

WEST INDIAN IGUANAS OF THE GENUS *Cyclura*

Their Current Status in the Wild, Conservation Priorities and Efforts to Breed Them in Captivity

By: David W. Blair

NATURAL HISTORY

Rock Iguanas of the genus *Cyclura* are among the largest and most impressive lizards in the Western Hemisphere. Unfortunately, the genus also includes some of the fastest disappearing, and most Critically Endangered lizard species on Earth. Historically these iguanas have always been restricted to islands in the Bahamas, the Greater Antillies and the Virgin Islands, although their former range was certainly much greater than it is today. On most of the islands where they still occur, they are the largest surviving native land vertebrates. In fact, adult iguanas have virtually no known natural predators. Their decline in numbers probably began in pre-Colombian times when the Arawak and Lucayan Indians sought them as food items to supplement their meager diet. This is evidenced by the bones of *Cyclura* that have been found in caves and Indian kitchen middens on several islands where they no longer occur including Saint Thomas, New Providence, Great Exuma and Puerto Rico. The pressures of hunting by these native peoples may have initiated the process of decline in the numbers of rock iguanas, but the real devastation began with the arrival of Europeans to the islands. Not only was extensive habitat lost as the human population increased, but with him, man brought his domesticated animals, many of them turning feral. Today the greatest threats to the rock iguanas are probably the direct predation by, or competition with these introduced animals. The list is extensive, with cattle, goats, pigs, rats, mongoose, dogs or cats present on most inhabited islands throughout the West Indies.

These large diurnal lizards inhabit subtropical areas of West Indian dry (xerophytic) thorn forests typical of many Caribbean islands. The substrate is usually heavily eroded limestone containing many caves and crevices that the iguanas utilize as retreats. Several species sometimes also dig their own burrows in sandy areas. Adults usually establish home ranges around these retreats that they actively defend against intruders. At least seasonally the home range of a dominant male will often overlap that of one or more females. Most wild *Cyclura* are generally polygamous but individuals may also be promiscuous or monogamous.

Rock iguanas are chiefly herbivorous, ingesting the leaves, flowers and fruits of as many as 58 different native plants on a single island. They also consume a very small amount

of animal matter in the form of very easily attainable items such as insects, land crabs and carrion, which can include dead seabirds, fish and, rarely, other iguanas. Iguanas are good climbers, especially when young, and have been observed browsing in trees more than five meters above the ground.

Mating virtually always occurs during the same two or three week period each year, regardless of climatic conditions. This would indicate that breeding activity is triggered by seasonal changes in the day length, or photo period. Depending upon the species, mating occurs from late May until mid June, with oviposition (egg laying) occurring approximately forty days later. Females often travel outside of their normal activity ranges to areas that are suitable for nesting. Several exploratory nests are sometimes begun before one is actually completed. Nest burrows range from 16" (.4 meters) to over 60" (1.5 meters) in length, with an enlarged chamber at its terminal portion which allows the female to turn around. Smaller species of rock iguanas, and very young females of many species, may lay between two to six eggs, while some of the largest forms may lay as many as twenty-three. Egg size may be dependent upon the size and age of the nesting female. On average, *Cyclura* eggs are among the largest eggs laid by any lizard on earth. After laying eggs, females of some species will often guard their own nest site for up to several weeks, repelling any intruder that ventures too close. The temperature at depth within nests that have been monitored by researchers remained a surprisingly constant 30–33C throughout much of the incubation period which can range from 65-90 days. It often requires the combined effort of many hatchlings to dig out of a nest chamber, sometimes not emerging for as long as two weeks after actual hatching. Neonates disperse quickly and lead solitary lives. Unfortunately, mortality rates for juveniles can be extremely high and on at least some islands they approach one hundred percent. In the wild, rock iguanas reach sexual maturity at two to nine years of age. It is believed that they are also among the longest lived of any lizard, reaching ages of at least twenty-five to forty years. Some researchers believe that they may actually live to be closer to eighty years of age!

The most recent taxonomic revision to date of the lizard genus *Cyclura* was conducted by A. Schwartz and M. Carey in 1977. They examined 378 preserved specimens and named seventeen forms representing eight species. According to the I.U.C.N. Red List of these recognized forms, at least one is thought to be extinct, eight are Critically Endangered, five Endangered and the remaining three Vulnerable. I have spent the last twenty years observing many populations in the wild and searching the available scientific literature to attempt to determine the status of all extant *Cyclura*. I would like to review and update each at this time.

STATUS AND DISTRIBUTION

***Cyclura carinata carniata* Turks and Caicos iguana**

Distribution: Turks and Caicos Islands

Size: Males to 360mm SVL and 1.86kg
 Females to 290mm SVL and 1.14kg

Status: I.U.C.N. Red List - Critically Endangered

There are 56 known cays with iguana populations with a total combined land area of 28km². Some populations are still dense (densities can exceed 30 adults per ha.), other definitely declining, and several recently extirpated.

Legal Status: U.S. Endangered Species Act – Threatened
C.I.T.E.S. – Appendix I

Priority Activities: Control or eradication of non-native mammals and livestock on all islands supporting iguanas that are uninhabited by humans. Genetic studies and long-term monitoring of different populations are needed.

