

The effect of black rat *Rattus rattus* control on the population of the Antiguan racer snake *Alsophis antiguae* on Great Bird Island, Antigua

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SUMMARY

Following black rat eradication, the Antiguan racer *Alsophis antiguae* population on Great Bird Island increased by over 300% over the next nine years.

BACKGROUND

The Antiguan racer *Alsophis antiguae* is a harmless colubrid snake which used to be abundant throughout the Lesser Antillean islands of Antigua (and its many satellite islands) and Barbuda (total area of 440 sq km). It is an ambush predator, feeding mainly on lizards such as Watts' anole *Anolis wattsi*, spotted anole *Anolis leachi*, and Antiguan ground lizard *Ameiva griswoldi*. It is a diurnal, ground dwelling snake preferring habitat with dense canopy cover, undergrowth and an accumulation of leaf litter).

However, in the late nineteenth century the Asian mongoose *Herpestes javanicus* was introduced to Antigua in order to control the invasive black rat *Rattus rattus* which was destroying European settlers' sugar cane *Saccharum officinarum* crops. The mongooses had negligible impact on the rats, instead predated on the more easily captured endemic species, and decimating the Antiguan racer population. In 1936 H.W. Parker declared the species extinct on mainland Antigua. Antiguan racers persisted for a few more decades on some of the mongoose-free offshore islets, but by the 1980's, they were confined to a single islet, Great Bird Island, 2.5 km off the north-east coast of Antigua. This islet represents less than 0.1% of the species' original range. Awareness of the plight of the Antiguan racer was raised in 1991 in an article in the journal *Oryx*, and the species was listed by IUCN as Critically Endangered in 1996.

ACTION

Study site: Great Bird Island (9.9 ha in area) comprises of a variety of distinct macro habitats, including beaches, forest, grassland and cliffs. It is a coralline limestone island, with more than half of its area covered in dry littoral forest, with a maximum canopy height of around 6 m. The centre of the island is low-lying and sandy, sparsely covered with grasses, agaves and trees.

Antiguan racer surveys Initially, before non-native black rats *Rattus rattus* were eradicated (Daltry 2006a) in 1995, a six-week survey was undertaken on Great Bird Island to determine the status of the Antiguan racer *Alsophis antiguae*. The total number of racers was estimated by means of a mark-recapture method, using passive integrated transponder (PIT) tags to uniquely mark the captured racers. AVID™ PIT tags are slender encapsulated transponders that are injected under the skin about 2 cm anterior of the tail, using a hypodermic syringe. Each tag is encoded with an individual nine or 11-digit number that can be read by passing a hand-held scanner over the animal.

Searches for racers were conducted throughout the day, focusing on early morning and late afternoon. As many racers as possible were caught, marked and released, with the researcher attempting to search as much of the island as possible every day. Access was limited in some areas such as cliff faces. Body length, body mass, head size, scale counts, any unusual markings and sex were also recorded.

Six weeks later, the subsequent frequencies of recapture were used to calculate the population size using Begon's Weighted Mean estimator. Begon's Weighted Mean was considered appropriate because relatively low numbers of animals were caught daily (0 to 6), the population was closed (no emigration or immigration) and it was unlikely that there would have been births or deaths within the study period. In 1995, 43 different individuals were caught and marked for the first time.

One of the main tenets of almost all mark-recapture models is that all animals in the population have the same likelihood of being caught. Few individuals less than one year old are caught on Great Bird Island each year, however. Therefore juveniles are excluded from population size estimates which focus on adults and sub-adults only. Individuals recaptured within 48 hours were similarly excluded from the statistics. Antigua racers commonly spend long periods ambush hunting in a small area (thus remaining stationary or virtually so), and the same individual may be disproportionately counted several times in the same day.

It is important to note that the mark-recapture study was carried out at the same time as the first radio-telemetry study of this species. Five racers (two males, three females) were anaesthetized and surgically implanted with 4-g miniature transmitters (Holohil Systems Inc, Ontario). The telemetry study yielded vital information on the activity patterns and habitat preferences of this species which not only helped the researcher (J. Daltry) to learn where and how to find the racers more proficiently, but also demonstrated that racers are very active and wide ranging, such that the mark recapture method used should adequately sample the population.

CONSEQUENCES

Initial survey 1995: In 1995, a six week survey was undertaken on Great Bird Island to find out the status of the Antigua racer. Using mark-recapture techniques, the survey estimated the population size to be approximately 51 (\pm SE 7) adult and sub-adult racers, with a skewed male:female ratio of 1:1.8. Although mongoose-free, black rats were common and identified as a serious threat to the population (Daltry 2006a).

