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"Sapphire" is one of the Queen Elizabeth II Botanic Park's most beautiful and most prolific female Blue Iguanas.

Restoring a New Wild Population of Blue Iguanas (*Cyclura lewisi*) in the Salina Reserve, Grand Cayman[1]

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Photographs by the author except where indicated.

Abstract.—Twenty-three immature Grand Cayman Blue Iguanas (*Cyclura lewisi*) were released into xerophytic shrubland in the Salina Reserve on Grand Cayman in December 2004. After seven months in the wild, at least 91% had survived, remained in the release areas, and grown. The iguanas are expected to reach sexual maturity by 2006. The females were occupying average usage areas of approximately 0.6 acres in summer 2005, very similar to the summer usage areas occupied by much older, mature females in the QE II Botanic Park. The maximum viable population density for this age class in this habitat is estimated to be between 4 and 5 iguanas/acre. The existing release area is just sufficient to accept the next release of 60–70 two-year-old Blue Iguanas, scheduled for December 2005. One concern is that these iguanas may instinctively leave the reserve to seek historic nesting habitat on the adjacent coast, where vehicular traffic is now a severe threat.

Key Words: *Cyclura lewisi*, Grand Cayman, Blue Iguana Recovery Program, Reintroduction, Restocking, Conservation

Burton (2004) wrote of the Blue Iguana Recovery Program's transition from successful pilot projects, to large-scale population recovery for the Grand Cayman Blue Iguana (*Cyclura lewisi*). Since then, 21 young Blue Iguanas have become established in the Salina Reserve on Grand Cayman, and thanks to strategically targeted grants and a truly impressive roster of international volunteers, we now know a great deal about how they are doing.

The Salina Reserve is a 625-acre protected area, owned and managed by the National Trust for the Cayman Islands. It is a very wild, inaccessible place, and exceptionally rich in natural diversity, mainly because it encompasses a wide range of different environments. The reserve is named for a large sedge wetland in its southern environs, a habitat somewhat reminiscent of Florida's northern Everglades. In the dry season, a cyanobacterial mat dries out to leave a pale crust that could be mistaken for salt. To the east and west, the sedge wetland transitions to seasonally flooded Buttonwood shrubland. To the north, the land rises and an almost pristine semi-deciduous dry forest cloaks a low ridge of savage dolostone karst terrain. Here are nesting parrots, bats roosting in caves, and rare trees thriving in a community that has been evolving together for millions of years.

North of the dry forest is the area of the Reserve that we believe once supported Blue Iguanas. Here the lower terrain supports the characteristic xerophytic shrubland of Grand Cayman's east end. This too is a highly diverse natural community that is in many ways quite distinct from the dry forest. For iguanas, it meets several critical needs. The shrubland canopy is low (often less than 10 ft) and open, allowing sun to reach the ground — vital for Rock Iguana thermoregulation. The karst offers a huge array of rock holes, providing potential retreats for iguanas of all sizes. The diverse vegetation provides a variety of food, sinkholes offer access to fresh groundwater, and here and there among the expanses of razor-sharp karst are soil basins where iguanas could nest.

We already knew that the Salina's xerophytic shrubland could support iguanas. In the early 1990s, we tested this point[1]. Three sterilized *C. lewisi* / *C. nubila caymanensis* were the "guinea pigs." We released and radio-tracked them for about six months, during which time they set up territories, found retreats, fed, and grew. While we were watching these temporary pioneers, a wild, true blue hatchling migrated in from who knows where, settled a while, then disappeared.

Since then the Blue Iguana Recovery Program has been focusing on establishing a small wild population of Blue Iguanas in the QE II Botanic Park. By 2004, that work had progressed so well that the Park was close to its carrying capacity for Blues and the time had come to embark on a larger-scale release in a new area. The Salina Reserve was the obvious choice.

The Release

Before we could monitor released iguanas in the Salina, we needed some sort of access. This was no trivial issue — the only 'trails' were the reserve's overgrown boundary cuts and the almost

[1] National Trust for the Cayman Islands, Annual Reports for 1993 and 1994. Grand Cayman, Cayman Islands.