Number Remaining: Estimated at 15,000 (no known captives)

***Cyclura carinata bartschi* Bartsch's iguana**

Distribution: Southern Bahamas Islands

Size: Males to 335mm SVL
Females to 285mm SVL

Status: I.U.C.N. Red List – Critically Endangered
Restricted to one small cay approximately 1.5km² in total area.

Legal Status: U.S. Endangered Act – Threatened
C.I.T.E.S. – Appendix I

Priority Activities: Remove feral goats from the cay and establish it as a protected area. Assess the status of iguanas on the cay and establish a captive breeding program for potential restocking.

Number Remaining: Estimated at 200-300 (no known captives)

***Cyclura collei* Jamaican iguana**

Distribution: Jamaica

Size: Males to 490mm SVL
Females to 378mm SVL

Status: I.U.C.N. Red List – Critically Endangered
Thought to be extinct for many years, a live specimen was brought to a zoo in Kingston, Jamaica in 1990. Unfortunately, it died after several months in captivity. A search of the area where it was found brought twenty-three sightings of what was thought to be at least fifteen individual animals.

Legal Status: U.S. Endangered Species Act – Endangered
C.I.T.E.S. – Appendix I

Priority Activities: The entire 114km² area should be set aside as a new national park with resident wardens. All additional development and hunting within this uninhabited area should be excluded. Charcoal burners have encroached to within 1km of the iguanas' only remaining habitat. Conduct predator control and continue the Zoo headstarting program and tracking of released animals. Additional field research, development of educational programs in schools and establishment of additional populations on offshore cays if deemed suitable.

Numbers Remaining: Approximately 100 in the wild (plus 100 captives)

***Cyclura cornuta cornuta* Rhinoceros iguana**

Distribution: Hispaniola

Size: Males to 560mm SVL and 10kg
Females to 510mm SVL and 5.4kg

Status: I.U.C.N. Red List - Vulnerable
Common and widespread until the 1950's, their numbers have been declining steadily in impoverished Haiti and portions of the Dominican Republic. Twenty or more subpopulations may exist on Hispaniola.

Legal Status: U.S. Endangered Species Act – Not Listed
C.I.T.E.S. – Appendix I

Priority Activities: Assess the current status of wild populations and investigate factors limiting their numbers. Control or eradicate exotic predators and competitors where practical.

Numbers Remaining: Estimated at 10,000-17,000 (several hundred additional in captive collections world-wide)

***Cyclura cornuta onchioppsis* Navassa Island iguana**

Distribution: Formerly Navassa Island

Size: Males to 420mm SVL
Females to 378mm SVL

Status: Believed Extinct. Navassa Island was visited in 1966 and 1967 and no animals were present. An entomologist visited the island again in 1986 and saw no signs of any iguanas although he was not specifically looking for them. An extensive search again in 1999 failed to find any iguanas. Military occupation of the island prior to the 1960's was apparently responsible for its extirpation. A very slim possibility exists that some specimens may remain in captivity somewhere in the world but they would certainly be aged. Unfortunately the three sub-species of *C. cornuta* are very difficult to distinguish from one another.

***Cyclura cornuta stejnegeri* Mona Island iguana**

Distribution: Puerto Rico

Size: Males to 535mm SVL (mean 517mm) and 6.4kg (mean 6.1kg)
Females to 490mm SVL (mean 475mm) and 5.2kg (mean 4.7kg)

Status: I.U.C.N. Red List – Endangered
They are reproducing successfully but the mortality rate for hatchlings is extremely high.

Legal Status: U.S. Endangered Species Act – Threatened (listed as *C. stejnegeri*)
C.I.T.E.S. – Appendix I

Priority Activities: Enforce existing laws. The Puerto Rican government has recently restricted visitation to the island. If a program to remove exotic predators and herbivore competitors is initiated, and successful, its continued survival is hopeful. Expand and maintain the fencing program to protect nesting areas. Assess the status of wild populations and habitats in order to develop a conservation strategy. Determine the cause of blindness affecting many adult iguanas.

Numbers Remaining: 1,500-2,000

***Cyclura cyclura cyclura* Andros Island iguana**

Distribution: Bahamas

Size: Males to 411mm SVL (total length close to 1500mm)
Females to 465mm SVL

Status: I.U.C.N. Red List – Vulnerable

Legal Status: U.S. Endangered Species Act – Threatened
C.I.T.E.S. – Appendix I

Priority Activities: Large uninhabited areas should be set aside as reserves with resident wardens to enforce protection. Determine population status and range and conduct ecological studies. Control introduced species and establish captive breeding programs.

Numbers Remaining: 2,500 – 5,000 (only two known captives)

***Cyclura cyclura figginsi* Exuma Island iguana**

Distribution: Bahamas

Size: To 542mm SVL and 8.15kg

Status: I.U.C.N. Red List – Endangered

Of the seven known populations, five were in good shape in 1980, while two were definitely declining. I visited one small cay in 1985 and found a dense colony with juveniles present.

