The Jamaican Iguana Pilot Final Report

for the
Mitigating the Threat of Invasive Alien Species in the Insular Caribbean Project

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Executive Summary

Following another successful campaign during the 2011-2012 period, the JIRG once again recorded a record year for recovering the Critically Endangered Jamaican iguana during the 2012-2013 period. Most notably, we recorded another record year for females nesting at the primary communal nesting sites -- 53! This represents a 6-fold increase over the original (core) nesting population documented in 1991, and constitutes the only measure of abundance that can be compared to the early years of the conservation effort. This dramatic recovery is presumably attributable to two primary interventions aimed at **MITIGATING THE THREAT OF INVASIVE ALIEN SPECIES** (IAS): (1) continuous IAS predator control in the core iguana conservation zone, and (2) the release of captive-reared, 'head-started' iguanas.

The project's primary field intervention is the continuous operation of an invasive predator trapping grid in the core iguana conservation zone. This mongoose-focused effort was expanded to include a new 'Western Loop' (completed in December 2012), including the addition of over 100 new mongoose/cat traps provided by the MTIASIC project. A new 'Eastern Loop' trail has been completed, and traps are currently (December 2013) being deployed to this new segment of the trapping system. Deployment of the remaining traps and activation of this new component is projected to occur in January-February 2014.

When both new segments are operational it will provide a ~3-fold increase in the area receiving protection from IAS predators such as the mongoose, including communal 'rock hole' nesting areas that had previously been subject to heavy (100% documented) nest predation by mongooses.

During the MTIASIC project period 2010-2013, trapping efforts resulted in the removal of 426 mongooses, 53 pigs, 33 cats, and various other IAS (e.g. dogs, *Rattus, Bufo marinus*). Notably, a total of 626 iguana captures were also recorded – including 100 captures in the nesting month of June 2013. And while many of these represented repeated captures of single individuals, or captures of recently released head-starters, these data are encouraging, and will ultimately be very useful in estimating the size of the wild population.

The release of head-started individuals from the Hope Zoo continued to be a successful effort for the duration of the project, over the course of which 88 individuals were repatriated into Hellshire. Those releases brought the overall total to 226 repatriations since the head-start programme began. 2013, the final year of the MTIASIC project, was also a banner year for these efforts, as a record 52 head-starters were released back into Hellshire in April.

Given the record number of iguanas (53) depositing eggs at the core, monitored nesting areas in 2013, it is perhaps unsurprising that the project closed with a documented record hatch and harvesting year – 320 hatchlings collected and processed, 42 of which were taken to the Hope Zoo for head-starting, with the remaining 278 being released at their respective hatching sites following field processing. These numbers bring the total identified deposited nests for the project period to 154, with 958 hatchlings being documented and 170 being added to the Hope Zoo contingent.

Other notable achievements for the period include the completion of a 17th consecutive year of a pitfall trapping experiment aimed at assessing the impact of mongoose control, and the continuation of related conservation projects in the Hellshire Hills (e.g., forest ecology, crocodile ecology and management). Finally, a new collaboration with the Botanical Research Institute of Texas resulted in four botanical

surveys (2012-2013) that significantly enlarged the species list for the Hellshire Hills, and further underscores the importance of the Hellshire Hills as a repository of global diversity.

Unfortunately, the primary threats to the iguana's persistence appear to be more ominous than ever. First, charcoal burning continues to proceed every day in Hellshire, and in 2013 incontrovertible (photographic) evidence of charcoal burning within 1 mile of the known communal nests was obtained; this should certainly be of concern to the relevant authorities.

Second, a government plan to essentially sell the Goat Islands and adjacent areas of the Portland Bight Protected Area to a Chinese investor threatens the future of not just the iguana, but the entire Goat Islands-Cabarita Swamp-Hellshire Hills ecosystem – arguably the most spectacular coastal marine and dry forest complex remaining in the insular Caribbean. It was against this unfortunate backdrop that the annual IUCN Iguana Specialist Group meeting was held in November, in Kingston. So, rather than a celebration of a globally recognized conservation success story, the meeting was a rather depressing affair held under a gloom of uncertainty.

Acknowledgements

Special thanks to Dawn Fleuchaus, Mark Gold, Tandora Grant, Evert Henningheim, Leon Samson, Dennis Smith, Rick van Veen, and Kenroy Williams for assistance with the work that went into this report.

