

## Establishment of two nonnative parthenogenetic reptiles on Saba, Dutch Caribbean: *Gymnophthalmus underwoodi* and *Indotyphlops braminus*

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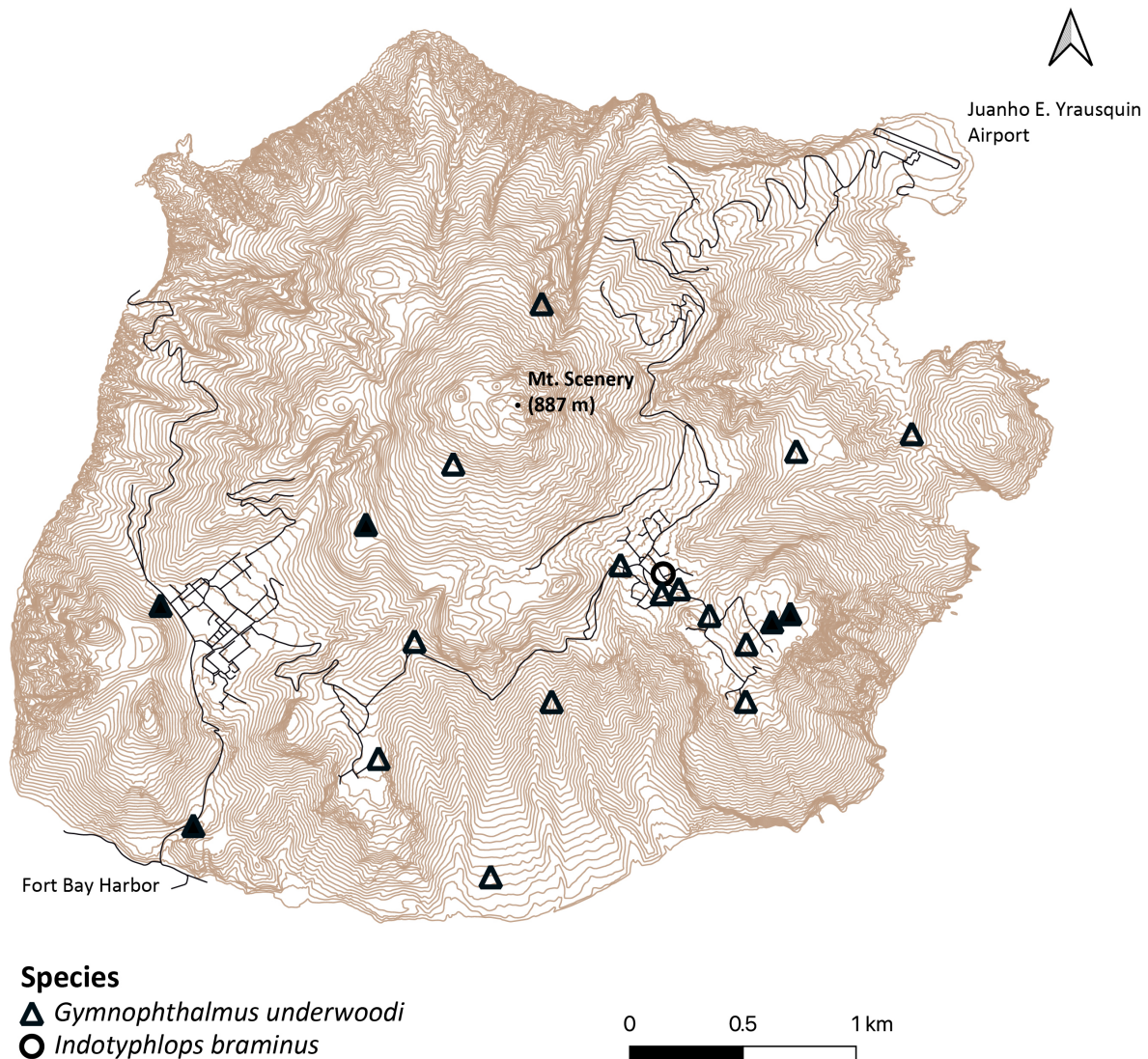
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The native herpetofauna of the Lesser Antillean island of Saba (13 km<sup>2</sup>; 17.63°N, -63.24°W) includes one snake, *Alsophis rufiventris*, and four species of lizards, *Anolis sabanus*, *Iguana melanoderma*, *Sphaerodactylus sabanus*, and *Thecadactylus rapicauda* (Powell *et al.* 2015). Here, we report the establishment of both *Gymnophthalmus underwoodi* Grant, 1958 and *Indotyphlops braminus* (Daudin, 1803) on the island.

We have observed and recorded smooth-scaled tegulets (*Gymnophthalmus underwoodi*) since May 2020 at numerous locations across Saba (Fig. 1). We captured five individuals with snout-vent lengths of 23.12–40.64 mm and preserved a single specimen (SVL = 40.64 mm) that will be cataloged in the collection of the Naturalis Biodiversity Center in Leiden, The Netherlands (Fig. 2). We encountered *G. underwoodi* in a wide range of habitats, including gardens, dry forest, manchineel (*Hippomane mancinella*) forests, and grass-overgrown rocky slopes. Sub-caudal scale (smooth) and head scalation morphology of the five captured individuals conformed to diagnostic characters of *G. underwoodi* (Cole *et al.* 1990, Williamson & Powell 2004, Recoder *et al.* 2018). We used non-native records from iNaturalist (van den Burg *et al.* 2020), as well as observations reported by on-island researchers to further infer the distribution of *G. underwoodi* (Fig. 1). Overall, *G. underwoodi* appears to be present across at least >50% of the island's surface, with the highest observed elevation at 711 m. Although the earliest verifiable observation dates from May 2020, given that *G. underwoodi* is known for rapid population growth (Daltry 2007), the island-wide distribution suggests an earlier arrival.

