Department of Environment
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Population assessment of the Sister Islands Rock Iguana (*Cyclura nubila caymanensis*) in Little Cayman – March 2025 Survey update

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Introduction

The Sister Islands Rock Iguana (*Cyclura nubila caymanensis*) is critically endangered due to habitat loss, invasive mammal predation, and mortality from car collisions along roads (Goetz & Burton, 2012). The Little Cayman population of *C. n. caymanensis* has been monitored since 2014 using distance sampling and repeated count methods. Recent invasive mammal control efforts have removed 176 feral cats, which predate primarily on hatchling rock iguanas, across seven sessions between June 2022 and May 2024 as part of a feral cat management plan for Little Cayman (~ 26 sq. km.). Here we report on the population trends and age class distribution of *C. n. caymanensis* since 2014.

Field methods

This survey is designed to monitor trends in the population size over time, with planned surveys originally occurring every two years in November depending on fair weather. However, since 2022, the survey frequency has increased to an annual cycle, and in 2024, the survey period was adjusted to February–March to optimize data collection. The change is frequency of surveys was due to ongoing cat control and the desire to obtain more frequent results to monitor the impacts of the control program on the iguana population. The change in survey date from November to February – March was done to avoid the rainy season (July – November) which frequently interrupted previous surveys. The November date was originally chosen to survey immediately after the hatchling emergence (August – November), however, we have found that hatchlings are still active in February – March. There is also a very reduced risk of prolonged rainy periods in February – March compared to November. The trade-off between having clear weather and being close enough in time to the hatchling emergence favored the change to survey the February – March going forward.

The most recent survey was conducted from 4 – 14 March 2025. Two teams of two people each surveyed 118 transects across Little Cayman. Each transect is 200 m long and is grouped into segments

to allow for efficient movement between transects during the survey. In total, there are 27 segments, with each line within a segment spaced a minimum of 80 meters apart, and each segment spaced a minimum of 200 meters apart from nearest other segment, but typically much further apart. Each transect was repeated between two to four times each survey (twice only in 2014-2015, three to four in 2019 – 2025). Teams visited transects on a staggered schedule rotating between the west, central, and eastern regions of the island, using the three cross-island roads to dissect the island into regions. This survey schedule was made to ensure there was a spread in dates and times when transects were visited. Observers recorded the distance to each SIRI detection made on transect, the age of the iguana (hatchling, under six months old; sub-adult, one to three years old; and adults, more than three years old), along with detection and site covariates.

Statistical methods

The analysis in this report is to estimate density, abundance and age class distribution using distance sampling, repeated count models and descriptive statistics. The distance between the line transects and detected rock iguanas was used to estimate the detection probability (P_d) and density using distance sampling methods (Buckland et al., 2001). Repeated visits to transects were used to estimate availability given detection (P_{da}), or the temporary emigration of animals from the sampling area, using occupancy models (Chandler et al., 2011). Availability was derived by dividing P_{da} by P_d to give P_a, we propagated the variance of the ratio of these two parameters using the delta method (Lye & Hirschberg, 2018). The availability estimate was used as a multiplier in the best fitting distance sampling model, which adjust the density estimate to account for the temporary emigration of animals during the survey period. Model selection was done using AIC scores and goodness-of-fit test.

The number of individuals in each age class seen on each repeat during a survey was used to calculate the average proportion of each age class for each year and its standard deviation. This simplified analysis of age class distribution over time was done due to the limited number of observations for individual age classes between 2019 – 2025 which precludes estimating age class specific densities in a distance sampling model. Despite this limitation the survey design, survey effort, and detection probability have remained similar each survey allowing for direct comparisons.

Standard T-test were used to test for significant differences between population size estimates each year and age-class estimates each year, respectively. All analyses were done in the R programming language using the ‘Distance’ and ‘unmarked’ libraries (Fiske & Chandler, 2011; R Core Development Team, 2014; Miller et al., 2017).

Results

Model selection & Goodness of fit tests:

The data was truncated at 25 meters and the covariate with iguana behavior, categorizing stationary or responsive movement, was included in the final model based on AIC scores, with a higher detection probability for stationary animals versus animals detected by responsive movement. This is due to the nature of responsive movement detections, where iguanas close to the line but are hidden from sight by vegetation but as the observer approaches, the iguana responds by moving away triggering the detection very close to the line. This results in a lower detection probability compared to stationary animals that are typically seen at a wider range of distances.

