

Social behaviour in the dwarf geckos *Sphaerodactylus sabanus* and *S. sputator* from St. Eustatius, Netherlands Antilles

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Abstract. In June 2004, on St. Eustatius, Netherlands Antilles, we examined intraspecific and interspecific interactions between the two native species of dwarf geckos, genus *Sphaerodactylus*. *Sphaerodactylus sabanus* and *S. sputator* occurred syntopically in sampled microhabitats of leaf litter and dead agave plants. Mean frequencies of behaviours differed significantly between the two species. Mean frequencies of behaviours also differed significantly between males and females of both species. Males of both species behaved passively in intra- and interspecific interactions; whereas, females tended to behave aggressively in intraspecific interactions and passively in interspecific interactions. Overall, these species appear to behave less aggressively than other species of *Sphaerodactylus*.

Key words. Squamata: Gekkonidae: *Sphaerodactylus sabanus*, *S. sputator*; St. Eustatius; social behaviour.

Introduction

Approximately 80 species of dwarf geckos, *Sphaerodactylus* spp., inhabit the West Indies (POWELL et al. 1996). Although systematic research on *Sphaerodactylus* is abundant (e. g., KING 1960, 1962, HASS 1991, 1996), little has been published regarding their behaviour. REGALADO (1997, 2003) examined social behaviour and sex recognition of *S. elegans* and *S. nicholsi*, respectively, and LEUCK et al. (1988) provided a brief account of social behaviour in *S. clenchi*. Those studies suggested that visual signals play a major role in sex recognition. Social behaviour in Lesser Antillean species of *Sphaerodactylus* has not been studied previously.

Sphaerodactylus sputator and *S. sabanus* are the only dwarf geckos native to St. Eustatius (Statia), Netherlands Antilles. *Sphaerodactylus sputator* is widely distributed across the Anguilla and St. Christopher (St. Kitts) banks. It is the larger of the two species on Statia, with a maximum snout-vent length (SVL) of 35 mm in males and 39 mm in females. The smaller *S. sabanus* is

endemic to the Saba and St. Kitts banks and has a maximum SVL of 29 mm in males and 28 mm in females (SCHWARTZ & HENDERSON 1991). Both species are found in a variety of habitats from xeric scrub to moderately mesic hillside forests where they utilise leaf litter, where available. They are also commonly found within dead agaves in xeric areas and under deadfall, rocks, human debris, or other cover.

On Statia, we collected both species together in heavily shaded Sea Grape (*Coccoloba uvifera*) forests, on the leeward slopes of The Quill (a dormant volcano near the southeastern end of the island), and in dead agaves in the xeric Northern Hills. Because the two species coexist in these microhabitats (HENSLEY et al. 2004), we examined both intraspecific and interspecific interactions.

Materials and Methods

In June 2004, we collected approximately equal numbers of *Sphaerodactylus sabanus* and *S. sputator*. *Sphaerodactylus sabanus* was abundant in *Coccoloba uvifera* forests

along Zeelandia Beach, in forested areas 500 m northwest of Fort de Windt, and on the leeward (western) slopes of The Quill. *Sphaerodactylus sputator* was abundant in dead agaves on the slopes above Wash Gut along the lower Venus Baai Trail in the xeric Northern Hills. We housed geckos collected at each site in 21 × 14 × 13 cm or 16 × 9 × 10 cm plastic containers provisioned with a soil substrate, shaded, and subjected to natural daily changes in temperature, humidity, and hours of daylight. We provided termites every 2-3 days and sprayed cages with water every other day.

We observed 55 interactions between pairs of geckos in the following combinations: male/male, male/female, and female/female for each species and between species. Some interactions were video taped and later reviewed. As in REGALADO (1997, 2003), no individual took part in more than three interactions or in consecutive interactions, and we repeated no pairings. Thirty minutes before interactions, we placed individuals in a lighted area. They were then simultaneously placed into a neutral cage containing a soil substrate onto which geckos had not been previously introduced. We recorded every individual's sequences of behaviour, beginning when an individual displayed a specific position or behaviour toward the other individual and stopped when both individuals were inactive for 20 minutes or if individuals ignored each other for 15 minutes after initial contact. Neutral cages were thoroughly washed with liquid detergent and rinsed with hot water after each encounter.

