

Establishment of the Smooth-scaled Tegulet (*Gymnophthalmus underwoodi*) and the Common House Gecko (*Hemidactylus frenatus*) on St. Eustatius

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Within the northern Lesser Antilles, the island of Saint Martin, including the Dutch part (St. Maarten, a constituent country of The Netherlands) and the French part (the Collectivity of Saint Martin), is considered the main hub for established non-native reptiles, currently numbering ten species (Table 1) (Dewynter *et al.* 2022; Thorpe 2022). The islands of Saba and St. Eustatius are special municipalities of The Netherlands and frequently trade with St. Maarten. During the last five years, several new non-native reptile species have been reported on Saba and St. Eustatius, which originate from the non-native populations already present on Saint Martin: the Green Iguana, *Iguana iguana* (van den Burg *et al.* 2018, 2022) on St. Eustatius, and the Brahminy Blindsnake, *Indotyphlops braminus* (van den Burg *et al.* 2021) and Smooth-scaled Tegulet, *Gymnophthalmus underwoodi* on Saba (van den Burg *et al.* 2021). It is believed that these newly established populations have been facilitated by poor biosecurity between the islands. Here, we describe the establishment of two species, *G. underwoodi* and the Common House Gecko, *Hemidactylus frenatus*, on St. Eustatius.

Gymnophthalmus underwoodi Grant, 1958 is a unisexual species occurring throughout South America, and on the southern islands of the Lesser Antilles (Recoder *et al.* 2018). Populations on northern Lesser Antillean islands are considered introduced (Daltry 2007). In recent years, the species has been reported as established on the islands of Saba and Montserrat (van den Burg *et al.* 2021); for an overview of its regional introduction history see Snyder *et al.* (2017). It is likely that the spread of *G. underwoodi* throughout the region is linked to parthenogenetic reproduction and the increase of regional transport (Tournadre 2014; Snyder *et al.* 2017).

On St. Eustatius, a single *G. underwoodi* was found during gardening work in the Fair Play area, in March 2020 (17.4967, -62.9748; Naturalis Biodiversity Center voucher RMNH.RENA.48801). Subsequently, multiple specimens were seen (but not captured) in the same area throughout 2020 and 2021. A follow-up assessment of the species' presence and distribution was opportunistically undertaken during iguana-focused surveys in July–November 2022. We recorded over 30 sightings of *G. underwoodi*, including two captures, across eight locations, in different habitat types, and at elevations of 40–250 m. (Fig. 1). Captured specimens included one adult with snout-vent length of 34.0 mm, and one juvenile with snout-vent length 19.5 mm (Fig. 2). Highest abundances were found north- and south-west of the Quill volcano (Fig. 1). *Gymnophthalmus underwoodi* was found in dry hills (Pisonia-Justicia) and mountains (Chionanthus-Nectandra, Pisonia-Eugenia, Capparis-Pisonia and Rauwolfia-Antigonon; de Freitas *et al.* 2014). The presence of a leafy litter layer was one overlapping prerequisite for the occurrence of *G. underwoodi* among all habitat types (Turk *et al.* 2010; Alfonso *et al.* 2012), with the exception of one area, which was mostly covered by grass, *Bothriochloa pertusa* (Fair Play).

Hemidactylus frenatus was first observed on St. Eustatius during targeted night surveys on 19 November 2022, undertaken due to its recent discovery on other islands within the Lesser Antilles (Brisbane *et al.* 2021,

Table 1. Reported presence of non-native reptiles on Saba, St. Eustatius, St. Maarten/Martin. Asterisks mark the records of this note.

Species	St. Maarten/Martin	St. Eustatius	Saba
<i>Anolis carolinensis</i>	2021	-	-
<i>Anolis cristatellus</i>	prior to 2020	-	-
<i>Anolis sagrei</i>	prior to 2010	-	-
<i>Iguana iguana</i>	prior to 2010	2018	2022
<i>Gymnophthalmus underwoodi</i>	prior to 2010	2022*	2021
<i>Hemidactylus mabouia</i>	prior to 2010	prior to 2010	prior to 2010
<i>Hemidactylus frenatus</i>	2021	2022*	-
<i>Lepidodactylus lugubris</i>	2021	-	-
<i>Indotyphlops braminus</i>	prior to 2010	prior to 2010	2021
<i>Trachemys scripta</i>	prior to 2010	-	-