Legal status: U.S. Endangered Species Act – Threatened
C.I.T.E.S. – Appendix I

Priority Activities: Determine population status throughout its range. Consider translocations to other cays. Conduct genetic, ecological, behavioral and natural history studies for each population. Establish captive breeding programs.

Number remaining: 1,000-1,200 (one or two dozen known captives)

***Cyclura cyclura inornata* Allens Cay iguana**

Distribution: Bahamas

Size: Males to 476mm SVL and 4.8kg (to 1000mm total length)
Females to 368mm SVL and 2.1kg

Status: I.U.C.N. Red List – Threatened

Two of the three small cays support fairly dense populations of iguanas with only about seven adults remaining on the third.

Legal Status: U.S. Endangered Species Act – Threatened
C.I.T.E.S. – Appendix I

Priority Activities: Incorporate all three cays into the Exuma Land and Sea Park. Introduced non-native trees are threatening nesting areas and should be removed. Collect reproductive data on marked populations. Consider modifying sinkholes on one cay to create additional iguana nesting habitats.

Number remaining: 400-500 (very few captives)

***Cyclura nubila nubila* Cuban Rock Iguana**

Distribution: Cuba

Size: Males to 745 mm (unconfirmed) SVL (mean SVL 405mm)
Females to 623 mm (unconfirmed) SVL (mean SVL 320mm)

Status: I.U.C.N. Red List – Vulnerable

This large iguana has by far the largest distribution of any member of the genus. As a result, it probably exists in greater numbers in the wild than any other *Cyclura*. Researchers report 2,000-3,000 individuals on the grounds of the U. S. military base at Guantanamo Bay. Density studies on small undisturbed cays have shown up to twenty-five iguanas per hectare. The introduced population on an island off of Puerto Rico is also relatively dense. These animals escaped or were released from a small zoo in the 1960's, but we have been unable to ascertain from what specific area of Cuba this small group originated. Interestingly, most of the Puerto Rican animals have predominantly rusty orange and brown coloration, while those from mainland Cuba are described as gray or "greenish" with tan.

Legal Status: U.S. Endangered Species Act – Threatened (Puerto Rico pop. excluded)
C.I.T.E.S. – Appendix I

Priority Activities: A thorough population status, ecology and natural history study should be conducted. Apparently the Cuban government has expressed a willingness to cooperate in such an endeavor. Any uninhabited cays with viable populations of *C. n. nubila* should be set aside as reserves and afforded protection. An in situ captive breeding program should be established.

Numbers Remaining: 40,000-60,000 (several hundred in captivity)

***Cyclura nubila caymanensis* Lesser Caymans iguana**

Distribution: Cayman Islands

Size: To 1360mm total length
Males to 570mm SVL (mean 544mm) and 8.5kg (mean 7.6kg)
Females to 472mm SVL (mean 440mm) and 5.2kg (mean 3.9kg)

Status: I.U.C.N. Red List – Critically Endangered

Only a very small population (<50) exists on the larger (38km²) of the two islands where this iguana is found. The other island (28.5km²) still supports a reproducing population, but feral cats take a great number of juveniles.

Legal Status: U.S. Endangered Species Act – Threatened
C.I.T.E.S. – Appendix I

Priority Activities: Plans in the 1980's to construct the world's largest oil transshipment terminal on one of the islands have, fortunately, been "indefinitely postponed". Future development of the smaller island should be restricted. Every effort should be made to bring the feral cat population under control. Additional imports of domestic animals to the islands should be prohibited. Additional studies are needed to determine population status, reproduction, natural history and genetic variation between island populations

Number Remaining: Less than 1000 (very few purebred animals in captivity)

***Cyclura nubila lewisi* Grand Cayman iguana**

Distribution: Grand Cayman Island

Size: Males to 515mm SVL
Females to 410mm SVL

Status: I.U.C.N. Red List – Critically Endangered

Legal Status: U.S. Endangered Species Act – Endangered
C.I.T.E.S. – Appendix I

Priority Activities: Captive breeding projects have been quite successful recently on Grand Cayman. The Cayman National Trust has established two reserves on the island into which captive produced animals will be released. The present concern is to be certain that all animals destined to be released are purebred *lewisi*. There is now DNA evidence that some of the captive stock has been inadvertently mixed with *caymanensis*. Current work with blood haplotypes will clear up any confusion. Needed projects include habitat acquisition and enhancement, feral animal control, field research and the production of an educational poster.

Number Remaining: 100-175 (several dozen additional captive animals)

***Cyclura pinguis* Anegada Island iguana**

Distribution: British Virgin Islands

Size: Males to 560mm SVL and 7.75kg
Females to 500mm SVL and 5.25kg

Status: I.U.C.N. Red List - Critically Endangered
Once distributed over the entire Puerto Rico bank, now restricted to one natural island population and two small introduced populations on other islands.

Legal Status: U.S. Endangered Species Act - Endangered
C.I.T.E.S. - Appendix I

Priority Activities: Additional studies are required to identify density and areas frequented by *C. pinguis* and to determine why the female population is declining. Carry out genetic studies and construct livestock exclosure fences around protected areas.

