HUSBANDRY

Green Iguana Management and Husbandry[1]

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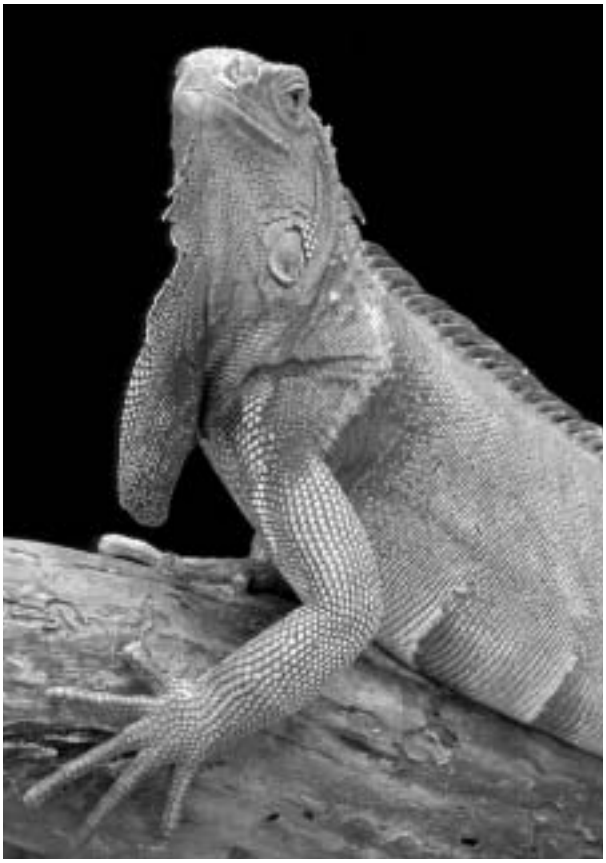
Green Iguanas (*Iguana iguana*) are inappropriate pets. Like monkeys, raccoons, and skunks, they are cute and tractable as juveniles but become difficult to manage as they grow. Most captives suffer one of two fates. Either their needs are poorly met and they die at a young age, or they grow into large, active, aggressive adults for which few keepers can provide. Reptile adoption and rescue agencies are overwhelmed with unwanted iguanas. Successful iguana owners, those experienced in iguana care and behavior, are among the first to suggest that this species is a poor choice for all but the most dedicated keepers.

In choosing a pet, people select reptiles in general, or iguanas specifically, for a variety of reasons. A small group of keepers has a strong, sincere interest in herpetology and iguanas in particular. These people make the best keepers, and are always reading, researching, and trying to improve their knowledge and level of care. A bigger group of keepers uses the reptile to satisfy the basic human need to be unique and stand out: "Look at me, I have a weird pet." Many exotic pets are chosen for this reason, and these owners often take shortcuts in providing care because the animal itself is not as important as having it. Still others choose a reptile because they are non-allergenic, low-maintenance pets that can be left unattended for days at a time, and convenience outweighs dedication. The final group of keepers incorporates the impulse buyers who see an interesting, inexpensive lizard in the pet store and buy it with little regard for its captive requirements. These people succumb to what Dr. Doug Mader calls the iguana's high "cool" factor.



A healthy female Green Iguana (*Iguana iguana*). *Photograph by Tom Wiewandt.*

Whatever the reason a reptile is chosen as a pet, iguanas are one of the more popular reptiles because they are inexpensive and readily available. Moreover, they are vegetarian and, in this age of animal rights, many owners prefer not to deal with insect or rodent prey. The down side, of course, is that vegetarian diets are much more difficult to balance than are insectivorous or carnivorous diets.

Like Pot-bellied Pigs, hedgehogs, and imported adult Ball Pythons before them, the Green Iguana fad is on the down slope of its bell-shaped curve of popularity when compared to the 1990s. The word

[1] This feature was adapted from an article of the same title presented as part of the Bayer Exotics Symposium in 2002 (*Suppl. Compend. Contin. Educ. Pract. Vet.* 24:13–22). Portions of that and this manuscript are based on Barten, S.L. In Press. Biology: Lizards. In: D.R. Mader (ed.), *Reptile Medicine and Surgery.* 2nd ed. W.B. Saunders, Inc., Philadelphia, Pennsylvania. Used with permission of the Bayer Corporation and Bayer AG Leverkusen.

is seemingly getting around that these are difficult captives. Nevertheless, a core of dedicated keepers will always be seeking veterinary advice.

One of the biggest problems of keeping iguanas — or any reptile — in captivity is that no standard of care has been established for them. Indeed, any internet search using the key words "iguanas, pets, and husbandry" (or "care in captivity") will turn up an astonishing number of personal web pages for individual pet iguanas which are laden with advice, often conflicting, on captive care. Recommendations for captive care are almost universally based on anecdotal or personal experience with a few specimens rather than scientific research. Instead, captive care should be based on the biology and natural history of iguanas in the wild. The more their conditions mirror what they evolved to utilize in nature, the healthier captive iguanas will be.