Behaviours recorded in this experiment that were previously identified by REGALADO (1997, 2003) included tongue flick (fast extension and retraction of the tongue), approach (movement toward other animal while keeping a normal pace), withdrawal (moving away from another individual), bite (lizard bit an opponent), stand (stationary animal keeps its body slightly separated from the substrate), head turn (animal is motionless and its head forms an angle 45-90° with the longitudinal axis of the body), stiff (legs are extended posteriorly, almost flat on

the substrate), head bob (head moves up and down), and crouch (animal's trunk is close to the substrate, legs are resting alongside the body, and the head is not in contact with the substrate).

We characterized two behaviours, raised tail (tail elevated and curved upward) and lick (fast extension and retraction of the tongue while coming in contact with other animal), somewhat differently than REGALADO (1997, 2003). We also included several behaviours not previously described: stare (animal watches the other animal), walk (animal moves around cage without any evident interaction with the other animal), sniff (animal touches other animal with its snout without tongue flicking), tail wave (tail quickly and rhythmically waved from side to side), touch (part of animal's body touching the other animal), root (animal places nose in the dirt), mount (animal mounts the other animal), and on wall (animal climbs the wall of cage).

We adjusted frequency data to per-individual figures to compensate for differing sample sizes for the two species and for males and females of either species. We then analyzed our data using Statview 5.0 (SAS Inst., Cary, North Carolina) and STAT-STAR Version 2 (Academy Software 2.0, Palm Harbor, Florida). For all tests, $\alpha = 0.05$.

Results and Discussion

We collected 21 *Sphaerodactylus sabanus*, mostly (71.4 %) in leaf litter, and 27 *S. sputator*, mostly (88.9 %) from dead agaves. When we examined frequencies of all nineteen behaviours (Table 1), only those for on wall, walk, and withdrawal differed significantly in different types of interactions (ANOVA, $df = 15$, $F = 16.07$, $P < 0.0001$; $F = 1.93$, $P = 0.03$; $F = 1.75$, $P = 0.05$, respectively). Both males and females in male *S. sabanus*/female *S. sputator* interactions exhibited on wall much more frequently than animals in any other interactions. Walk occurred much more commonly in male-female interactions of all types than in any same-sex



Fig. 1. Adult *Sphaerodactylus sabanus* (top) and small adult *S. sputator* (bottom) from St. Eustatius: although both species were syntopic in many habitats, *S. sabanus* was more abundant in leaf litter and *S. sputator* was more frequently encountered in the debris associated with dead agave plants.

interactions. Withdrawal occurred more often in same-sex interactions of *S. sabanus* and *S. sputator* than in inter-sex interactions. In addition, some pairwise comparisons (Fisher's PLSD) between types of interactions were significant ($P \leq 0.05$) for all behaviours. For example, overall differences in frequencies for approach, head bob, and sniff were not significant; however, when examining these behaviours in different types of interactions, most interactions that involved a female *S. sabanus* were significant. Frequencies of head turn in most male *S. sputator*/male *S. sabanus* interactions differed significantly from other types of interactions, whereas root, tail wave, and touch were most abundant in male-female *S. sabanus* interactions.

Mean frequencies of all behaviours between *S. sabanus* and *S. sputator* differed significantly ($df = 18$, $\chi^2 = 232.37$, $P < 0.0001$; Fig. 2A). For example, *S. sputator* displayed head turn and tongue flick sub-

