The Distribution and Dispersion of the *Alsophis rufiventris* on the Quill, Sint Eustatius

RAVON

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List of acronyms

Colubrid	-	A very large family of snakes (family Colubridae), that includes mostly harmless species. The few venomous species have grown fangs in the rear of the upper jaw, and are often referred to the family Dipsidae (Dipsus = venom).
Dorsal	-	The back side or spine side of the snake.
Gestation	-	Caring of the eggs or embryos.
IUCN Red List	-	International Union for Conservation of Nature, list of endangered species.
Mediolateral	-	Diagonal side of the back of the snake.
Neonatal	-	New-born or infants.
Offspring	-	New-borns.
Oviparous	-	Egg-laying animals.
Posterior	-	Front of the snake (head side).
RAVON	-	Reptiles Amphibians and Fish Conservation Netherlands.
STENAPA	-	Sint Eustatius National Parks.
Subcutaneously	-	Underneath the skin, between the skin and muscle layer.
S-V	-	Snout-vent length.
TL	-	Total length.
V-T	-	Vent-tail length.
Viviparous	-	Animals that give life birth.
Ventral	-	The belly side of the snake.
Quill	-	Dormant volcano on Statia.

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Abstract

The Lesser Antilles are home to four different colubrid snakes of the *Alsophis* genus. *Alsophis* used to be common around the Lesser Antilles, but has declined dramatically. The Red-bellied Racer snake (*Alsophis rufiventris*) is one of those four endemic *Alsophis* species of the Lesser Antilles. The islands St. Eustatius (Statia), Saba, St. Kitts and Nevis used to be home to *A. rufiventris*, when in the 1900s *A. rufiventris* got extirpated on St. Kitts and Nevis. Only two subpopulations exist today, on 10.9% of its original range. Therefore, *A. rufiventris* is now classified as endangered on the IUCN red list. A better understanding of these animals can help in effectively protecting them. To get an idea of the distribution and dispersion on the trails of the western slope of the Quill was investigated, because the abundancy of *A rufiventris* was thought to be the highest there.

In total 66 snakes were PIT tagged, over a three month period, of which 34 males and 32 females, suggesting a sex ratio of 50:50. Every snake was measured to see if there was a difference in tail length between males and females, to create an easy, costless and harmless way to distinguish both sexes, other than from the look of the exterior. Males had a significant longer tail, making it possible to use this method to identify the sexes.

Encounters and reencounters were mapped to give an idea about the dispersion of *A. rufiventris*. There were 43 reencounters, of which 4 snakes where reencountered three times after initial tagging. Different snakes were reencountered several times within a 80 meter range. Only one snake was reencountered about a kilometre from the first three encounters of that individual. Therefore, over this short period *A. rufiventris* seemed to have a certain home range, though the behaviour of other *Alsophis* species suggest that they will be rather nomadic over a longer time period. For that reason, long time study is suggested, to learn more about the specific behaviour of this species.

1. Introduction

The Lesser Antilles are home to four different colubrid (Latin: coluber = snake) snakes of the *Alsophis* genus (Sajdak *et al.* 1991; Schwartz *et al.* 1991: Day 1996). *Alsophis* used to be common around the Lesser Antilles, but has declined dramatically. Insular snakes, like those of the *Alsophis* genus, are nowadays prominent on the IUCN Red List (Dodd 1987; Sajdak *et al.* 1991). The Red-bellied Racer snake (*Alsophis rufiventris*) is one of those four endemic *Alsophis* species of the Lesser Antilles (Day 1996; Sajdak *et al.* 1991). The snake is named after Latin "rufus" = red and "venter" = belly, though only its chin has a red glow (Powell *et al.* 2005; Powell *et al.* 2016). Despite being the most geographically widespread colubrid snake genus in the West Indies, little is known about the ecology of most *Alsophis* species (Savit *et al.* 2005).

The islands St. Eustatius (Statia), Saba, St. Kitts and Nevis used to be home to *A. rufiventris* (figure 1), until in the 1900s, when *A. rufiventris* got extirpated from Saint Kitts and Nevis (Sajdak *et al.* 1991; Savit *et al.* 2005). The small Asian mongoose (*Herpestes javanicus*), a carnivorous mammal that preys on snakes, is thought to be the reason for the extirpation of *A. rufiventris* on the two islands, since the extirpation of *A. rufiventris* started right after the introduction of this invasive non-native mammal (Sajdak *et al.* 1991; Day 1996; Savit *et al.* 2005; Daltry *et al.* 2016).

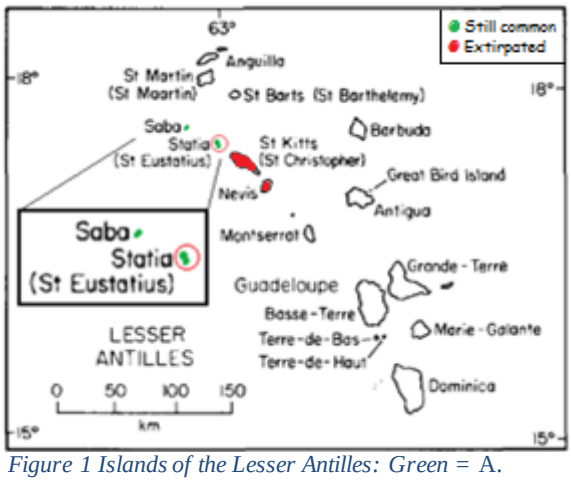

Figure 1 Islands of the Lesser Antilles: Green = A. rufiventris *still widely spread on the island; Red =* A. rufiventris *extirpated from the island (Cartography by E. Warne, in ed. M. Zobel)*