Natural History

Few reptiles have been studied as extensively as have Green Iguanas. This very brief summary of their biology is an overview meant to illustrate applications to captive management. Green Iguanas inhabit the New World tropics and subtropics from northern Mexico to Paraguay and southeastern Brazil, along with many Caribbean islands. Iguanas are diurnal and arboreal, preferring tree tops along rivers, lakes, and mangrove swamps. Trees provide an abundance of sun and shade for thermoregulation and basking, as well as food and sleeping perches. Iguanas sporadically descend to move to other trees, avoid threats or nest. An iguana may stay in one tree for anywhere from one day to several weeks. Iguanas also utilize more open, arid habitats if sufficient food resources are available.

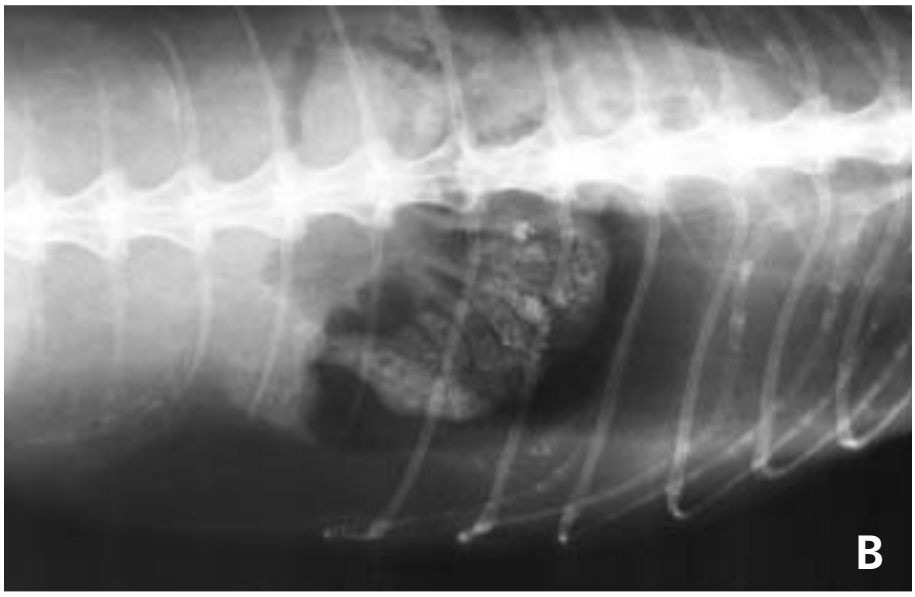
The home range of a reptile is that area utilized for acquiring or accessing necessary resources such as food, shelter, basking sites, escape routes, mates, and nesting sites. Home ranges are not defended against conspecifics and ranges of individuals typically overlap. Territory is that subportion of the home range that is defended from conspecifics or other species, usually because it contains a critical resource. For iguanas living in trees, food is abundant and the main defendable resource is reproductive females. The measurement of home ranges for arboreal species is difficult because it is three-dimensional and contains gaps of unusable areas. Nevertheless, one study reported mean home ranges for iguanas observed at least three times over a minimum of two months. Large males occupied 800 m^2, medium and small males covered 2,200 m^2, and females ranged over 2,450 m^2. Another study showed mean daily movement totals of 111 m for male and 135 m for female iguanas. Flight distances of iguanas in trees (the distance at which the approach of a threat caused the lizard to flee) was 50–60 m after basking and 90 m before basking.

Iguanas are one of few totally herbivorous lizards. They are joined by many of the other New World Iguaninae, the spiny-tailed agamid *Uromastyx* spp., Sailfin Dragons (*Hydrosaurus* spp.), Fiji Island Iguanas (*Brachylophus* spp.), and the Solomon Island Skink (*Corucia zebrata*). Suggestions that iguanas undergo an ontogenetic shift from insectivory to herbivory are based on observations of captives and anecdotal field observations and are incorrect. Iguanas spend 90–96% of their time resting and only 1% eating. Daily forage times last only 20–30 min. Iguanas

Tropical rain forest in Costa Rica. Green Iguanas were abundant and dozens and dozens of adult lizards were seen.

Iguanas are arboreal and prefer trees along rivers, lakes and mangrove swamps (A). This river was in Costa Rica. The speck on the branch of this tree is a large Green Iguana (B). Basking high in the top of a tree is typical iguana behavior, and serves as proof that most captive iguanas are kept in inadequately small cages.

generally eat the leaves of trees and vines. Analysis of stomach contents from 31 iguanas in Panama revealed only plant material comprising 26 plant species. Twenty-four stomachs contained only leaves, four contained leaves and flowers, two only fruit, and one only flowers. Iguana teeth work like pinking shears and cut out sections of leaves, but iguanas do not masticate before swallowing. All herbivorous lizards have an enlarged colon divided into compartments by circular and semilunar valves composed of infolded mucous membrane, submucosa, and the internal muscularis externa. The number of valves varies by species and Green Iguanas usually have 6 (5–7, but only four in populations from the northern Lesser Antilles). Their function may be to slow gastrointestinal transit time, increase surface area, or provide habitat for commensal microbe and nematode populations. Wild herbivorous lizards typically have huge oxyurid (intestinal roundworms) burdens of up to 15,000 worms per lizard. These are not found in other lizard species. The nematodes may serve to mechanically mix and break down plant material, produce useable cellulase, vitamins and fatty acids, or promote healthy populations of fermentative microbes in the colon. Nevertheless, dewormed lizards had efficient digestion, so nematodes, although common, may be relatively unimportant. Thirty to 40% of nutritional energy derives from microbial fermentation in the hindgut. This process requires high temperatures and slow passage times, averaging 6.9 days in wild iguanas in Venezuela. Wild neonate iguanas inoculate themselves with fermentative bacteria by ingesting the feces of adult iguanas after hatching.