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1. Introduction

Once thought to be extinct, the Jamaican iguana was rediscovered in 1970, and again in 1990, in the interior Hellshire Hills. Although recovery efforts have been demonstrably effective, the Jamaican iguana remains one of the most Critically Endangered (CR) species in the world. Persistent threats to its survival make it a high conservation and research priority, and at present the species in considered to be 'conservation dependent'. This document represents a summary of work completed during the MTIASIC project, which supported JIRG activities for the period June 2010 – September 2013. Of course, project work and significant developments have occurred since the cessation of MTIASIC funding, and for completeness, this 2010-2013 summary will include the period October-December 2013. The results of the period are presented in the context of ongoing conservation in the Hellshire Hills, along with a discussion of current conservation challenges.

1.1 Primary Project Objectives

1) ***Mitigating the impact of IAS predators on the remnant Jamaican iguana population I: predator control.***

A major objective of the MTIASIC project was to maintain and expand the predator (IAS) trapping programme to provide enhanced protection to threatened endemic species such as the iguana. At the time of this writing (January 2014), the planned expansion is nearly complete. The effort, which entailed cutting walk-able trails enclosing (on the east and west) the core iguana area, was a massive undertaking by the field crew. All recently obtained mongoose/cat traps (from the MTIASIC project) have now been hand carried into the core area, and the last ~100 traps are now being positioned along the recently completed 'Eastern Loop'. The 'Western Loop' has been operational since December 2012.

2) ***Mitigating the impact of IAS predators on the remnant Jamaican iguana population II: head-start-release.***

At a workshop to revise the Species Recovery Plan (SRP) for the Jamaican iguana (Kingston, 2006) it was agreed upon to expand the head-start programme by doubling the number of hatchlings harvested annually (from 20 to 40), and ultimately, double the number of head-starters repatriated into Hellshire on an annual basis. So beginning in 2007, the field team has collected 40-40+ hatchlings for the Hope Zoo head-start programme, and 2013's record release of 52 iguanas is proof of the improved efficacy of this programme.

3) ***Protect and monitor primary communal nesting sites.***

This effort, integral to #2, above, results in two outcomes: First, intensive IAS trapping and human presence provide significant protection to these critically important nesting areas. Second, our most valuable index of iguana abundance is the number of females using these same monitored nesting areas; this, because these two sites were subjected to detailed investigation in 1991, and provide our only 'window' into the iguana population at the time of its re-discovery. Hence, our index of success, and

proxy for overall iguana abundance, is the number of females depositing nests at the same sites monitored by Vogel et al. in 1991 (published in 1994; Carib. J. Sci.).

Vogel et al. (1994) confirmed that 6 females laid eggs in 1991, and several other gravid females (up to 3) were observed in the area but not documented as laying eggs at the monitored nests. Based on this index of abundance, the core nesting population has increased 6-fold since 1991, and has nearly doubled since 2010, the beginning of the MTIASIC project.

The number of hatchlings harvested is dependent on several factors, including the number of nests deposited, average clutch size, hatching success, and of course, harvesting success. Nevertheless, with the exception of years during which harvesting efficiency was compromised by tropical storms or bad luck, the number of hatchings enumerated has steadily increased in concert with the increasing number of females depositing nests. For example, in 2010 a total of 216 hatchlings were collected and processed; in 2013 that number had increased to 320 – a 50% increase!

1.2 Primary Activities of the Pilot Project

1) Activity 1: IAS Predator Trapping
2) Activity 2: Head-start Release
3) Activity 3: Protection and Monitoring of Primary Communal Nesting Sites
4) Other Activities Undertaken:
    a. Continuation of annual pitfall trap surveys to index abundance of terrestrial vertebrates and large arthropods in core iguana area – serves as both a long-term monitoring exercise and a field experiment testing the efficacy of predator control as a conservation tactic.
    b. Continue baseline, pre-eradication surveys of the Goat Islands, including the establishment of vegetation plots to monitor post-eradication responses.
    c. Continue monitoring (1-3 times per week) ~3 km of coastline fringing the iguana conservation zone.
    d. Continue Hellshire forest structure and regeneration project.
    e. Continue up-grading remote field station in Hellshire.
    f. Continue surveys aimed at delimiting the iguana's distribution within Hellshire, and generating a quantitative estimate of population size based on mark-recapture data.
    g. Deploy camera traps to gather information on species abundance, distribution patterns, and behavior.

2. Activity 1: IAS Predator Trapping

2.1 Methodology

2.1.1 Study Site

The remnant iguana population is restricted to a core area in the central and south-central portion of the Hellshire Hills (Figure 1a). The area contains what is arguably the most intact dry tropical forest remaining in the insular Caribbean.