In 1991 a paper was published by Richard A. Sajdak and Robert W. Henderson, concerning the distribution of the West Indian racers, including *A. rufiventris* on Statia and Saba. Through field surveys and interviews with the inhabitants of Statia, Saba, Saint Kitts and Nevis, it became clear that people on St Kitts and Nevis had indeed not seen the snake for many years. Also, that if they saw a snake, they would kill it, even if they knew it was harmless (Sajdak *et al.* 1991). Since the extirpation of *A. rufiventris* on these islands, only two populations exist today, with a remaining distribution of 33 km^2 (Sajdak *et al.* 1991; Day 1996; Savit *et al.* 2005; Daltry *et al.* 2016). This means only 10.9% of its original range remains (Sajdak *et al.* 1991; Day 1996; Daltry *et al.* 2016). On Saba they found 21 snakes during field surveys in four days and 7 of the same species on Statia (Sajdak *et al.* 1991). Therefore *A rufiventris* was thought to be still widely spread on these two islands, especially on Saba (Sajdak *et al.* 1991; Savit *et al.* 2005). The size of the remaining populations was last assessed in 1996, after which the Red List categorization went from *Vulnerable* (1994), to *Endangered* (Day 1996; Daltry *et al.* 2016).

The two remaining populations' only native predator on Statia and Saba, is the endemic American kestrel (*Falco sparverius*) (Powell *et al.* 2008). Unfortunately, besides the native kestrel, the snakes are also threatened by rats, feral cats and dogs introduced by man (Sajdak *et al.* 1991; Savit *et al.* 2005). However, at present the snake remains abundant with an apparently stable population (Sajdak *et al.* 1991; Savit *et al.* 2005; Daltry *et al.* 2016). A risk that is increasing due to increasing traffic betrween the islands St. Kitts and Nevis, on which the invasive predator has already established, is the mangoose (Daltry *et al.* 2016). In order to preserve the remaining populations of *A. rufiventris*, it is important to know more about their distribution and dispersion and to prevent the mongoose from entering and establishing on the island (Sajdak *et al.* 1991; Savit *et al.* 2005; Daltry *et al.* 2016).

There is only little known about the distribution and dispersion of *A. rufiventris* on Statia. Most research was executed on the western slope of the Quill (dormant volcano on Statia), because of higher concentrations of *Anolis schwartzi*, an important prey species for the *A. rufiventris* (Henderson *et al.* 1991; Savit *et al.* 2005). Also the higher humidity on the western slope of the Quill has been a reason for researchers to believe there is a higher change of encountering the snake on that side of the volcano (Savit *et al.* 2005). *A. rufiventris* appears to be strictly diurnal (Henderson *et al.* 1991; Savit *et al.* 2005). The average number of encounters rises considerably after 0900 am and remains relatively high until 1200 pm (Henderson *et al.* 1991). This repeats itself between 0300 pm and 0500 pm. The highest encounter rate is between 0100 pm and 0200 pm. This suggests that *A. rufiventris* has a bimodal pattern of activity, influenced by daily temperatures (Henderson *et al.* 1991). Also the microhabitat seem to have an effect on the amount of encounters, whereby segments of the trail with the highest encounter rates, contain the most rocks (Henderson *et al.* 1991). Rocks may be attractive to *A. rufiventris*, because of the abundancy of refuge for *A. schwartzi* (Henderson *et al.* 1991; Savit *et al.* 2005). Usually the abundancy of prey species does not determine the whereabouts of snakes, this is due to the metabolism of snakes which is very efficient, they do not need many prey items a year to survive (A. Rijsewijk, personal communication, 4 January 2017). For instance, many snake species do not eat throughout their whole gestation period (Gregory *et al.* 1975; Gregory *et al.* 1997).

The main goal of this project was to gather more information about this species, in particular the distribution and dispersal of *A. rufiventris* on the west slope of the Quill. The *A. rufiventris* was expected to be widely distributed over the western slope of the Quill and to disperse rather nomadic, as they are closely related the *Alsophis antiguae*, which is known to be (Daltry *et al.* 2017). In order to verify this hypothesis, every encountered snake was tagged with a passive integrated transponder (PIT) tag with an unique alphanumeric ID-number, thus giving every tagged individual an 'identity'. PIT tags are harmless when inserted carefully, even for neonatal snakes (Keck 1994). Using a geographic information system (GIS), every encounter and reencounter was mapped to follow the movements of the individual snakes over the studied period.

Also the sex ratio of the *A. rufiventris* was taken into account. Knowing the distribution of the different sexes can be helpful to gain more information about the behaviour and reproduction of the species. The gender of different snake species, like the *C. austriaca*, are often determined by the body-tail length ratio (A. van Rijsewijk, personal communication, 8 July 2016). The expectation is that the tails of males are indeed longer than those of females, as Colubrid snake males usually have a longer tail than females (Goddard 1984).

Natural park Boven, was not taken into account, as a higher survey area reduces the chances of reencountering individual snakes. Also the eastern slope of the Quill was thought to be less attractive to the snakes and therefore left out (H. Maddan, personal communication, 23 September, 2016).

