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The Smell of Fear: Responses of Native and Invasive Geckos to Predator Scent Cues on Moorea, French Polynesia

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The Smell of Fear: Responses of Native and Invasive Geckos to Predator Scent Cues on

Moorea, French Polynesia

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Abstract

Hemidactylus frenatus, a globally invasive species, is syntopic with the native gecko *Lepidodactylus lugubris* on the island of Moorea, French Polynesia. The success of an invasive species, *H. frenatus* can be attributed to many factors and is the subject of much study. Some research suggests that invasive and native geckos may differ in their response to chemosensory cues from predators. We compared the responses of *H. frenatus* and *L. lugubris* to the scents of both a native local predator; centipede, and a common predator of geckos that is not present on Moorea; snake. While neither gecko species showed any significant avoidance of the scent of the snake, both species strongly avoided the scent of the native centipede, a shared predator on Moorea. Our results help narrow the search for factors associated with the success of *H. frenatus* on Moorea and possibly other locations where the species is invasive.

Introduction

The common house gecko, *Hemidactylus frenatus*, is one of the most widely distributed invasive species globally (Case et al., 1994; Lapwong et al., 2021). Many factors determine the success of an invasive species such as interactions with predators, prey, and competitors. Interest in studying how successful invasive species may outperform their native counterparts has revealed that invasive species sometimes exhibit increased wariness of novel predators (e.g., Cisterne et al., 2014) and a greater ability to detect said predators through chemosensory cues. (Cornelis et al., 2018). These abilities potentially give invasive geckos an advantage over the native species they displace. Cisterne et al. (2014) demonstrated that invasive *H. frenatus* tended to avoid multiple snake odors including of species not inside their current geographic range via a generalized avoidance response, while native geckos showed discrimination in avoidance behavior by failing to avoid snake species outside their geographic range. We chose to compare predator avoidance behavior of invasive *H. frenatus*

with native *L. lugubris* when presented with scents of a snake and scent of a native invertebrate predator, on Moorea, French Polynesia. Moorea lacks snakes, but invertebrate predators such as the Giant Pacific Centipede, *Scolopendra subspinipes*, which may select similar retreat sites as geckos studied (e.g., Pike et al., 2010) are abundant. We hypothesized, based on other studies, that *H. frenatus* would be more likely to avoid *S. subspinipes* and the snake when compared to *L. lugubris*.

Methods

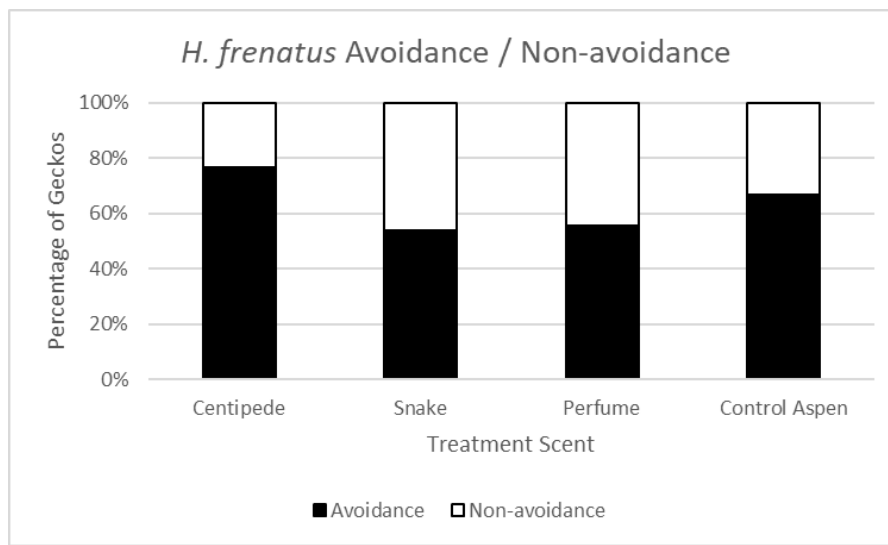
Behavioral trials were conducted on the island of Moorea in French Polynesia between May 31st – June 6th, 2023. We followed the protocols of Cisterne et al., (2014) with only slight modifications. We also abided by all IACUC protocols upheld by the university and the French government. Geckos were captured at night using herpetology nooses and released individually into plastic terraria (59.7cm L x 47.2 cm W x 31.2 cm H) for a 6-hour trial ending at sunrise the following morning. During the trial, geckos could choose between two tile shelters covering filter papers at opposite ends of the terrarium. In each trial, one filter paper was scented, and the other was an unscented control. Scents presented were snake (*Morelia spilota*), centipede (*Scolopendra subspinipes*), or a pungency control (Bal a Versailles, 1:10 dilution). Predator scent was transferred from used aspen bedding of *M. spilota* or directly from wild caught *S. subspinipes* onto DI water wetted filter papers (Whatmans 11 cm). Clean aspen bedding was used as an additional control for the snake-exposed aspen bedding.