Number Remaining: Probably fewer than 200 (very small number in captivity)

***Cyclura ricordi* Ricord's iguana**

Distribution: Hispaniola

Size: Males to 495mm SVL and at least 3.18kg
Females to 430mm SVL

Status: I.U.C.N. Red List - Critically Endangered
C. ricordi and *C. c. cornuta* are the only sympatric forms of *Cyclura*, although the range of the former is much more restricted than that of the latter. Estimated at near 5,000 individuals in 1970, the population is much reduced today and is divided into two populations separated by 2000m high mountains

Legal Status: U.S. Endangered Species Act - Not Listed

C.I.T.E.S. - Appendix I

Priority Activities: Establishment of areas as national parks with resident wardens to enforce protection. Conduct status surveys, natural history and ecology assessments. Eradicate cats from one small island population. Establish local and national education programs. Re-establish captive breeding program at ZooDom and strengthen programs in the U.S.

Number Remaining: 2,000 to 4,000 (14 known captives as of 1995)

***Cyclura rileyi rileyi* San Salvador iguana**

Distribution: Bahamas

Size: Males to 395mm SVL (890mm total length) and at least 1.25kg

Females to 320mm SVL and 1.25kg

Status: I.U.C.N. - Endangered

Populations are primarily restricted to seven small cays that have a total combined area of 26ha of marginal to excellent habitat. *C. r. rileyi* does still inhabit mainland San Salvador, albeit in very small numbers.

Legal Status: U.S. Endangered Species Act - Endangered

C.I.T.E.S. - Appendix I

Priority Activities: Access to cays where iguanas still occur should be limited to prevent the introduction of exotic animals. Land and sea parks could be established to incorporate the most important of these cays. Continue surveys of individual populations at least every two years. Eradicate rats on infested cays. Monitor the impact of *Cactoblastis* moths and rats on vegetation.

Number Remaining: 500 to 1000

***Cyclura rileyi cristata* White Cay iguana**

Distribution: Bahamas

Size: Males to 280mm SVL and .634kg

Females to 254mm SVL

Status: I.U.C.N. Red List - Critically Endangered

Occurs on only a single island that comprises about 25ha.

Legal Status: U.S. Endangered Species Act - Threatened

C.I.T.E.S. - Appendix I

Priority Activities: Incorporate this small cay into the park system of the Bahamas National Trust. Develop an educational program. Institute a program of rat control. Conduct a status survey of the population at least every two years. Consider establishing a secondary population at a somewhat distant location within the protection of the existing Exuma Islands Land and Sea Park.

Number Remaining: 150 to 200

***Cyclura rileyi nuchalis* Acklins iguana**

Distribution: Bahamas

Size: Males to 263mm SVL

Females to 240mm SVL

Status: I.U.C.N. Red List - Endangered

Current natural populations occur on only two small cays with one additional introduced population known.

Legal Status: U.S. Endangered Species Act - Threatened

C.I.T.E.S. - Appendix I

Priority Activities: Officially all iguanas in the Bahamas are protected by law.

Regrettably enforcement throughout the islands is problematic. Certainly small cays will remain very vulnerable to disturbances without a warden present to enforce protection. As this is a popular area for fishing boats, there is always the danger of cats or rats being introduced by visiting yachts. Accurate censusing of all three populations is needed. Genetic studies, threat assessment and exploration of the potential of restocking vacant cays should be conducted.

LONGITIVITY IN CAPTIVITY

Historically *Cyclura* iguanas have done very poorly in captivity at zoological institutions. The average longevity in zoos worldwide before 1987 was less than 2.5 years although I personally believe that figure has improved significantly in recent years. Apparently the private sector has done somewhat better. We currently maintain many animals that are 15 to 25 year captives. There are reliable records of animals that have been captive for more than 30 years. Most of these older animals show little evidence of their advanced ages and, in fact, still appear to be active reproductively.

DIET AND FEEDING

We believe our success in breeding these iguanas at Cyclura Research Center (C.R.C.) is due to several factors. The first of these factors is providing a high quality, balanced diet heavy in green leafy vegetables that have a positive calcium to phosphorous ratio. We feed a mix from the following list on a daily basis to hatchlings and 2-3 times per week to adults.

Green Leafy Vegetables:

Kale, Collard greens, Mustard greens, Parsley, Chard, Turnip greens, Escarole and Dandelion Greens.

Legumes:

Bean sprouts (alfalfa, mung, soybean, etc.), Beans (lima, kidney, string, etc.)

Mixed Vegetables:

Squash, grated (banana, summer, zucchini, etc.), Corn, Broccoli, Cauliflower, Asparagus, Brussels Sprouts and Yams.

Fruits and flowers:

Melons, Apples, Plums, Pears, Bananas (sparingly), Figs (very high in calcium!) and Grapes.

Hibiscus flowers, Dandelion flowers and Squash blossoms.

Optional Items (less than 5% of diet for juveniles and gravid females, 2% for other adults):

Dry, low fat, low protein, premium senior or less active dog food soaked in water first to soften (Science Diet, Iams, Pro-Plan, Nutro, etc.)

