



# Jamaican Iguana

Species Recovery Plan, 2006—2013

Edited by Tandora Grant, Lee Pagni, and Byron Wilson



International Union for Conservation of Nature



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**Citation:** Grant, T., Pagni, L. and Wilson, B. (eds.) (2013). *Jamaican Iguana: Species Recovery Plan, 2006—2013*. IUCN SSC Iguana Specialist Group, Gland, Switzerland.

**ISBN:** 979-2-8317-1586-5

**Cover photo:** Adult female Jamaican Iguana in molt. ©Rick Van Veen.

**Layout by:** Rocío Covarrubias

**Produced by:** IUCN SSC Iguana Specialist Group; [www.iucn-isg.org](http://www.iucn-isg.org)

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# Jamaican Iguana

*Cyclura collei*

## Species Recovery Plan

2006-2013

Developed in a workshop held on 10-13 July 2006, in Kingston, Jamaica,  
hosted by the Jamaican Iguana Recovery Group.

Facilitators: Frederic J. Burton and Quentin M. C. Bloxam

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National Environment and Planning Agency Jamaica

The University of the West Indies

IUCN SSC Iguana Specialist Group

International Iguana Foundation

Urban Development Corporation

Hope Botanical Gardens and Zoo



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## ABBREVIATIONS

AZA	American Zoo and Aquarium Association
C-CAM	Caribbean Coastal Areas Management Foundation
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
FWZ	Fort Worth Zoo
GIS	Geographic Information System
IAS	Invasive Alien Species
IC	Island Conservation
IIF	International Iguana Foundation
IOJ	Institute of Jamaica
ISG	Iguana Specialist Group
IUCN	International Union for Conservation of Nature
JIRCG	Jamaican Iguana Research and Conservation Group
JIRG	Jamaican Iguana Recovery Group
NEPA	National Environment and Planning Agency
NRCA	Natural Resources Conservation Authority
PBPA	Portland Bight Protected Area
SDZICR	San Diego Zoo Institute for Conservation Research
SSC	Species Survival Commission
SSP	AZA Species Survival Plan
UWI	University of the West Indies





## FOREWORD

For those of us not fortunate enough to have been born in Texas, we are fond of saying “But I got here as fast as I could.” This reflects my sentiments toward the Jamaican Iguana Recovery Group (JIRG), and though I was not here in the early years of the program (1991- 92), I jumped in with both feet in 1993 and 2012 marks my 20th year with this historic effort. In 1991, I was chairing the AZA Lizard Advisory Group (LAG), which had begun to focus attention on threatened Caribbean reptiles and amphibians. We wanted to champion one of the iconic West Indian Rock Iguanas (*Cyclura*) so when the Jamaican Iguana was rediscovered, it seemed the perfect fit. A group of LAG zoos began directing support to the late Dr. Peter Vogel and his early conservation efforts, and in 1993 we organized - with the Conservation Breeding Specialist Group - a Population Habitat Viability Assessment (PHVA) workshop that provided both a foundation and direction to the intensive conservation actions that would be successfully implemented over the next 20 years. The rest is history as they say, and today the recovery programme is globally recognized as a modern-day conservation success story. The compelling story of a species, long written-off as extinct, being given a second chance for survival served as a clarion call to donors and supporters. AZA zoos championed the program and donated freely because they could see momentum building, and new successes followed with each year. The program became the “darling” of the IUCN, AZA, and a host of other international conservation groups. In 2000, the AZA awarded a group of twelve institutions, led by the Fort Worth Zoo, their prestigious International Conservation Award. In short, the global conservation community was buzzing with news of the Jamaican Iguana.

Having spent 20 years intricately associated as a member of the Jamaican Iguana Recovery Group, I have the benefit of a nearly full historical perspective of the successes, setbacks, and challenges that this program has experienced. I am pleased to say that I can look back at this program with only pride, and forward with only optimism. Back in the late 1990s when we began releasing headstarted iguanas in the Hellshire Hills to restore the depleted population, none of us could have predicted the rapid recovery that we were initiating. Today, one can trek through the core of this habitat and often encounter free-ranging and even a few human-habituated iguanas. A full-time field team, led by two extraordinary and highly-motivated individuals, Dr. Byron Wilson and Rick Van Veen, continues to build on a long list of significant conservation achievements including a four-fold increase in the number of nesting females since 1991, 174 headstarted iguanas released to the wild, and over 200 hatchlings collected and tagged emerging from nests in 2011!

But despite this impressive list of milestones, the most important one continues to elude us: repatriation to the Goat Islands. Long-recognized as the *ultimate solution* to the long-term survival of the Jamaican Iguana, we currently find ourselves paralyzed by government inaction. Make no mistake: we are simply holding our ground in Hellshire, and there is little doubt that we will be forever challenged to combat the ubiquitous non-native mongoose; and sadly we continue to watch as this pristine habitat is destroyed by the steady onslaught of charcoal burners. The Jamaican Iguana is simply conservation-dependent in Hellshire, and consumes scarce conservation dollars with every passing year. But it doesn't have to be this way. If the Goat Islands were restored and protected as a Jamaican Iguana sanctuary, a robust and naturally-breeding iguana population would thrive without intensive and costly recovery actions, and assure a future for this enduring symbol of Jamaican biodiversity. Speaking from the perspective of someone whose career has largely been defined by the Jamaican Iguana story, we cannot close the book on this one, or rest easy, until the Goat Islands are returned to the iguanas.

Rick Hudson, Co-Chair Emeritus, Steering Committee Member  
IUC SSC Iguana Specialist Group

## **PLAN OVERVIEW**

This Species Recovery Plan was created from the input of 24 participants who attended a July 10-11, 2006 planning workshop. This group, comprised of conservation professionals, scientists, and managers, combined their expertise to generate the list of actions in this plan.

Although the plan was not formally published immediately after the workshop, some of the interested parties (especially the Jamaican Iguana Recovery Group) still carried out actions delineated in the plan. In 2011, Rick Hudson of the International Iguana Foundation took up the charge to ensure that the plan was published by 2013.

While the framework and substance of this plan is from the 2006 workshop, many of the due dates for the actions have been updated to maintain the relevance of the plan. Appendix I provides an overview of all the actions laid out in the plan, their due dates, parties involved, a progress update on the action, and the level of priority. The one action that was added to the plan deals with creating a system to replace Dr. Byron Wilson who plans to relinquish his primary responsibilities to the program in 2014 (see below). The editors felt this was a sufficiently important action to warrant inclusion in the SRP.

The only other addition to this plan is the aforementioned priorities list. The editors of this publication felt it important to rank activities so that limited resources would be put toward the most effective actions. A ranking exercise was also conducted via feedback from members of the JIRG, and the results compiled to reflect an average of the responses. These priorities were then given to the IUCN SSC Iguana Specialist Group steering committee to review and confirm their importance to the success of the recovery of the Jamaican Iguana.

The top six priorities for this plan (in descending order of importance), which have been endorsed by the Iguana Specialist Group, are:

- Priority 1 - Protect recovering iguana population in Hellshire Hills (reference 3.1)
- Priority 2 - Establish healthy iguana population on the Goat Islands (reference 3.4)
- Priority 3 - Management plans and agreements in place and acted on (reference 3.3)
- Priority 4 - Continue the headstart program at Hope Zoo (reference 3.6)
- Priority 5 - Communicate key elements of the plan to the Prime Minister (reference 3.8.4)
- Priority 6 - Prepare for Byron Wilson's departure from leading the JIRG by January 2014 (reference 3.9.5)

## EXECUTIVE SUMMARY

Thought to be extinct by the mid 1900s, the Jamaican Iguana was rediscovered in 1970, and again in 1990. The 1970 rediscovery generated surprisingly little interest, either within Jamaica or among international conservation organizations. But when pig hunter Edwin Duffus brought a live specimen to the Hope Zoo in 1990, the local Jamaican Iguana Research and Conservation Group (JIRCG) was rapidly formed, and international support quickly materialized.