2. Materials and methods

2.1 Study site

Statia is approximately 8 km long and 4 km wide, covering a total of 21 km^2 (Unknown[a] 2005). The island has a population of 3193 (www.CBS.nl) and is located in the north eastern Caribbean (www.statiacovernment.com). Quill National Park is protected and maintained by St. Eustatius National Parks (STENAPA) (Unknown[a]). Therefore a permit (appendix I) has been granted by Clarisse Buma, the director of the park, before this study was executed. This national park is named after the volcano, the *Quill* (meaning pit), covering most of the park (Unknown[b] 2005). The last eruption of the Quill dates back to around 400 AD (over 1600 years ago) and the present period of inactivity is referred to as dormancy (Roobol *et al.* 2004). The highest point of the Quill is Mazinga peak at just over 600 m above sea level (Unknown[b] 2005). The bottom of the crater is 273 m above sea level.

The research was conducted on the trails of Quill National Park, focussing on the *Quill trail* (orange trail, figure 2.1) and the southern part of the *Around the Mountain trail* (S-trail, figure 2.1) to *White Wall* (Unknown[a] 2005; Unknown[b] 2005). Both trails are about 2 km long. For this study, the Quill trail is divided in two parts, from the top of *Rosemary Lane* to the bifurcation, referred to as *Orange trail*, and from the bifurcation to the *Rim*, referred to as *Rim trail*. The trail on the Around the Mountain trail (s) is referred to as *RTM-S trail*.

Figure 2.1 Quill National Park Map, showing the different trails on the Quill (STENAPA 2005).

2.2 Species profile – *Alsophis rufiventris*

The study subject is the *Alsophis rufiventris* (Basionym: *Dromicus rufiventris*), also known as the Black racer (Saba), Saba racer (Saba), Red-bellied racer or Orange-bellied racer (Daltry *et al.* 2016). *A. rufiventris* is a moderate size snake with a total length of usually under 1.0 m, but exceptionally large individuals may approach 2.0 m (Schwartz *et al.* 1991; Powell *et al.* 2005; Powell *et al.* 2016). Colours range from pale to dark brown and to grey and grey-brown. The dorsal side of *A. rufiventris* ranges from dark brown to relatively light shades of grey. This snake is sexually dimorphic. The males have black-bordered, yellowish blotches that transit into a broad, dark mid-dorsal stripe towards the posterior, while females have a series of middorsal streaks and smudges that fade towards the posterior (figure 2.2). Both males and females have a stripe that runs from near the nostrils through the eyes and onto the foremost scales of the back.

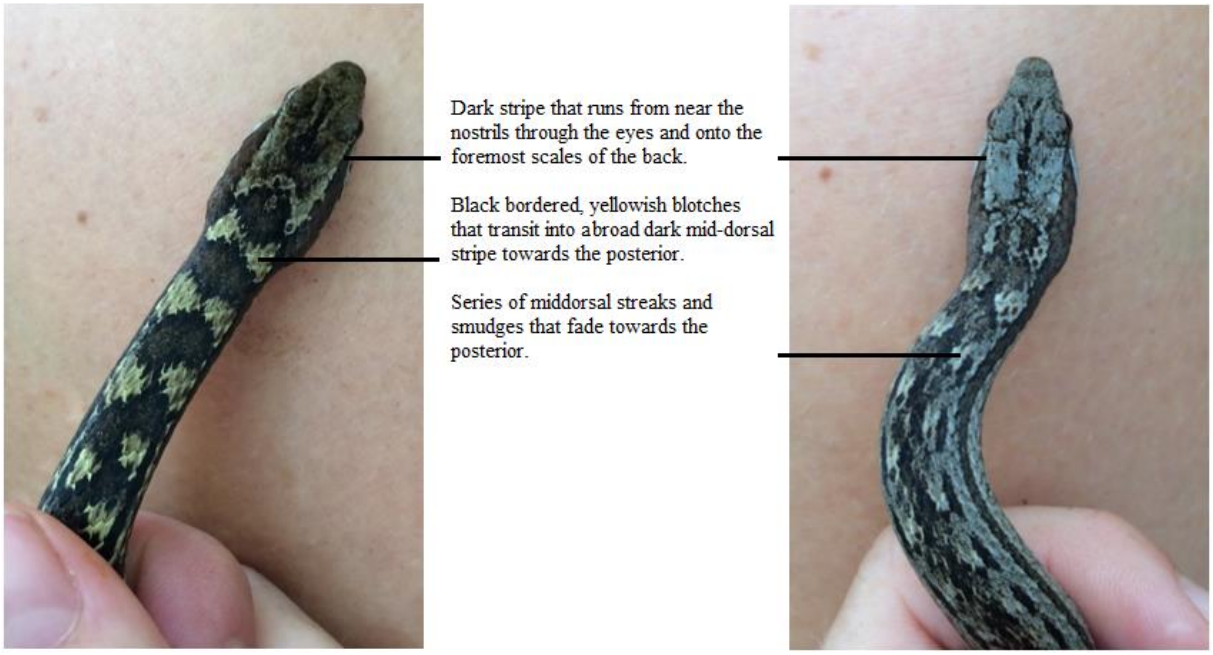

Figure 2.2 Sexually dimorphic differences of A. rufiventris. *Left male snake, right female snake. Colours of the snake can vary from dark brown to relatively light shades of grey.*

Nothing is known about the reproduction of the *A. rufiventris* in particular, but other species of *Alsophis* species are oviparous (egg laying) (Schwartz *et al.* 1991; Powell *et al.* 2005; Powell *et al.* 2016).