Figure 1a: Map showing study area.

2.1.2 Methods

The trapping grid of live box traps is operated every day, with traps being checked and re-baited every 1-3 days. These traps form the core of our control efforts, as they focus on mongooses in the primary iguana nesting area (Figure 1b).

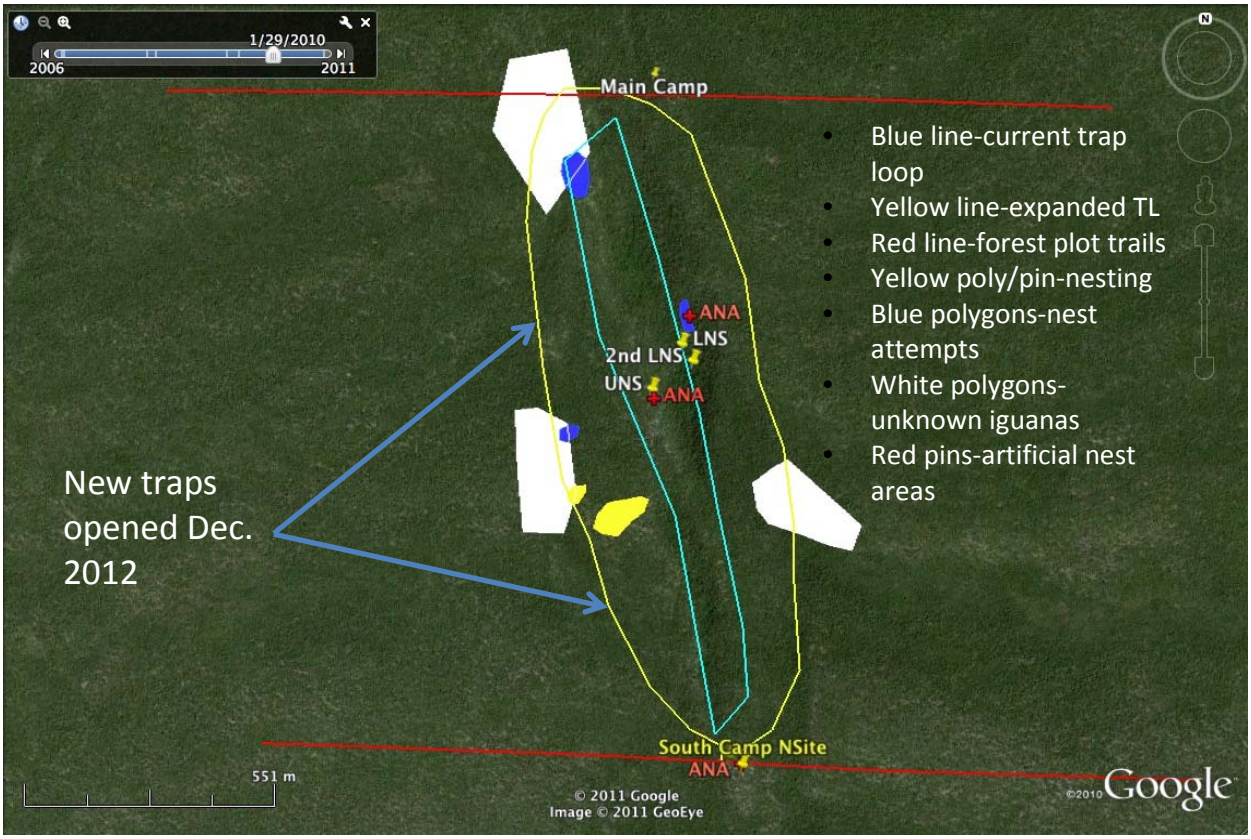

Figure 1b: Map showing trap loop and expansion, monitored nesting areas, and artificial nesting areas.

2.2 Results

During the period of the MTIASIC project (June 2010 to September 2014), a total of 426 mongooses were trapped and removed from the core iguana area. In addition, 33 cats and 53 pigs were also removed.

2.3 Discussion

Because of previous experimental confirmation that iguana nests and hatchling iguanas show enhanced survival as a result of predator control, this activity remains the most important in situ intervention.

2.4 Conclusion

Although the establishment of an IAS-free reserve on the Goat Islands, as outlined in NEPA's National Strategy and Action Plan on Biodiversity (Jamaica, 2003), would result in a protected iguana habitat that did not require constant removal trapping, for now this intervention must be considered essential to the survival of the iguana.