The geckos were placed in terrariums with two retreat sites, each of which consisted of 10cm x 10cm tile raised by two 1cm support blocks. Each site housed a filter paper infused with the treatment or control scents. Over a period of 6 hours, the geckos were free to move and select a refuge site within the terrariums. The geckos' positions were recorded the next morning as either "avoidance" or "non-avoidance," (Cisterne et. al, 2014). Avoidance meant

the gecko was under the tile with control paper or was found somewhere outside of the shelter. Non-avoidance indicated the gecko was under the tile with the treatment paper.

Results

We used a Chi square goodness of fit test to determine if there was significant avoidance displayed in the choices offered during trials . A total of 97 trials were conducted over the course of 6 nights. For *H. frenatus*, 76.5% avoided centipede ($P=0.0245$), 53.8% ($P=0.0245$) avoided snake, 55.6% ($P=0.5$) avoided perfume, and 66.7% ($P=0.5$) (Figure 1). *L. lugubris* produced qualitatively similar results as 73.7% ($P=0.0592$) of individuals avoided centipede, 50% ($P=0.0245$) avoided snake, 72.7% ($P=0.1133$) avoided perfume, and 42.9% ($P=0.5982$) avoided control aspen (Figure 1).

A

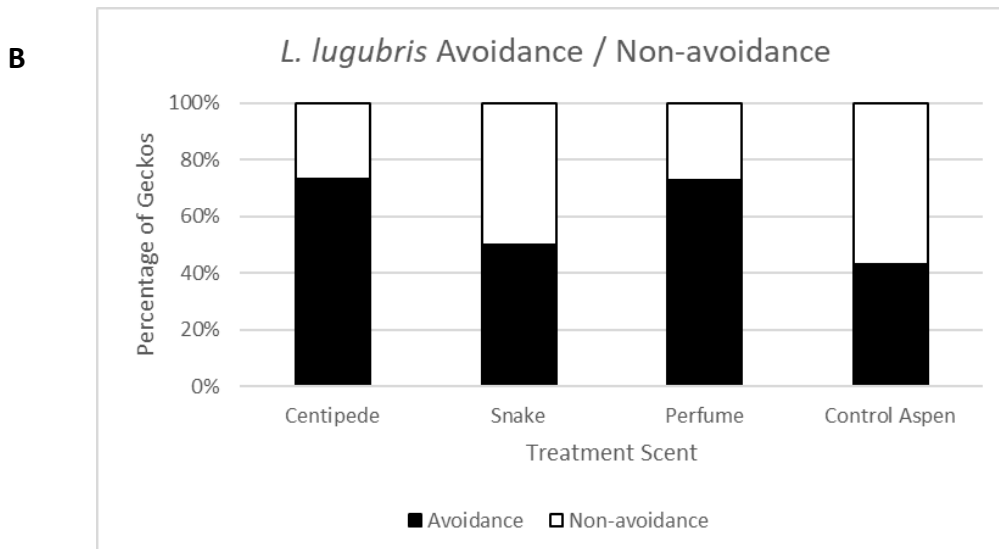


Figure 1: Distribution plots show percentage of avoidant or non-avoidant behavior seen in gecko species **A.** *H. frenatus* and **B.** *L. lugubris* when exposed to treatment scent. Scent variables including centipede (*Scolopendra subspinipes*), snake (*Morelia spilota*), perfume (Bal a Versailles), and control aspen bedding. Geckos were given the choice of two shelters with one containing a treatment scent filter paper and the other containing control DI water filter paper. Avoidance was confirmed when a gecko was observed under the control shelter while non-avoidance meant the gecko was under the treatment shelter. Asterisk (*) indicates that the proportion of geckos that avoided a shelter with a specific scent is significant ($p < 0.05$)

Discussion and Conclusion

Our data suggests that *H. frenatus* and *L. lugubris* did not recognize the scent of a snake as a threat or predator cue. Moreover, only *H. frenatus* significantly avoided centipede scent ($p = 0.02$). However, *L. lugubris* showed a non-significant tendency to avoid the centipede scent although the small sample size prohibits drawing the conclusion they behaved similarly to *H. frenatus*. On balance, we don't have strong evidence to suggest there are significant differences in behavioral responses of these two geckos to native predator or novel scents, including the scent of snakes to which neither species has been exposed to on Moorea. Because our findings differ from those of Cisterne et al., (2014), it may be that the results of such experiments may be species specific or might depend upon other details of the

experimental design (in which we tried to closely match Cisterne et al. 2014). Nevertheless, the role such behaviors play in the success of invasive species including *H. frenatus* is worth further study if we want to predict outcomes of continued expansion of invasive geckos like *H. frenatus* or reveal the potential for developing strategies to slow their spread.

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