Annual surveys: Following the eradication of rats, the snake population quickly recovered,

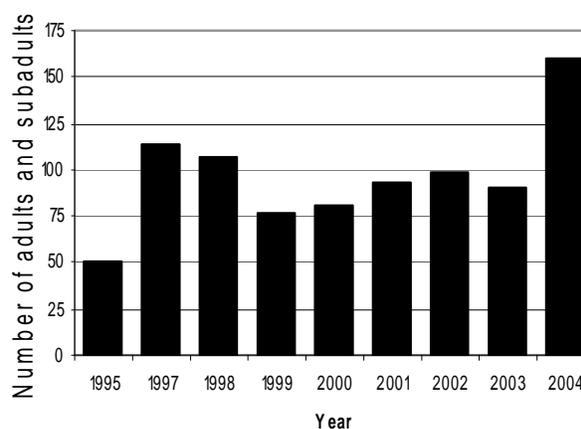


Figure 1. The Antigua racer *Alsophis antiguae* population size on Great Bird Island from 1995 to 2004.

more than doubling within 18 months. The population then declined in the late 1990s, suggesting that the snake population was limited by something other than rats. Figure 1, summarises numbers of Antigua racers on Great Bird Island from 1995 to 2004.

Factors limiting population growth: The Antigua Racer Conservation Project (ARCP) scientists perceived that a reduction in prey availability was limiting the size of the racer population. The large increase in snake numbers in the late 1990s had a negative impact on the racer's main food source: Watt's anole *Anolis wattsi* and the Antigua ground lizard *Ameiva griswoldi*. From 1995 to 1997, when the snake population was increasing, only 1.8% of all snakes examined (92 individuals) had protruding ribs and were thus considered underweight. By 1998 and 1999, this figure had soared to 17% (of 93 individuals weighed).

Further evidence that the racers on Great Bird Island were facing stiff competition for food can be seen from the response of individuals to being translocated to other islands where there were few other snakes and plenty of lizards. In all cases observed, even older racers underwent a dramatic growth spurt in response to a plentiful food supply.

In September 1998, there was severe flooding of the lower parts of Great Bird Island by the sea during Hurricane George, which was inferred to have killed up to 20% of the racer population.

Sex ratio: The sex ratio of the racer steadily improved to 1:1 by 1999, but recent surveys have found females to outnumber males. It appears that male racers do not live as long as their female counterparts, but the reasons for this discrepancy are unknown.

Ongoing monitoring: Subsequent annual surveys have been carried out to monitor the post rat eradication racer population. The use of PIT tags has enabled known individuals to be monitored for many years, providing valuable information about this species' growth and population dynamics. It is now known, for example, that racers can live for at least 10 years, their colour pattern changed dramatically with age, and old animals often suffer from warts and cataracts. Another startling finding has been that approximately 44% of the population dies every year, independent of age. This suggests that the racer population could crash very quickly if there were one or two poor breeding years.

Conclusions: Predation from rats was the primary threat to the endangered Antiguan racer on Great Bird island. The successful rat eradication was the first of a series of conservation activities to safeguard the future of the Antiguan racer. Not only has the racer benefited from rat eradication - the population more than doubling within 18 months - but other species on the island have also benefited.

The rigorous surveying on Great Bird Island revealed that it is likely that the racer population is limited by prey availability, and cannot sustain more than approximately 100 individuals. The need to enable the species to attain a more viable population size (i.e. at least 500 breeding adults) meant that further conservation efforts were required, including establishing more populations on islands within the racer's historical range.

A translocation program to other offshore islands has begun, with two new populations

reintroduced in 1999 and 2002 (see Daltry 2006b and 2006c for details of reintroductions to Rabbit Island and Green Island).

Publicity campaign: The ARCP has also implemented a successful publicity campaign and education programme run alongside the ecological work. Publicity initiatives have included: making television documentaries, hosting numerous field trips, signboards, postcards, posters, pamphlets, public slide shows, and newspaper articles. The very active education programme includes 'floating classroom' trips to the island, 'meet a snake' events, competitions, curriculum development and teacher training. Most Antiguan schools now have wildlife conservation established within their curriculum, and thousands of Antiguan have met or even handled a racer. In a recent questionnaire survey, 26% of independent visitors to Great Bird Island said they first heard about the racer through the education programme. Despite the increasing number of visitors to Great Bird Island (from 17,000 in 1994 to over 40,000 in 2005), the number of incidents of racers being killed by visitors has dropped.

REFERENCES

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