The snakes are most likely to be encountered early in the morning or in the latter part of the afternoon, as they are strictly diurnal and avoid the hottest times of the day (Henderson *et al.* 1991; Powell *et al.* 2005; Powell *et al.* 2016). During cool weather or in shaded areas, they can be observed basking in patches of sunlight (Powell *et al.* 2005; Powell *et al.* 2016).

A. rufiventris are active hunters, while hunting they move slowly over the ground, nosing into leaf litter, rocks or in logs, flickering their tong constantly in search of unwary prey (Powell *et al.* 2005; Powell *et al.* 2016). *A. rufiventris* is known to eat Woodslaves (*H. mabouia*), Island dwarf geckos (*S. sputator*), Johnston's Whistling tree frogs (*E. johnstonei*), Anolis species (*A. schwartzi* and *A. bimaculatus*), juvenile Iguana's (*I. delicatissima*), Red faced ground lizards (*A. erythrocephala*) and the eggs of these prey species (Powell *et al.* 2005; Debrot *et al.* 2013; Powell *et al.* 2016). The snakes are equipped with enlarged teeth at the rear of the upper jaw (Powell *et al.* 2005; Powell *et al.* 2016). These fangs contain a very weak venom which is hardly strong enough to kill a small frog or lizard. The snakes will chew on their prey in order to inject the venom into the bloodstream. When encountered by humans, they will either stay still or flee. If handled, they rarely attempt to bite (Powell *et al.* 2016).

2.3 Methods

The transects were walked with a consistent speed of about 3 km per hour, excluding the handling time of the snakes.

After a week's trial in September 2016, to establish when and how the snakes were best to be found and if the PIT tags could be placed without harming the snakes, the research was conducted approximately five days a week, from October 2016 to January 2017, between 0700 am and 1400 pm. All transects were walked every time, with a total of 61 times, over a period of over 245 hours of fieldwork (Appendix II).

2.3.1 Sexual dimorphism

The exterior of snake species often differs in colours and patterns, between males and females. The exterior of the *A. rufiventris* also shows dimorphic differences, though, it is sometimes hard to tell the gender just by the colours and patterns. It is known to most snakes species, that the ratio of the tail-body lengths differ too and is used to verify the gender, since males often have a longer tail than females (Goddard 1984). Therefor each snake was measured with a tape-measure from snout to vent (S-V), from vent to tail (V-T) and total length (TL) in cm (van Wagensveld 2015). IBM SPSS Statistics 20 was used to verify the difference in ratio of the tail body length between the genders. This was done using an *Independent Sample T-Test* after normality was tested.

2.3.2 Distribution and dispersion

In order to recognise every snake individually, all snakes were tagged with a PIT tag. The PIT tags were 10.9 x 1.6 millimetre, about the size of a rice grain (www.AUV.nl). The sterile needle containing the PIT tag had a diameter of 2 mm. Sterile gauze pads with Betadine were used to clean the skin before inserting the PIT tag. After cleaning the skin, the PIT tag was placed subcutaneously in the mid-body region on the mediolateral side of the body, the part of the body with the largest diameter. The needle was placed between two scales, where the skin is softer, to lower the damage caused by the needle. The needle was placed facing the posterior and the opening of the wound was closed by Krazy glue to prevent the PIT tag from falling out when the snakes slithered against objects. Krazy glue contains the same components (Cyanoacrylate) as skin glue (S. Veira, personal communication, 22 sept 2016). The ID-number can only be read when an external transponder is used at a maximum of five cm distance from the PIT tag (Camper *et al.* 1988). The signal energizes the transponder, which causes it to transmit the code back to the reader. The lifespan of the PIT tags is 15-20 years, making long term research possible.

In order to determine the home range of every tagged snake, each encounter was linked to GPS coordinates, date and time the snake was caught. ArcMap 10.3.1 was used to map the coordinates of all snake encounters.

To determine the sex ratio per transect, dots referring to males are blue, and dots referring to females are red. IBM SPSS Statistics 20 was used to examine if there was a difference in the distribution of males and females over the transects, using a *Pearson's chi-squared test.*

To determine the dispersion of the *A. rufiventris*, different colours were used to show the difference between first and reencounters of the snakes. First encounters are red, reencounters orange, second reencounters yellow and third reencounters green.

In order to show the dispersion of snakes that were encountered multiple times, a colour, shape and number was given to each individual.

3. Results

3.1 Normal distribution

No normal distribution was found in the collected data. The data remained non-normal, even after several transformations and deleting the outliers. Deleting these outliers made no difference to the outcome of the results and were therefore preserved in the dataset.

3.2 Body-tail length ratio

The mean total length (a = Total length) of both sexes differs significantly ($P < 0.05$). The mean total length of the males is 89.8 cm, differing 6.0 cm on average from the mean total length of the females, which is 83.8 cm.

The mean body length (b = Snout to vent) of both sexes, on the other hand, do not differ significantly ($P > 0.05$). The mean body length of males is 64.3 cm and 64.0 cm for females, differing only 0.3 cm on average.