The distance sampling data did not pass the goodness-of-fit test (χ^2: P-value = <0.001) due to the spike in the 0 – 5 m distance bin which the half-normal model underfits (Figure 1). This is likely due to the large number of hatchlings detected this year which are typically seen at short distances from the line. Other detection functions failed to model the data appropriately, they overfit the spike in 0 – 5 m and inflated density estimates, so the half-normal model was chosen as the most suitable model for this data. The repeated count data was a good fit for the occupancy model ($\hat{C}$ = 0.85, χ^2: P–value = 0.61).

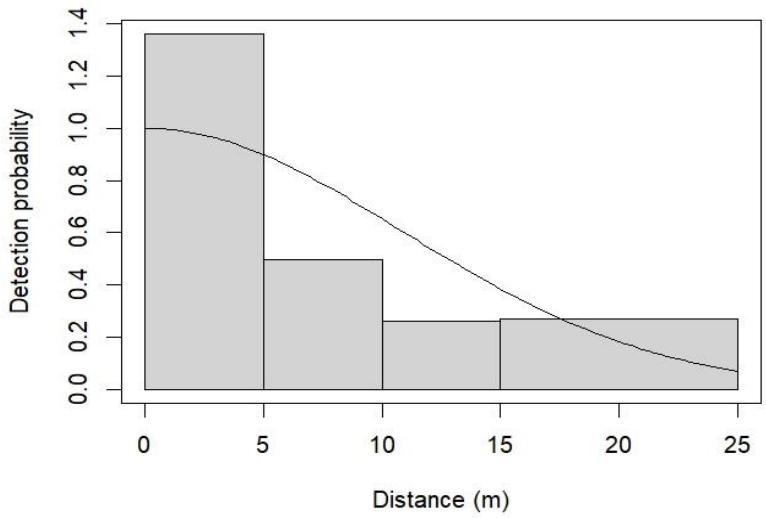

Figure 1. Detection function for the 2025 survey with truncation distance at 25 meters.

Detection & availability probabilities:

The detection probability has been variable between 0.4 and 0.7 over the years, with 2025 being near the mean detection probability (mean P_d = 0.53) (Table 1). The availability probability has increased the last three years and is now at its highest level since the survey began indicating that the iguanas are now being seen more regularly during the survey compared to the lows of 2019 and 2022 (Table 1).

Table 1. Detection and availability probability estimates from the Sister Islands Rock Iguana surveys on Little Cayman 2014 - 2025.

Year	Detection Probability (P_d)	P_d Standard Error	Availability Probability (P_a)	P_a Standard Error
2014	0.4	0.04	0.87	0.03
2015	0.67	0.07	0.83	0.03
2019	0.47	0.04	0.62	0.06
2022	0.63	0.08	0.64	0.08
2023	0.51	0.04	0.73	0.06
2025	0.49	0.02	0.94	0.03

Population size estimates:

The estimated population size of *C. n. caymanensis* in Little Cayman in 2025 was the highest recorded since we began surveying the population in 2014 (Table 2). The population was significantly higher than estimates between 2015 – 2023 (P–values < 0.001; Table 2). The population is now at a similar size to when we first started surveying in 2014 (t–test = 0.16, P–value = 0.9; Table 2). From the lowest population estimate in 2022, which was done three months before the start of the feral cat control program, the 2023 estimate represented an 83 % (95% CI = 75 – 92) increase in population size. The 2025 estimate further builds on the increase observed in 2023 with an additional 91 % (95% CI = 84 – 97 %) increase in population size.

Table 2. Population estimates from the Sister Islands Rock Iguana surveys on Little Cayman 2014 – 2025.

Year	Mean	Standard error	Coefficient of variation	2.5% Confidence Interval	97.5% Confidence Interval
2014	3487	757	0.22	2153	5123
2015	2915	576	0.20	1966	4135
2019	1928	437	0.23	1127	2865
2022	1000	257	0.26	550	1578
2023	1834	372	0.21	1168	2583
2025	3501	572	0.16	2472	4708

Age-class distribution estimates:

The average proportion of hatchlings seen during the survey increased by 8.2% (95% CI = -4 – 21%) in 2025 compared to 2023 but the increase was not significant (T–test = 1.6, P–value = 0.16; Table 3). However, the 2025 estimate builds on the significant increase of 21% (95% CI = 11 – 31%) in the hatchling proportion observed in 2023 when compared to 2022 (T–test = -5.22, P–value < 0.005; Figure 2). The 2025 hatchling proportion was significantly higher than the proportion of hatchlings seen in every other year 2014 – 2022 (P–value < 0.05) and represents the highest hatchling proportion observed to date.

