

RECOVERY PLAN FOR
THE MONA IGUANA

CYCLURA STEJNEGERI

Prepared by

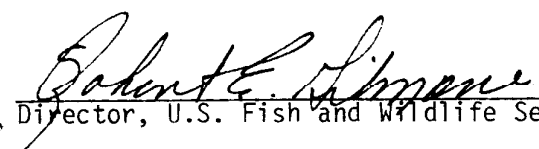
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Approved:

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Date:

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I. INTRODUCTION

Description and Distribution

The Mona iguana (Cyclura stejnegeri) belongs to the genus Cyclura, which comprises the rock iguanas indigenous to the Greater Antilles and the Bahamas (Wiewandt 1977).

Cyclura stejnegeri is the largest Puerto Rican lizard. It measures 1 to 1.3 m (3-4 feet) total length, has a heavy body, a large head, and a stout, laterally compressed tail. The lizard has a large jaw under the angle of the jaw, a large median dewlap that is joined posteriorly by a transverse fold, and a small horn on the snout just in front of the eyes. A dorsal crest is present, extending from head to tail. The general color is olive to olive gray, sometimes with brown and/or blue lines (Rivero 1978).

Wiewandt (1977), considers the Mona iguana distinct from C. cornuta of Hispaniola. On the other hand, Schwartz and Thomas (1975) consider the Mona iguana a subspecies of Cyclura cornuta (C. cornuta stejnegeri). In this work, the Mona iguana is considered to be endemic to Mona and is referred to as Cyclura stejnegeri Barbour and Noble.

Cyclura stejnegeri is restricted to Mona Island, a 5500 ha. rocky limestone island located midway between Puerto Rico and Hispaniola (lat. 18 5'N, long. 67 53'W) in the Greater Antilles (Fig. 1). Mean annual temperature is 30.7 C, and mean annual rainfall is 800mm.

Mona Island is characterized by a flat plateau, a gently sloping upland surface that is terminated by high sheer cliffs along its northern