Adaptations for herbivory in Green Iguanas. (A) Iguanas have homodont (all the same shape), pleurodont (frequently shed and replaced) teeth designed for cutting large pieces of leaves, which are then swallowed relatively whole with little chewing. The points of the teeth interdigitate to cut leaves like pinking shears. (B) Dorsoventral radiograph of an iguana. The colon is silhouetted by air density in the lung. The semilunar valves that divide the colon into compartments, which are typical of herbivorous lizards, are outlined and made visible by ingesta.

Thermal ecology of reptiles is complex. The term "Preferred Optimum Temperature Zone" is common in the veterinary literature, but thermoregulation in ectotherms involves much more than that. The "Preferred Temperature" is the temperature selected by lizards in a thermal gradient when not distracted by other influences, like shelter. The "Mean Activity Temperature" is the mean temperature of all active lizards. The "Activity Temperature Range" is the range in which activity occurs. The "Voluntary Minimum and Maximum" are the lowest and highest temperatures tolerated in laboratory conditions, and these define the endpoints of the Activity Temperature Range. The "Critical Thermal Minimum and Maximum" are the extreme temperatures that result in immobility and death. Voluntary minimum, maximum, and mean temperatures for Iguanidae were reported as 18.0°, 46.4°, and 36.7° C (64.4°, 115.5°, and 98° F), respectively. Circadian temperature fluctuations (low at night and high during the day) within the activity temperature range are very important, and lizards kept at uniform temperatures 24 hours a day fail to thrive.

Iguanas appear to have high requirements for ultraviolet light for vitamin D and calcium metabolism, although specific wavelengths, intensities, and photoperiods have not been quantified. Nonbreeding iguanas in Venezuela basked for approximately 4 h in the morning and another 2–3 h in the afternoon. Basking provides for thermoregulatory as well as ultraviolet needs.

Iguanas communicate primarily through visual signals. Dominant males exhibit physical characteristics that emphasize their size, such as large heads, opercular scales, crests, spines, and dewlaps, and sometimes orange skin coloration. Likewise, head bobs, pushups, throat expansions, and dewlap erection are used to convey threat. Threats may escalate to lunging, biting, and tail slapping, although, in the wild, displaying males tend to be well spaced so that displays outnumber actual fights. Chemical and tactile signals are less important; however, femoral pores are well developed in males and produce secretions that provide both chemical and visual cues. The femoral pore secretions of Desert Iguanas (*Dipsosaurus dorsalis*) reflect UV light in wavelengths that are visible to the lizards but not to humans.

Breeding is seasonal and associated with the dry season. Males display on perches and defend territories from November through January, becoming very aggressive toward intruding males. This corresponds to a seasonal testicular recrudescence, during which the testicles undergo marked enlargement and testosterone production peaks. Breeding behavior is characterized by dominant male hierarchies utilizing small mating territories, intense competition between males, and female mate selection determined by male fitness. Females nest 3–7 weeks after breeding, produce clutches ranging from 14–76 eggs (average 35–43), and eggs hatch after 10–14 weeks of incubation at 28–32° C. Iguanas often nest communally due to limited numbers of available sites, excavating nest sites at the bottom of burrows 1–2 m long and 0.25–0.5 m deep. Females guard nests from other females.

Nonbreeding iguanas are more tolerant of the presence of other iguanas and do not defend territories. Low-intensity antagonistic interactions occurred when two iguanas passed on a branch but ceased after they separated. Nonbreeding females occupy prime basking and sleeping perches and chase away new females.

Husbandry

The conditions iguanas require and utilize in the wild obviously cannot be provided in captivity.

A very large, male, sedated Green Iguana. Size and dominance are communicated through visual cues. Note the large head, large opercular scale on the jowl, large dewlap, and tall dorsal spines. This iguana was caught as a feral animal in Florida, where it was thriving outdoors. The right front foot and forearm are swollen as a result of a bite wound from another iguana. Several iguanas including territorial males were housed together due to lack of space at an animal dealer's facilities.

No iguana husbandry can be described as "proper," and captive conditions always have room for improvement. Captive iguanas tolerate less than ideal conditions, nevertheless keepers must be aware of iguana natural history and make every effort to provide for their needs. These needs include large, three-dimensional home ranges, focal heat sources approaching 36.7° C (98° F), strong UV sources, a balanced vegetarian diet, and avoidance of the various levels of aggressive and antagonistic behavior between individuals. Every captive iguana is under some degree of chronic stress just from being in captivity. Conditions that are well-tolerated by one lizard may cause serious problems in another, and keepers must be flexible in their techniques according to their results. Captive management should be investigated and improved for any iguana presented to a veterinarian for any reason, without exception.