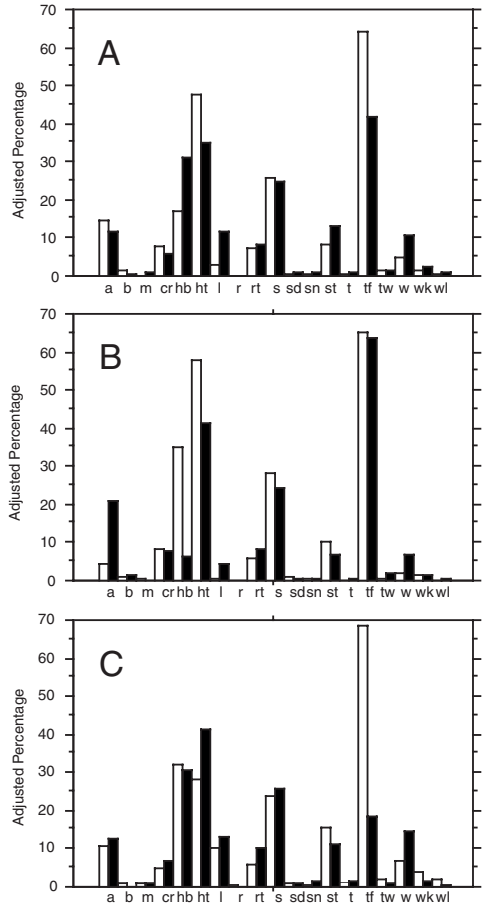


Fig. 2. Mean frequencies of behaviours during all types of intra- and interspecific interactions (see text) by: (A) *Sphaerodactylus sputator* (white bars) and *S. sabanus* (black bars); (B) male (white bars) and female (black bars) *S. sputator*; (C) male (white bars) and female (black bars) *S. sabanus*. Abbreviations are as in Table 1.

stantially more frequently than *S. sabanus*, whereas *S. sabanus* displayed head bob, lick, and withdrawal more frequently than *S. sputator*. On the other hand, *S. sputator* and *S. sabanus* had similar frequencies of raised tail, root, stand, and stare.

Mean frequencies of all behaviours differed significantly between male and female *S. sputator* ($df = 18$, $\chi^2 = 421.75$, $P < 0.0001$; Fig. 2B). Head turn and head bob were more