The renamed Jamaican Iguana Recovery Group (JIRG) is a consortium of local Jamaican organizations and international conservation groups that held a workshop in July 2006 to formulate the present Species Recovery Plan (SRP). The overriding goal of that workshop was to reach a consensus on priority conservation actions and agree on the organizational responsibility for those activities. Because of the time lag between the workshop and the printing of the final SRP document (*ca* 6 years), some actions have been completed and others have been initiated. Appropriately then, this final SRP document includes an update on the progress of specific recovery actions identified during the July 2006 workshop. A lack of progress on an identified objective points to the need for increased attention to be directed at that priority. Finally, based on recent (2006-2011) research results, several actions have been added to those identified in the original workshop; otherwise, proposed activities and timelines remain as originally formulated.

Beginning in 1991, the JIRG has been protecting the known communal nesting areas, operating a successful headstart-release programme, and attempting to divert charcoal burners away from a core conservation zone. Beginning in 1997, the group has been controlling mongooses, cats, dogs, and pigs in and around the known iguana nesting areas, and has expanded the collection of hatchlings from wild nests to facilitate the expansion of the Hope Zoo headstart programme. Ongoing research continues to provide the informed foundation for adjusting and implementing the evolving plan for the recovery of this iconic species.

Headstarted iguanas are now nesting naturally in Hellshire, and together with recently recruited wild animals, the small, core nesting population has increased five-fold in the past 15 years. This SRP will build on these earlier successes in the Hellshire Hills while simultaneously launching a major initiative on the adjacent Goat Islands.

Headstarting of hatchlings collected from nests in the Hellshire Hills will be expanded, and repatriation efforts will ensure that the Hellshire population remains viable and increases in both numeric and geographic extent. Control of mongooses, feral cats, and wild pigs will also be expanded. Targeted searches and wide area surveys will ensure that the full genetic diversity of surviving Jamaican Iguanas is known and available to rebuild their population, and will also identify priority areas for focused conservation attention.

While efforts to secure the surviving Hellshire population continue, the two Goat Islands, which lie close to the western margin of the Hellshire Hills, will be restored through the removal of goats and the eradication of cats and mongooses. Once the eradications are complete, carefully selected founding iguanas from the Hellshire population will be reintroduced to the Goat Islands, where, in the absence of non-native predators, their population should expand rapidly to carrying capacity.

As the Goat Islands iguana population rebounds it will provide a major source of iguanas to release back into the Hellshire Hills, enabling the accelerated restoration of at least 1,000 Jamaican Iguanas in

the wild. As this work progresses, improving techniques for invasive predator control may enable wide area reductions in mongooses, feral cats, and other problem species.

As a hedge against disaster, a captive population of Jamaican Iguanas has been established in partnering zoos in the USA. This ex-situ population will be managed to maintain its long-term genetic diversity. The establishment of additional captive populations in Jamaica will also be explored in the context of public education and the creation of revenue generating enterprises to provide support for the long-term viability of the conservation programme.

Long-term legal and policy measures in place for the environmental protection of the Hellshire Hills and surrounding areas will be maintained and implemented, and strengthened where appropriate. At the same time, public awareness and education activities will be expanded to build a broad base of support for the conservation of the Jamaican Iguana and its natural habitat.



Adult female Jamaican Iguana #38 being released into the Hellshire Hills in 2005. She was subsequently tracked and created a nest in 2006. Photo: Rick Hudson.



## 1 CURRENT ASSESSMENT

### 1.1 THE JAMAICAN IGUANA

#### 1.1.1 TAXONOMY AND DESCRIPTION

*Cyclura collei* is endemic to the island of Jamaica, and was described by Gray in 1845. Attaining moderate size for a member of this genus (SVL to 428 mm in males, to 378 mm in females), *C. collei* has presumably been isolated from its congeners for a long time. Indeed, next to the Anegada Iguana (*C. pinguis*), the Jamaican Iguana possesses the most unique genotype in the genus.

#### 1.1.2 STATUS

The Jamaican Iguana is listed as Critically Endangered in the most recent IUCN Red List, and as Appendix I under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Nationally, the species is protected under the Wildlife Protection Act (NRCA, Government of Jamaica); the species is also considered to be Endangered under the U.S. Endangered Species Act (United States Fish and Wildlife Service).



Adult male Jamaican Iguana. Photo: Rick Van Veen.

#### 1.1.3 DISTRIBUTION AND NATURAL HISTORY

Historically, the Jamaican Iguana occurred along much of the island's southeastern coastal dry forest belt. The Liguanea Plains above the city of Kingston take their name from the Spanish word for iguana, and the species was once sufficiently plentiful to have supplied a market demand. Now restricted to the undisturbed portions of the Hellshire Hills, the species exists at low density in rugged karst limestone areas that contain primary dry forest. Although population size is not known, published estimates suggest that there may be as few as 100-200 adults remaining in the wild, perhaps fewer.

Like all *Cyclura* species, *C. collei* is primarily herbivorous, feeding on a wide variety of fruits, flowers, and leaves. Feeding on invertebrates (e.g., spiders, snails) has also been observed among juveniles. Although primarily terrestrial, Jamaican Iguanas spend considerable time in trees, especially when young. Daily activity patterns vary with age. Hatchlings emerge to bask in mid-morning, then forage until early afternoon, at which time they retire to refuges - usually hollows in dead snags 1-3 m above ground. Adults can be active until late afternoon, and tend to use holes in the karst as retreats. Nesting generally occurs during the first few weeks of June, and clutches averaging 15 eggs hatch around 88 days later. Historically, adult iguanas would not have had any natural predators; hatchlings and juveniles would have been vulnerable to several bird species, the endemic Jamaican Boa (*Epicrates subflavus*), and the likely extinct Jamaican Racer (*Alsophis ater*).

#### 1.1.4 CAUSES OF DECLINE

As with so many insular endemic species in the Caribbean and elsewhere, the Jamaican Iguana has been decimated by the combination of habitat loss and predation by introduced mammals. Agricultural and urban development, together with timber extraction, caused extensive habitat loss along Jamaica's southeast coast in the centuries following colonization, and the species was ultimately restricted to the Hellshire Hills and nearby Goat Islands. Today, illegal tree cutting for charcoal production is the greatest source of continued loss of the iguana's dry forest habitat, though the potential for large-scale development represents an additional and ominous threat.

Invasive alien species represent the greatest threat to the iguana where its habitat is still in prime condition. Dogs were brought to Jamaica by the Tianos, and are the only predator capable of killing large adult iguanas. The Indian Mongoose (*Herpestes javanicus*) was imported in 1872 in an attempt to control sugar cane pests and quickly established itself as a major threat to the island's endemic wildlife. Recent field studies have underscored the importance of this predator as a threat to the iguana's persistence. Feral cats are also virulent predators of small iguanas, and roam throughout the Hellshire Hills. Wild pigs represent a threat to iguana nests, and European rats (*Rattus sp.*) may also be a problem but this has not been documented.

Although once harvested for human consumption, intentional hunting is not an issue in Jamaica, nor is collecting for the pet trade. This is unsurprising given the species' scarcity, and the isolated, rugged nature of its remaining habitat.



Female iguana photographed by a camera trap exploring a cavity, possibly for nesting. The next photo from the same camera trap shows a mongoose entering the same cavity. Photo: Jamaican Iguana Recovery Group.



An access road into the Hellshire Hills used by charcoal burners. Photo: Rick Hudson.



An active illegal charcoal burning camp in the Hellshire Hills, close to the Jamaican Iguana core area. Photo: Rick Hudson.

## 2 OVERALL GOAL

*"To conserve viable populations of Jamaican Iguanas and the biodiversity of their natural habitat, in perpetuity."*

We envision an abundant, self-sustaining wild population of Jamaican Iguanas restored to the Hellshire Hills and the Goat Islands, reproducing naturally and continuing to evolve with their ever-changing natural environment. The iguanas and the dry forest ecosystem upon which they depend will be protected by strong legislation and active management.

Ongoing management and localized eradication of invasive exotic species in the Hellshire Hills and Goat Islands will restore near-natural survival of hatchling iguanas, with wide-ranging benefits to other unique Jamaican fauna and flora, and the entire natural biodiversity of the Hellshire Hills and Goat Islands ecosystem.