The average proportion of sub-adults in 2025 increased significantly by 17 % (95% CI = 14 – 20%) compared to the estimate in 2023 (T–test = 14, P–value < 0.001) and when compared to 2019 and 2022 (P–value < 0.001). The 2025 estimate is similar to the estimate in 2015 (T–test = 0.98, P–value = 0.36) but significantly lower than the high estimate in 2014 (T–test = -2.96, P–value = 0.02).

Because the proportion of sample metric is a relative one the increases observed in the hatchling and sub-adult populations have caused the adult proportion to decrease. This does not indicate that adult population is declining but rather it represents that they now make up a smaller amount of the total population relative to sub-adult and hatchling age-classes.

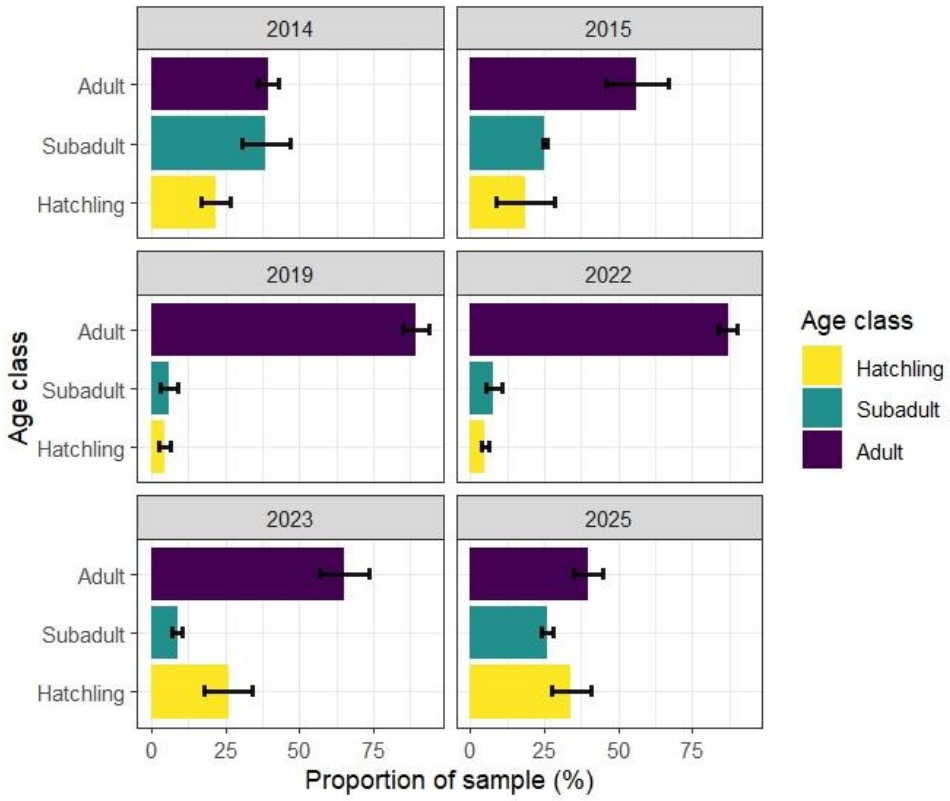

Figure 2. The age-class distribution of animals observed during surveys from 2014 – 2023 shown as the average proportion and standard deviation of each age class for each survey year.

Table 3. The average proportion of each Sister Islands Rock Iguana age class and its standard deviation on Little Cayman 2014 – 2023.

Year	Average Hatchling Proportion (%)	Hatchling Proportion S.D. (%)	Average Sub-adult Proportion (%)	Sub-adult Proportion S.D. (%)	Average Adult Proportion (%)	Adult Proportion S.D. (%)
2014	21.9	4.9	38.7	8.3	39.4	3.4
2015	18.6	10	25.1	0.7	56.3	10.8
2019	4.5	1.8	6.1	2.9	89.4	4.4
2022	5	1.3	8	2.8	87.1	3.3
2023	26	7.9	8.7	1.6	65.3	8.3
2025	34.2	6.5	26.1	1.9	39.8	4.9