Type of Behaviour	Type of Interaction															
	1 N=4	2 N=9	3 N=9	4 N=26	5 N=6	6 N=10	7 N=10	8 N=2	9 N=4	10 N=4	11 N=4	12 N=4	13 N=8	14 N=8	15 N=1	16 N=1
rt	0.8±0.5 0-2	0.7±0.2 0-2	0.7±0.2 0-2	1.0±0.2 0-3	0.7±0.2 0-1	0.6±0.3 0-2	1.3±0.4 0-3	0	0.8±0.2 0-1	0.5±0.3 0-1	0.5±0.3 0-1	0.2±0.2 0-1	0.4±0.2 0-1	0.2±0.2 0-1	0	0
ht	3.2±2.3 0-10	5.1±1.3 1-13	3.3±1.0 0-10	4.7±0.9 0-15	2.0±0.9 0-6	3.3±1.1 0-8	4.5±1.1 1-12	2.5±1.5 1-4	8.2±3.1 1-14	2.8±1.5 0-7	2.5±1.3 0-6	0.8±0.5 0-2	6.6±1.1 3-13	5.8±1.7 0-14	3	4
tf	8.2±4.6 0-19	7.8±3.1 0-29	8.7±3.6 0-31	6.3±1.6 0-29	12.8±12.6 0-7	6.6±3.1 0-25	2.0±0.7 0-5	1.5±1.5 0-3	2.5±1.0 0-5	0	3.2±2.4 0-10	1.0±1.0 0-4	6.2±2.5 0-18	2.1±0.9 0-6	1	0
hb	3.2±3.2 0-13	8.2±4.5 0-36	0	1.0±0.8 0-20	0	6.7±8.0 0-59	2.4±1.7 0-16	14.5±14.5 0-29	0	0	0	0	0	2.6±2.6 0-21	0	0
a	0	0.8±0.3 0-2	0.6±0.3 0-3	0.8±0.3 0-4	0	2.2±1.6 0-16	0.8±0.3 0-3	3.5±3.5 0-7	0.8±0.5 0-2	0	0	0.2±0.2 0-1	0.1±0.1 0-1	1.8±1.0 0-8	0	0
w	0.2±0.2 0-1	0.3±0.2 0-2	1.0±0.5 0-4	0.7±0.2 0-4	0	1.2±0.5 0-4	2.4±1.1 0-11	2.5±2.5 0-5	0	0.5±0.3 0-1	0	0	0.1±0.1 0-1	0.8±0.2 0-2	0	0
st	1.5±0.6 0-3	1.1±0.4 0-3	0.4±0.2 0-2	0.8±0.2 0-3	0.5±0.2 0-1	2.4±0.9 0-8	1.2±0.5 0-4	2.5±0.5 2-3	0.8±0.2 0-1	1.5±0.6 0-3	0.8±0.5 0-2	0.2±0.2 0-1	0.8±0.4 0-3	1.1±0.4 0-3	0	0
s	2.5±0.6 1-4	2.4±0.8 0-8	2.2±0.5 1-5	2.7±0.4 0-8	0.8±0.3 0-2	3.3±1.1 1-12	3.0±0.8 0-8	1	4.5±1.2 3-8	2.8±1.6 0-6	0.8±0.8 0-3	1.2±0.6 0-3	2.6±0.7 0-5	3.1±0.6 0-5	1	3
wk	0	0.3±0.3 0-3	0.4±0.3 0-3	0	0	0.5±0.2 0-2	0.1±0.1 0-1	0	0	0.2±0.2 0-1	0	0	0.1±0.1 0-1	0.2±0.2 0-1	2	1
sn	0	0.1±0.1 0-1	0.1±0.1 0-1	0	0	0.1±0.1 0-1	0	0.5±0.5 0-1	0	0	0	0	0	0.2±0.2 0-1	0	0
cr	0.2±0.2 0-1	1.3±0.4 0-3	1.0±0.3 0-3	0.8±0.2 0-3	0.2±0.2 0-1	0.6±0.3 0-3	1.0±0.5 0-5	0.5±0.5 0-1	0.5±0.3 0-1	0.8±0.8 0-3	0	0.2±0.2 0-1	0.8±0.2 0-2	0.5±0.3 0-2	0	0
tw	0	0.1±0.1 0-1	0.2±0.2 0-2	0.2±0.5 0-1	0	0.4±0.3 0-3	0.2±0.2 0-2	0	0	0	0	0	0	0	0	0
b	0	0.3±0.3 0-3	0	0.2±0.1 0-3	0	0.2±0.2 0-2	0	0	0	0	0	0	0	0	0	0
l	0	0.1±0.1 0-1	0	0.7±0.3 0-6	0	2.1±1.7 0-17	1.9±1.4 0-14	4.0±4.0 0-8	0	0	0	0	0	0.5±0.3 0-2	0	0
sd	0	0	0	3.82±3.8 0-1	2	0.2±0.2 0-17	2.1±1.7 0-14	1.9±1.4 0-1	0.5±0.5 0-1	0	0	0	0	0	0	0.1±0.1 0
t	0	0	0	0.1±0.1 0-1	0	0.2±0.1 0-1	0.3±0.2 0-2	0	0	0	0	0	0	0	0	0
r	0	0	0	0	0	0.1±0.1 0-1	0	0	0	0	0	0	0	0	0	0
m	0	0	0	0	0	0.2±0.1 0-1	0	0.5±0.5 0-1	0	0	0	0	0	0.1±0.1 0-1	0	0
wl	0	0	0	0	0	0	0	0	0	0	0.2±0.2 0	0	0	0	3	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.1

common in males than females; however, approach was displayed extensively more by females than males. Conversely, males and females displayed raised tail, root, stand, and stare with relatively similar frequencies. Mean frequencies of all behaviours between male and female *S. sabanus* (Fig. 2C) also differed significantly ($df = 18$, $\chi^2 = 405.53$, $P < 0.0001$). Males displayed tongue flicks more frequently than females, whereas females displayed both head turn and withdrawal more frequently than males. Conversely, males and females had similar frequencies of head bob, mount, approach, touch, stand, and stare.