Iguana husbandry has been the subject of innumerable books and magazine articles. To cover the topic in depth here would be to reinvent the wheel, and such a complex subject cannot be discussed in detail in this limited space. Veterinarians and owners alike should be thoroughly familiar with one or more of the three best books on iguana husbandry: Kaplan's *Iguanas for Dummies*, Hatfield's *Green Iguana: The Ultimate Owner's Manual*, and Rosenthal's *The Iguana: An Owner's Guide to a Happy Healthy Pet*. Melissa Kaplan is considered a leading authority on captive iguana management and, in addition to her excellent book, she maintains the Melissa Kaplan's Herp Care Collection web site at www.anapsid.org. This is one of the finest web sites on herp care because it is comprehensive, current, accurate, well-referenced, and frequently updated.

Two main schools dominate captive reptile husbandry. Traditionally, bare cages with newspaper substrate and a single branch and water bowl were recommended and popular. Ease of maintenance was achieved at the cost of stimulation and enrichment for the iguana. Lately, complex, naturalistic vivaria have become fashionable. Such cages are aesthetically pleasing, but also labor-intensive to maintain, and few but the most dedicated and experienced hobbyists do an adequate job of sustaining hygiene in complex cages. If a keeper cannot properly maintain a complex vivarium, then a simpler setup would be a better choice. Likewise, ingestion of substrate is common when gravel or bark is used, especially if the diet is unbalanced or inadequate in amount. In spite of the potential problems, cages should be enriched to reduce stress and allow normal behaviors among inhabitants.

Caging.—Iguanas are arboreal lizards that require huge cages to accommodate their active behavior, and most keepers provide cages that are too small. One expert recommends a cage length equal 1.5–2 times the total length of the lizard housed within, and a cage width at least half that distance. Another expert suggests even more space, 0.4 m^3 cage space per 0.1 m total length for arboreal lizards. These are suggestions only and come nowhere near providing the space that wild iguanas utilize, with home ranges measuring over 2,000 m^2 (a square measuring 146 ft per side) and daily movements exceeding 100 m (328 ft). With that in mind, iguanas should be provided the biggest possible cages with the goal for adult lizards of at least 10 x 3 by 6 ft high, although a room-sized enclosure would be better. Anything smaller would be the equivalent of a human living in a telephone booth: possible, but hardly humane. Aquaria sold for juvenile iguanas will be outgrown in a few months, and the need for custom cages should be anticipated from the beginning. Outdoor aviary-style cages with shelters from the sun and inclement weather are strongly recommended in warm climates or during the summer months.

Cage sides should be smooth to prevent rostral abrasions. Metal screening should be used with caution, since it doesn't retain heat and can result in foot and rostral trauma. Plastic mesh, polyethylene hardware cloth, and plastic-coated wire mesh are less abrasive. Cages made of wood must be sealed with polyurethane, marine epoxy paint, or a similar waterproofing agent, and joints should be caulked to allow cleaning and disinfection. Ventilation is crucial, as ample air exchange is necessary to prevent the harmful buildup of bacteria and fungi.

Lizards allowed to roam free in the house may suffer suboptimal temperatures from the lack of a heat source or exposure to cold outside walls and windows or drafty floors. Trauma is common in free-roaming iguanas that may be trampled, closed in doors, fall from high shelves or curtains, or be attacked by dogs and cats. Uncaged iguanas commonly escape.

Arboreal species require vertical space and climbing branches. Dry climbing branches approximately the same diameter as the lizard's body

A Bahamian Ground Iguana (*Cyclura cychlura figginisi*) in a huge outdoor enclosure. Although not a Green Iguana, the principles are the same. About one eighth of the cage is visible here. It is located under a tree, providing both sun and shade. Note the ramp behind the lizard which leads to a heated enclosure to provide shelter on cool nights. Note, too, that the concrete walls are buried in the ground to prevent the lizards from burrowing underneath them. *Photograph by Juliann Sweet.*

should be placed diagonally in the cage and anchored to prevent toppling. Live, non-toxic plants that lack spines and slippery surfaces and are big enough to bear the weight of the lizard are recommended. *Dracaena* and *Ficus* trees with trunks as thick as the lizard's body work well for iguanas. These act as cage furniture, add humidity, shelter, and visual enhancement. They should be potted to facilitate cleaning. Silk plants may be coated with toxic, water-soluble stiffeners and should not be used.

Substrate.—Substrate can be flat newspaper, indoor/outdoor carpet, orchid or so-called "reptile" bark chips, alfalfa pellets, cyprus mulch, or commercial animal bedding made from recycled paper or wood pulp. Newspaper is inexpensive, clean, and easy to use, but not aesthetically pleasing. Carpet is labor-intensive, requiring washing. Alfalfa pellets are digestible if ingested and look nice, but are dusty and foul smelling when they get wet. Orchid or "reptile" bark products made from fir may be used, but never redwood or cedar. If bark chips are excessively dusty, they should be rinsed and dried before use. Coarse-grade bark can irritate the feet of lizards that dig repeatedly and fine-grade bark can cause fatal gastrointestinal impaction if swallowed. With the current popularity of naturalistic vivaria, many keepers feel the advantages of bark outweigh these risks. A shallow feeding dish can be used to minimize the risk of accidental substrate ingestion, but the bark should be removed if a keeper sees the lizard eat some or finds it in droppings. Recycled paper animal bedding currently is a popular substrate to use because it is more absorbent and less dusty than alfalfa pellets; it can be changed less frequently and it is more or less digestible if swallowed.