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Dry shrubland of the Salina Reserve, Grand Cayman, with the Salina wetland in the background.

Agave caymanensis, an endemic succulent, is a characteristic species of Cayman's dry shrubland environment.

vanished remnants of our 1993–4 study site paths. Now, after careful examination of aerial photography, and an IRCF-sponsored helicopter survey flight, we had three main soil areas from which to choose, and no trails to two of those. This turned into a marathon trail-cutting exercise, with then-volunteer and now Blue Iguana Warden, Chris Carr, helping me through the summer of 2004. As we approached the target release date in September, student Nick Louis and the Durrell Wildlife Conservation Trust's Matt Goetz joined the team, and we finished a trail network to the northern and central soil zones.

At the same time we needed to build release retreats, wooden "iguana houses," which had recently proven themselves to be extremely successful in anchoring young iguanas to their release sites in the Botanic Park. Again with help from local volunteers, notably Chris Carr and Penny Clifford, 23 hefty release retreats were ready to be placed in the Salina Reserve. We planned to lift them there by helicopter.

Then Hurricane Ivan slammed the island, and suddenly all thought of work in the Salina had to give way to coping with crisis. That somber story has been told elsewhere, but from those difficult times the program has found its feet again and, thanks to truly amazing support from all quarters, we were able to resume the release plan in December.

The helicopter was 'Ivanized," so we had to backpack the retreats in, one by one. By the beginning of December, everything was ready and our first team of trackers was standing by. Late in the afternoon of 4 December, we carried the first 13 young iguanas into the north and central soil zones of the Salina Reserve and placed each one into its designated release retreat. These were the females, which we released first in order to allow them to set up territories before having to deal with males. Initially nervous at the sight of the dark tunnel, each iguana hesitated, half in hand, half in the retreat, then scrambled deep inside. The daylight was fading, and we knew from experience that they would all remain in the retreats overnight.

Each iguana was fitted with a PIT tag, a unique bead tag, and a tiny 2-gram radio transmitter glued to the back near the tail. Starting on 6 December, the tracking team began their routine, which continued almost without interruption until 17

Wooden iguana retreats stacked and ready to be backpacked into the Salina Reserve.

Two-year-old *Cyclura lewisi* being introduced to an artificial retreat.

January 2005. The males went out on 28 December, bringing the total release to 23.

Seven days a week, one tracker went to the north zone, another went to the south. Each one used radio-tracking gear and an array of other sleuthing techniques, to locate every iguana about once per hour. We recorded their positions by estimating distance and compass bearing from previously mapped fixed points or new GPS locations. By the time the tracking team went home, we had 6,399 separate observations of iguanas in specific places at specific times. We then took the radio

TEAM BLUE

The program's permanent staff was assisted throughout by a rotating team of volunteers and professional assignments, primarily from overseas. The International Reptile Conservation Foundation took the lead role in recruiting and coordinating this essential human resource. The project teams were as follows:

Blue Iguana Recovery Program staff:

Frederic Burton
Samantha Addinall
Chris Carr

Habitat survey, summer 2004:

John Binns - IRCF

Salina release team, December 2004–January 2005:

Andrew Grant
Craig Pelke, Milwaukee County Zoo
Desiree Wong, IRCF
Janice Blumenthal, Cayman Island Department of Environment
John Bothwell, Cayman Islands Department of Environment
John Kunna
Jude Bryja, Houston Zoo
Robby Addinall
Sarah Doty, IRCF
Tandora Grant, San Diego Zoo / CRES

Team Blue 2005, fieldwork April–July 2005:

Ae Nash, Colorado Reptile Humane Society
Amanda Stenman
Barbara Watkins
Brian Carson
Coralie Farren, Reading University, UK
Desiree Wong, IRCF
Emily Holfeldt
Erika Delgado
Gaby Besne
Janice Gerritts, National Zoo, Washington DC
Janie Coleman
JeffreyAckley
Joel Kuhns
Jude Bryja, Houston Zoo
Karin Nelson
Lorraine Scotson
Matthias Goetz, Durrell Wildlife Conservation Trust
Nick Louis
Paul Watler
Tandora Grant, San Diego Zoo / CRES

Ae Nash, Coralie Farren and Lorraine Scotson examine an iguana in the northern release zone.