3. Activity 2: Head-start Release

3.1 Methodology

3.1.1 Study Site

See above.

3.1.2 Methods

The head-start programme begins with the collection of recently emerged hatchlings in the field (August and September), and the transport of ≥40 individuals to the Hope Zoo for head-starting. After attaining a size that confers protection from the mongoose, iguanas are health screened and then transported back to Hellshire for repatriation.

3.2 Results

In 2013, a record 52 head-starters were selected for repatriation, and all were health screened and ultimately returned to their birth place in the central Hellshire Hills. Overall, 88 head-starters were repatriated during the MTIASIC project (2011-2013), bringing to 226 the number of head-started iguanas that have been repatriated back into Hellshire.

3.3 Discussion

Given the long-term survival (>12 years) of repatriated head-starters, and their contribution to the nesting population, this intervention has clearly been critical to the recovery of the species. For example, well over half of the breeding population now consists of repatriated, head-started individuals.

3.4 Conclusion

Although improved trapping efforts (more traps spread over a larger area; different types of traps [especially leg-hold traps for cats]) might one day obviate the need for head-starting, at present this intervention is critical to recovering the iguana population.

4. Activity 3: Protection and Monitoring of Primary Communal Nesting Sites

4.1 Methodology

4.1.1 Study Site

See above.

4.1.2 Methods

Primary nesting areas are observed daily from hides constructed adjacent to these monitored, communal nesting areas (mid-May through June). Nest site surrounds are erected around the monitored communal nesting areas in anticipation of hatching season, beginning in early- to mid-August. Enclosures are checked a minimum of 2-3 times daily throughout the hatching season (mid-August up to mid-September, and all hatchlings found within enclosures are collected and processed (weighed, measured, PIT tagged, blood sampled).

4.2 Results

2013 was a record year for nesting females, with 53 female iguanas depositing clutches in the monitored communal nesting areas (= UNS, LNS and secondary LNS; see Figure 2). Overall, ~154 nests were deposited during the 3-years of the MTIASIC project.

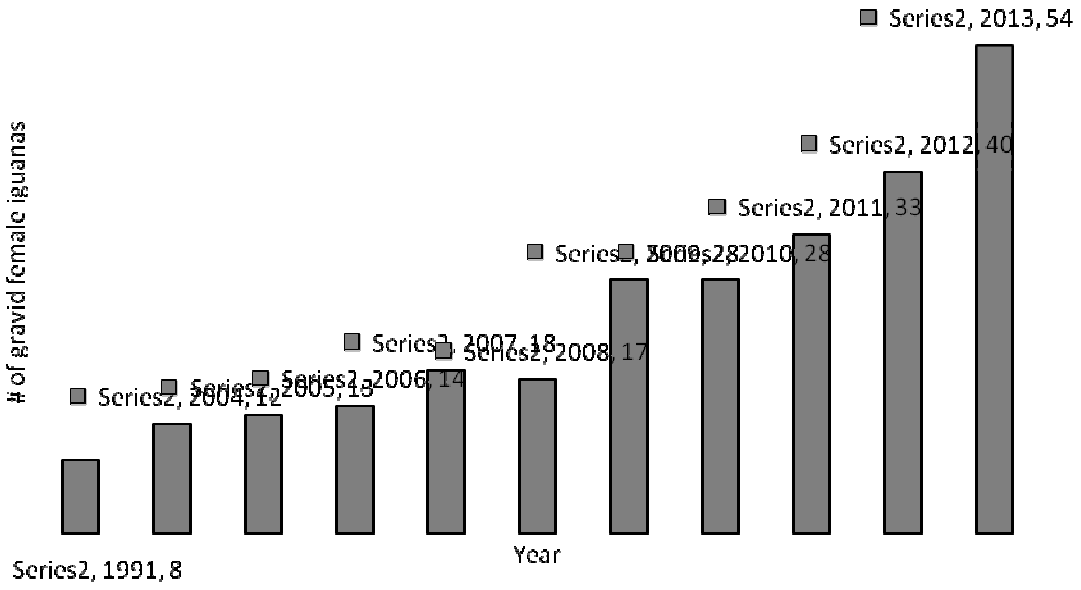

Figure 2. Number of gravid females recorded as nesting in the monitored, communal nesting areas.

Also noteworthy was the use (2 successful nests in 2013) of the artificial nesting area that was completed in 2012. It will be interesting to follow the future success of this intervention, but evidence to date, together with the longer-term success of the 'accidental' artificial nesting area at South Camp, suggest that the construction of additional nesting areas in predator-controlled zones would enhance both nesting and nesting success.