The reason for the difference in total length is therefore due to the mean tail length (c = Vent to tail), that again does differs significantly between the sexes ($P < 0,05$). The males have an mean tail length of 25.9 cm, while the mean tail length of the females is just 19.8 cm. Leaving a mean difference in tail length of 6.1 cm.

When in doubt of which sex a certain snake belongs to, the tail length / total length ratio of males should be around 0.289 cm, while the ratio of females should be around 0.238.

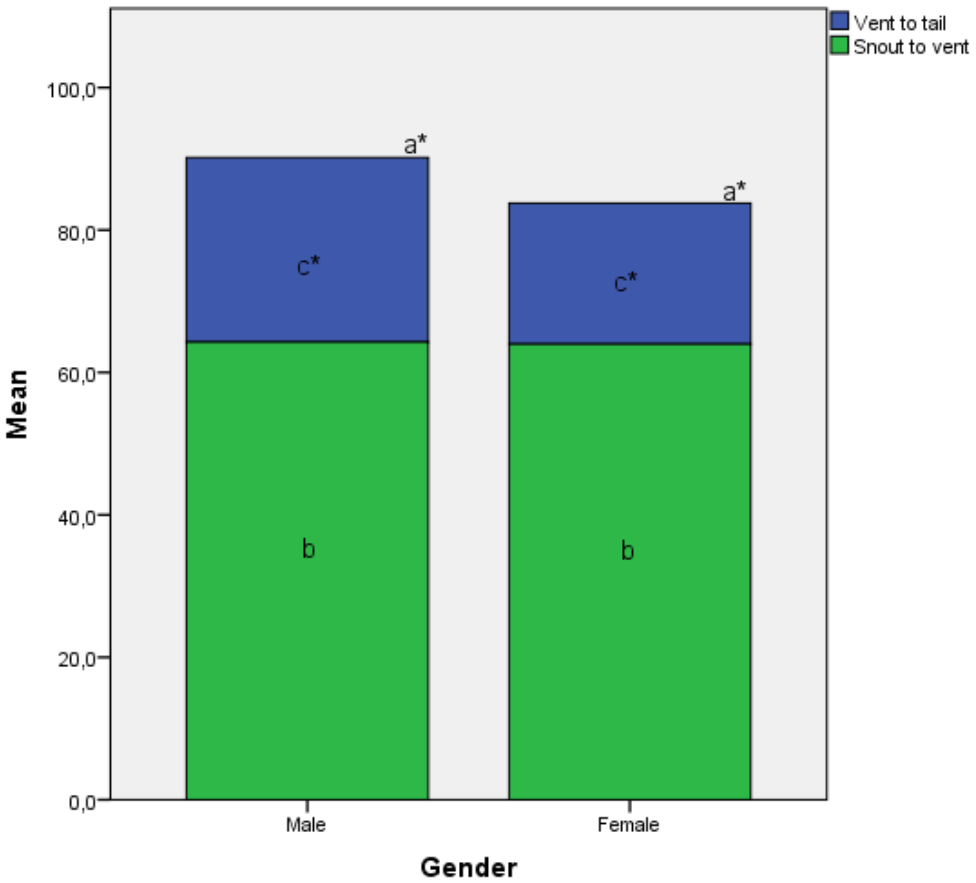

Figure 3.2 The mean total length (a = Total length), body length (b = Snout to vent) and tail length (c = Vent to tail) per gender. *Means within columns addressed by a letter, followed by an asterisk (*) are significantly different at P = 0.05.

3.3 Distribution

A total of 66 snakes were tagged: 34 males and 32 females (almost a 50:50 sex ratio) (figure 3.3). The Orange trail and Rim trail together measure the same length as the RTM-S trail alone (about 2 kilometres) and house 32 snakes. The RTM-S trail houses 34 snakes. The Orange and Rim trail together house significantly less ($P < 0{,}05$) males (13) than females (21), while the RTM-S trail houses significantly more males (21) than females (11).

The snakes on the orange and rim trail seem to be more clustered with gaps in between the clusters, especially the last steep section of the trail to the rim and a couple of sections at orange trail, while the snakes on the RTM-S trail seem to be more evenly distributed over the whole trail.

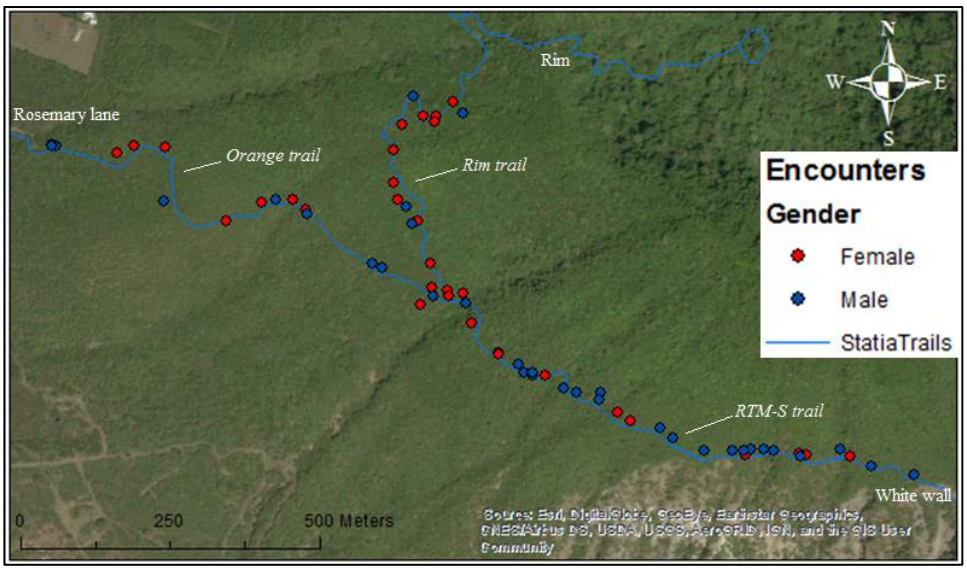

Figure 3.3 Number of tagged males (Blue, 34 individuals) and females (Red, 32 individuals) on the Orange, Rim and RTM-S trail.