Conclusions and recommendations

The increase in the hatchling and sub-adult age classes in 2025 continues to provide evidence that reducing the feral cat predation pressure through removal trapping in 2022 – 2024 has had a positive impact on hatchling survival in the 2023 & 2024 hatchling emergence seasons (Figure 2). The resultant increase in the sub-adult age class observed in 2025 indicates that survival rates of hatchlings from 2022 and 2023 remained high and supported the growth of the sub-adult age class over that time (Figure 2). These increases in the younger age classes are also reflected in the significant increase in population size in 2025 compared to 2015 – 2023 (Table 2; Figure 3). Indicating the increase was primarily driven by the younger age classes observed in this year's survey. Similarly, the availability increased from the low points in 2019 – 2022, corroborating that individuals were more available for detection during the 2025 survey (Table 1). Together these results highlight the inherent capacity of the population to recover when predation pressures on hatchling age-class are reduced and a significant rebound in the population of *C. n. caymanensis* in Little Cayman to the highest mean estimated population size since the survey began.

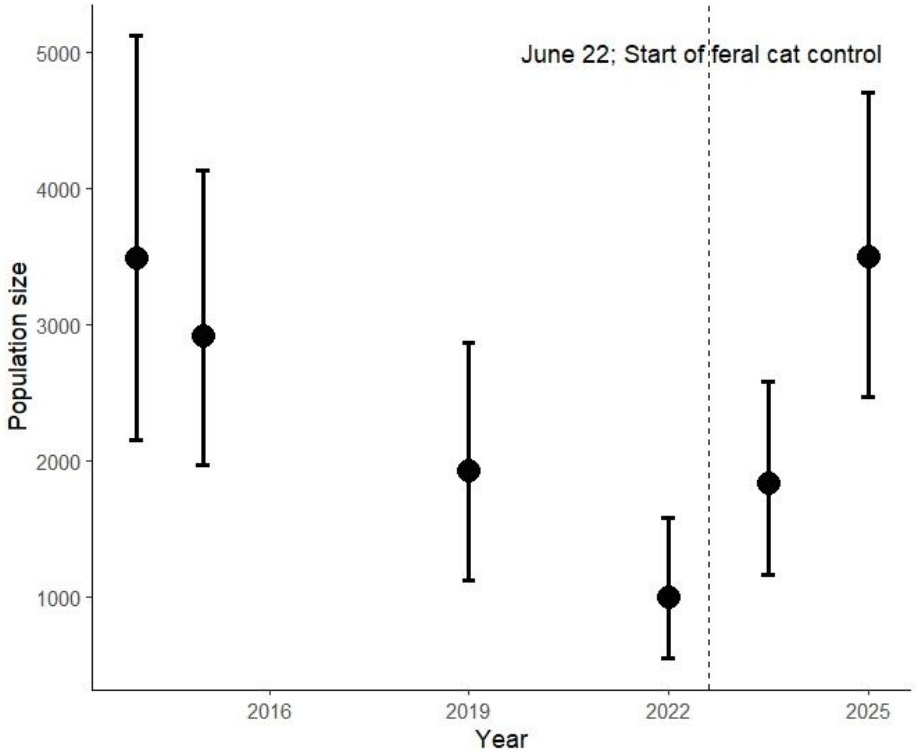

Figure 3. Population estimates of the *C. n. caymanensis* population in Little Cayman from 2014 – 2025. Points are mean estimates and error bars represent 95% confidence intervals.

It is important to note that the 2025 survey was done in March due to poor weather conditions in the originally scheduled November 2024 survey period while the 2014 – 2019 and 2023 surveys were all done in November. There is a possibility that hatchlings would be less available for detection in March compared to November when they are just emerging from their nests. Another possible effect of the change is that the weather is more favorable in March compared to November which could positively impact the availability for detection of all age-classes. These two factors could interact to influence the availability of iguanas for detection in different ways, but we believe these impacts are minimal and at worst would result in less hatchling detections in March when compared to November. However, the 2022 survey was also completed in March, three months before we began feral cat control, and marks the low point in the population estimates to date allowing for a direct comparison point for the 2025 survey. We have decided to move the survey to February – March period going forward to avoid any further confusion given that hatchling detections are still high in March and the weather is more reliable.

There is still a population of feral cats in the wild of Little Cayman and in Cayman Brac, where the only other population *C. n. caymanensis* is found; continued management of this threat on both islands is necessary for the continued increase in the younger age classes and the long-term viability of the overall population size. We should continue to monitor the population of *C. n. caymanensis* in Little Cayman every year and use the estimates to inform conservation management decisions.

Acknowledgements

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