When examining whether a particular behaviour was performed or not during specific types of interactions, a significant difference existed between all types of intraspecific *S. sabanus* interactions, intraspecific *S. sputator* interactions, and interspecific interactions only for stare ($df = 2$, $\chi^2 = 7.18$, $P = 0.03$). Data for head bob ($df = 2$, $\chi^2 = 5.00$, $P = 0.08$), tongue flick ($df = 2$, $\chi^2 = 5.53$, $P = 0.06$), lick ($df = 2$, $\chi^2 = 5.72$, $P = 0.06$), tail wave ($df = 2$, $\chi^2 = 5.24$, $P = 0.07$), and crouch ($df = 2$, $\chi^2 = 5.57$, $P = 0.06$) were indicative of trends, suggesting that differences may exist. In all male-male interactions, female-female interactions, and male-female interactions of both species, significant differences existed for whether head turn ($df = 2$, $\chi^2 = 7.49$, $P = 0.02$), approach ($df = 2$, $\chi^2 = 6.04$, $P = 0.05$), lick ($df = 2$, $\chi^2 = 6.23$, $P = 0.04$), and walk ($df = 2$, $\chi^2 = 11.63$, $P = 0.003$) were performed. In every interspecific interaction, behaviours such as mount, tail wave, head bob, lick, bite, and

touch were very rarely performed. In all male-male interactions, behaviours involving contact with the other individual (e. g., lick, bite, sniff, touch) were very rare.

Our data often were comparable to those of REGALADO (1997, 2003), but differed in some parameters. For example, when male *S. nicholsi* and *S. elegans* were placed with other conspecific males, they behaved very aggressively by biting and tail thrashing. We rarely observed those behaviours in male *S. sabanus* and *S. sputator*, which were more likely to ignore each other and avoid all contact.

Male-female interactions of both *S. sabanus* and *S. sputator* were very similar to those of *S. nicholsi* and *S. elegans* (REGALADO 1997, 2003). In most interactions, males would initiate courtship by staring at females, head bobbing, approaching while head bobbing, licking, waving their tails from side to side, and finally attempting to mount. However, in most cases, females would withdraw at some stage during the males' approach. In only a few instances did males mount females and, in those cases, we did not observe copulation. Most females in our samples were gravid when captured, possibly accounting for the lack of successful copulation. When a female *S. sputator* was placed with a male *S. sabanus*, neither individual initiated any contact. However, when female *S. sabanus* were placed with male *S. sputator*, females would head bob, approach, and lick the male, usually causing him to withdraw. In one instance, a female *S. sabanus* mounted a male *S. sputator* after licking him.

left page: Tab. 1. Types of behaviours observed during interactions in and between *Sphaerodactylus sputator* and *S. sabanus* from Stata. Each entry includes the mean \pm one standard error (SE) and range. Types of interactions are: (1) male *S. sputator* in M/M interactions, (2) male *S. sputator* in M/F interaction, (3) female *S. sputator* in M/F interactions, (4) female *S. sputator* in F/F interactions, (5) male *S. sabanus* in M/M interactions, (6) male *S. sabanus* in M/F interactions, (7) female *S. sabanus* in M/F interactions, (8) female *S. sabanus* in F/F interactions, (9) male *S. sputator* in M/M interactions between species, (10) male *S. sabanus* in M/M interactions between species, (11) female *S. sputator* in F/F interactions between species, (12) female *S. sabanus* in F/F interactions between species, (13) male *S. sputator* in M/F interactions between species, (14) female *S. sabanus* in M/F interactions between species, (15) male *S. sabanus* in M/F interactions between species, and (16) female *S. sputator* in M/F interactions between species. Types of behaviours (see text) are: rt (raised tail), ht (head turn), tf (tongue flick), hb (head bob), a (approach), w (withdraw), st (stiff), s (stare), wk (walk), sn (sniff), cr (crouch), tw (tail wave), b (bite), l (licking), sd (stand), t (touch), r (rooting), m (mounting), and wl (on wall).

Female *S. sabanus* and *S. sputator* were very aggressive toward conspecific females, similar to observations of *S. nicholsi* and *S. elegans* (REGALADO 1997, 2003). In most interactions, one female would dominate the interaction by head bobbing, approaching, and then either licking or biting. However, when females of the two species were placed together, neither initiated any contact. Both females would remain stiff or crouched while staring at one another.

In 65.5 % of all interactions, no contact occurred. *Sphaerodactylus sabanus* and *S. sputator* appear to be relatively passive compared to the species examined by REGALADO (1997, 2003). The fact that the two St. Eustatius species coexist in the same microhabitats may have led to a suppression of potentially costly and harmful agonistic behaviours.

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