3.4 Dispersion

When all encounters of the tagged snakes are displayed (figure 3.4.1), the sections without snakes remain, showing that there were no snakes found in these sections within this study's time period.

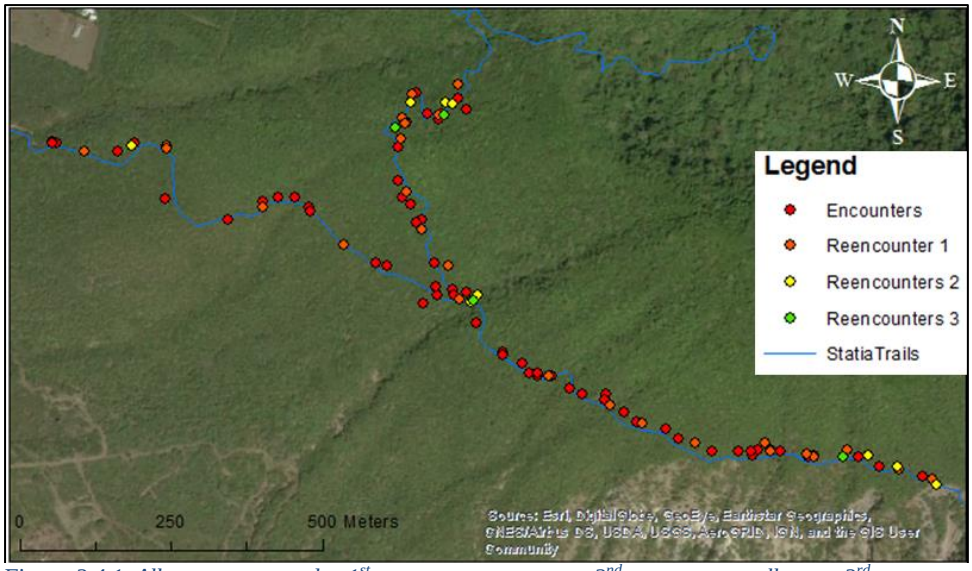

Figure 3.4.1 All encounters: red = 1st encounters; orange = 2nd encounters; yellow = 3rd encounters; green = 4th encounter.

Of all reencountered snakes, 9 snakes where caught at least two times after the initial tagging, 4 snakes where caught three times after initial tagging, over a 3 month period.

In these 3 months, all individual snakes were caught on different dates, within a 80 meter range of the place of initial tagging, exept snake number 5 (ID: 6862, blue octagon). This 85,9 centimeter long male, was caught about one kilometre from where the snake was initially tagged.