Cedar shavings contain aromatic resins that may be toxic to reptiles. Other substrates to avoid include gravel, sand, crushed corn cob, clay kitty litter, and miscellaneous wood shavings.

Thermoregulation.—Reptiles are ectothermic and require supplemental heat in captivity. Temperatures within the Activity Temperature Range are necessary to optimize metabolic processes including digestion, growth, healing, reproduction, and immune system function. The Mean Activity Temperature (T_b, body temperature) for Iguanidae is reportedly 36.7° C (98° F); consequently, a focal hot spot reaching this level must be provided. Iguanas also are heliothermic (gain heat by basking) and not thigmothermic (gain heat by conduction from lying on warm rocks), thus overhead heat sources are preferred to substrate heaters. So-called hot rocks are commonly sold by pet stores for use with pet reptiles, but are inappropriate for this species. Substrate heaters under the tank may be used to provide background heat in cold climates, but not primary basking heat.

Reptiles in the wild control their core body temperature to within a few degrees of their mean activity temperature by thermoregulation — they move all or parts of their bodies into or out of

direct sunlight. Keepers should create a thermally complex environment for captive reptiles to allow them to adjust their body temperature behaviorally as they would in the wild. A thermal gradient on both a horizontal and vertical axis is ideal. This can be achieved by providing a focal hot spot on one side of the cage, covering less than 25% of the cage, using overhead lamps with reflectors, infrared ceramic heating elements, or radiant heat panels. These must be secured to prevent them from being tipped over or burning the lizard. Heat sources should be attached to thermostats to prevent accidental overheating, and a number of commercial models are available specifically for use with captive reptile enclosures. Fire safety precautions and smoke alarms should be used. However, maintaining the entire cage at a uniform temperature would be unnatural. Diurnal temperature fluctuations between day and night occur in the wild, so heat lamps should not be left on 24 h/day. Daily fluctuations in temperature seem to be important for lizards. Nighttime temperatures can approach the voluntary minimum temperature for iguanas (18.0°C, 64.4°F), but should not reach it to avoid stress and immunosuppression. Nighttime lows around 22°C (72°F) are well-tolerated as long as adequate daytime highs are provided.

The temperatures at both the hottest and coldest parts of the enclosure must be measured daily. Digital thermometer-hygrometers are useful. Likewise, infrared thermometers that instantly measure the surface temperature of objects from a distance are highly recommended. Both are available from electronics stores and reptile supply dealers. Adhesive aquarium thermometers stuck to the side of the cage are not recommended, because the temperature of the basking site where the reptile rests should be measured rather than the temperature on the side of the cage.

Osmoregulation.—Tap water usually is adequate, but bottled water might be used where the tap water quality is in question. Aging the water or dechlorination is not necessary. *Pseudomonas* spp. bacteria grow rapidly in water bowls, so bowls should be changed and disinfected or washed in hot soapy water every day.

Humidity is an important but often overlooked factor. In general, iguanas require more humidity than is typically present in our homes. From a practical standpoint, maintaining humidity levels of 50% is almost impossible, and such levels result in blooms of mildew. Good ventilation is essential to prevent the rapid growth of bacteria and mold in the cage when humidity is added. Humidity may be increased by using water bowls with large surface areas to increase evaporation, frequent spraying of the cage, or the use of humidifiers. Different humidifier models produce hot or cold mist. The former must be kept far enough from the lizard to prevent burns. Machines kept within the enclosure must be secured to prevent iguanas from tipping them over.

Ultraviolet Requirements.—Ultraviolet wavelengths (UV) are important for vitamin D synthesis and calcium metabolism in diurnal lizards that do not eat vertebrate prey. UV-A (nearwave, 320–400 nm) produces beneficial behavioral and psychologic effects, but does not activate vitamin D precursors in the skin. UV-B (middlewave, 290–320 nm) is necessary for vitamin D activation. Reptiles benefit from *both* UV-A and UV-B light. Nevertheless, scientific studies into the specific requirement for UV light in captive lizards are lacking, and specific requirements for UV wavelength, intensity, and length of exposure are largely unknown. Iguanas are known to bask for many hours every day in the potent tropical sun, receiving levels of UV radiation that are difficult to duplicate in captivity.