Primate diet, monkey chow biscuits

Supplements:

Multi-vitamin (Reptivite, Herptivite, etc.)

Calcium and mineral supplement (Rep-Cal, Miner-all, Neo-Calglucon, etc.)

Water:

Fresh water for drinking is available at all times or offered at least every other day

A mix is prepared from the above list consisting of about 70% leafy greens, 15% mixed vegetables, 10% fruit and flowers, and less than 5% animal protein based products. Chop or grate finely for juveniles (a food processor works well) or more coarsely for adults. It is not necessary to feed a huge variety of items at every feeding. Simply vary the items offered from week to week so that a great variety of foods are fed overall.

HOUSING

All of our adult iguanas are kept in outdoor enclosures constructed of a 2" x 4" wood framework covered by 14 gauge galvanized after welded wire; ½ "x 1" mesh wire is used on cages housing juveniles, while 1" x 2" mesh is adequate to confine adults. Two basic designs have been used. Originally we built wire mesh cages around a central building built upon a concrete slab and heated by a thermostatically controlled space heater. Individual inside cages within the structure are lined with Formica and have large access doors to facilitate easy cleaning. Openings are cut through the building's walls to allow access to the exterior wire sunning cages. There are locking doors on these opening so that animals can be restricted to either the indoor cage or the outdoor enclosure while cleaning or maintenance is being conducted or when outside temperatures are too low.

The outdoor portion of the enclosure is begun by digging a 6" wide, 18" deep trench into which concrete is poured to form a footing. A wood frame is constructed and is attached to the footing either with lag-bolts or with spikes shot by 22 caliber shell powered stud gun. A 60" (1.5 meter) square section in one corner of the outdoor enclosure is dug out and the soil removed to depth of about 16" (.4 meters). This hole is filled with sand and provides a nesting area for the iguanas. The remainder of the enclosure is planted with grass and landscaped with piles of rocks and small palms trees. While this is our preferred enclosure, it has several disadvantages. The building and concrete footing and slab are expensive and time-consuming to construct. Also, in many areas of the U.S. such structures requires building permits and must be inspected periodically during construction.

A second design is now used on all new enclosures built. It is begun by first assembling a square base out of 2"x 8" clear redwood lumber. PVC coated hex mesh wire is stapled across the frame and individual strips are overlapped and secured to one another with hog ring clips. This coated wire mesh prohibits any iguanas from burrowing out of the enclosure. The entire base is then flipped over, set into place on a level area, and then filled with sand or decomposed granite. A 2"x 4" wood frame is constructed and secured onto this base and covered with galvanized welded wire. Finally a 24" wide strip of 5/8" thick exterior siding is added along the sides of the enclosure to prevent nervous animals

from charging into the wire or rubbing their noses on it. Cages are normally at least 6 feet tall so they may be serviced comfortably by an average height adult.

Within each cage a 36" (1 meter) long by 20" (.5 meter) wide by 12" (.3 meter) high wooden box is placed on concrete blocks. This box is constructed with 2" thick sides and ¾" thick plywood top and bottom which has been coated several times with a non-toxic sealer. The top is hinged so that the interior is easily accessible and a lockable door is cut in the front to allow animals entry. There are also a variety of commercially made wooden or plastic dog houses that can also be used. 110 volts AC is then run in plastic conduit to a grounded outlet box in each container. A rigid heating pad ("pig blanket") designed specifically for use with animals is used as a heat source in each box. These are available from several manufacturers (Kane, Lectro-Kennel, Osborne, etc.) in a variety of sizes. Most draw under 100 watts and can be used with a rheostat or thermostat and 24 hour timer to control the heat output and duration. Heat pads should fit the container so that there is approximately 6" (15 cm) of space between its edges and the sides of the box. This allows the animals to lie off of the pad if the temperature becomes too warm, but does not allow them to get so far away from the pad that they become chilled when temperatures are quite low. This heating method has proved successful for more than 15 years in inland Southern California where outside winter temperatures sometimes drop to as low as 23F (-5C). All heaters are wired to a time clock so they may be run for only a few hours at night, or used continuously during inclement weather. Supplemental heat is not used at all during six months of the year. It is first turned on in the fall when nighttime temperatures begin to drop below 55F (12.5C). Animals are then checked each evening to be sure that they are inside the heated boxes. When temperatures drop to lower than 50F (10C) the doors to all the boxes are closed every evening and opened up again every morning. This not only helps to retain heat within the unit, but also prohibits any animal from leaving the box when outside temperatures are dangerously low. At the other extreme mid-summer temperatures can sometimes reach 110F (44C). To help moderate such heat, 70% shade cloth is installed over 2/3 of each enclosure. A drip irrigation line runs down the center of each roof with spray nozzles every few meters. These misters are controlled by an automatic watering timer which can either be programmed to come on as often as needed or operated manually. Fresh water faucets are present in each cage for washing and refilling water receptacles. Previous authors have listed lack of sufficient space as the primary reason that rock iguanas fail to thrive and reproduce in captivity. While I would certainly agree that enclosures provided should be as large as possible, access to natural sunlight and adequate diet is at least as important. We have had young adult *C. nublia* produce viable eggs in cages with as little as 3.25 square meters of floor space. A more appropriate size, however, for a large adult pair would be at least 9 square meters of floor area supplied with several basking sites. Visual barriers can be helpful in reducing stress during breeding and nesting seasons. We have tried several different arrangements for establishing breeding groups including pairs, trios and quads. Dominant adult males can rarely be kept together except in extremely large enclosures (200 sq. meters) that are usually impractical for the average breeder to construct. Females are often quite aggressive toward one another and nearly always establish a pecking order. Submissive females often do not do well and usually remain smaller and exhibit a slower growth rate than their dominant counterparts.