The people of Jamaica will enjoy a sense of pride in the recovery of their unique iguana, which will be celebrated as a symbol of the protected biodiversity of the Portland Bight area.



### 3 OBJECTIVES AND ACTION STEPS

#### 3.1 OBJECTIVE: Manage the Hellshire Hills for biodiversity conservation.

*Manage the Hellshire Hills to conserve their native biodiversity and to promote the recovery of the Jamaican Iguana.*

**3.1.1** Enforce exclusion of charcoal burners from the Hellshire Hills core iguana areas, and incrementally, from the entire Hellshire protected area.

*Action:* UDC rangers in coordination with relevant enforcement agencies, NEPA, and NEPA-delegated managers of the PBPA (C-CAM), with assistance from JIRG staff and volunteers.

*Timeline:* 2011

*Resources:* UDC, JDF Coast Guard.

**3.1.2** Investigate and instigate alternate livelihood programs for displaced charcoal burners, including the potential establishment of tree farms to provide for sustainable charcoal production.

*Action:* UDC, NEPA-delegated managers of the PBPA (C-CAM).

*Timeline:* 2011

*Resources:* UDC and potential C-CAM grant funding.

**3.1.3** Maintain present trapping network (60 trapping stations) for mongooses and cats, and expand with an additional loop trail (additional 150 traps) by mid-2007.

*Action:* JIRG in collaboration with UDC.

*Timeline:* Ongoing

*Resources:* JIRG staff, plus USD 10,000 needed for additional traps and rust-proofing; field wages for new JIRG Field Assistant also required.

**3.1.4** Continue to trap pigs in core areas, especially near nesting sites and along coastline bordering core iguana area.

*Action:* JIRG staff and volunteers, UDC rangers.

*Timeline:* Ongoing

*Resources:* Grant funding to JIRG, UDC.

**3.1.5** Remove all dogs that appear in the core areas.

*Action:* JIRG staff and volunteers, UDC rangers.

*Timeline:* Ongoing

*Resources:* Grant funding to JIRG, UDC.

**3.1.6** Determine feasibility of purchasing undeveloped private lands within the northern limits of the Hellshire protected area, to enable unified UDC management.

*Action:* UDC.

*Timeline:* 2012

*Resources:* UDC.

**3.1.7** Conduct a cost-benefit analysis comparing a plan of perpetually patrolling a buffer zone between protected forest and urbanized areas east of the Hellshire protected area, versus investing in a cat, dog and, pig exclusion fence to separate these two zones.

*Action:* Byron Wilson and Island Conservation.

*Timeline:* 2006

*Resources:* UDC.

### **3.2 OBJECTIVE: Restore Hellshire Hills population to at least 1,000 iguanas.**

*Restore a self-sustaining, genetically healthy population of at least 1,000 iguanas throughout the Hellshire Hills, ongoing beyond 2010.*

**3.2.1** Collect 20 hatchlings for headstarting in 2006, and at least 40 per annum thereafter, depending on capacity at the Hope Zoo. Collections should be from as many different nests as possible, including any nests found as a result of surveys of outlying areas. To the extent possible, all hatchlings should be identified as nestmates. Sex ratio may be biased in favor of females by up to 3:1.

*Action:* JIRG staff and volunteers in collaboration with Hope Zoo.

*Timeline:* Ongoing

*Resources:* Grant funding to JIRG.

**3.2.2** Assess the genetic diversity of wild iguanas from all possible locations in Hellshire, headstarted releases, and all current captives. Attempt to allocate individuals to clutch, investigate evidence of multiple paternity and over-representation by dominant males, and identify key animals for future restoration of a Goat Islands population.

*Action:* Collaborating ISG geneticist.

*Timeline:* Ongoing

*Resources:* Grant funding to JIRG, SDZICR.

**3.2.3** Release all sub-adults (2002 hatch and older) currently captive at Hope Zoo.

*Action:* JIRG, Hope Zoo, SDZICR, Fort Worth Zoo.

*Timeline:* Annually

*Resources:* Grant funding to JIRG, Fort Worth Zoo, SDZICR.

**3.2.4** Release and monitor successively younger iguanas annually to determine the most conservation-effective size for release.

*Action:* JIRG field personnel, Hope Zoo.

*Timeline:* 2007

*Resources:* Grant funding to JIRG; Hope Zoo.

**3.2.5** Translocate sub-adult iguanas from the restored Goat Islands population to bring the Hellshire population up to at least 1,000 adult iguanas.

*Action:* JIRG staff and volunteers.

*Timeline:* 2012

*Resources:* To be assessed closer to the time of translocation.

### **3.3 OBJECTIVE: Implementation of habitat management policy.**

*Generation of comprehensive Protected Areas management policy, and incremental implementation, to be fully in place by 2013.*

**3.3.1** Formalize an MOU between UWI Life Sciences and the UDC, confirming authority for JIRG's iguana conservation activities in the Hellshire Hills and Goat Islands, and clarifying UDC's role in funding and human resources in support of this work.

*Action:* UDC and UWI (Byron Wilson).

*Timeline:* 2006

*Resources:* JIRG, UDC, UWI.

**3.3.2** Clarify the role of C-CAM in management of the Hellshire Hills, Goat Islands, and outlying Portland Bight cays, in light of UDC management authority over the majority of the areas of concern for the Jamaican Iguana.

*Action:* NEPA.

*Timeline:* 2011

*Resources:* NEPA.

**3.3.3** Submit UDC Management Plan for UDC's lands in the Hellshire Hills area to NEPA for final approval.

*Action:* UDC.

*Timeline:* 2011

*Resources:* UDC, NEPA.

**3.3.4** Revise approved C-CAM management plan to adjust for UDC management of UDC lands, clarify responsibilities, and strengthen collaboration between C-CAM and UDC.

*Action:* C-CAM, UDC, NEPA.

*Timeline:* 2012

*Resources:* UDC, C-CAM.

**3.3.5** Operational plan for C-CAM's revised Management Plan finalized.

*Action:* C-CAM, NEPA.

*Timeline:* 2012

*Resources:* C-CAM, NEPA.

**3.3.6** UDC operational plan for their Management Plan finalized.

*Action:* UDC, NEPA.

*Timeline:* 2012

*Resources:* UDC.

**3.3.7** MOU agreed between C-CAM, UDC, and NEPA, to implement understandings reached during revision of C-CAM's management plan.

*Action:* C-CAM, UDC, NEPA.

*Timeline:* 2012

*Resources:* C-CAM, UDC, NEPA.

**3.3.8** Finalize and gazette enforcement regulations for the Portland Bight Protected Area, develop operations based on those regulations.

*Action:* C-CAM, NEPA, UDC.

*Timeline:* 2012

*Resources:* C-CAM, UDC, NEPA.

**3.3.9** Seek JDF Coast Guard and Marine Police involvement in policing the protected area, especially the Hellshire Hills and Goat Islands coasts.

*Action:* JIRG, UDC, NEPA, and relevant enforcement agencies.

*Timeline:* 2011

*Resources:* JIRG, UDC, NEPA, and relevant enforcement agencies.

**3.3.10** Ensure that any development of nature tourism in the Hellshire Hills and Goat Islands area does not negatively impact the natural environment, does not involve building hotels or resorts within the areas currently zoned for protection, and ensures that financial benefits flow to protection and management of the protected area.

*Action:* NEPA, UDC, C-CAM.

*Timeline:* Ongoing

*Resources:* UDC.

#### **3.4 OBJECTIVE: Creation of “Iguana Islands Biodiversity Reserve” (IIBR).**

*Rehabilitate the Goat Islands through invasive species eradications and re-establish a viable population of Jamaican Iguanas.*

**3.4.1** Baseline habitat assessments of Goat Islands completed.

*Action:* JIRG, UDC.

*Timeline:* Ongoing

*Resources:* JIRG, UDC.

**3.4.2** Develop eradication strategy and a plan for prevention of potential reintroductions on Goat Islands.

*Action:* IC, JIRG.

*Timeline:* 2008

*Resources:*

**3.4.3** Review eradication report and agree on final strategy.

*Action:* IC, JIRG.