Representative hatchlings from multiple nests were sampled; given the large number of successful clutches, it was not possible to determine the number of successful clutches, but a conservative estimate, based on the number of hatchlings enumerated (plus estimated contributions from a few clutches known to have hatched outside of, or escaped from the surrounds), would be over 40 – a rate of hatching success comparable to previous estimates (roughly >80%, perhaps closer to 90%).

A total of 958 hatchlings were collected and processed over the project period. 170 hatchlings were transported to the Hope Zoo for headstarting, and the remaining individuals were released at their site of capture.

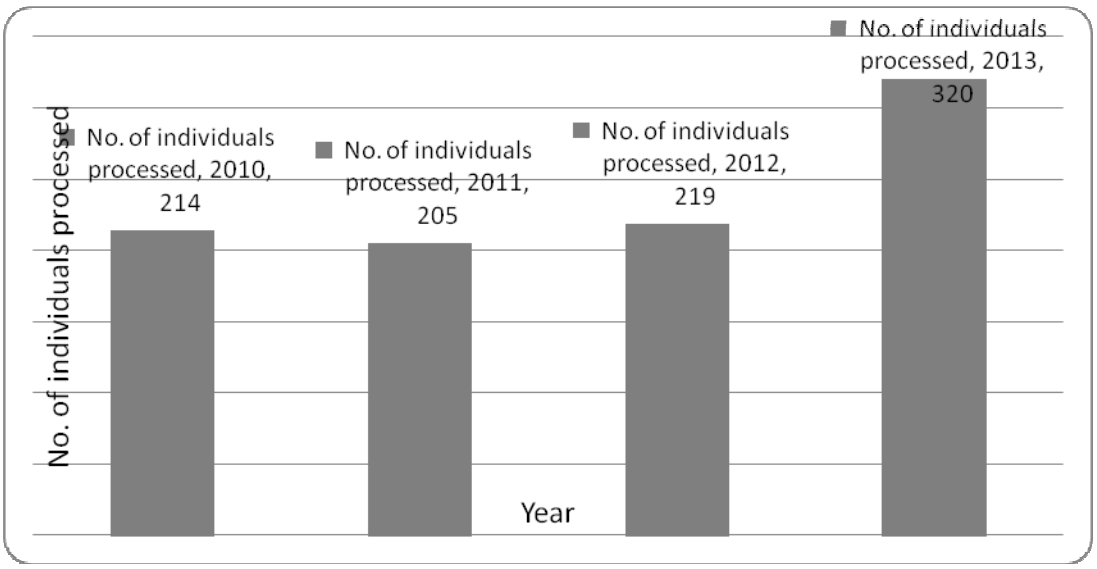

Figure 3. Number of processed *C. collei* hatchlings from annually monitored nesting areas for the period 2010-2013.

4.3 Discussion

Given that only eight or nine females nested in 1991, the first year of nest site monitoring, our 2013 results indicate that the remnant breeding population has increased 6-fold in the past 20 years – presumably due to intensive recovery efforts.

4.4 Conclusion

Monitoring and protecting nesting areas during the nesting season is critical to the recovery effort, and constitutes the main index for assessing trends in iguana population size. Daily monitoring of nesting areas during the hatching season, processing of hatchlings, and transfer of hatchlings to the Hope Zoo headstart facility are also critical to the recovery effort.

5. Other Activities Undertaken

The following ongoing activities were also undertaken during the life of the MTIASIC project.

a) Collect DNA samples for determining genetic structure and variability of the iguana population.

Method: DNA (blood) samples were collected from all intercepted hatchlings during hatching seasons (late August-early October). These samples are stored at the Herpetology lab at the Department of Life Sciences, UWI, until they are taken to the laboratory of Dr. Mark Welch in

Mississippi, USA – ideally coinciding with the annual health screening and headstart-release effort, generally around March or April.

Dr. Welch and his postgraduate student, Armed Rasberry, have been conducting the laboratory analyses and have made excellent progress. Both Dr. Welch and Mr. Rasberry delivered talks at the recent IUCN ISG meeting and iguana workshop held in Kingston, in November 2013.