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The Salina Reserve: Xerophytic shrubland and artificial retreat.

BLUE IGUANA SUPPORTERS HONOR ROLL

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International Reptile Conservation Foundation
International Iguana Foundation

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Accommodation for the teams was donated by Roger and Mary Bumgarner and Frederic Burton. Transport assistance was provided by Nigel and Penny Clifford.

The Blue Iguana Recovery Program operates under the auspices of the National Trust for the Cayman Islands, with local and international partners. The Trust provided hospitality and other support throughout.

transmitters off, weighed and measured each iguana, and let them free to live their lives without observers.

In May, we caught them again and, after another weighing and measuring session, we glued on the radio transmitters once more and tracked the iguanas from 13 May to 25 June. Another 4,157 observations went into the huge database, another batch of boots was destroyed, and another team of scratched, bruised, and bitten volunteers headed triumphantly home. Now the iguanas are living free and unmolested, and the time has come to assess the huge mass of information we gathered and to draw some conclusions.

Survival and Growth

The most conspicuous observation resulting from our winter tracking data was that the released iguanas were very slow to move away from their retreats. The vast majority of observations recorded iguanas in, on, or very near the retreat into which they were released. After many weeks, some individuals moved into new retreats; by the end of the winter tracking, six had abandoned artificial retreats in favor of rock holes or tree holes.

The wild card was the male, bead-tagged Orange-Pale Blue-Pale Blue (OPP). From the day he was released, OPP was a loner and a wanderer. Over the winter tracking period, he gradually drifted north and eventually left the Salina Reserve altogether. I caught him in late January, and re-released him in the central zone, where he was sure to encounter other iguanas. By summer, he had moved off again, and we have not seen him since.

Jude Bryja (Houston Zoo) with radio tracking equipment.

JUDE BRYJA

A pair of released two-year-old *Cyclura lewisi* courting.

By summer, another male (Green-Red-Green, GRG) also had disappeared. We do not know if he migrated away or if he died. Apart from those two, however, all of the iguanas we released were seen at least once in the summer, so we know we have at least a 91% survival rate in the seven months after release.

The iguanas almost all lost weight in the two months after release, as they adjusted to life in the wild and faced the dry season. By May, the trend had reversed and the iguanas grew vigorously through the summer — so much so that they all shed their old skins — with radio transmitters attached! Fortunately,

by this stage they were so used to their trackers that we managed to recapture them to re-glue the transmitters.

The other big change from the winter was that the iguanas were now far more adventurous. Their "usage area" (a measure of their home range over the periods during which we tracked them) was about sixteen times as large in the summer compared to the two months after release. This was as true of females as it was for males, so this was not just the typical expansion in usage area we normally see in males during the breeding season.

Examining the patterns of land use by the iguanas, we found that they had discovered one resource we had not realized was so important. Scattered around the release areas in the rocky shrubland, the scrambler "Yellow-root" (*Morinda royoc*) sometimes grows into impressively large, tangled masses. These "Yellow-root bushes" are all visited regularly by the iguanas, indeed the little male WOW makes a journey every day from his retreat in the central zone to a Yellow-root bush some 70 yards away. He is commuting for food. The iguanas eat the Yellow-root leaves and also the fruits, which soften, turn translucent, and (to human noses) start to smell distinctly unpleasant as they ripen and fall. The dense tangle also is a safe place to hide, and it provides convenient shade in the heat of the day.