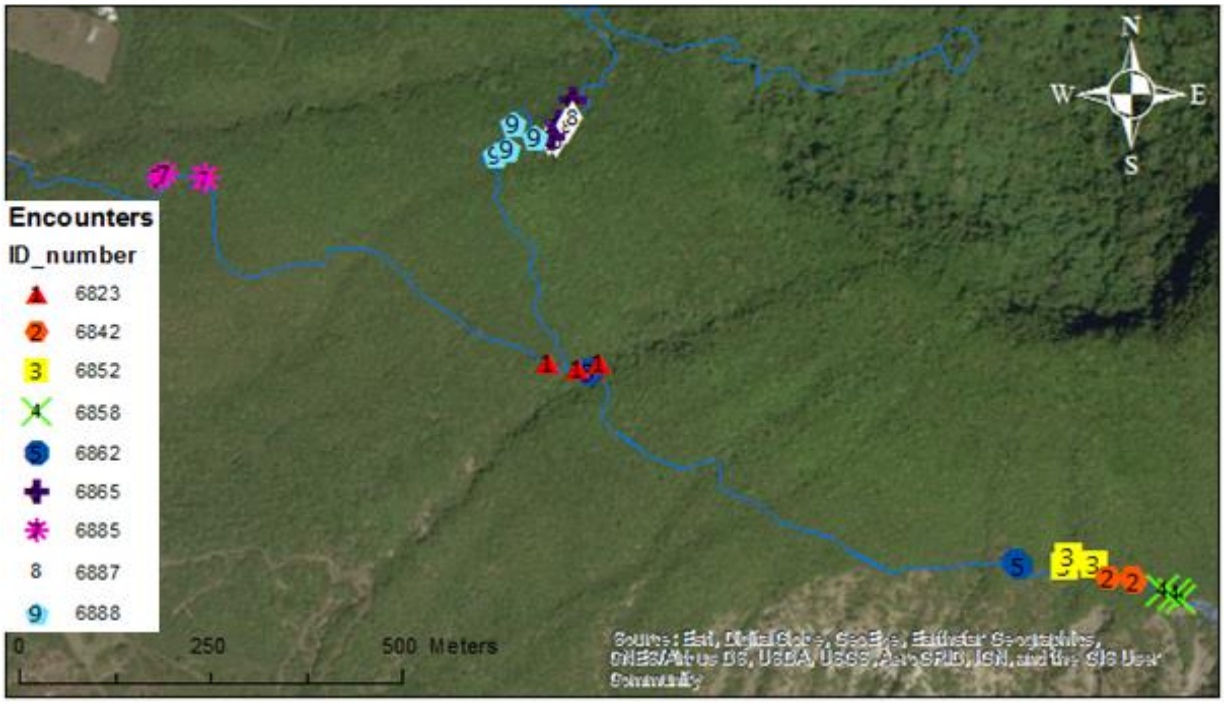

Figure3.4.2 The coordinates of all 9 snakes that were encountered at least 2 times after initial tagging.

3.5 Other findings

The behaviour of the *A. rufiventris* seemed to differ depending on sex. The males seemed to freeze when encountered by humans until touched, whereas females were more likely to flee as soon as they felt watched. Also females secreted a greenish, tallow-like substance with a strong odour coming from the vent, more often than males when handled.

Although there is no evidence that it is truly a snake egg, it seems that a female snake of 81.4 cm (ID: 6888) laid an premature egg (figure 3.5) while being handled.

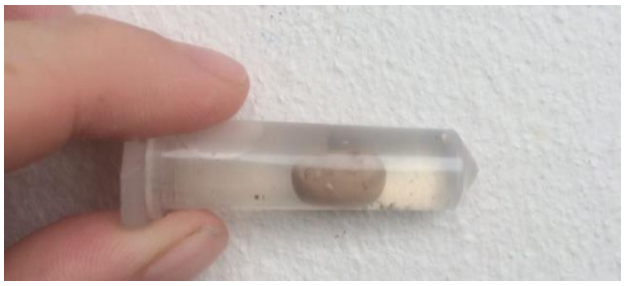

Figure 3.5 Possible A. rufiventris *egg, laid while handling.*

4. Discussion

Even though the mean body lengths of the different sexes of *A. rufiventris* differed only 0.3 cm, the mean tail length of *A. rufiventris* differed significantly. The mean tail length of the males is 6,0 cm longer than those of females. Therefore, when in doubt of which sex a snake belongs to, the tail-body length ratio can help verifying whether one is dealing with a male or female, without using invasive, slow or expensive methods like popping, probing and DNA-sampling. The body-tail length ratio of males should be around 0.289, while the ratio of females should be around 0.238. This correlates with the study of P. Goddard, who studied the tail-body ratio of the *C. austriaca* in southern Britain (1984).

Using this method, the sex of 66 individual snakes was determined on the trails on the west slope of the Quill. The sex ratio on these trails was about 50:50. It also showed that the females were mostly found on the Orange and Rim trail, while males where mostly found on RTM-S trail. This could be due to behaviour also seen in the Smooth snake (*C. austriaca*) (Arnold van Rijsewijk, personal communication, 5 January 2017). *C. austriaca* only tolerates males during breeding season. After which, she will protect her offspring, who she gives live birth to, by chasing the males away. In some cases this protective behaviour, during and shortly after the gestation period (caring of the eggs or offspring), can even lead to cannibalism to protect their youngsters (Drobenkov 2000).

For the development of the offspring during the gestation period, the females of the *C. austriaca* need sun, shelter, refuge and rest (Arnold van Rijsewijk, personal communication, 5 January 2017). If *A. rufiventris* has the same needs, whether the females are oviparous or viviparous, it could explain why two third of all females encountered on the west slope of the Quill, were encountered on the Orange and Rim trail. Whereas only one third of the females was encountered on the RTM-S trail. The Orange and Rim trail are covered with more low, bushy vegetation, leaf litter and shade from the thick canopy, providing shelter and refuge, while the RTM-S trail is more rocky, with only high trees, providing a bare, rough and steep landscape that might be less suitable for females during gestation (Díaz *et al.* 2004; Savit *et al.* 2005).

The vegetation and leaf litter alongside the trails could also explain why the distribution of the *A. rufiventris* on the Orange and Rim trail was more clustered than on the RTM-S trail. It could be that they were just as evenly distributed, but harder to locate in certain areas, due to the abundancy of shelter and refuge. Especially at the top of the Rim trail, where the tropical rainforest (leading to the inside of the crater) starts (Savit *et al.* 2005). The tropical plants cover most of the ground area around that section of the trail. This correlates with the personal experience of Arnold van Rijsewijk (5 January 2017). After searching for snakes in a set area with several specialists, they used a satellite tracker to locate the tagged snakes. It soon became clear that they missed snakes that were very close to where they walked, because they were hiding in low vegetation.

Within the researched timeframe, individual snakes were found several times within a range of about 80 m. This could mean that individual snakes have a certain home range or even territory. Only one of 9 snakes, encountered at least two times after initial tagging was found more than 80 m from initial tagging. Another snake species from the *Alsophis* genus, the Antiguan racer (*Alsophis antiguae*), which is closely related to *A. rufiventris*, has been tracked by radio trackers over a longer period (Daltry *et al.* 2017). It appeared that *A. antiguae* have a home range, but after tracking the snakes for a longer period, they seemed to be rather nomadic. This could indicate that *A. rufiventris* might also be nomadic. Long term capturing and recapturing could give more insight on this matter.