Results and Discussion: Although the population experienced a major genetic bottleneck subsequent to the initiation of the recovery programme in 1991, it now appears that the rate of inbreeding, which is an unavoidable consequence of small population size, is decreasing. Because the rate of inbreeding is inversely proportional to the genetically effective population size (NE), the recent successes in increasing the size of the breeding population appear to have mitigated the potential influence of inbreeding depression. This seems likely because approximately 95% of the genetic variation observed in the population upon its rediscovery is present among hatchlings that have been sampled in recent years.

Laboratory analyses and the completion of Mr. Rasberry's thesis are eagerly awaited, and will contribute greatly to future efforts aimed at managing the Jamaican iguana population – both in situ and ex situ.

b) Locate new iguana nesting sites and, if possible, collect new genetic material to invigorate the existing captive population.

Method: The study area was surveyed on foot for signs of any soil rich areas that may have been in use by wild iguanas as nesting areas, but were not yet being monitored. No new nesting areas were discovered, but several known nesting sites outside of the core nesting area were monitored with camera traps (N=11 units in total), and results were similar to previous years: mongoose predation (see discussion below).

Results and Discussion: Amazing images have verified both the long-assumed carnage attributable to mongoose predation, and the importance of maintaining and expanding an IAS trap-removal programme. Specifically, camera trap monitoring indicates that nest loss attributable to the mongoose can reach 100% in areas with no predator control. These observations also underscore the importance of a rapid initiation of the Goat Islands rehabilitation and iguana re-introduction project. (NB: camera trap units will be in used through 2014 as part of R. van Veen's UWI thesis research)

c) Continuation of annual pitfall trap surveys to index abundance of terrestrial vertebrates and large arthropods in core iguana area – serves as both a long-term monitoring exercise and a field experiment testing the efficacy of predator control as a conservation tactic.

Method: All 64 assessment traps were opened on 8 February each year and checked daily until being closed on 16 March. As per the previous years dating back to 1997, traps were again opened on 27 March and checked daily until being closed for the season on 8 April. Thus, we completed a 17th consecutive year of this novel experiment in 2013. On capture, targeted species (e.g., most ground lizards) were measured (SVL), weighed, assigned a unique toe-clip combination, and released. Other reptiles and arthropods were enumerated and released. In addition to targeted native species, we also recorded the presence of IAS, especially cane toads,

rats, and mice. These data will be used to assess changes in the populations of these non-native species, particularly in relation to on-going predator control activities. In all, several thousand records (per year) were generated and have now been entered into the master EXCEL file. Analyses of these data are underway, in conjunction with the Climate Studies Group (Physics Department, UWI), and will provide novel information on potential changes in faunal abundance in light of the impacts of Global Climate Change.

Results and Discussion: Postgraduate student Ms. Kimberly Stephenson has been conducting these analyses, and she was successful with her PhD up-grade in early 2013. This research project aims to map and project the climate of Hellshire, and to develop a model to project future abundance of arthropods and lizards, based on the current influence of rainfall, temperature and relative humidity. Climatologies were compiled for the Hellshire Hills using site specific weather station data, which followed the general climate patterns of the island, with the deviations expected of a dry forest (drier and hotter than average). Data analyses have shown patterns of interannual variability in abundance, similar to that exhibited by climate variables, indicating potential for a climate signal to be identified. Climate associations have been found to be strongest seasonally, with particularly strong linkages between trapping season abundance and rainfall during the late rainy season and dry season of the year prior to trapping. Findings also indicate that predictive equations can be constructed using climate variables and interspecies relationships for even a small population, and can explain most of the variance in population size. The ultimate goal of the project is to identify the vulnerability of the study site to the affects of the shifting climate of the island and, by extension, to consider future conservation needs.

d) Continue baseline, pre-eradication surveys of the Goat Islands, including the establishment of vegetation plots to monitor post-eradication responses.

Method: No field activities were undertaken on this objective, with the exception of botanical surveys conducted by colleagues from the Botanical Research Institute of Texas.

Results and Discussion: Because the Goat Islands project never received the requisite government approval, it never got off the ground, and ultimately, the MTIASIC project took the decision to cancel the planned Goat Island eradication and iguana re-introduction activities that it was to have supported. Given the importance of this objective to the long-term survival of the iguana, and given its stated priority in NEPA's National Strategy and Action Plan on Biodiversity for Jamaica, failure to realize the initiation of this project was a major disappointment to the JIRG and to international collaborators and funding partners.

e) Continue monitoring (1-3 times per week) ~3 km of coastline fringing the iguana conservation zone.

Method: All five (5) sea turtle index beaches were surveyed (by foot) a minimum of once per week.