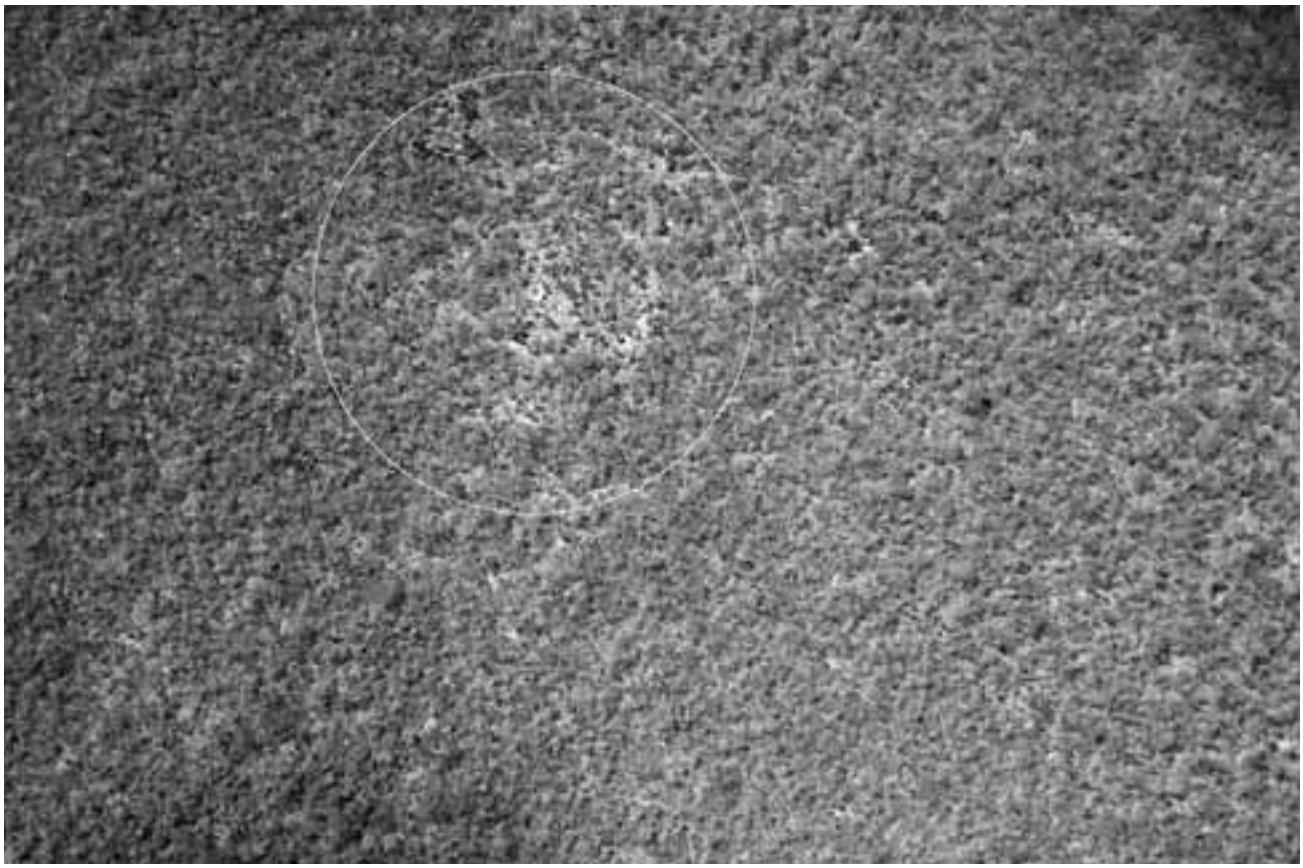
They survived, discovered and claimed their surroundings, and grew, but this year, despite all the courting we saw, the released Blues were not quite big enough to reproduce. Everything looks to be on course for these iguanas to nest for the first time in 2006.