*Timeline:* 2008

*Resources:*

**3.4.4** Management policy and protected area enforcement in place for the Goat Islands.

*Action:* UDC.

*Timeline:* 2011

*Resources:*

**3.4.5** Acceptance of UDC Management Plan for Goat Islands by NEPA and others.

*Action:* NEPA.

*Timeline:* 2011

*Resources:*

**3.4.6** Encourage stakeholder support and sensitize public regarding eradication effort.

*Action:* UDC.

*Timeline:* 2012

*Resources:*

**3.4.7** Establish a Ranger Station on the degraded part of Little Goat Island, to be staffed by UDC rangers, with security support from JDF Coast Guard and Marine Police. Appropriate safeguards enforced to prevent reintroduction of invasives.

*Action:* UDC.

*Timeline:* 2012

*Resources:*

**3.4.8** Meet with owner(s) of the goats and agree on a plan for removal of all that can be relocated without excessive investment.

*Action:* UDC, in collaboration with JIRG and C-CAM.

*Timeline:* 2012

*Resources:* UDC.

**3.4.9** Capture and relocate as many goats as possible.

*Action:* UDC, working with goat owner(s).

*Timeline:* 2012

*Resources:* UDC.

**3.4.10** Eradicate all remaining goats on the Goat Islands using traps, poison baits, trained dogs, or other techniques (depending on eradication strategy).

*Action:* UDC.

*Timeline:* 2012

*Resources:* Funding to be obtained from international donors, UDC.

**3.4.11** Eradicate cats and mongooses from the Goat Islands, and implement planned reintroduction prevention measures.

*Action:* JIRG, UDC, IC.

*Timeline:* 2013

*Resources:* Funding to be sought closer to time of activity.

**3.4.12** Post-eradication verification and monitoring – see action 3.3.2.

*Action:* JIRG, UDC.

*Timeline:* 2014

*Resources:*

**3.4.13** Reintroduce the maximum available genetic diversity of Jamaican Iguanas as a founder population for the Goat Islands, using translocation and release from captivity as needed.

*Action:* JIRG, Hope Zoo.

*Timeline:* 2015

*Resources:* To be determined.

**3.5 OBJECTIVE: Acquire sufficient information to design, adapt, and assess the conservation actions in this plan.**

*Conduct the research and monitoring activities that will provide the information requisite for the long-term management of the iguana and the habitats in which it occurs, including the conservation of other components of biodiversity.*

**3.5.1** Conduct a helicopter survey of the entire Hellshire Hills area for potential iguana nesting sites.

*Action:* JIRG, UWI students under supervision by K. McLaren and B. Wilson (UWI).

*Timeline:* 2011

*Resources:* JIRG with support from UDC and NEPA to request allocation of JDF helicopter time.

**3.5.2** Create a habitat map of the Hellshire Hills (including Goat Islands) from satellite imagery with extensive ground-truthing. The map should at least distinguish degraded areas from primary areas, and wetlands from dry forest, but should also distinguish variation in the quality of iguana habitat. Note: habitat ground-truthing team should also search intensively for evidence of iguanas (e.g., using baited track plates), and recording the locations of other sign (e.g., scat, skin sheds, sites of active use).

*Action:* JIRG, UWI students under supervision by K. McLaren and B. Wilson (UWI).

*Timeline:* 2011

*Resources:* JIRG funding, Forestry Department satellite images, IKONOS images currently housed at the Department of Geography and Geology and the Department of Life Sciences, UWI.

**3.5.3** Conduct targeted searches for iguanas at eastern coastal areas, and the western area where iguana presence had been recorded previously. At these sites, and at soil zones identified in the helicopter survey and throughout Hellshire during ground truthing for habitat mapping, search for potential nest sites and retreats, and attempt to trap, tag, and sample all iguanas for genetic material. Targeted searches of eastern coastal and western areas to be conducted with the use of “Judas iguanas” (i.e., radio-transmitted headstarters released at selected localities).

*Action:* JIRG staff and volunteers, ground truthing team.

*Timeline:* 2009

*Resources:* Grant funding to JIRG, UWI personnel.

**3.5.4** Monitor the number of wild and headstarted females nesting each year, and document recurrence and nest site fidelity.

*Action:* JIRG staff and volunteers.

*Timeline:* Annually

*Resources:* Grant funding to JIRG.

**3.5.5** Radiotrack post-oviposition females and adult males, to determine location, home range overlap, habitat use, and diet.

*Action:* JIRG field staff and volunteers.

*Timeline:* 2007

*Resources:* Grant funding to JIRG.

**3.5.6** Maintain operation of existing pitfall trap network and schedule to assess consequences of localized and future potentially large-scale IAS controls in Hellshire, and to provide a comparison to Goat Islands.

*Action:* JIRG.

*Timeline:* 2011

*Resources:* Grant funding to JIRG.

**3.5.7** Establish pitfall trap network on Goat Islands prior to eradications, to establish baseline levels of faunal abundance and to serve as a monitoring tool for tracking post-eradication and (potentially) post-introduction changes.

*Action:* JIRG.

*Timeline:* 2012

*Resources:*

**3.5.8** Revisit existing permanent forest plots, and establish additional plots, to monitor long-term change in forest tree diversity, structure, and regeneration, and to provide a comparison to the Goat Islands.

*Action:* K. McLaren and UWI postgraduate student.

*Timeline:* 2012

*Resources:* Grant funding to JIRG.

**3.5.9** Establish and census three permanent forest plots on each of the Goat Islands.

*Action:* K. McLaren and UWI postgraduate student, IOJ, others.

*Timeline:* 2011

*Resources:* Grant funding to JIRG.

**3.5.10** Establish monitoring programmes for other native species (e.g., standardized point counts for forest birds, sea bird nesting surveys) that were either present before eradications or were introduced or recolonized afterward.

*Action:* JIRG team with UWI postgraduate students, others.

*Timeline:* 2015

*Resources:* Funding needed.

**3.5.11** Survey the Portland Bight Cays for the presence of invasive species and suitability for reintroduction of iguanas.

*Action:* JIRG.

*Timeline:* 2008

*Resources:* JIRG, NEPA.



**3.5.12** Review data from Portland Bight cays surveys, and determine policy and strategy for possible eradication of invasive species and reintroductions of iguanas.

*Action:* JIRG, NEPA, C-CAM.

*Timeline:* 2012

*Resources:* JIRG, NEPA, C-CAM.

**3.5.13** Centralization of Jamaican Iguana data bank (studbook), including the identification and consolidation of different data sets. All captive and field records should be forwarded to Tandora Grant, for incorporation into master database of all known individuals. Other relevant monitoring and research results also are to be centralized. Duplicate (electronic) copies to be maintained at UWI and SDZICR, and available to other JIRG members, given appropriate safeguards concerning academic rights.

*Action:* JIRG, Tandora Grant (SDZICR), all data holders.

*Timeline:* 2010

*Resources:* JIRG, SDZICR.

**3.5.14** Continue updating data records to the Studbook, ARKs, and field database.

*Action:* T. Grant, R. Van Veen, B. Wilson, O. Robinson.

*Timeline:* Ongoing

*Resources:*

### **3.6 OBJECTIVE: Expand the Hope Zoo headstart and captive breeding programme.**

*Increase the number of headstarters available annually for reintroduction to the Hellshire Hills, toward the goal of restoring historical levels of abundance.*

**3.6.1** Optimize captive diet for maximum growth by sourcing sufficient callaloo (grown off site), other greens (currently bok choy and cucumber), and fruit (papaya, melon, mango, bananas) to feed all captive iguanas daily, to satiety.

*Action:* Hope Zoo, Fort Worth Zoo.

*Timeline:* 2012

*Resources:* Hope Zoo.

**3.6.2** Approach Hope Gardens horticulture department with request to establish and maintain an iguana food supply garden.

*Action:* Hope Zoo.

*Timeline:* 2011

*Resources:* Hope Zoo.

**3.6.3** Raise level of husbandry expertise at Hope Zoo with the goal of accelerating growth rates.

*Action:* Hope Zoo, IIF, JIRG Fort Worth Zoo, SDZICR.