Results and Discussion: Although sea turtle activity was meager, and most nests continue to be depredated by IAS, this exercise remains one of the more important activities necessary to ensure the success of the overall iguana recovery project. Beginning in 2004, these regular patrols of the iguana forest's southern boundary have amounted to providing the ranger patrols that are otherwise absent from this 'protected' area. Indeed, even more frequent (than weekly) patrols

should be a critical management activity conducted by the relevant management authority, once such an entity is identified.

f) Continue Hellshire forest structure and regeneration project.

Method: Postgraduate student Adit Sharma successfully up-graded to a PhD in 2013, and has now completed data collection for his thesis, except for one component. During the period, Mr. Sharma completed measurements on his 36 permanent sample plots and entered/analyzed data already gathered. Mr. Sharma will use an IRGA (infrared gas analyzer) to assess seedling ecophysiology and separate species into functional types. This effort is part of an analysis of change over time, in the prevalence of different functional types, in response to deforestation and/or climate change.

Results and Discussion: Measurements were completed on ~3600 trees/seedlings representing approximately 56 species. Analyses continue.

g) Continue up-grading remote field station in Hellshire.

Method: Basic maintenance and a few significant up-grade efforts were completed during the period.

Results and Discussion: Significant improvements to the remote field station (South Camp) included construction of another concrete pad for tent erection and rat-proofing the main food storage area. The deck at South Camp was replaced with used 2 X 4's, and a portion of the main hut was rebuilt as well. Additionally, there was continuous basic maintenance, including the harvesting and storage of rain water.

h) Continue surveys aimed at delimiting the iguana's distribution within Hellshire, and generating a quantitative estimate of population size based on mark-recapture data.

Method: Iguana team members were in the field in Hellshire during most days and every week of the year. Particularly during the nesting season assessments, efforts were made to trap iguanas (in addition to the live predator traps in continuous operation). Toward that end, 2013 saw a record number of captures in a single month, with 100 iguana captures recorded for the month of June.

Results and Discussion: In all, 626 iguana captures were recorded during the period of the MTIASIC project. These records will be added to the long-term data set, and their analysis to generate a quantitative estimate of population size will constitute a chapter in the thesis of Rick van Veen, the completion of which is anticipated in 2014.

i) Deploy camera traps to gather information on species abundance, distribution patterns, and behavior.

Method: Reconyx Hyperfire camera traps (up to 23 simultaneously), were deployed throughout the iguana conservation zone during 2012-2013. Aside from traps stationed at nesting areas during the nesting season, the primary objective was to continue gathering image data to index the abundance of both native species and IAS in relation to our predator control efforts. Our pitfall trapping experiment was designed to index the relative abundance of small terrestrial

species; use of camera traps is allowing us to index the relative abundance of larger species, particularly the endemic iguana and hutia, as well as various IAS predators (mongoose, cat, dog, pig). Of course, this effort also assists in delineating the distribution of the iguana population, and provides supplementary information for demographic analysis.

Results and Discussion: In all, literally thousands of faunal images have been obtained, and the analysis is tedious, and on-going. Preliminary results however, have been obvious, and astounding. Most importantly, and as expected, camera trap data will confirm the experimental reduction in mongoose density due to trapping and removal, and have already highlighted the exceedingly high rates of nest loss due to mongooses in areas not protected by removal trapping.

In addition to the demographic and distribution data obtained for the iguana, camera traps have also captured phenomenal images of iguana behavior (including mating), temporal data (i.e., activity times) and other natural history information for various species (such as the little known Jamaican hutia), and other incidents of management importance (e.g., a cat eating a Blue-tailed Galliwasp; mongoose raiding iguana nest in the dark of early morning).

6. Constraints

Conservation challenges

Woodley (1971) long ago articulated the major conservation challenges facing the iguana: IAS predators, charcoal burning, and the specter of large scale development projects. As detailed above, the biological interventions aimed at mitigating the impact of IAS predators have been demonstrably effective, with the core breeding population increasing by a factor of six (6) since conservation activities were initiated in 1991.

Unfortunately, essentially nothing has been done to ameliorate or eliminate the potentially catastrophic threats posed by charcoal burning and large scale development projects.