Relationships sometimes change very quickly in an apparently compatible trio or quad. Even after many peaceful months together, a subordinate female may suddenly be found with missing digits or more serious lacerations. This often occurs immediately after another female cage mate has oviposited (laid eggs). The most compatible group has proven, not surprisingly, to be one male and one female. We arrange cages in such a way that males can see one another and display back and forth. There is some evidence that these displays may help to stimulate breeding activity.

REPRODUCTION

Copulation can occur at various times throughout the year in captivity, particularly when iguanas are introduced to each other for the first time. Normally though, breeding takes place for just a few weeks each year during May and June. I have observed successful copulation on many occasions. It is usually preceded by numerous head bobs by the male, who then circles around behind the female grasping the nape of her neck in typical iguanid fashion. He then attempts to restrain her and to maneuver his tail under hers to position himself for intromission. Copulation generally lasts from 30 to 90 seconds (rarely longer) and a pair is rarely observed mating more than once or twice per day. Our captive *C. nubila* are always the first species to oviposit beginning as early as the first week of June. *C. cornuta* are usually somewhat later, nesting in August. Any eggs laid after October 1st have always been infertile. Gravid females normally begin the nesting process with a reduction in the intake of food and an increase in activity level about two weeks before laying. Abdomens of large, mature adult females often become distended to the point where the outline of individual eggs can easily be seen. Several days before actual egg laying, females begin to dig all over the cage, excavating many shallow depressions. In the cages with only 8" deep sand substrate a triangular piece of plywood is laid in one corner. This enables even the largest females to excavate adequate nests under the plywood in soil that would otherwise be too shallow. It usually takes an entire afternoon to excavate a complete nest burrow. Females often remain in burrows overnight rather than returning to their regular retreats. Occasionally females will remain underground up to two days while laying eggs, but more often emerge the following morning and begin to fill the nest burrow with sand. Huge quantities of sand are moved from around the nest site until a large mound is formed over the spot where the eggs were laid. We always remove the eggs immediately after being laid and artificially incubate them indoors, but many females will continue to guard their now empty nest site for weeks afterwards. If the mound of sand is raked flat after egg removal, a female will often immediately move large quantities of sand to attempt to re-cover the area. This behavior normally lasts for one or two weeks but can be induced in some individuals for months afterward by simply turning on the sprinkler system or by a moderate rain.

INCUBATION OF EGGS

After removal, eggs are placed into plastic sweater or shoeboxes containing a 2" (5 cm) deep layer of vermiculite or perlite. This dry substrate should first be moistened by mixing one and one-quarter parts purified water with one part (1.25:1) incubation medium (measured by weight, NOT by volume). Eggs are then placed into the substrate

with one half buried and the other half exposed to the air space inside the container. Care is taken not to turn the eggs over and to keep them in the same position as they were laid. The loose fitting covers are set onto each container and they are placed into an incubator set at 86F (30C). Containers are opened for a period of 30 seconds every three days to allow for some air exchange. A pan of water in the bottom of the incubator helps to maintain a fairly high relative humidity. Fertile eggs are usually full, turgid, and white in color. They are sometimes distinguishable from infertile eggs, which are often, but not always, soft, flabby and somewhat yellow in color. Eggs that are retained too long by a female before being laid may also be hard and misshapen. All eggs laid are incubated but ones appearing infertile are kept separate from “good” eggs and usually collapse and mold very quickly and are subsequently discarded.