Isla de Mona

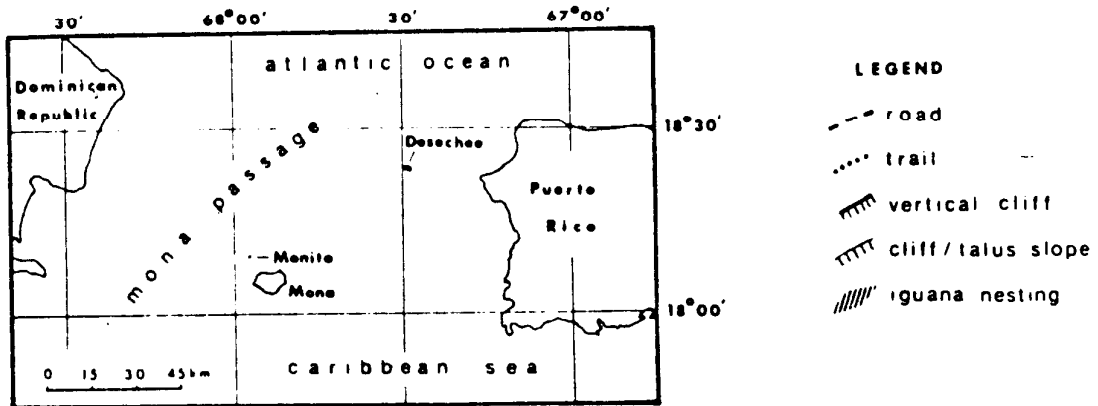
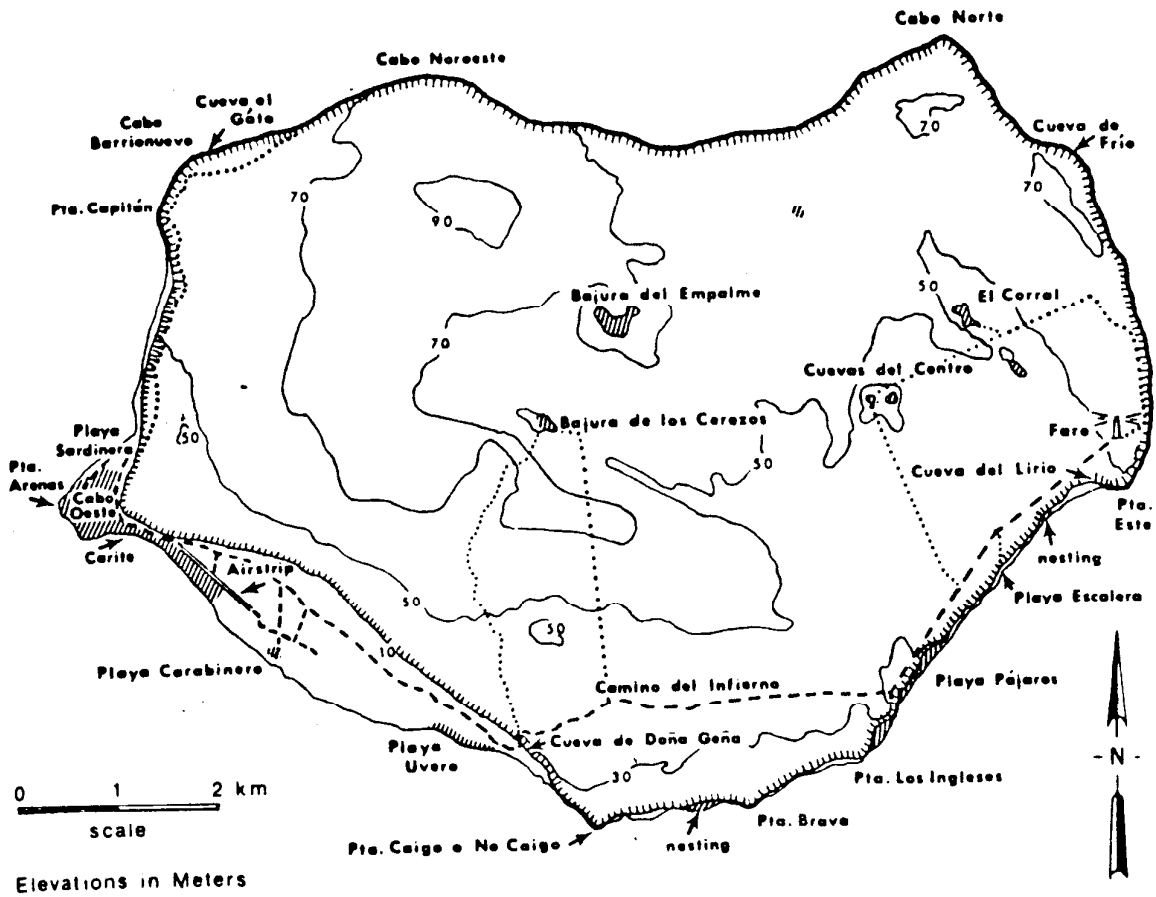


Fig. 1. Topography, place names, and principal iguana nesting habitat of Mona Island.

and southern perimeter and by somewhat lower, less steep cliffs that descend to coastal lowlands along its western, southwestern, and southeastern margins.

Large parts of the Mona Plateau are covered by outcrops of solid limestone, dominated by a dry and semideciduous scrub vegetation of low trees and shrubs, interspersed with cacti. On the eastern side of the plateau, where salt spray exposure is greatest, organpipe cacti are locally dominant, forming a cactus forest 3-4 m tall. Over the rest of the plateau, a thin and discontinuous soil layer permits tree growth only on cracks, crevices, and soil pockets. As a result the tree canopy is low (4-5 m) and the tree layer is discontinuous. Dominant species include Bursera simaruba (gumbo-limbo), Coccoloba microstachya (uverille), Ficus citrifolia (wild fig), Tabebuia heterophylla (West Indian white cedar), and Metopium toxiferum (poison tree). Between trees, the plant cover is composed largely of shrubs 1-2 m high. Dominant species include Reynosa uncinata, Croton discolor, C. humilis, Plumeria obtusa, and Antirhea acutata.

In large plateau sinkholes and depressions, and along the southwestern coastal terrace, deeper soils support more mesic, closed canopy forest. Dominant trees include Krugiodendron ferreum, Bumelia obovata, Ficus citrifolia, Clusia rosea, Chlorophora tinctoria, Mastichodendrum foetidissimum, Pisonia albida, and Dipholis salicifolia. Subcanopy trees include Capparis flexuosa (favored iguana food), C. cynophallophora, Myrcianthes fragrans, Schaefferia frutescens, and on the coast Gymnanthes lucida.