Land Use

One key question underlying this study is one we have been asking for years: How much protected, managed iguana habitat is going to be needed to support at least 1,000 wild Blue Iguanas? This question will have to be answered in stages. We started getting hard facts about Blue Iguana population density with Rachel Goodman's research (Goodman et al. 2005) on the released population in the QE II Botanic Park. With this summer's tracking data, we have another piece to fit into the puzzle. The pattern that seems to be emerging is that the females establish and maintain small, stable home ranges, which do not seem to get much bigger as they age and grow. They seem to defend even smaller, exclusive territories, and overlap with their neighbors in the rest of their range. In contrast, the males occupy larger and larger home ranges as they grow. Because the sex ratio remains around 1:1, this means that mature male home ranges overlap much more than those of females.

The immature females in the Salina, the much older ones in the Park, and even one totally wild female we monitored in the eastern interior this year are all occupying average summer usage areas of about 0.6 acres. In the Salina, the centers of their core territories have settled down at an average closest-neighbor spacing of 112 ft.

Using these female core territories as a guide, we think we can roughly double the number of females in the Salina release areas that are already somewhat occupied. To maintain the even sex ratio, that means doubling the number of males as well. The



Aerial view of the Salina's northern release zone. The circle indicates the area of soil patches where the release took place.

iguanas seem to be telling us that, in this habitat, they can accept between four and five two-year-old iguanas per acre.

Implications for the Future

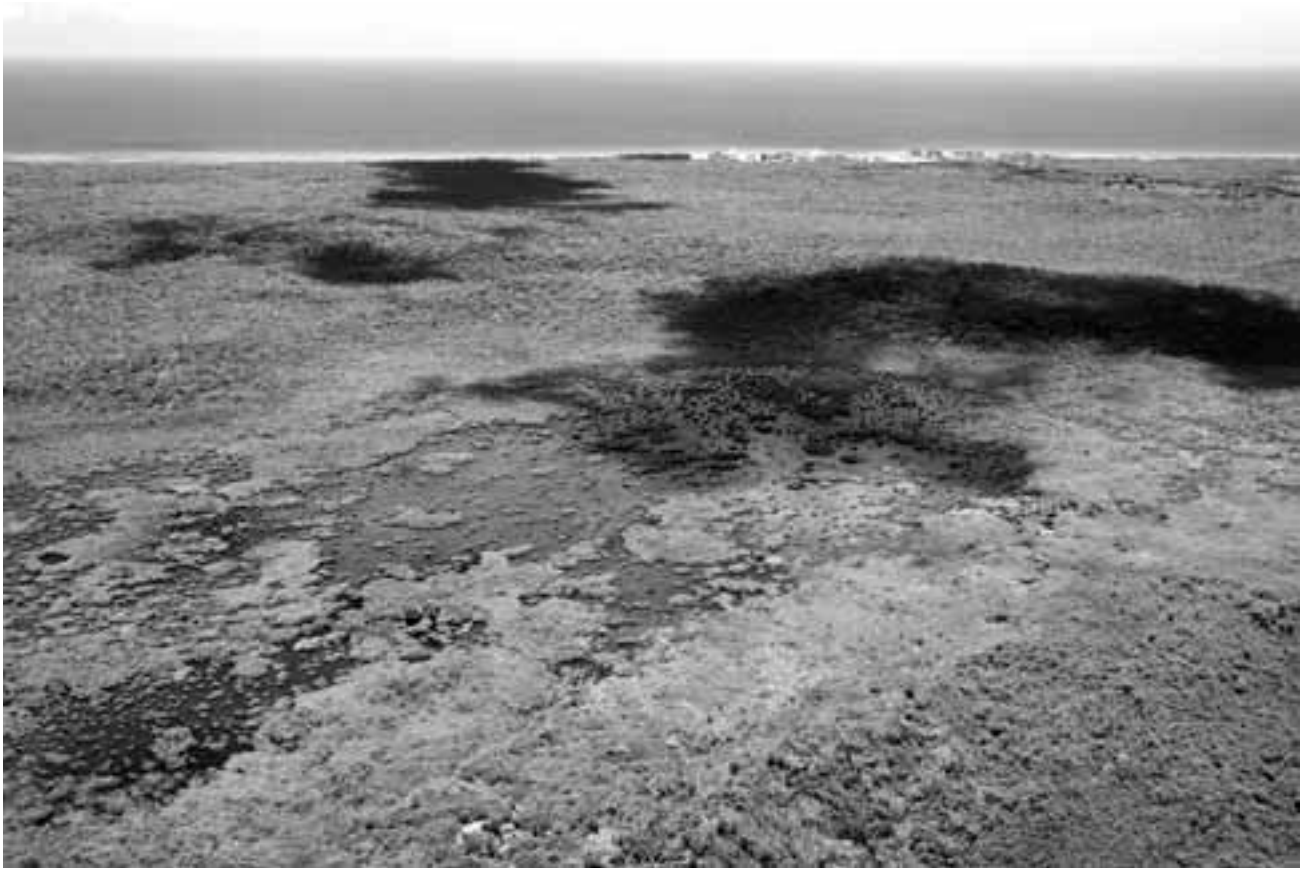
In December 2005, we plan to release between 60 and 70 two-year-old iguanas into the Salina Reserve. At that time, the first released group will be three years old and coming into sexual maturity. Our results from this year suggest we can squeeze these — but no more — into and immediately around the northern and central soil zones, where we have been working this year. That will bring the total population in this area to 80–90 individuals.