HATCHING AND CARE OF HATCHLINGS

During incubation, fertile eggs increase substantially in size as they absorb moisture from the substrate. At 30C, eggs begin to hatch in as soon as 80 days, often dimpling in slightly several days before the first slit appear. After successfully slitting the eggshell with their tiny egg tooth, hatchlings will often sit with only their heads protruding for up to two days. During this time it is important not to disturb the hatchlings. If frightened, they may exit the egg before all of the remaining yoke material can be absorbed into their abdominal cavity. Once free of the eggs, they are left in the container for two or three days to allow the “umbilical” opening time to close. The movement of the first ones out crawling over the other eggs probably stimulates them all to hatch in unison. This is necessary in the wild to assure that they can burrow to the surface from the underground nest chamber, a process that requires a group effort. Once hatching is observed, covers of the containers are set ajar to allow for more air circulation. They must, however, be taped securely in place as the active youngsters can easily knock them off and scatter about the incubator. At these incubation temperatures, all healthy hatchlings are usually out by 90 days. For this time period, it is not necessary to add additional moisture to the substrate but if incubation exceeds this time or if eggs appear dehydrated, more purified water can be added if necessary. Water should be added to the substrate between the eggs but never poured or sprayed directly onto the eggs themselves. Even a few degrees reduction in temperature will result in prolonged incubation times of as much as 120 to 140 days with a larger percentage of eggs failing to hatch. Some eggs containing normal appearing fully developed embryos fail to hatch at all even under natural conditions. It is also common to have one or more infertile eggs in an otherwise fertile clutch. We’ve had no cases of “twinning” in our *Cyclura* eggs but are aware of two other documented incidences at other institutions of twins hatching from the same egg. I normally wait until all of the hatchlings in each plastic box have been out of their eggs for two three days before removing them from the incubator. Four or five juveniles are placed into a 30 gallon or larger terrarium with a bottom substrate of clean paper. An under-tank heat pad is placed under one end of the terrarium. Two light hoods are used; one holds a 60 watt red or blue bulb or ceramic heat emitter used to heat the container. The other is a strip hood containing a UVB producing full spectrum fluorescent tube. Both lights can be controlled with 24 hour timers and thermostats. The fluorescent light is turned on and off automatically for alternating 12 hour periods. By this method, nighttime temperatures are

maintained at 70-80F (21-27C), rising to 90-95F (32-35C) during the day. A hide box (optional) can be placed in one end of the terrarium and a shallow container of purified water is added for drinking.

Baby Iguanas shed almost immediately in tiny flakes as their skin dries out for the first time. At hatching, their bellies are distended with yolk and they often do not begin to feed for 7-10 days. Also at about 7-10 days old they shed completely once again, this time in large patches. We have seen no differences in growth rates or survivorship between hatchlings fed feces from adult Iguanas and ones that are not. Sufficient microflora for proper digestion is probably obtained from the crickets and mealworms that are sometimes, but not always fed to hatchlings in the first few weeks. In fact, in the 1999 hatching season no insects were fed at all and all of the hatchlings are developing normally. Interestingly, *C. nubila* seem to really relish crickets and mealworms, while *C. cornuta* youngsters consumed them rather sparingly. Hatchlings are kept indoors through the first winter and are moved into indoor/outdoor cages when the weather begins to warm in spring. Growth is rapid and we have seen iguanas attain over 20 inches in overall length within the first year.

SEXING

The most reliable method for sexing *Cyclura* is by probing. We do not recommend probing iguanas younger than two to three months of age, for the membranes within the cloaca are very delicate. Probes may puncture through the membranes and slip under the skin of the tail even with slight pressure. At three months of age, females probe about 5 mm in depth, while males are close to 12 mm deep. A relatively small probe (1-2 mm) is generally used on hatchlings. By two to four years of age, the secondary sexual characteristics are becoming evident and the presence of the male reproductive organ, the hemipenes can usually be detected visually at the ventral base of the tail. Adult *C. cornuta* females will probe near 15 mm in depth while adult males will probe 50 mm or more in depth. Sexually mature males (of most species) will also have enlarged and exuding femoral pores arranged in one or two rows along the underside of the rear legs.

SEXUAL MATURITY

Growth rates are often accelerated in captivity as compared to that of wild iguanas. This is certainly due to the richer diet they receive on a continuous basis. Consequently, sexual maturity is sometimes reached at a younger age than in their wild counterparts. Captive bred and raised female *C. nubila* have laid fertile eggs at as young as 21 months of age although it is more common in their third year. *C. cornuta* have also reproduced successfully in their third or, more commonly, fourth year.

MEDICAL ISSUES

We have seen very few medical problems with our animals. *Cyclura* iguanas kept in outdoor enclosures sometimes become infested with mites and these are kept in check

with the use of a .03 percent pyrethrin, or on of the synthetic pyrethrin sprays (as used for birds). The spray is allowed to sit on the iguana for one or two minutes and then is thoroughly rinsed off. The prescription drug Ivermectin is also used as both an injection and a topical spray for the control of ectoparasites on reptiles. Care should be taken to avoid spraying into the eyes, nostrils or mouth. A second treatment is applied two weeks following the first. Containers housing iguanas may be treated with the same spray allowing it to remain on surfaces for ten minutes before rinsing.

Wild *Cyclura* harbor huge swarms of oxyurids (worms) in their caecum. Because these endoparasites are sometimes associated with health problems in captive animals we now conduct routine worming once or twice per year with Panacur 10% paste or granules (Fenbendazole). Although otherwise healthy animals are not usually negatively affected by normal parasite loads heavy infestations can greatly debilitate an animal that is ill or under stress.

Several injuries have been severe enough to require suturing in our iguanas. These sometimes occur to both males and females during the somewhat violent mating process. Minor cuts and scrapes usually heal on their own, although we often apply an antibiotic spray or topical ointment to the afflicted area to help reduce the chance of infection. We have suffered the loss of very few adult *Cyclura* at C.R.C. over the last 20 years. One of those rare losses was an adult female that had outwardly appeared perfectly healthy up until the day that she died. A necropsy revealed that this female had become egg-bound from several ruptured eggs. Yolk material coated many internal organs. Salmonella and Arizona organisms are sometimes seen in fecal analysis of both captive and wild *Cyclura*. These are considered to be part of the normal intestinal microflora but may become pathogenic when animals are under great stress. As these organisms can be transferred to humans and other animals and sometimes cause serious health problems and rarely even death, sound hygiene practices should always be observed.