Dewynter *et al.* 2022, Griffing *et al.* 2022, Thorpe 2022). Individuals were first observed around artificial lighting on the walls of a hardware store and imported construction material storage area, as well as among lights and walls around the harbor; species identity was confirmed after capture through assessment of the lamellae on the 4th digit (Krysko and Daniels 2005) (Fig. 3). Additional surveys on 20 and 21 November 2022 showed its presence at one additional site within the town of Oranjestad (adjacent to another hardware store), as well as on several buildings in the proximity of the harbor. Across all sites (Fig. 1), 15 specimens were recorded. At the harbor, we observed only *H. frenatus*, while at the hardware store *H. frenatus* (four individuals) and the Tropical House Gecko, *H. mabouia* (one individual), occurred sympatrically.

Data pertaining to the extent of initial occurrence have been used to infer the incursion pathways of non-native species (e.g., Brisbane *et al.* 2021). However, in addition to inter-island traffic (aircraft, ferry, and cargo ships) between St. Eustatius and St. Maarten, imports are also received from Florida, USA, which is also well known for being a regional hub for non-native species (Krysko *et al.* 2016, Thorpe 2022). For *G. underwoodi*, as it occurs at all connecting locations, including Saba (van Buel and Powell 2006; van den Burg *et al.* 2021), identifying the origin of the reported population on St. Eustatius is challenging. This is made equally challenging given the already widespread distribution of *G. underwoodi* on the island, which furthermore indicates that it has been present for some years as suggested from ad-hoc communication with residents. Indeed, rapid population growth of *G. underwoodi* is well known given that it breeds parthenogenetically (Daltry 2007).

Hemidactylus frenatus is also known to occur in Florida and St. Maarten/Martin. Its presence at the harbor and at island hardware stores (importing building materials, including sand, gravel, cinder blocks, and PVC pipes) on St. Eustatius, and its apparent absence in several other sampled locations, strongly suggests its incursion has been facilitated through the transport of goods by sea. It is likely the species arrived from one or both non-native hubs. We share the view that *H. frenatus* is probably already present on more Lesser Antillean islands but is yet to be reported since it is easily confused with the already established *H. mabouia* (Brisbane *et al.* 2021, Griffing *et al.* 2022); as also highlighted by its recent discovery on St. Barths (Questel *et al.* 2023).

For *G. underwoodi*, there is insufficient evidence to support claims of its ecological impact on flora and fau-