Large areas of the coastal terrace were cleared and planted with West Indian mahogany (Swietenia mahogani) and Australian pine (Casuarina equisetifolia) by the Civilian Conservation Corps in the late 1930's and 1940's. Iguanas nest in semiopen areas within and around the edges of these plantations, in exposed patches of loose sandy soil.

Feeding Biology

Cyclurid iguanas are known to be herbivorous-omnivorous. From 118 fecal samples Wiewandt (1977) determined that 71 plant species and 12 animal species were included in the iguana's diet. Predominant plant species in the samples were Capparis flexuosa, Centrosema virginiana, and Galactia dubia. The most commonly eaten plant parts (12 species) were thin walled leaves (28 samples) and fruits (47 samples). For the most part, leaves were absent from samples in which fruits were present indicating a probable preference for fruits. These predominate as the principal plant food contributing towards growth, reproduction, and fat reserves. Iguanas forage on the ground (Wiewandt 1977) although some individuals occasionally climb 2 or 3 meters on shrubs. Leaves are eaten from the plant except those from Capparis flexuosa which are taken from the ground. Most fruits are eaten from the ground. Land crabs (Geocarcinus spp.), and coleoptera and lepidoptera larvae are the most common animal food items (Wiewandt 1977).

All the plant species eaten by iguanas also are eaten by goats. The only exception is Hippomane mancinella, a poisonous coastal plant that is consumed by iguanas in limited quantities (Wiewandt 1977). Consumption of these species by goats reduces the amount of food available to the iguanas.

Iguanas do not expend much energy in foraging. They eat what is most readily available. Movements are slow and behavioral activities are restricted to areas near their retreat burrows. Outside of the breeding and mating season 94% of their time is spent resting (Wiewandt 1977). The remaining time is spent foraging and eating. With the exception of females traveling to nesting grounds, distant movements are related principally to the search for food (Wiewandt 1977).

Reproductive Biology

The breeding season begins in mid-June, when all mating occurs, and ends by November, when eggs hatch. Prior to the breeding season, males establish a territory that includes female retreat burrows. Territories are defended aggressively. This is presumed to increase the probability of mating by insuring access to females. Fights usually involve head bobbing, tossing, and pushing, but biting rarely is involved. Combats last for about 15 minutes when one of the opponents retreats (Wiewandt 1977).

Mating occurs from mid-June through the end of that month. During this period males increase territorial movements, reduce the time spent foraging, and defend territories more eagerly.

Females seldom move from their retreat burrows within male territories. After mating, females migrate to nesting grounds on the plateau or the southwestern coastal plain, where most of the favorable nesting sites occur. Most egg-laying occurs 2 to 4 weeks after mating.

Only 5 percent of the island has soils deep enough for iguana nesting. These are located on the lateritic soils of the plateau and on the southwestern coastal plain (Wiewandt 1977). Traditional nesting sites include Sardinera, Punta Arenas, the coastal plain, and depressions or bajuras in the plateau, such as Bajura de los Cerezos, Bajura del Empalme, Bajura de los Cabros, and Corral de los Indios.

Gravid females may migrate great distances searching for favorable nesting sites. This annual migration occurs with no apparent relation to rainfall or temperature. Once in an appropriate, sunlit area, females search for potential pits and dig for about 2 hours. Usually they retreat to nearby bushes to cool off, returning several times until the hole is large enough to accommodate the whole animal (Wiewandt 1977).

Once the nest is ready, oviposition takes place during the day. Clutches average 12 eggs. Larger, older females have larger clutches. After egg laying, females cover the egg chamber, but leave an air space over the eggs. They usually guard the nest up to 10 days after oviposition. If tunnel collapse destroys the air space, eggs and embryos will fail to develop. Eggs hatch in October and November, 3 months after oviposition. The young emerge by cooperatively digging out from the nest chamber. Young lizards receive no parental care (Wiewandt 1977).

Status of the Species

The status of the Mona iguana prior to Wiewandt's work from 1972 to 1975 only can be inferred. Although scarce notes are available prior to 1972, most are anecdotal, covering some aspects of food habits and behavior.