IN CONCLUSION

We are very pleased with the advances made in captive propagation at Cyclura Research Center and other facilities around the world. Captive-produced animals provide a source for zoos, research, and the private sector without exerting any pressure on wild populations. Although still controversial, more and more of these animals may be recycled back into the wild to restock depleted areas. This has been done for years in the Dominican Republic with *C. cornuta* and programs begun in both Jamaica the Cayman Islands will attempt to do the same with *C. colei* and *C. n. lewisi* in the near future. Ultimately, the continued survival of *Cyclura* iguanas will depend upon how aggressive we are in preserving their natural habitat and attempting to reverse much of the damage that has already been done to it. Until, and unless, these goals are accomplished, captive breeding programs will remain their most important hedge against extinction.

Revised March, 2000
David W. Blair

Care in brief of hatchling Cyclura Iguanas

- Cage: Minimum of 200 sq. inches of floor space for each iguana with basking sites.
- Temperature: 70-80F night, 85-95F daytime. 100-105F basking site.
- Lighting: Natural sunlight is best or full-spectrum UVB producing fluorescent tube. Photo period adjusts seasonally from 11.5 hrs. of daylight on Dec. 23 to 13.25 hrs. on June 22nd.
- Water: Small, shallow container of fresh water available daily.
- Food: Daily feedings recommended until 1 yr. of age, thereafter every other day.

We feed the following mix:

- 3-4 green leafy vegetables (parsley, chard, collard, turnip, mustard, etc).
- 2-3 fruits, chopped (apples, pears, melon, grapes, etc.)
- 2-4 vegetables, grated or processed (squash, carrot, legumes, etc.).
- Very small amounts (<5% of diet) dry, low-fat dog food soaked in water to soften (optional).
- Dust at least once weekly with quality vitamin/mineral powder.
- Occasional crickets and mealworms (optional)

BIBLIOGRAPHY

- Auffenberg, W. 1976 Rock iguanas, Part II. *Bahamas Naturalist* 2:9-16
- Blair, D.W. 1983 Dragons of Cayman. Rock iguanas cling to their islands. *Oceans* 16 (2):31-33
- Blair, D.W. 1991a. West Indian rock iguanas: their status in the wild and efforts to breed them in captivity. Pages 55-66 in *Northern California Herpetological Society Special Publication No. 6*, R.E. Staub, ed. Northern California Herpetological Society.
- Blair, D.W. 1991b. Update on the status of the San Salvador rock iguana, *Cyclura rileyi*. *Iguana Times* 1(2):1-3.
- Blair, D.W. 1992a. A cay by any other name. *Iguana Times* 1(5):2-7.
- Blair, D.W. 1992b. Booby or bust! *Iguana Times* 1(6):4-9.
- Blair, D.W. 1994. Status of currently recognized taxa of the iguanid genus *Cyclura*. *Reptiles* 1(4):60-61.

Carey, W.M. 1975. The rock iguana, *Cyclura pinguis*, on Anegada, British Virgin Islands, with notes on *Cyclura ricordi* and *Cyclura cornuta* on Hispaniola. *Bulletin of the Florida State Museum of Biological Sciences* 19 (4):180-234

Duval, J.J. 1982. Recommendations for the captive management of West Indian rock iguanas, (*Cyclura*). In *Proceedings 6th reptile symposium on captive propagation and husbandry*. :181-196

IUCN/SSC West Indian Iguana Specialist Group, 2000. *West Indian Iguanas Status Survey and Conservation Action Plan*, A. Alberts, ed.

Iverson, J.B. 1979. Behavior and ecology of the rock iguana *Cyclura carinata*. *Bulletin of the Florida State Museum of Biological Sciences* 24:175-358

Noble, G.K. 1923. Trailing the Rhinoceros Iguana. *Journal of the American Museum of Natural History in New York* 23:541-558

Perera, A. 1985a. Datos sobre la dieta de *Cyclura nubila* (Sauria : Iguanidea) en los alrededores de Cayo Larga del sur, Cuba. *Poeyana* 291:1-12

Schwartz, A. and W.M. Carey 1977. Systematics and evolution in the West Indian iguana genus *Cyclura*. *Fauna of Curacao and the Caribbean Islands*.173:16-97

Schwartz A. & R. Thomas 197?. A checklist of West Indian amphibians and reptiles. *Special Publication Carnegie Museum of Natural History* 1:1-216

Wiewandt, T.A. 1977. Ecology, behavior, and management of the Mona Island ground iguana *Cyclura stejnegeri*. Ph.D. Dissertation, Cornell University, Ithaca, NY.

Wiewandt, F.A. 1982. Known and extinct forms of *Cyclura* iguanas. Pages 392-394 in *Iguanas of the World*, G.M. Burghardt and A.S. Rand ,eds. Noyes Publication, Park Ridge, New Jersey.