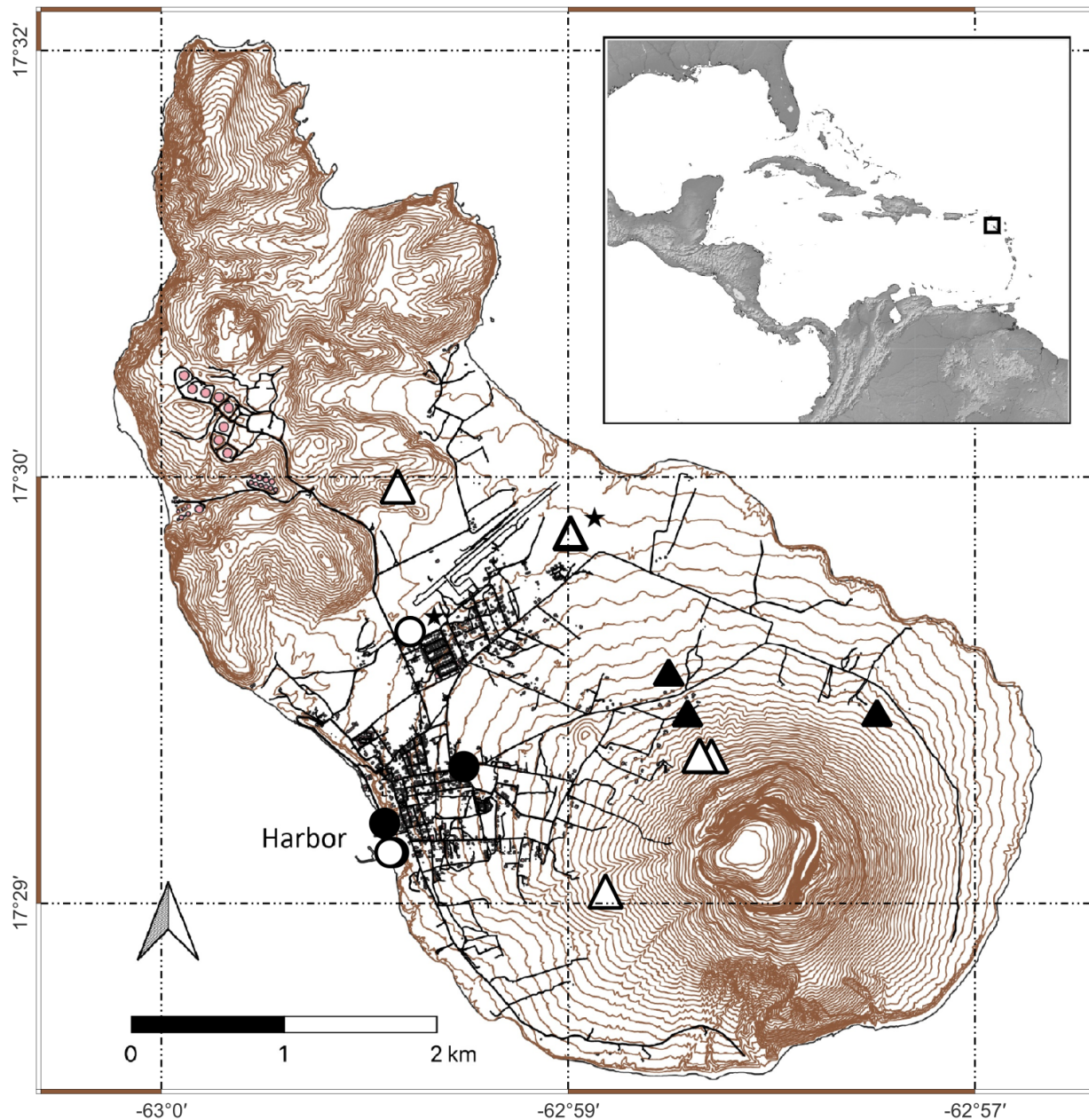


Figure 1. Distribution of *Gymnophthalmus underwoodi* (triangles) and *Hemidactylus frenatus* (circles) on St. Eustatius. Filled shapes indicate locations with 1 observed specimen, unfilled shapes indicate locations with >1 specimen. Asterisks mark the vouchers sent to Naturalis Biodiversity Center.

na native to St. Eustatius. The new arrival has a partial niche overlap with the Leeward Banded Geckolet (*Sphaerodactylus sputator*) and the Saint Kitts Bank Geckolet (*S. sabanus*) (Powell *et al.* 2015). However, *G. underwoodi* is diurnal with peak activity during the hottest part of the day, while both *Sphaerodactylus* species are active during the late afternoon and early evening (Powell *et al.* 2015; van den Burg *et al.* 2021), suggesting sufficient niche differentiation to limit competitive interactions. Likely predators of *G. underwoodi* include the Red-bellied Racer, *Alsophis rufiventris*, and the Red-faced Groundlizard, *Pholidoscelis erythrocephalus*.

Hemidactylus species are well known for interspecific competition (e.g., Weterings and Vetter 2018), and thus this is expected on Lesser Antillean islands where multiple species meet. Comparable to the situation report-



Figure 2. Dorsal and ventral side of juvenile *Gymnophthalmus underwoodi* (SVL 19.5 mm) on St. Eustatius. Rule units in centimeters. Photo: Julian Thibaudier.