*Gymnophthalmus underwoodi* has a wide native distribution, occurring both on the South American continent and throughout the Lesser Antilles (Recoder *et al.* 2018); however, island populations in the northern Lesser Antilles are currently believed to have been introduced (Daltry 2007, Powell *et al.* 2011). This report adds Saba to the list of Lesser Antillean island on which the species has been recorded: Antigua, Barbados, Barbuda, Dominica, Grenada, Guadeloupe (Basse-Terre, Grande-Terre, La Desirade, Les Saintes, Marie-Galante), Martinique, Montserrat, Nevis, St. Barthélemy, St. Kitts, St. Martin, and St. Vincent and the Grenadines (Snyder *et al.* 2017). On Saba, direct competition with native herpetofauna is considered unlikely. Although *Sphaerodactylus sabanus* and *G. underwoodi* both occupy habitat with abundant leaf litter, highest-activity periods are non-overlapping, with that of *G. underwoodi* coinciding with the heat of the day and that of *S. sabanus* occurring from late afternoon to midnight (Powell *et al.* 2015).

A local resident observed the first Brahminy Blindsnake (*Indotyphlops braminus*) on Saba when she encountered several individuals in her garden in Windwardside from May to July 2021 (Fig. 1). These observations involved at least two different individuals based on size differences; one with a total length of ~6 cm (see <https://www.inaturalist.org/observations/54618365>), the other >10 cm (Fig. 3); neither was collected. Head scalation patterns are similar to those described in Hedges *et al.* (2014) and coloration and head shape were typical of the



**Figure 1.** Contour map of Saba, Dutch Caribbean, with localities where *Gymnophthalmus underwoodi* (triangles) and *Indotyphlops braminus* (circle) have been captured (filled) or observed (open). Contour lines at 10-meter intervals.

species (S. B. Hedges, pers. comm.). No other observations from Saba are presently known. Although *I. braminus* is believed to have recently arrived in the Caribbean region (Censky & Hodge 1997), its occurrence on Saba is not surprising given that this widely introduced species (Rato *et al.* 2015) is already known from a large number of Lesser Antillean islands: Anguilla, Barbados, Guadeloupe, La Désirade, Martinique, Montserrat, Petite St. Vincent, St. Barthélemy, St. Eustatius, St. Kitts, and St. Martin (Henderson & Breuil 2012, Lorvelec *et al.* 2016, Snyder *et al.* 2019).

Although currently no native scolecophidians have been documented for Saba (Powell *et al.* 2015), targeted fieldwork should be implemented now that *Indotyphlops braminus* has been recorded. If a native species is present, resource competition could occur given the similar feeding habits of blindsnakes (Webb *et al.* 2001). Additionally, *I. braminus* is believed to have greater reproductive potential than native Lesser Antillean scolecophidians (Snyder *et al.* 2019), which if present could threaten a local population of a native species. That native species can go unnoticed was confirmed by the recent discovery of *Antillotyphlops geomotus* on neighboring St. Eustatius (van Wagensveld *et al.* 2020).





**Figure 2.** *Gymnophthalmus underwoodi* specimen (SVL = 40.64 mm) collected on Saba, Dutch Caribbean. Photos by M.P. van den Burg.



**Figure 3.** Lateral view of the head of an *Indotyphlops braminus* observed on Saba, Dutch Caribbean. Photo by Debbie Verdult.

Both *Indotyphlops braminus* and *Gymnophthalmus underwoodi* are established on several other Lesser Antillean islands as well as in Florida (USA). Given that most Saban inter-island traffic of goods and people occurs with neighboring St. Martin, populations there are the most likely source of the Saban introductions. On neighboring St. Eustatius, also part of the Dutch Caribbean but with less frequent traffic connections with St. Martin, only *I. braminus* is present, although its presence has been inconsistently reported (Powell 2006, 2011, Henderson & Breuil 2012, Powell *et al.* 2015, van Wagensveld *et al.* 2020).

Overall, our report doubles the number of established nonnative amphibians and reptiles on Saba, adding *Indotyphlops braminus* and *Gymnophthalmus underwoodi* to *Eleutherodactylus johnstonei* and *Hemidactylus mabouia*. Nonnative species now comprise 40% of the total terrestrial herpetofauna.

Invasive alien species (IAS) are among the top drivers of worldwide biodiversity loss (Kaiser 1999, Butchart *et al.* 2010) and ecosystem change (IPBES 2019). The high threat that IAS pose within the Dutch Caribbean has been previously documented (Debrot *et al.* 2011, van der Burg *et al.* 2012, van Buurt and Debrot, 2011, 2012) and key elements toward implementation of a joint IAS strategy have been drafted (Smith *et al.* 2014). Since then, however, the need to address IAS has been highlighted as a major policy issue within two successive ministerial nature and environment policy plans (EZ 2013, LNV, I&W and BZK 2020) but has not yet been implemented. Our results serve to illustrate the continuing problem of preventing and controlling the spread of nonnative species and potential IAS, and emphasize the need for swift and decisive action to address this escalating threat to the unique and

vulnerable endemic biodiversity of the windward Dutch Caribbean (Bos *et al.* 2018).

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