The sun is a more effective UV source than any bulb, but certain precautions must be taken before exposing captive lizards to direct sunlight. First, window glass filters out UV rays, thus sunlight through a window is of no benefit. A reptile in a glass cage should never be placed in direct sunlight or overheating and death may occur. Reptiles should be in a screen or mesh cage to allow sunlight to enter but, at the same time, prevent the escape of the lizard. Part of this enclosure must be shaded with an overhang or plants to allow the animal to get out of the sun. Iguanas basking in the sun should be kept in an enclosure and not handheld, even with a leash, because direct sunlight can result in temporary changes in personality, and normally tame lizards can become agitated and very aggressive. These changes reverse readily when the lizard is brought back inside. Lizards basking in sunlight should be monitored to prevent overheating, exposure to predators, or theft, or any other problem that might arise. Basking outside should not be allowed if the ambient temperature is excessively high. Even 15–30 min of direct sunlight a week can be quite beneficial.

A number of artificial UV-B light sources for reptiles are commercially available. Obviously a bulb producing 5.0% of its emitted light as UV-B is more efficient than one producing 2.0% UV-B. Moreover, a 48-inch tube produces more light than an 18-inch tube, and two tubes produce twice as much light as a single tube. Traditionally, fluorescent tubes have been considered better UV-B sources than incandescent bulbs, but new products are available that claim to provide UV-B and heat in a single incandescent bulb. New UV light sources are becoming available on a regular basis, and each should be evaluated based on the wavelengths of UV produced.

Caution should be taken to avoid human exposure or eye contact with the UV rays, as these have been associated with skin cancer and cataract formation. Artificial UV light sources should mimic natural photoperiods and be turned off at night.

Artificial light sources cannot replace natural sunlight, and those reptiles with access to the sun in outdoor enclosures, even on a screen porch or patio, invariably have better growth, health, behavior, reproduction, and longevity than those kept indoors.

Visual Security.—Visual security is beneficial, especially for nervous specimens. A shelter or retreat should be provided for all cage inhabitants. Hiding places can be made from a cardboard box, terra cotta pottery, plastic flower pots, cardboard tubes, sheets of cork bark, or driftwood. Arboreal iguanas also should be provided with real or artificial plants in which to hide. Some iguanas eat poorly and become stressed if they lack visual security.

Disinfection.—Cages and food and water bowls must be cleaned frequently. Three-percent sodium hypochlorite solution is an effective and economical disinfectant. The cage and its furniture must be rinsed thoroughly before returning a lizard to the cage. Keepers must wash their hands thoroughly after cleaning each cage and not transfer water bowls, uneaten food, or climbing branches between cages without disinfecting them first.

Quarantine.—Reptiles new to a collection must be kept in a separate area from the main collection for a minimum of 3 months. New arrivals should have physical examinations, body weights recorded, fecal examinations, parasite treatment, and be monitored for appetite, normal behavior, and symptoms of illness. At the very least, the owner should inspect new arrivals. The main collection should be fed and cleaned first and the quarantined animals second, with no transfer of animals, cages, food and water bowls, uneaten food items, or cage furniture between the two. Keepers must wash their hands and consider clothing changes after working with either collection to prevent the inadvertent transfer of pathogens. Ideally, different keepers would care for the two collections. The farther apart the two collections are physically, the less likely an epizootic will occur. No transfer of air should occur between the two

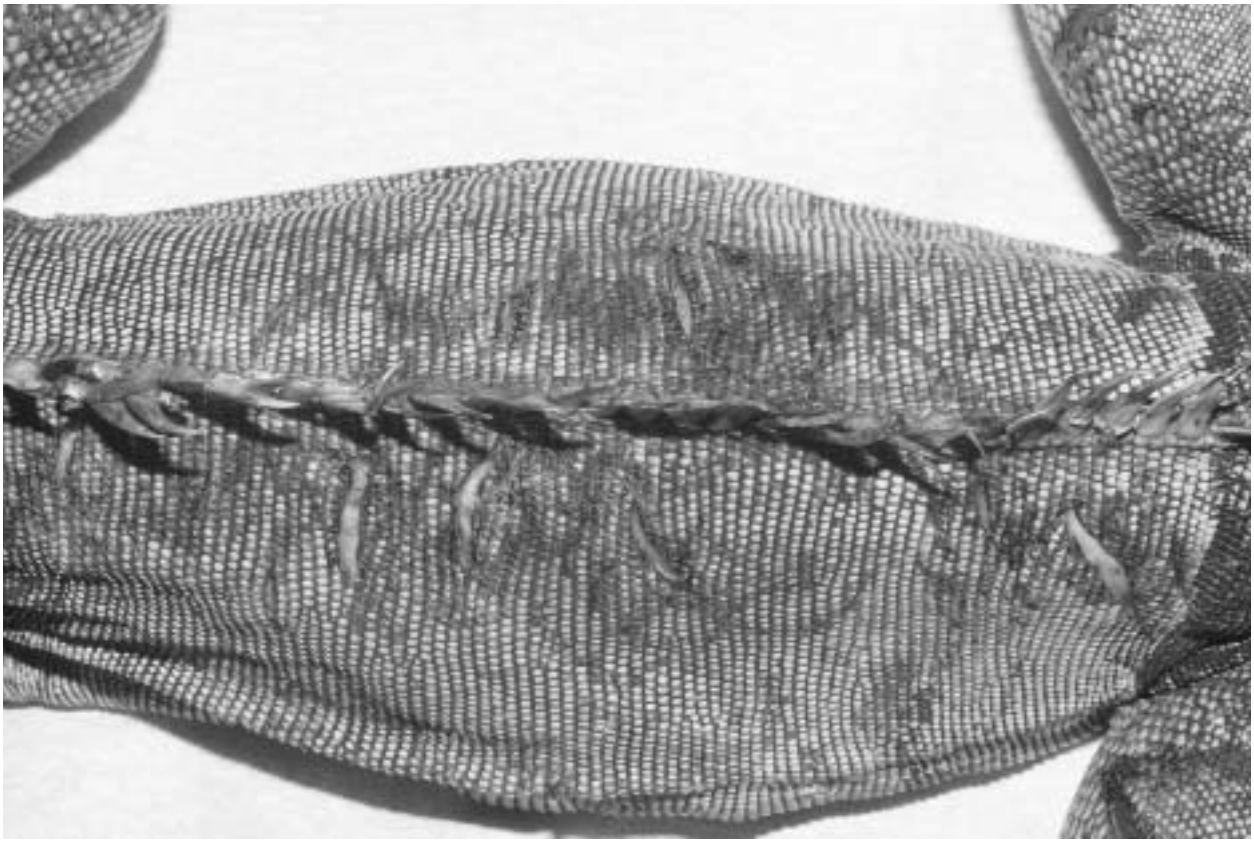
Two Rhinoceros Iguanas (*Cyclura cornuta*) in a large outdoor enclosure. The lizard on the right is threatening the other one with vigorous head bobs. Note the erect posture and orientation directly towards the other lizard. The other iguana soon submitted by retreating to the far corner of the cage.