The hazards to which the Mona iguana has been subjected probably are of recent occurrence. Mammals such as cats, burros, dogs, mice, rats, goats, and pigs introduced to Mona Island by early colonists (burros and dogs are no longer found on the Island) adversely affected the iguana population. Predation of iguanas by cats and dogs has been documented on other islands such as Pine Cay (Wiewandt 1977). Other mammalian species such as goats, pigs, and burros often have an adverse impact on native species causing changes in the native vegetation (Bratton and Hable 1981). Pigs constitute a serious threat, for they are known to dig up nests and eat iguana eggs, a behavior less frequently observed in very wet years (Wiewandt 1973).

Cyclura stejnegeri probably has been threatened since pre-Columbian times. Remains of C. pinguis, now extirpated from Puerto Rico although

still present in the British Virgin Islands (Pregill 1981), have been recovered from kitchen middens, indicating their past use as food by native aborigenes (Wiewandt 1977). These natives also were present on Mona Island.

The Mona iguana occurs throughout Mona Island. They are most common along major escarpments and cliffside talus slopes, and less common on the southwestern coastal plain, except during the summer nesting season. Escarpments provide many retreats and a great variety of food. The southwestern plain lacks natural shelters, is extensively forested, and does not provide natural conditions suitable for the species.

Wiewandt (1977) estimated the Mona iguana population at about 2,000 individuals, a density of one iguana for every 2 hectares. Also, he indicated there was an apparent scarcity of immature individuals, suggesting senescence and a declining density. Comparison with other threatened cycluran species also suggested that Cyclura stejnegeri was declining in species biomass. Cyclura cornuta in Petite Gonaive Island (Haiti) showed densities of 13 adults per ha, 26 times greater than the Mona Island species. However, an apparent increase in juveniles from the last three breeding seasons has been observed, suggesting an increase in the reproductive success of the Mona iguana. These 3 years have been characterized by above-average rainfall, when less egg predation by wild pigs occurs.

Nevertheless, the Mona iguana still faces the same pressures as during Wiewandt's work, and from the long-term standpoint the population may still be declining because of the limited effort devoted to controlling introduced mammals.

Causes of Decline

Man-related activities can be shown to be the major causes of decline.

Iguanas in all their insular forms have slow individual growth characteristics. This is due in part to the stable physical environment and to the lack of native predators of adults (Wiewandt 1977). On Mona Island, the introduction of mammals, hunting, agriculture and reforestation, and recreational activities have posed a threat to iguana adults, juveniles, and eggs, thus limiting population growth or stability of the species.

During the colonial period man introduced to Mona Island many exotic species of plants and animals that were used as human food. Mona was used as a way station between Hispaniola and Puerto Rico, where boats could be replenished with water and food (Fernandez de Oviedo 1538). Although only goats and pigs were introduced for food, other mammals (mice, rats, dogs, and cats) were released accidentally and later became feral. Burros were introduced as cargo animals and freed when no longer needed.

Of the mammals introduced to the island, only mice and rats do not represent a threat to iguanas. Although concentrated around human structures, they occur throughout the island. They feed on items such as seeds, leaves, trash, and eggs and nestlings of birds (Wiewandt 1973).

Cats and dogs were introduced as early as 1898 (Hubener 1898). Dogs are no longer found on Mona Island, but cats range throughout the Island. From a small sample of cat stomachs, Wiewandt (1977) reported reptiles and a few species of invertebrates. Neither mice, rats, nor iguanas were found. However, cats are known to prey upon young iguanas. On Pine Cay Island, Iverson (1977) reported that cats and dogs were a threat to Cyclura carinata. He reported a 71 percent loss of the iguana population on a

1-year basis (1974-75), and almost a total extinction on the 2nd year (1975-76). Cats preyed upon juvenile iguanas, whereas dogs preyed upon adults.

If the feral cat population of Mona Island increases to a level where other food items become scarce, they could become a threat to juvenile iguanas.

Feral pigs are known to cause habitat destruction on other islands. On Mona Island pigs uproot many plants causing substantial modification to plant communities. They also dig up and eat iguana eggs, causing up to 100 percent nest destruction on some nesting sites (Wiewandt 1977). Nest destruction was correlated with rainfall patterns--the wetter the year the less destruction occurring. In dry years there is a reduction in food and rain ponds, and the pigs search for water from roots and iguana eggs.