The following release, tentatively scheduled for December 2006, will have to involve a new area — probably the southernmost soil zones of the Salina Reserve, where we currently have no access. These areas are so far from the north coast road that we may need to set up a field camp where trackers can stay in the field for several days at a time. Establishing a trail network and preparing release sites will require months of work.

Overall, the limited soil zones and modest area of xerophytic shrubland in the Salina Reserve looks capable of establishing at least 200 Blue Iguanas in the wild. However, in the enthusiasm of initial success, we should not lose sight of potential problems that may yet surprise us.

One nagging question is to what extent these iguanas will seek access to the coast as they mature and grow. The coast immediately north of the Salina Reserve, across the Queen's Highway with its fast vehicular traffic, is a historic nesting site

A blanket of oxisol in the Salina's southern soil patches, a future release area.



View across the Salina Reserve toward buildings on the northern coast.

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One outstanding question faced by researchers is whether the iguanas released in the Salina will instinctively seek historic beach nesting habitat — on the far side of the busy coastal highway — especially as human population pressure increases.

Cactus, Thatch Palm, and Agave: shrubland plants adapted to the harsh dry climate of Grand Cayman's East End.

for Blue Iguanas. Unfortunately, this large sandy coastal area is now slated for a major hotel development. Before the highway was built, iguanas used to move freely between the sandy coast and the interior xerophytic shrubland.

The coast, especially before it was claimed by humans, probably provided much richer food resources for iguanas than the xerophytic shrubland. The Blue Iguana Recovery Program's staff deliberately focuses its attention on sandy coasts when collecting food for the captive-breeding and head-starting facility; large stands of *Scaevola plumieri*, mats of *Ipomoea pes-caprae* and *Canavalia rosea*, and a range of other fast-growing coastal strand species make iguana food collection more efficient in this environment than in any other. The sand may also be an easier and more reliably moist nesting substrate, especially when compared to the compacted and seasonally desiccated oxisols in the Salina soil basins.

The possibility exists that the female Blue Iguanas now living in the Salina Reserve may instinctively head for the coast when they are older, ready to nest, or when unseasonable drought strikes and food resources in the Salina Reserve become scarce. Any iguana that heads to the coast from the Salina Reserve faces the grave risk of being flattened by a 50-mph vehicle. Even if successful in crossing the highway, it then will find all the trappings of modern human civilization developing in place of Inkberries, Beach Morning-glory, and Sea Bean vines.

This and other potential concerns, not to mention the need to manage forthcoming releases, means we need to be keeping a very close eye on happenings in the Salina Reserve over the next few years. Any claims of success are premature at this time.

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