groups. When multiple animals are being quarantined, they should enter and leave the quarantine area as a group.

Communal Housing and Handling.—Pet stores often display iguanas for sale in crowded community tanks, suggesting that these are social animals. In the wild they may form loose aggregations if food is abundant, but they also have the opportunity to run away if they are being stressed or threatened by other iguanas. Lizards locked in a cage or room cannot run away. Male lizards are more territorial than females, and react more violently to other males than to females. Hormone fluctuations, and thus territoriality, are seasonal and are manifested most acutely during the breeding season. Iguanas gain little benefit from being housed together, but cannot stress or injure each other if housed separately.

When two or more lizards are kept together, the more aggressive individual may physically attack the subordinate one, sometimes inflicting serious wounds. More often it dominates in more subtle ways by keeping the subordinate lizard away from food and heat sources. This allows the dominant one to digest its food more efficiently, grow faster, and have a more effective immune system than the subordinate lizard. The subordinate in a pair invariably suffers chronic stress, and thus fails to thrive. Symptoms include slow growth, emaciation, poor muscle tone, poor color, lethargy, and susceptibility to infections and parasites. The solution is to separate the lizards. Reflective surfaces and mirrors should be avoided, as lizards, especially males, will attack their own reflection. Keepers might occasionally observe two lizards in a cage to lie in the same spot and overinterpret that they have a relationship. However, stress may still be present.

Two or more iguanas may be kept together only if certain requirements are met. First, the enclosure must be large enough, with 1.5–2 times the recommended area for the biggest iguana pro-



Multiple bite wounds on the back of a subordinate male iguana, which also suffered a fractured ulna as the result of an additional bite. Seventy-eight stitches were needed to close the wounds. The owner had purchased two iguanas thinking they were social and in need of companionship. As the lizards grew, they both turned out to be males and began to fight. The owner tried to separate them by confining them in separate (and inadequate) 55-gallon aquaria in the same room. He came home one day to find the larger male had broken out of his cage and into the cage of the smaller lizard, pinning him down and chewing on him until the owner separated them.

vided for each iguana in the cage. Second, separate feeding, basking, and hiding areas must be provided for each iguana. Spatial complexity, so the iguanas can stay out of sight of each other behind logs, driftwood, and plants, is crucial. Third, keepers must be observant of the iguanas' behavior. A cage may appear suitable by the book, yet the individual iguanas may require more space or additional shelters or basking sites. Different iguanas have different personalities and requirements. Finally, the keeper must be aware that two iguanas simply may be incompatible. Just because they are the same species does not mean that they will get along. Females may dominate males, and smaller lizards may dominate larger ones, so the largest male is not always at the top of the social hierarchy. Lizards that are initially compatible may begin to fight months or years later. Keepers getting more than one iguana should be prepared to provide separate enclosures if the lizards become incompatible. Separate enclosures are not always enough, and often cages must be kept in separate rooms.

Food and Feeding.—Wild Green Iguanas are specialized folivores, eating primarily leaves from trees. Captive iguanas are exposed to, and accept, a number of food items they would never see in the wild. The owner must patiently work with his or her pet iguana and train it to eat a balanced diet. The lizard should never be allowed to choose what it eats, as taste and palatability do not necessarily equate to nutritional value.

Suboptimal temperatures and other husbandry conditions prevent adequate food intake and digestion. Under poor captive conditions the best diet in the world will be inadequate.

No captive iguana diet can be accurately described as "proper." The exact nutritional requirements for Green Iguanas have never been scientifically determined, and precise nutritional requirements for this species are not known. Wild iguanas eat leaves from trees that are not available in captivity. We can approximate a nutritious diet, but most formulations are based on anecdote, experience, and speculation rather than scientific feeding trials.