Charcoal burning

2010-2013 was another horrible time to be a tree in the Hellshire Hills Forest Reserve. Although charcoal burning and illegal tree cutting for other purposes (e.g., fence posts, fish pot sticks) have progressed unchecked for decades, two recent episodes stand out as noteworthy. First, in 2011, a chain saw was heard from the field station 'South Camp' -- for the first time since the station's establishment in 1997. This served as a sobering reminder that the destruction of the remaining primary forest is progressing steadily, and will eventually reach the most sensitive iguana areas. To be sure, much of what was formerly considered the 'core iguana zone' has now been degraded by charcoal burning. Second, a helicopter flyover in 2013 resulted in the detection (and photographic documentation) of active charcoal burning within one mile of the primary communal nesting areas.

Large scale development projects

The 'big news' of 2013 of course, was the announcement in August that the Government of Jamaica was in discussions with Chinese investors, and was giving serious consideration to plans for the construction

of a trans-shipment port on the Goat Islands. The plan has been shrouded in much secrecy, but if true, and if it were to come to fruition, it would eliminate the iguana's best hope for survival (i.e., an IAS-free Goat Islands reserve), and almost certainly lead to the destruction of the adjacent Hellshire Hills dry forest ecosystem – home to the iguana's only remaining wild population.

7. Recommendations

1. Continue IAS predator removal trapping programme in Hellshire Hills.
2. Genetic management of the population is essential, especially for selection of potential founders for new populations (e.g., Goat Islands). DNA samples should be obtained whenever possible.
3. Daily monitoring of known iguana nesting areas to assess nesting composition and nest position could be very beneficial to the future recovery effort; additional artificial nesting areas should be constructed in core, predator-controlled area.
4. Repatriation of headstarted individuals into the Hellshire iguana population should continue; releases should also begin on the Goat Islands, after appropriate IAS eradications.
5. Continue monitoring (1-3 times per week) ~3 km of coastline fringing the iguana conservation zone. Although not directly required for continuing the iguana recovery, this activity represents the only early warning system for incursions into the iguana forest from the coast. Given that such incursions occur periodically, these patrols represent a critical means of detecting and reporting infractions.
6. Continue up-grading remote field station in Hellshire. A critical component of the recovery effort is simply providing a presence in the forest; in all likelihood the core iguana area would have been burned down by now, were it not for the near constant presence of the iguana team in the area. Maintaining a comfortable, livable camp is a requirement for extended living in the forest. This objective should not be trivialized; rather, an emphasis should be placed on camp maintenance, and on encouraging workers to remain in the forest as much as possible.
7. Continue surveys aimed at delimiting the iguana's distribution within Hellshire, and generating the first-ever quantitative estimate of population size based on mark-recapture data. This activity is critical to long-term monitoring of the iguana population.
8. The pitfall trapping effort represents the longest running terrestrial fauna monitoring programme on the island. Given the specter of Global Climate Change, it is recommended that this activity be continued as a tool for detecting long-term trends in biodiversity. And while not essential to the recovery of the iguana, this activity requires field workers to patrol northern portions of the iguana area; hence, it benefits the iguana project indirectly by increasing observer presence.

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Annual IUCN SSC Iguana Specialist Group Meeting. November 13-17, Antigua, Guatemala.

Appendix A

Conservation of the Jamaican Iguana and Its Remaining Natural Habitat

Workshop hosted by the University of the West Indies, Mona, the Hope Zoo, and NEPA

In collaboration with the IUCN-Iguana Specialist Group

12-13 November 2013, Hope Zoological Gardens

Abbreviated Schedule for Day One (12 November): Jamaican iguana/Hellshire Hills Symposium (to be published as a special volume of ***Caribbean Naturalist***)

0925 Introduction of Plenary Speaker – Stesha Pasachnik
0930 Plenary Talk – Blair Hedges
1015 Thanks to Blair – Stesha Pasachnik

1020 Coffee Break

1040 History of Jamaican iguana recovery effort – Rick Hudson
1110 History, value, and future of Hellshire -- Byron Wilson
1130 Geology and geomorphology of Hellshire Hills – Simon Mitchell and David Miller
1150 Cultural history of Hellshire -- Andrew Pearson
1210 Botanical inventory of Hellshire Hills -- Amanda Neil
1230 Forest ecology and impacts of charcoal burning -- Kurt McLaren
1250 Climate change impacts on the Hellshire fauna -- Kimberly Stephenson

1310 Lunch

1415 Introduction to afternoon session – Chuck Knapp
1420 Overview of captive population and headstarting programme -- Tandora Grant
1440 Ecology and status of the Jamaican iguana in the wild -- Rick van Veen
1500 *C. collei* management: genetic issues (Mark Welch)
1515 Closing comments and introduction to Hope Zoo tour – Orlando Robinson
1530 Tour of Hope Zoo, refreshments