*Timeline:* 2012

*Resources:*

**3.6.4** Supply of diet supplement formula to be delivered to Hope Zoo.

*Action:* Fort Worth Zoo.

*Timeline:* 2011

*Resources:* Fort Worth Zoo.

**3.6.5** Enhance captive breeding programme by modifying existing headstart pens to accommodate genetically unrelated pairs for breeding. Excavate nests and incubate eggs to gain experience in captive breeding techniques. Hope Zoo keeper to learn incubation techniques from BIRP at the same time as food collection training (3.6.3).

*Action:* Hope Zoo, IIF.

*Timeline:* 2011

*Resources:* Require funds to purchase incubator and training visit costs in 3.6.3.

**3.6.6** Optimize existing space available for iguana headstarting by repairing broken enclosures, restoring empty cages to use, dividing larger groups of older animals to minimize competition and maximize growth.

*Action:* Hope Zoo.

*Timeline:* 2011

*Resources:* Hope Zoo.

**3.6.7** Build additional set of headstart cages to accommodate older animals in groups of 4-6.

*Action:* Hope Zoo.

*Timeline:* 2011

*Resources:* Hope Zoo

**3.6.8** Submit a proposal to the Director and Board of the Nature Preservation Foundation, to obtain Hope Gardens human resource assistance in all facility improvements.

*Action:* Hope Zoo Director.

*Timeline:* 2011

*Resources:* Hope Zoo.

**3.6.9** Gain support of Hope Gardens staff to maintain zoo grounds, especially the iguana cages areas, free of overgrowth and in appealing condition, to maximize donor response and ensure that iguanas receive sufficient sunlight.

*Action:* Hope Zoo and Hope Gardens.

*Timeline:* Ongoing

*Resources:* Hope Zoo/Gardens.

**3.6.10** Increase number of hatchlings collected and headstarters released, to 40 per annum. Release candidates identified and healthscreened prior to annual releases.

*Action:* JIRG, Hope Zoo, Fort Worth Zoo veterinary team, SDZICR.

*Timeline:* 2012

*Resources:* JIRG, Hope Zoo, Fort Worth Zoo, SDZICR.

**3.6.11** Healthscreen a selection of other captives to maintain cross-sectional data collection on the Hope Zoo population.

*Action:* Fort Worth Zoo veterinary team, SDZICR.

*Timeline:* Annually

*Resources:* Hope Zoo, Fort Worth Zoo, SDZICR.

**3.6.12** Expand the release area south, toward Manatee Bay, with potential to release in other areas as information from field surveys indicates.

*Action:* JIRG, Hope Zoo, Fort Worth Zoo, SDZICR.

*Timeline:* 2007

*Resources:* JIRG, Hope Zoo, Fort Worth Zoo

**3.6.13** Trial use of in situ “semi-headstart” facility and associated artificial retreats.

*Action:* JIRG.

*Timeline:* 2007

*Resources:* JIRG grant funding.

**3.6.14** Export blood samples from all iguanas being headstarted, for genetics work. Secure CITES export permits to transfer samples for storage at SDZICR.

*Action:* Hope Zoo, Fort Worth Zoo veterinary team, SDZICR.

*Timeline:* Annually

*Resources:* T. Grant (SDZICR) to supply vials and digestion buffer (as needed).

**3.6.15** Monitor growth rates of captive headstarters by measuring SVL, TL, and mass of all iguanas at Hope Zoo, in October and March each year, to permit predicting year of suitability for release. Communicate results to Studbook Manager and all members of JIRG.

*Action:* Hope Zoo.

*Timeline:* Annually

*Resources:* Hope Zoo, FWZ, SDZICR, international volunteer assistance through ISG if needed.

### **3.7 OBJECTIVE: Establish a viable breeding population of Jamaican Iguanas out of country.**

*Increase the capacity of off-island (captive) C. collei facilities and enhance their ability to manage captive populations to serve as long-term repositories of genetic diversity.*

**3.7.1** Update MOU between Jamaican government (Hope Zoo) and U.S. zoos.

*Action:* Hope Zoo, all participating U.S. zoos, *Cyclura* SSP.

*Timeline:* 2011

*Resources:* None needed.

**3.7.2** Identify all suitable AZA zoos and seek commitments of space for expected outputs from ex-situ breeding.

*Action:* *Cyclura* SSP.

*Timeline:* Ongoing

*Resources:* None needed.

**3.7.3** Investigate potential of EAZA zoos to expand suitable high-quality space available for captive *Cyclura*.

*Action:* Q. Bloxam, R. Hudson.

*Timeline:* 2012

*Resources:* None needed.

**3.8 OBJECTIVE: Build support for the conservation of the Jamaican Iguana and its natural habitat.**

*Form a task force to plan and conduct an education and awareness campaign aimed at generating support for the implementation of this conservation plan, both locally and globally.*

**3.8.1** Formation of an education team under JIRG auspices, identifying key individuals and institutions that can collaborate to implement the education and awareness components of this recovery plan.

*Action:* NEPA, Hope Zoo, JIRG.

*Timeline:* 2011

*Resources:* None needed for this objective.

**3.8.2** Develop and submit an education program funding proposal for 2011 activities to IIF (in range of USD 8-10K).

*Action:* JIRG, NEPA, Hope Zoo.

*Timeline:* 2012

*Resources:* None needed beyond labour inputs.

**3.8.3** Maintain contact list and agreements with photographers with high quality images of the Jamaican Iguana and the JIRG activities, as essential for education and awareness outputs.

*Action:* JIRG Education Group and all field staff and volunteers.

*Timeline:* Ongoing

*Resources:* None needed

**3.8.4** Communicate key elements of this Plan to the office of the Prime Minister, and seek his/her ongoing support for the protection and conservation management of the Hellshire Hills and Goat Islands.

*Action:* NEPA.

*Timeline:* 2012

*Resources:* None needed.

**3.8.5** Presentation on the key elements and purpose of this Plan to the NRCA Biodiversity Committee.

*Action:* NEPA.

*Timeline:* 2012

*Resources:* None needed.

**3.8.6** Presentations on this plan, emphasizing enforcement needs, to the JDF Coast Guard, the Jamaica Constabulary Force, and the Island Special Constabulary Force.

*Action:* NEPA.

*Timeline:* 2011

*Resources:* None specifically needed.

**3.8.7** Use all available contacts and channels to secure local media coverage of JIRG activities.

*Action:* JIRG and JIRG Education Group, NEPA, IOJ, UDC.

*Timeline:* Ongoing

*Resources:* None needed.

**3.8.8** Pursue additional avenues of public awareness and dissemination of information related to the JIRG and the conservation of the iguana and its habitat.

*Action:* JIRG and JIRG Education Group, NEPA, IOJ, UDC.

*Timeline:* Ongoing

*Resources:* To be determined.

**3.8.9** Review options for website presentation of JIRG materials, including the potential for using existing websites (e.g., IOJ) or the development of a dedicated JIRG website. Implement selected option. Site content may include links for sponsoring, donations, and materials for download.

*Action:* JIRG, IIF, ISG.

*Timeline:* Ongoing

*Resources:* To be determined.

**3.8.10** Targeted outreach activities directed at communities close to Hellshire to emphasize the importance of the Hellshire Hills and Goat Islands for the conservation of the iguana and the natural heritage of Jamaica generally. Special targets would include charcoal burners and other forest users.

*Action:* UDC, with support from other JIRG members.

*Timeline:* Ongoing

*Resources:* UDC.

**3.8.11** Education campaigns directed at Jamaican school children to instill knowledge of and appreciation for the value of the iguana and its unique dry forest habitat. Actions to include:- 1) competition to develop a Jamaican Iguana 'jingle', 2) Adopt-an-Animal Program, and 3) possibly a traveling live animal presentation.

*Action:* JIRG, Hope Zoo.

*Timeline:* 2012

*Resources:* To be determined.

**3.8.12** Plans for biological interventions (e.g., eradications, reintroductions) to be disseminated to fisherfolk active in the Hellshire/Goat Islands area.

*Action:* UDC.