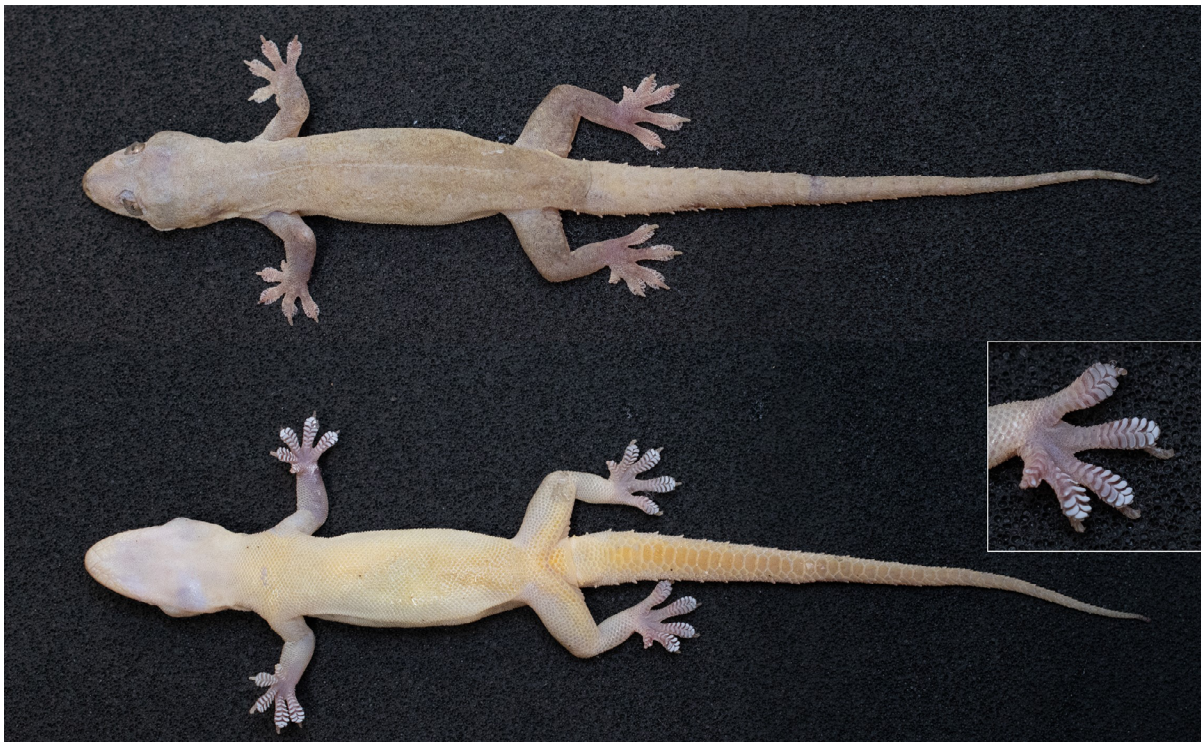


Figure 3. Dorsal (above) and ventral (below) sides of male *Hemidactylus frenatus* (SVL 60.5 mm), including inset of left hind feet, on St. Eustatius. Rule units in centimeters. Photo: Matthijs P. van den Burg.

ed on St. Lucia, we observed *H. frenatus* either exclusively or sympatrically with fewer *H. mabouia*, potentially suggesting competitive advantage of the former (Griffing *et al.* 2022). An assessment of competition with the native Northern Turnip-tailed Gecko (*Thecadactylus rapicauda*) remains to be performed.

Introductions of non-native reptiles may have severe (invasive) effects on native flora and fauna, such as competition with native species, hybridization, or the introduction of diseases such as dermatitis (Hellebuyck *et al.* 2017), and ophidiomycosis (Allender *et al.* 2020). The recent increase in established non-native species on Saba and St. Eustatius (Table 1), as well as occasional single arrivals (Jesse *et al.* 2016; Debrot *et al.* 2022), highlights the importance of continuous monitoring of terrestrial fauna on small Caribbean islands. Lastly, high priority should be given to implementing biosecurity regulations to prevent future introductions of non-native species that might become established on the island.

This report demonstrates the continuing increase of established non-native reptiles on St. Eustatius (Table 1), highlighting the importance for immediate preventive actions. Non-native reptiles and amphibians now make up 42% of all terrestrial reptile and amphibian species of St. Eustatius (Powell *et al.* 2015; Thorpe 2022). We note that table 20.1 in the St. Kitts Bank chapter of Thorpe (2022) mentions, without evidence, the presence of *H. frenatus* on St. Eustatius, which is instead present on St. Kitts as referenced within the chapter's text. Assessments of *H. frenatus* presence on all regional islands is necessary to properly understand its current non-native range. Across the northern Lesser Antillean islands, *G. underwoodi* only remains unreported on Anguilla, although there have already been suspected sightings on this island (Farah Mukhida pers. comm. 10 October 2022).

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