Pre-dispersal Seed Predation in *Dalbergia stevensonii*

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Summary

Ya'axche has documented rosewood seed predation by an unidentified weevil species in its reserves since 2013. However, in 2016-2017, the extent of weevil damage to seeds collected across the Maya Golden Landscape was greater than 85%, severe enough to limit the viability of seeds collected for nursery propagation. This phenomenon is being explored further to better understand the geographical distribution, species life history and life cycle, and extent of damage in order to determine the threat level to rosewood and whether actions need to be taken to assist with regeneration.

Apionid Weevil

Taxonomy

ORDER: Coleoptera
SUPERFAMILY: Curculionoidea
FAMILY: Brentidae
SUBFAMILY: Apioninae*

Photo 1. Weevils are approximately 4 mm. in size, with compact, pear-shaped, and entirely black bodies and legs. Elytra have striate-punctate patterning.

This weevil has been preliminarily identified to subfamily (Brentidae: Apioninae) using keys developed for Mexico and South America (Marvaldi & Lanteri, 2005; Marrone, 2000). Weevils from this subfamily are characteristically small and pear-shaped (see **Photo 1**). Larvae develop inside stems or roots, seeds, or leaves, sometimes forming galls within those structures.

This subfamily contains 15 tribes worldwide, with 3 tribes and approximately 300 species described in North and Central America (Kissinger 1968). Twelve species have been documented in Belize as of 1982 (O'Brien & Wibmer), though given the high diversity of the subfamily and difficulty documenting the tiny insects, this is likely not an exhaustive list. Of the 12 documented species, one introduced species, known as the sweetpotato weevil, belongs to the genus Cylas and feeds on plants in the family Convolvulaceae. The remaining 11 documented species belong to the large genus Apion. Members of this genus are mostly seed predators and live mono- or oligophagously on plants of the same genus within the family Fabaceae (Cane et al. 2013). Due to its morphology and behaviour, it is likely that this weevil is an Apion species, though expert assistance is needed to confirm this.

Host Associations

There is precedence for this sort of relationship between weevils and *Dalbergia* species. Insects from the family Brentidae have been noted as important pests of *Dalbergia tucurensis*

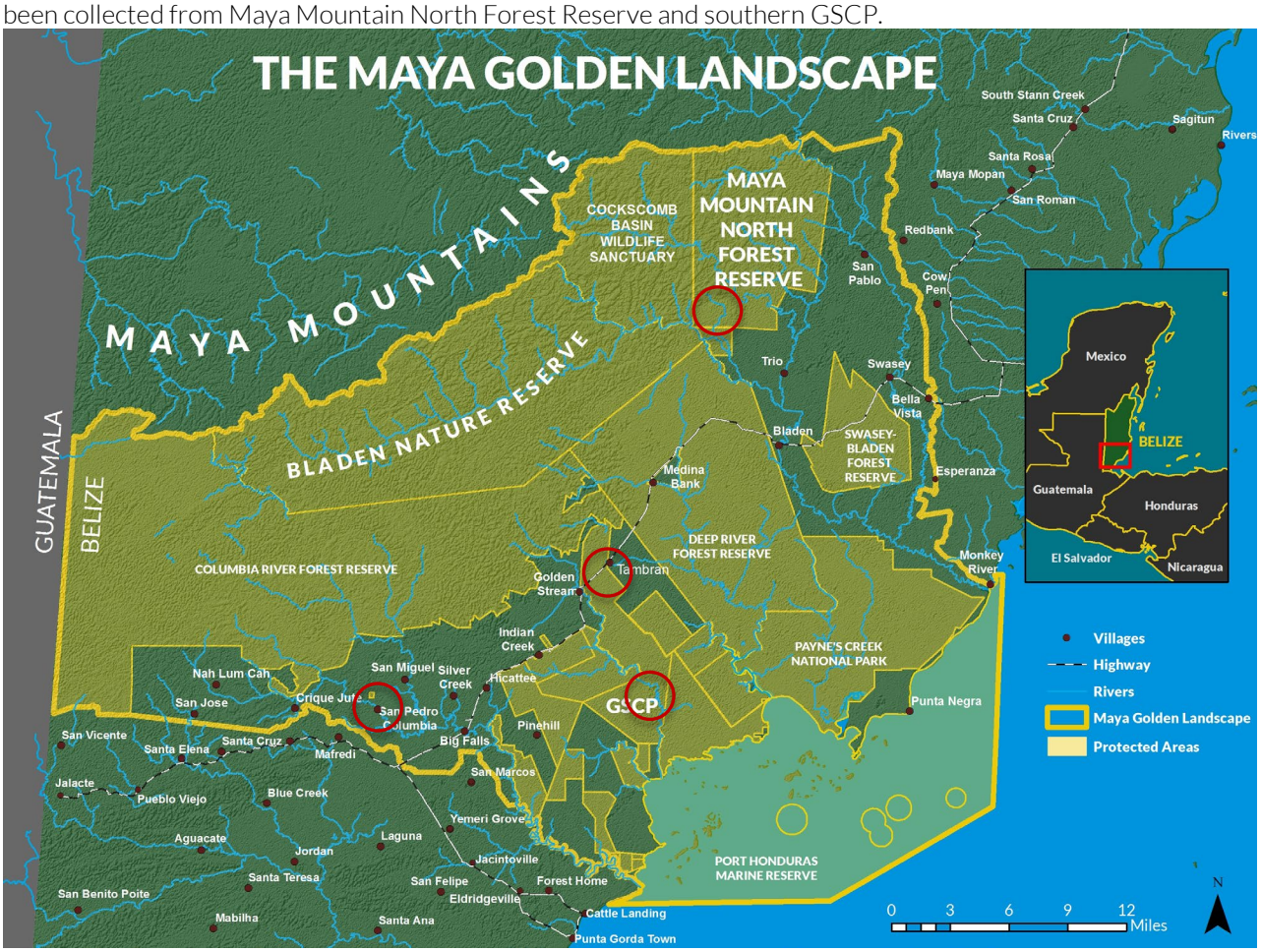
*Given that the superfamily Curculionoidea is one of the largest and most diverse groups in the order Coleoptera, the higher levels of classification are continuously and currently in flux. According to Marrone, some authors recognize Apioninae as the distinct family Apionidae.