*Timeline:* 2012

*Resources:*

**3.8.13** Resources and training for teachers to be provided.

*Action:* Education Group of JIRG.

*Timeline:* As soon as possible

*Resources:* Ongoing.

**3.9 OBJECTIVE: Access sufficient human and financial resources to implement this plan.**

*Continue to access conservation and research funding and seek the additional resources that will be required to implement this recovery plan.*

**3.9.1** Reform the former JIRCG as the Jamaican Iguana Recovery Group (JIRG) with each partner organization to formalize their institutional involvement and commitment to the JIRG.

*Action:* All JIRG members and institutions.

*Timeline:* Ongoing

*Resources:*

**3.9.2** Identify all other major potential sources of project grant funds and prioritize for specific elements of this plan.

*Action:* JIRG.

*Timeline:* Ongoing

*Resources:* None needed for this objective.

**3.9.3** Species Recovery Plan formally adopted by all members of the JIRG by the end of 2011, and reviewed annually.

*Action:* JIRG.

*Timeline:* Annually

*Resources:* JIRG.

**3.9.4** Annual review meeting to assess progress and refine plans for the coming year.

*Action:* All JIRG members.

*Timeline:* Annually

*Resources:* None needed.

**3.9.5** Create institutional framework for oversight and management of the recovery program that allows Byron Wilson to hand off his responsibilities to another qualified entity by January 2014.

*Action:* JIRG.

*Timeline:* 2014

*Resources:*

**APPENDIX I. JAMAICAN IGUANA SRP ACTION INDEX AND UPDATES**

Updated February 2013

GREEN=Completed, YELLOW=Not completed, some progress made, RED=No progress.

[Year] denotes proposed completion date from original 2006 SRP Workshop.

Action	Due Date	Project Steps	Agency	Notes	Priority
<b>3.1</b>		<i>Manage the Hellshire Hills for biodiversity conservation</i>			
<b>3.1.1</b>	2011 [2007]	Enforce exclusion of charcoal burners from the Hellshire Hills.	UDC, NEPA		Critical
<b>3.1.2</b>	2011 [2007]	Instigate alternative livelihood programs for displaced charcoal burners.	UDC, NEPA, PBPA (C-CAM)		High
<b>3.1.3</b>	Ongoing	Maintain present trapping network (60 trapping stations) for mongooses and cats.	JIRG	Predator trapping grid operational every day since July 2006 SRP workshop. 11/2010: 75 traps currently operational.	Critical
<b>3.1.4</b>	Ongoing	Continue to trap pigs in core areas.	JIRG	Trapping has been ongoing, and results in the removal of several dozen pigs every year. 11/2010: expansion of current snaring program and live cage traps pending.	High
<b>3.1.5</b>	Ongoing	Remove all dogs that appear in the core areas.	JIRG	11/2010: 4 dogs removed from the core iguana area since 2007. Other dogs, likely brought by pig hunters, were present in the area in 2007 for brief periods and may have been responsible for the deaths of 1-2 iguanas. 9 camera traps being used to target IAS for removal. Two dogs seen in 2010. 12/2012: Acquired 12 large cage traps; deployment pending.	Critical
<b>3.1.6</b>	2012 [2007]	Determine feasibility of purchasing undeveloped private lands within the northern limits of the Hellshire protected area.	UDC		Normal
<b>3.1.7</b>	2006	Cost-benefit analysis of patrols vs. fencing to control cats, dogs, and pigs.	Byron Wilson and Island Conservation	Site visit and discussions with IC in April 2007. Acquisition of 12 leg-hold traps and subsequent (successful) deployment near the core nesting area. 11/2010: Fencing determined to not be practical.	Normal
<b>3.2</b>		<i>Restore Hellshire Hills population to at least 1,000 adult iguanas</i>			
<b>3.2.1</b>	Ongoing	Collect 20 hatchlings for headstarting in 2006, and at least 40 per annum thereafter, depending on capacity at the Hope Zoo.	JIRG, Hope Zoo	11/2010: 20 hatchlings collected in 2006, with an average of 40 collected since 2007 (39 in 2007, 40 in 2008, 29 in 2009, 52 in 2010, 43 in 2011, 46 in 2012).	Critical
<b>3.2.2</b>	Ongoing	Assess the genetic diversity of all iguanas [Hellshire, current Jamaican captives, and U.S. Captives].	JIRG, Mark Welch, Tan- dora Grant	327 samples were collected from 2005-2009 from iguanas with hatch years 1991-2009. An additional 219 samples were exported from the 2010 hatch year and 214 from 2011 hatchlings. Analysis currently ongoing. Samples at Mississippi State University. Study led by Mark Welch with help from Tandora Grant; funded through international grants. More funds will be needed to refine the analysis of DNA. Second proposal submitted in 2011.	Critical



<b>3.2.3</b>	Annually	Release all sub-adults (2002 hatch and older) currently captive at Hope Zoo.	JIRG, Hope Zoo, SDZICR, FWZ	18 headstarters released in March 2007. A total of 20 individuals repatriated in 2008 (inclusive of 10 Judas iguanas). Close to target of releasing all animals before age six. 11/2010: 138 animals released to date.	High
<b>3.2.4</b>	2007	Release and monitor successively younger iguanas annually to determine the most conservation-effective size for release.	JIRG, Hope Zoo, FWZ, SDZICR	11/2010: Results from 2008 indicate that even relatively "large" smaller size classes (900 g) are vulnerable to mongoose predation. Minimum size for repatriation should therefore be > 1 kg. It was determined that in the core area, a slightly smaller size class can be released since they are apparently less likely to disperse from the predator control zone.	Normal
<b>3.2.5</b>	2015 [2010]	Translocate sub-adult iguanas from the restored Goat Islands population to bring the Hellshire population up to at least 1,000 adult iguanas.	JIRG	11/2010: pending restoration of Goat Islands.	High
<b>3.3</b>		<i>Implementation of habitat management policy</i>			
<b>3.3.1</b>	2006	Formalize an MOU between UWI Life Sciences and the UDC.	UWI, UDC	Completed MOU signed by UWI and UDC in January 2007.	High
<b>3.3.2</b>	2011 [2006]	Clarify the role of CCAM in management of the Hellshire Hills, Goat Islands, and outlying Portland Bight cays.	NEPA		Critical
<b>3.3.3</b>	2011 [2007]	Submit UDC Management Plan for Hellshire Hills area to NEPA.	UDC		High
<b>3.3.4</b>	2012 [2008]	Revise approved CCAM management plan.	C-CAM, NEPA		High
<b>3.3.5</b>	2012 [2008]	Operational plan for CCAM's revised Management Plan finalized.	C-CAM, NEPA		High
<b>3.3.6</b>	2012 [2008]	UDC operational plan for their Management Plan finalized.	UDC, NEPA		High
<b>3.3.7</b>	2012 [2008]	MOU agreed between CCAM, UDC, and NEPA.	C-CAM, UDC, NEPA		Critical
<b>3.3.8</b>	2012 [ASAP]	Finalize and gazette enforcement regulations for the Portland Bight Protected Area.	NEPA, UDC, C-CAM		Critical
<b>3.3.9</b>	2011 [ASAP]	Seek JDF Coast Guard and Marine Police involvement in policing the protected area.	UDC, NEPA, JIRG	Several joint trips to Hellshire coastal locations involving JIRG, Marine Police, and UDC have occurred. Enforcement remains inadequate as of March 2013.	Critical
<b>3.3.10</b>	Ongoing	Ensure that any development of nature tourism in the Hellshire and Goat Islands area does not negatively impact the natural environment.	NEPA, UDC, C-CAM		Critical
<b>3.4</b>		<i>Creation of "Iguana Islands Biodiversity Reserve" (IIBR) on Goat Island</i>			
<b>3.4.1</b>	Ongoing	Baseline habitat assessment of Goat Islands completed.	JIRG, UDC	11/2010: Trips completed 2006-2007, survey work initiated in 2008 and ongoing. Use of camera traps in 2010 confirmed IAS (mongooses, cats, goats, rats, cane toads), and failed to detect sensitive, non-target species (e.g., iguana, coney, boa).	Critical

