 25 June 2020.

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