seeds in Honduras (Knoblauch 2001), but the extent of seed predation was not identified. This weevil species has so far only been observed on *Dalbergia stevensonii*. It is not yet known if it predates other *Dalbergia* species. Given that *D. stevensonii* has a limited range and Apion weevils have close associations with specific host plants (Winter et al. 2017), it is likely that this weevil is native to the region and not an introduced species. However, it is unclear why the weevil infestation has become more severe in the last few years.

Distribution

This particular species has been recovered from fruits of rosewood populations in the southern regions of Golden Stream Corridor Preserve and southwestern Maya Mountain North Forest Reserve (**Figure 1**). It appears to be common throughout the Maya Golden Landscape, as multiple farmers in the region have described damage to rosewood seeds caused by tiny beetles. The weevil has not been documented in other rosewood populations in Belize to our knowledge, but the limits of its range should be explored further.

Figure 1. Map of the Maya Golden Landscape. Red circles mark where the weevil has been observed. It has been collected from Maya Mountain North Forest Reserve and southern GSCP.



Life Cycle

In other weevil species from the subfamily Apioninae, adult females are documented to deposit eggs into the fruit of the immature pod of their host plant early during the fruiting season, while the plant is still in flower (May, 1993). Larvae often feed on the developing seed, pupate when the pod is mature and dry, and emerge when the pod splits open.

This weevil has been observed in adult form emerging from both mature and immature (green) *Dalbergia stevensonii* fruits (**Photos 2 and 3**). The weevil's development and emergence does not appear to be influenced by the ripeness of the fruit. *D. stevensonii* produces one seed per fruit, and every infested fruit has contained one adult weevil. Seeds are predated from inside the fruit pod before the adult emerges, such that the adult leaves behind an empty pod. The exterior of the fruit is otherwise undamaged except for a small hole at the place of emergence (as seen in the cover photo). In one instance, a dead adult weevil was found inside an immature fruit where the developing seed was still intact (**Photo 3**), suggesting that seeds may be eaten late in the stages of the insects' development and not during the larval stage, though this may have been an extraordinary case. Immature forms have not yet been observed.

Photos 2 & 3. Adult weevils have been observed in mature (left) and immature (right) fruits. In all cases except the one captured in photo 3, the weevils had already consumed the seed while inside the fruit pods.

Extent of Impact

Dalbergia stevensonii produces the majority of its fruit between September and January. Ya'axché has documented its collection efforts during the past two years to track seed viability in its reserves. In December 2016, mature, fallen fruits were collected, but nearly all had weevil damage (**Table 1**). Of the remaining seeds, few were not viable for other reasons. An earlier collection effort was made in November the following year, in which immature fruits were harvested from the trees. Though seemingly intact when harvested, adult weevils began emerging from the pods within 24 hours, in the end destroying greater than 94% of the collected seeds.

Seed damage from seed feeding weevils can be extensive. For the herbaceous legume *Astragalus australis* in western North America, a single weevil species destroyed as much as

80% of the plant's seed production, making the weevil the most important factor limiting reproductive success of *A. australis* (Kaye 1999). The weevil's impact to the natural regeneration of *D. stevensonii*, which appears to abort a majority of its seeds, is especially concerning.

Table 1. Extent of weevil damage to seeds collected from two of Ya'axché's reserves in 2016-2017

Collection Date	Collection Method	No. Mother Trees	No. Seeds Collected	No. Seeds Infested	No. Visually Viable Seeds	Percent Infested
December 2, 2016	Fallen, ground	6	84	72	3	85.7
November 6, 2017	Pruned green	2	1875	1769	99	94.3

Conclusion

For several years, Ya'axché rangers have reported lack of seedlings surrounding mature *D. stevensonii* in GSCP. Pre-dispersal seed predation could be a contributing factor to this. More information is needed to understand the extent of predation and how it impacts the species in order to inform conservation and management efforts.

Recommendations are, first, that a formal study of the impact of seed predation on rosewood natural regeneration be done. Second, studies of the weevil should continue, especially regarding the following:

- further identification of the species, which can lead to insight on its life cycle and time to maturity
- observation of weevil behaviour and/or literature review to understand its ecological role and whether it has natural enemies
- observation of host associations for the weevil—does it predate only *D. stevensonii* or other rosewood?
- mapping the range extent for the species

Ya'axché will continue to monitor and document the presence and of the weevil in its reserves and will pursue vegetative propagation options to generate rosewood saplings.

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