Goats and pigs shared the same source of introduction (Fernandez de Oviedo 1538) in the 16th century. Overbrowsing by goats causes changes in the vegetation by reducing or eliminating the more palatable plant species and causing an increase of spiny plants or plants that contain high concentrations of toxic sap. Goats eat the same plant species as the iguana (except for one species), consuming roots, stems, bark, leaves, flowers, fruits, and seedlings, while iguanas only eat fruits, flowers, and some leaves. The browseline created by goats puts some foods out of the browsing range of iguanas.

Goats, as well as pigs, cause destruction of nest chambers. The weight of the animals can cause the collapse of the air space over the eggs, preventing the successful hatching of iguanas.

Land use has threatened the survival of the Mona iguana through impact on nesting areas. Unfortunately, much of the area suitable for iguana

nesting was planted with trees, altering the natural conditions of the coastal plain. This action, together with past agricultural practices, has reduced sunlit areas necessary for nesting activities.

Privacy is crucial to the completion of mating and egg-laying. Human activities can cause females to abandon the nest and use suboptimal sites. Trampling by humans causes destruction of nest chambers. Vehicles also have caused the death of several individuals. Weiwandt (1977) reported four deaths caused by vehicles during his research (1972-1975); three other individuals were reported as killed by hunters, one was poisoned by a soap bar, and cause of death was not determined for four.

Conservation Efforts

Little was done for the Mona iguana until the creation of the Department of Natural Resources (DNR) in 1973. The Department has managed the island since then, protecting its wildlife and vegetation. From 1973 to 1976, one resident biologist was assigned to the Island, improving the enforcement of Commonwealth laws and the protection of Mona's unique species. In 1977 the Department of Natural Resources created the Ranger Corps. Five to seven rangers, together with a resident biologist, are now residing on the Island. In addition to law enforcement, they educate visitors on the importance of the native wildlife and flora of Mona Island. Camping has been restricted to designated areas to reduce harassment to wildlife and trampling of iguana nests.

To determine the impact of goats and pigs on the native vegetation, a goat and pig enclosure was built on the Bajura de los Cabros in 1976. Data have been collected by Rogers and by Cintron to determine plant species growth and seedling survival (Cintron 1979).

An experimental goat and pig enclosure was built in 1977 over part of a nesting ground near the old airport. The enclosure proved to be a success, enabling nesting and hatching of iguanas while preventing pig or goat destruction of nests. Nest destruction was observed on unprotected, nearby areas.

Trapping of feral cats has been carried out since 1978. However, trapping has proved a difficult task because nontarget species, especially hermit crabs, tend to spring the traps. Sporadic cropping of goats and pigs is done by DNR personnel.

The Mona iguana was designated as a threatened species in 1978 (Federal Register, February 2, 1978), and Mona Island was designated as its critical habitat.

II. Recovery

A. Recovery Objective

The objective of this plan is to increase the population of the Mona iguana to levels at which it can be delisted and to eliminate or reduce present threats. The lack of information on population levels and trends since Wiewandt's work precludes the establishment of a reliable figure indicative of a recovered population. We suggest the Mona iguana be considered recovered when: (a) the population increases or stabilizes during ten consecutive years; (b) nesting sites are effectively protected from predation by pigs and goats, as well as trampling by humans, by means of enclosures; (c) feral mammals threatening the species are effectively controlled, or eradicated if feasible; and (d) a habitat management plan to insure long-term availability of nesting areas for an expanded population is prepared and put into effect.

However, it should be noted that if eradication of cats, pigs, and goats is considered as a prerequisite to consider the Mona iguana as recovered, recovery and delisting may never be achieved. Eradication of feral mammals has proven successful in some areas (e.g., New Zealand), but difficult if not impossible in others (e.g., in Hawaii). The vegetation, climate, and topography prevalent in Mona Island make the eradication of feral mammals an exceptionally difficult task. Strong opposition to the eradication of pigs and goats is to be expected from hunters.