3.4.2	2008	Develop eradication strategy and a plan for prevention of potential reintroductions on Goat Islands.	IC, JIRG	IC site visit to Goat Islands in April 2007. Eradication plan submitted to UDC and JIRG in January 2008.	Critical
3.4.3	2008	Review eradication report and agree on final strategy.	JIRG, IC, UDC, NEPA	11/2010: reviewed and plan finalized.	Critical
3.4.4	2011 [2007]	Management policy and protected area enforcement in place for the Goat Islands.	UDC		Critical
3.4.5	2011 [2007]	Acceptance of UDC Management Plan for Goat Islands by NEPA and others.	NEPA		High
3.4.6	2012 [2007]	Encourage stakeholder support and sensitize public to eradication.	UDC		High
3.4.7	2012 [2008]	Establish a Ranger Station on the degraded part of Little Goat Island.	UDC		High
3.4.8	2012 [2007]	Meet with owner(s) of the goats and agree on a plan for removal.	UDC		Critical
3.4.9	2012 [2008]	Capture and relocate as many goats as possible.	UDC		High
3.4.10	2012 [2008]	Eradicate all remaining goats.	UDC		High
3.4.11	2013 [2009]	Eradicate cats and mongooses from the Goat Islands, and implement planned reintroduction prevention measures.	UDC, IC		Critical
3.4.12	2013 [2006]	Post-eradication verification and monitoring.	UDC, JIRG		High
3.4.13	2015 [2010]	Reintroduce the maximum available genetic diversity of Jamaican Iguanas as a founder population for the Goat Islands.	JIRG, Hope Zoo		High
3.5		<i>Acquire sufficient information to design, adapt, and assess the conservation actions in this plan</i>			
3.5.1	2011 [2007]	Conduct a helicopter survey of the entire Hellshire Hills area for potential iguana nesting sites.	JIRG, UDC, NEPA	Multiple JDF helicopter trips in 2008 in support of other JIRG activities, but including time for aerial inspection for potential nesting areas and assessments of charcoal burning activities. 11/2010: Not completed, more surveys needed.	Normal
3.5.2	2011 [2009]	Create a habitat map of the Hellshire Hills (including Goat Islands) from satellite imagery with extensive ground-truthing.	JIRG, UWI students under supervision by K. McLaren and B. Wilson (UWI)	Surveys and ground-truthing conducted in eastern and western portions of the peninsula. Post-graduate student registered in September 2008, to begin field work and GIS analyses in 2009. 11/2010: aerial photos or satellite images from 1940, '60, '80, and 2000 obtained. Analysis will be led by K. McLaren and due to be completed in 2013.	High
3.5.3	2009	Conduct targeted searches for iguanas at eastern coastal areas and the western area identified in 1990.	JIRG	Eastern and western Hellshire surveys conducted in conjunction with Judas iguana project in 2008. Unfortunately, no sign of additional iguanas was detected.	High
3.5.4	Annually	Monitor the number of wild and headstarted females nesting each year, and document recurrence and nest site fidelity.	JIRG	2007-2010 nesting season monitoring completed. 11/2010: over 50 percent of core nesting population comprised of repatriated headstarters.	High

3.5.5	2007	Radiotrack post-oviposition females and adult males, to determine location, home range overlap, habitat use, and diet.	JIRG	26 individuals telemetered and radiotracked during period of June-October 2006. 18 animals telemetered and radiotracked during period of May-December 2007. Focused effort completed but additional information continually collected.	Normal
3.5.6	2011	Maintain operation of existing pitfall trap network and schedule to assess consequences of localized and future potentially large-scale IAS controls in Hellshire, and to provide a comparison to Goat Islands.	JIRG	2007-2011 pitfall trapping successfully completed (2012 was 16th consecutive year of data collection). Currently data is collected but not analyzed. Analyzed dataset scheduled to be completed by a student by end of 2011.	High
3.5.7	2012 [2007]	Establish pitfall trap network on Goat Islands prior to eradications.	JIRG		High
3.5.8	2012 [2007]	Revisit existing permanent forest plots in Hellshire and establish additional plots to monitor long-term change in forest tree diversity, structure, and regeneration, and to provide a comparison to the Goat Islands.	K. McLaren and UWI post-graduate student	Funding proposal to Environmental Foundation of Jamaica rejected in 2007. Assessment of long-term regeneration dynamics completed in 2009. Assessments of forest structure and growth dynamics initiated in 2009, to be completed in 2012.	Normal
3.5.9	2011 [2008]	Establish and census three permanent forest plots on each of the Goat Islands.	K. McLaren and UWI post-graduate student, IOJ, others	Reconnaissance surveys conducted in 2010. Plots to be established by 2011.	Critical
3.5.10	2015 [2008]	Establish monitoring programmes for other native species that were either present before eradications or were introduced afterward.	JIRG team with UWI postgraduate students, others		High
3.5.11	2008	Survey the Portland Bight Cays for the presence of invasive species and suitability for reintroduction of iguanas.	JIRG	Surveys completed in 2007.	Normal
3.5.12	2012 [2008]	Review data from PB cays surveys, and determine policy and strategy for possible eradication of invasive species and reintroductions of iguanas.	JIRG, NEPA, C-CAM	Management structure that addresses issues related to human incursion needs to be addressed before site is viable for eradication and reintroduction.	Normal
3.5.13	2010 [2006]	Centralization of Jamaican Iguana data bank.	JIRG, T. Grant (SDZICR), all data holders	Initiation of data compilation by R. Van Veen and T. Grant (for JIRG). 2010: completed, database and studbook now held at Hope Zoo, San Diego Zoo, and UWI.	High
3.5.14	Ongoing	Continue updating data records to the Studbook, ARKs, and field database.	T. Grant, R. Van Veen, B. Wilson, O. Robinson	Current as of 11/2012.	Critical
3.6		<i>Optimize the Hope Zoo headstart and captive breeding programme</i>			
3.6.1	2012 [2006]	Optimize captive diet for maximum growth	Hope Zoo, FWZ		High
3.6.2	2011 [2006]	Approach Hope Gardens horticulture department with request to establish and maintain an iguana food supply garden	Hope Zoo		Normal

3.6.3	2012 [2007]	Raise level of husbandry expertise for Hope Zoo with the goal of accelerating growth rates.	Hope Zoo, IIF, BIRP, FWZ, SDZICR	Diets and feeding protocols from U.S. zoos were shared with Hope Zoo staff (Lung and Hudson). Cage transfer strategy developed to describe optimum housing for individuals per age class in existing spaces (T.Grant). Ongoing: growth data of animals is collected at annual inventory and healthscreen. 2011: a complete review of growth data, diet, and husbandry protocols is needed. Follow up needed to train Hope Zoo staff at BIRP program.	High
3.6.4	2011 [2008]	Supply of diet supplement formula to be delivered to Hope Zoo.	FWZ		Normal
3.6.5	2011 [2007]	Enhance captive breeding programme by modifying two headstart pens to accommodate genetically unrelated pairs for breeding.	Hope Zoo, IIF	Unrelated pairs are on display at Hope Zoo. Passive effort for breeding in place.	High
3.6.6	2011 [2007]	Optimize existing space available for iguana headstarting by repairing broken enclosures, restoring empty cages to use, dividing larger groups of older animals to minimize competition and maximize growth.	Hope Zoo	Some repairs have been made and cages are back in use (HdSt 2). Safari cages have not yet been repaired (Apr 2011) though there is some discussion of not restoring them for iguana use and keep all iguanas (except exhibit) together and physically isolated from the rest of the zoo. "Dividing larger groups" needs to be addressed per the cage space strategy and is ongoing.	Critical
3.6.7	2011	Build additional set of headstart cages to accommodate older animals in groups of 4-6.	Hope Zoo	7/2011: completed with building of Headstart 3 and in use since 2010.	High
3.6.8	2011 [2006]	Submit a proposal to the Director and Board of the NPF, to obtain Hope Gardens human resource assistance in all facility improvements.	Hope Zoo Director	Action is no longer relevant because the Nature Preservation Foundation is not involved.	
3.6.9	Ongoing	Gain support of Hope Gardens staff to maintain zoo grounds, especially the iguana enclosure areas, in prime condition.	Hope Zoo	Tree-trimming and vine removal over iguana enclosures completed.	Normal
3.6.10	2012	Increase numbers of hatchlings collected and headstarters released, to 40 per annum.	JIRG, Hope Zoo, FWZ, SDZICR	18 health-cleared animals released in March 2007. 20 animals released in 2008. ~40 hatchlings collected in both 2007 and 2008. 11/2010: Close to goal of releasing all animals before 6th birthday. Raised number of released from 20 to almost 40.	Critical
3.6.11	Annually	Healthscreen a selection of other captives to maintain cross-sectional data collection on the Hope Zoo population.	FWZ, SDZICR	Completed annually.	High
3.6.12	2007	Expand the release area south, toward Manatee Bay in 2007.	JIRG	18 headstarters released just north of the eastern end of Manatee Bay in March 2007. Several others have been released along the coast in following years.	Normal
3.6.13	2007	Trial use of in situ "semi-headstart" facility and associated artificial retreats in 2007.	JIRG	Trial facility constructed in 2007. Planned expansion for 2008 not completed, but new plans for augmenting retreat options explored. At least 3 wild hatchlings from the 2004-2008 period now resident in vicinity of research station (South Camp). 11/2010: 21 2008 hatchlings were released in the vicinity of South Camp.	Normal