In conclusion, the tail-body length ratio of *A. rufiventris* can be used as a harmless and costless method to verify the gender of an individual, giving inside on the habitat preferences of both sexes. If the oviparity of this species can be confirmed by identifying the secreted egg, it could tell a lot about

the behaviour of the *A. rufiventris*. The species is widely distributed and does not seem to disperse widely in a three month period, but a long term capturing and recapturing could give more insight to this matter. Also radio trackers could tell more about where *A. rufiventris* find shelter (Daltry *et al.* 2017), but more field work in general will provide more inside about this species (J. Daltry, personal communication, 21 November 2016). Knowing more about the species will raise the chances of preventing *A. rufiventris* from extinction.

Literature

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Appendix I Permit for executing fieldwork on the Quill

St Eustatius, 4 October 2016

To whom it may concern:

Re: catching and PIT-tagging red bellied racer

Marieke Zobel, student at the HAS University of Applied Sciences in Den Bosch, the Netherlands, will be visiting St. Eustatius from 1 September 2016 – 6 February 2017 to perform her traineeship focussed on the red bellied racer snake.

We hereby give permission, after consultation with the local veterinarian Sharon Veira, to catch and PIT tag red bellied racer snakes in and outside the national parks. This permit doesn't give allowance to enter private property without consent of the owner.

Marieke is supervised by Hannah Madden (EcoPro) and Tim van Wagensveld (RAVON). Both have also permission of STENAPA to work with Marieke Zobel regarding this snakes research.

This permission assumes no snakes will be harmed during fieldwork and that all will be safely released back into the wild.
STENAPA and ms.Veira will receive both a copy of the final report.

Sincerely,

Clarisse Buma
Director St Eustatius National Parks STENAPA
St Eustatius, Caribbean Netherlands
manager@statiapark.org

STENAPA, National Parks Office, Gallows Bay, St Eustatius,

+599 318 2884 (phone/fax); manager@statiapark.org (email); www.statiapark.org (web)

Appendix II Data protocol fieldwork

Table II.a Example data collected from fieldwork first encounters.

ID	Date(1)	Time(1)	ID-number	Coordinates(x1)	Coordinates(y1)	Elevation (m) (2)	Trail(1)	Gender	S-V(cm)	V-T(cm)	T-L(cm)	Abnormailties
1	23-9-2016	08:26	5014	17,47297	-62,96744	-	RTM-S	Male	62,2	27,4	89,6	-
2	23-9-2016	09:02	5020	17,47181	-62,96369	-	RTM-S	Male	61,5	23,1	74,6	-
3	3-10-2016	08:29	6862	17,47172	-62,96328	340	RTM-S	Male	60,9	25,0	85,9	-
4	4-10-2016	10:26	6865	17,47683	-62,96875	331	Rim	Female	57,8	17,4	75,2	-
5	5-10-2016	07:50	6868	17,47311	-62,96753	293	RTM-S	Male	70,5	26,4	96,9	-
6	5-10-2016	08:18	6864	17,47267	-62,96628	269	RTM-S	Male	69,9	27,7	97,6	Very skinny
7	5-10-2016	08:36	6869	17,47214	-62,96539	301	RTM-S	Male	70,5	26,7	97,2	Bit skinny
8	5-10-2016	08:59	6870	17,47183	-62,96403	324	RTM-S	Male	55,1	23,1	78,2	-
9	5-10-2016	10:14	6867	17,47422	-62,96858	257	Rim	Female	59,6	17,4	77,0	-
10	5-10-2016	11:55	6866	17,47558	-62,96933	249	Rim	Female	57,8	17,7	75,5	-
11	7-10-2016	08:35	6889	17,47239	-62,96603	290	RTM-S	Female	65,6	21,0	86,6	-
12	7-10-2016	08:54	6886	17,47181	-62,96472	337	RTM-S	Male	58,6	26,2	84,8	-
13	12-10-2016	07:30	5018	17,47639	-62,97447	137	Orange	Male	73,0	30,2	103,2	-
14	12-10-2016	07:48	6885	17,47639	-62,97331	180	Orange	Female	70,8	20,6	91,4	-
15	12-10-2016	09:26	6887	17,47706	-62,96850	355	Rim	Female	64,5	18,8	83,3	-
16	12-10-2016	09:45	5034	17,47633	-62,96939	299	Rim	Female	68,1	20,4	88,5	Bruised skin several places
17	12-10-2016	10:11	5036	17,47417	-62,96836	268	RTM-S	Female	56,1	17,0	73,1	-
18	12-10-2016	10:32	5035	17,47294	-62,96711	298	RTM-S	Female	52,8	17,3	70,1	Bruised skin above vent

Table II.b Example data collected from fieldwork reencounters.

ID	Date(2)	Time(2)	ID-number	Coordinates(X2)	Coordinates(Y2)	Elevation (m) (2)	Trail(2)	Abnormality
15	23-11-2016	12:09	6887	17,47681	-62,96869	333	Rim	Chip healing nicely.
22	2-11-2016	09:30	6852	17,47172	-62,96275	380	RTM-S	-
31	29-12-2016	10:47	6888	17,47662	-62,96942	301	Rim	-
35	16-12-2016	10:34	6823	17,47405	-62,96827	271	RTM-S	Deceased after an hour.