B. Step-down outline

1. Determine the current status of the Mona iguana population.
 - 1.1. Census the population.
 - 1.2. Delimit and monitor current use of breeding grounds.
 - 1.3. Determine and monitor the net recruitment of population.
2. Protect the existing population.
 - 2.1. Minimize human disturbance.
 - 2.1.1. Avoid construction of new, permanent facilities at nesting areas.
 - 2.1.2. Control visitor movements in nesting areas from mid-June to mid-November.
 - 2.1.3. Prepare informative pamphlets stressing the importance of protecting nesting sites and the reduction of harassment to the species.
 - 2.1.4. Forbid camping on and near nesting areas during nesting and incubation season (June-November).

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- 2.2. Recondition previously used nesting areas that now are forested
 - 2.2.1. Prepare a habitat management plan for nesting areas.
 - 2.2.2. Clear forest patches so new sunlit areas for nesting are available.
 - 2.3 Fence pigs and goats from nesting areas taking care not to hamper the movement of the iguana to these areas.
 - 2.3.1. Determine the most efficient and cost-effective fencing method.
 - 2.3.2. Build fences.
 - 2.4. Continue law enforcement activities by DNR Rangers.
3. Reduce adverse impact by introduced mammals.
 - 3.1. Determine the ecological impact of feral mammals on iguanas and plant communities.
 - 3.1.1. Provide information on plant species consumed by introduced mammals.
 - 3.1.2. Discriminate between the different kinds of threats to iguana adults, juveniles, and eggs.
 - 3.1.3. Conduct research on plant community recovery after fencing out feral mammals.
 - 3.1.4. Determine the population levels and reproductive dynamics of goats and pigs.
 - 3.1.5. Census goat and pig populations on an annual basis.
 - 3.2. Cropout cats, pigs, and goats in and near iguana nesting areas from mid-June to December.
 - 3.3. Control cat, pig, and goat populations through Mona Island, or extirpate if feasible.

C. Narrative

1. The population levels and trends are unknown. This information, especially the net recruitment of the population, should be obtained in order to make sound decisions concerning the time when the species can be considered as recovered, and in the formulation of management plans. Adequate survey methods and the delimitation of the areas are needed in order to assign priorities for habitat protection.
2. Protection of the existing population is a high priority because it may serve as a means of stabilizing the situation.
 - 2.1. Human disturbances from new construction and visitors should be minimized by appropriate regulations and a strong public relations program.
 - 2.1.1. Permanent facilities should not be built on or near the nesting areas. However, it is possible that the creation of camping sites could serve as a way of clearing forest patches, creating suitable places for nesting, provided that camping is prohibited during the breeding season.
 - 2.1.2. Movement of visitors throughout nesting areas should be discouraged or closely regulated during the nesting season. A prohibition would be unfeasible, unpopular, and not cost effective. The number of visitors increases during the summer months. However, the number of visitors that actually walk through nesting sites is relatively small.
 - 2.1.3. Public information should be released in order to effectively reduce visitor movement and nest destruction during the nesting season. Brochures should be available in Spanish and English.

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- 2.2. A habitat management plan should be prepared to insure longterm availability of nesting areas for an expanded population. On the southwestern coastal plain, plantations of mahogany and casuarina exist, reducing sunlit areas suitable for nesting. Small patches in soil offering suitable nesting conditions should be cut throughout the forest. It is possible that this activity may be compatible with the creation of new camping areas. These would be available for use from December 1 to June 15.
- 2.3. Fencing of nesting areas should be implemented. It would reduce the impact of goats and pigs to the nest chambers, and would curtail human movement throughout the area. Fences should not hamper the movement of iguanas to the nesting sites, but holes should be small enough to prevent goats and pigs from entering the area.
- 2.3.1. The efficiency and cost effectiveness of different types of fences must be evaluated. Whether or not the same results can be achieved by potentially less expensive methods such as hunting of pigs and goats before and during the nesting season by DNR personnel should be determined.
- 2.3.2. Once the evaluations of 2.3.1. are completed, fences should be installed as necessary, contingent upon the availability of funds.
- 2.4. The present level of enforcement (five to seven rangers) should be continued, along with the public relations function that has been assigned to the rangers.