<b>3.6.14</b>	Annually	Sample and export blood samples from all iguanas PIT-tagged for genetics work.	FWZ, SDZICR	4/2011: All samples collected to date exported to U.S. for analysis.	High
<b>3.6.15</b>	Annually	Monitor growth of captive headstarters by measuring SVL, TL, and mass, of all iguanas at Hope Zoo, in October and March each year, to permit predicting year of suitability for release.	Hope Zoo	Done in March-April of each year. Allows for identification of individuals not meeting growth expectations and release suitability.	High
<b>3.7</b>	<b><i>Establish a viable breeding population of Jamaican Iguanas out of country</i></b>				
<b>3.7.1</b>	2011 [2007]	Update MOU between Jamaican government (Hope Zoo) and U.S. zoos.	Hope Zoo, all participating U.S. zoos, <i>Cyclura</i> SSP	11/2010: All iguanas in U.S. zoos are governed by breeding loans and are property of Jamaican government. Further clarification on commitments needed but not necessarily an MOU.	High
<b>3.7.2</b>	Ongoing	Identify all suitable AZA zoos and seek commitments of space for expected outputs from ex-situ breeding.	<i>Cyclura</i> SSP	11/2012: Three breeding events have occurred in the U.S.	Normal
<b>3.7.3</b>	2012 [2007]	Investigate potential of EAZA zoos to expand suitable high-quality space available for captive <i>Cyclura</i> .	Q. Bloxam, R. Hudson		Normal
<b>3.8</b>	<b><i>Build support for the conservation of the Jamaican Iguana and its natural habitat</i></b>				
<b>3.8.1</b>	2011 [2007]	Formation of an education team under JIRG auspices to implement the education and awareness components of this recovery plan	NEPA, Hope Zoo, JIRG		Normal
<b>3.8.2</b>	2012 [2007]	Develop and submit an education program funding proposal for 2011 [2007] activities to IIF (in range of \$8-10K USD).	JIRG, NEPA, Hope Zoo		Normal
<b>3.8.3</b>	Ongoing	Maintain contact list and agreements with photographers with high quality images of the Jamaican Iguana and the JIRG activities.	JIRG		Normal
<b>3.8.4</b>	2012 [2008]	Communicate key elements of this Plan to the office of the Prime Minister.	JIRG	11/2010: Reassessment required due to change in the Government of Jamaica in 2007.	Critical
<b>3.8.5</b>	2012	Presentation on the key elements and purpose of this Plan to the NRCA Biodiversity Committee.	NEPA		High
<b>3.8.6</b>	2011 [ASAP]	Presentations on this plan, emphasizing enforcement needs, to the JDF Coast Guard, the Jamaica Constabulary Force, and the Island Special Constabulary Force.	NEPA		High
<b>3.8.7</b>	Ongoing	Use all available contacts and channels to secure local media coverage of JIRG activities.	JIRG, NEPA, IOJ, UDC		Normal
<b>3.8.8</b>	Ongoing	Pursue additional avenues of public awareness and dissemination of information related to the JIRG and the conservation of the iguana and its habitat.	JIRG, NEPA, IOJ, UDC	Various JIRG members contributed information for the publication of an article in "Americas" magazine, published in 2008. B. Wilson contributed to and edited a coffee table book on Jamaican biodiversity in 2008.	Normal

<b>3.8.9</b>	Ongoing	Review options for website presentation of JIRG materials.	JIRG, IIF, ISG	New information is available via IIF and ISG.	Normal
<b>3.8.10</b>	Ongoing	Targeted outreach activities directed at communities close to Hellshire. Special targets would include charcoal burners and other forest users.	UDC, with support from JIRG members		Critical
<b>3.8.11</b>	2012 [ASAP]	Education campaigns directed at Jamaican school children, to instill knowledge of and appreciation for the value of the iguana and its unique dry forest habitat.	JIRG, Hope Zoo	2010: Jamaican Iguana display established, Port Royal Marine Laboratory. Additional signage placed at Hope Zoo.	Critical
<b>3.8.12</b>	2012	Plans for biological interventions (e.g., eradications, reintroductions) to be disseminated to fisherfolk active in the Hellshire/Goat Islands area.	UDC		High
<b>3.8.13</b>	Ongoing	Resources and training for teachers to be provided.	Education Group of JIRG	B. Wilson supplied information to be incorporated into primary school textbook in 2008.	High
<b>3.9</b>		<i>Access sufficient human and financial resources to implement this plan</i>			
<b>3.9.1</b>	Ongoing	Reform the former JIRCG as the Jamaican Iguana Recovery Group (JIRG) with each partner organization to formalize their institutional involvement and commitment to the JIRG.	All JIRG members and institutions	Name change accepted by all members at the 2006 SRP workshop in Kingston. Formalization of commitment needed.	High
<b>3.9.2</b>	Ongoing	Identify all other major potential sources of project grant funds and prioritize for specific elements of this plan.	JIRG	Funding for JIRG field activities obtained through international grants and an anonymous donor. Proposals submitted to local funding organizations (EFJ and Forest Conservation Fund) were not successful.	High
<b>3.9.3</b>	Annually	Species Recovery Plan formally adopted by all members of the JIRG by the end of 2011 [2006] and reviewed annually.	JIRG	Plan adopted in 2007. Set to have an update published in 2013.	High
<b>3.9.4</b>	Annually	Annual review meeting to assess progress and refine plans for the coming year.	JIRG		High
<b>3.9.5</b>	2014	Create institutional framework for oversight and management of the recovery program that allows Byron Wilson to hand off this responsibilities to another qualified entity by January 2014.	JIRG		Critical

## APPENDIX II. WORKSHOP PARTICIPANTS

Quentin Bloxam	Durrell Wildlife Conservation Trust
Fred Burton	Blue Iguana Recovery Program
Karlene Cal	Jamaican Society for the Protection of Cruelty to Animals
Oneil Dawkins	Hope Zoo
Errol Ennis	Minister of State, Ministry of Agriculture
Natalie Fearon	NEPA
Royan Gayle	UDC
Tandora Grant	San Diego Zoo Institute for Conservation Research
Kapleton Hall	NEPA
D. Brandon Hay	C-CAM
Rick Hudson	Fort Worth Zoo, International Iguana Foundation
Elizabeth Mariner	IOJ
Ricardo Miller	NEPA
Richard Nelson	NEPA
Marlon Osborne	
Orlando Robinson	Hope Zoo
Hopeton Smith	UDC
Marva Smith-Moodie	NEPA
Heidi Sorelli Sodberg	UNEP
Yvette Strong	NEPA
Bernie Tershy	Island Conservation
Rick Van Veen	UWI
Faith Walker	NEPA
Ordell Williams	Hope Zoo
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