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3. Some additional studies are needed to refine current information on the impact of introduced mammals, but the main thrust should be toward proceeding with a rigorous control program. If it appears feasible, introduced mammals should be completely eradicated.
 - 3.1. Research should be conducted to provide information on the population dynamics of feral introduced mammals. Up-to-date information for Mona Island could be used to educate the public on the need for feral mammal control or eradication, and could be used to offset hunter and other public opposition to this task.
 - 3.1.1. Better information is needed as to which plant species are being impacted by feral mammals. The work of Wiewandt (1977) and Cintron (1979) should be reviewed as a basis for developing future research needs.
 - 3.1.2. Threats to the iguana vary according to the stage in the life cycle. These threats should be defined and quantified as to their potential for limiting the iguana population size.
 - 3.1.3. Research should be conducted on the effect of fencing, both on the vegetation and the survival of young iguanas.
 - 3.1.4. Research on population levels and reproductive dynamics of feral pigs and goats will determine average recruitment of population.
 - 3.1.5. Census of feral populations should be conducted to determine their size and composition. Annual surveys should provide up-to-date data on estimated levels of threat to the iguana.

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- 3.2. Cropping of pigs, cats, and goats by DNR personnel before, during, and after the nesting season should reduce predation and nest destruction.
- 3.3. Cats should be shot on sight, and a vigorous cat-trapping program implemented as soon as possible. If the results of research conducted under 3.1. document the need for further control (or eradication) of pigs and goats, this objective could be achieved through the institution of a vigorous hunting and trapping effort, including an extension of the current hunting season and bag limit.

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Part III Implementation Schedule

Mona Iguana

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency			Estimated Fiscal Year Costs			Comments/Notes
					FWS Region	Program	Other	FY 1	FY 2	FY 3	
R1	Determine the current status of the Mona iguana population	1	3	Cont	4	RES*	DNR	60,000	20,000	20,000	*Asterisks indicate current or anticipated primary funding source.
M3	Minimize human disturbances	2.1	3	Ongoing	4	SE	DNR*	2,000	1,000	1,000	
M3	Recondition previously used nesting areas that now are forested	2.2	3	2 YR	4	SE*	DNR	35,000	35,000		
R4	Determine the most efficient and cost effective fencing method (for nesting areas).	2.3.1	1	1YR	4	RES*	DNR	15,000			
M3	Build fences	2.3.2	1	Cont	4	SE	DNR*	UNK	UNK		
O2	Continue law enforcement activities by DNR Rangers	2.4	1	Ongoing	4	FA/SE	DNR*	175,000	175,000	175,000	Enforcement estimates are for Mona Is. as a whole.
R3	Provide information on plant species consumed by introduced mammals	3.1.1	2	1YR	4	RES*	DNR	15,000			
I9	Discriminate between the different kinds of threats to iguana adults, juveniles and eggs.	3.1.2	3	1YR	4	FA/SE*	DNR	15,000			
R4	Conduct research on plant community recovery after fencing out feral mammals.	3.1.3	3	UNK	4	RES*	DNR	1,000	1,000	1,000	
R1	Determine population levels and reproductive dynamics of goats and pigs.	3.1.4	3	4YR	4	RES*	DNR	60,000	50,000	50,000	
R1	Census goat and pig populations on an annual basis.	3.1.5	3	Cont	4	RES	DNR*	5,000	5,000	5,000	

Part III Implementation Schedule

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency			Estimated Fiscal Year Costs			Comments/Notes
					FWS Region	Program	Other	FY 1	FY 2	FY 3	
M4	Crop-out cats, pigs, and goats in and near iguana nesting areas from mid-June to December.	3.2	2	Cont	4	FA/SE	DNR*	500	500	500	
M4	Control cat, pig, and goat populations throughout Mona Island, or extirpate if feasible.	3.3	2	UNK	4	FA/SE*	DNR	15,000	15,000	15,000	

KEY TO IMPLEMENTATION SCHEDULE COLUMNS 1 & 4

General Category (Column 1):

Information Gathering - I or R (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Other - O

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Priority (Column 4):

- 1 - Those actions absolutely necessary to prevent extinction of the species.
- 2 - Those actions necessary to maintain the species' current population status.
- 3 - All other actions necessary to provide for full recovery of the species.

IV. APPENDIX

List of Reviewers

Dr. Richard Thomas
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