In captivity, herbivorous lizard diets should be based on a variety of chopped, dark green, leafy vegetables. Greens that contain oxalates, like spinach, or goitrogens, like kale, should be used sparingly. Fruit should be minimized, not because it is toxic but because it dilutes the beneficial nutrients of the other ingredients. In one study, adding one cup of strawberries to one cup of romaine reduced the protein and calcium concentrations by two-thirds compared to romaine alone. A recommended diet including ingredients, amounts, schedules, and vitamin and mineral supplementation is described in the accompanying Table.

All plant material must be washed, chopped (a food processor is recommended), and thoroughly mixed. This will ensure a balanced diet in that all food items will be eaten, rather than just the favorites or the most tasty items. Prepare enough for 4–7 days, store it in the refrigerator between feedings, and serve it at room temperature or slightly warmer. Offer food after the iguana has had several hours to bask under its heat source in the morning, leave it in all day and remove uneaten food in the evening.

Grains such as bread, crackers, pasta, and seeds are recommended in some iguana diet recipes. This food group is low in the nutrients that iguanas need, especially fiber, protein, and calcium. Grains should be limited to occasional treats if used at all.

Traditionally, animal protein sources have been recommended. However, these lizards are vegetarians from birth, even though they might occasionally accept unnatural foods (e.g., crickets or even mice) in captivity. Although animal protein sources often are recommended for iguanas, their necessity has not been scientifically documented. Any protein supplements should be plant-based.

Commercial iguana diets are available, but vary in quality and palatability. The advantage of these products is that they are easier to use than preparing a balanced salad several times a week. The disadvantage is that, in spite of claims that the commercial diets are complete and balanced, they may not be. Commercial diets that have high levels of animal protein, fat, corn, soy, wheat, grains, goitrogenic vegetables, fruits, or flowers should be avoided. The main ingredient, which is always mentioned first on the ingredient list, should be alfalfa. Nutrient levels on a dry matter (DM) basis should include plant-based protein > 20%, fiber > 15%, and calcium 1.4%. Pelleted or powdered diets contain only 10% water compared to 85–90% in salads. Consequently, these diets must be moistened with water prior to feeding. Frozen diets can be deficient in thiamine. Commercial iguana diets may have a role in iguana nutrition but should be limited to less than half of the total diet until more is known.

Recommended Diet for Captive Green Iguanas

Hatchlings
(to 14" in length)

- Feed twice a day or provide continuous availability
- Plant matter finely chopped or shredded
- 1 small pinch of vitamin/mineral supplements per feeding. Give vitamins 4–5 days a week and calcium 7 days a week.

Juveniles
(to 2.5 years of age or to 3 ft in length)

- Feed once a day
- Plant matter fine to medium chopped or shredded
- 1 small pinch of vitamine/mineral supplements per feeding. Give vitamins 4–5 days a week and calcium 7 days a week.

Adults
(over 2.5 years of age or over 3 ft in length)

- Feed daily or every other day (an iguana cannot be overfed when using the high fiber, vegetarian diet recommended here)
- Plant matter coarsely chopped
- One full pinch of vitamine/mineral supplements per 2 lbs of body weight. Give vitamins 2–3 times per week and calcium 4–5 times per week (unless gravid or sick, then 5–6 times a week).

Ingredients

1. Calcium-rich leafy greens, 40–45% of the diet or more with three or more items per feeding: turnip greens, mustard greens, collards, pesticide-free dandelion greens and flowers, clover, escarole, carrot tops, parsley, nasturtium leaves and flowers, and hibiscus leaves and flowers. Also offer endive, romaine, mint, and cilantro.

Spinach, chard and beet greens have high levels of oxalates which can tie up calcium, and kale, bok choy, and broccoli leaves have high levels of goitrogens. Both groups can be used, but in moderation.

Iceberg, Boston, butter, and head lettuces have little nutritional value compared to dark leafy greens. Romaine is intermediate in value, and should be used only in combination with the dark leafy green mentioned above.

2. Other vegetables, 40–45% of the diet with a variety weekly: raw green beans, snow and snap peas, squash, sweet potato, okra, bell pepper, mushrooms, and yams. Thawed, frozen mixed vegetables can be used occasionally. Grated carrot should be used only occasionally, as it also contains high levels of oxalates. Vegetables with lower nutritional values include cucumbers, tomatoes, onions, olives, zucchini, and radishes.

3. Alfalfa is a good source of fiber and protein. Alfalfa is available as minibales or pellets for small mammals from pet and feed stores. Read pellet ingredient labels to make sure alfalfa is the first ingredient listed. Do not use mixes that contain seeds and other ingredients. Alfalfa also is available as powder, tablets, or capsules from health food stores. Pellets and powder should be softened by soaking them in water prior to feeding. Be sure to use mature leaves and stems rather than sprouts. If an iguana refuses to eat alfalfa as offered, powder or crushed tablets can be added at low levels to the salad, gradually increasing the amount over several weeks.

4. Fruits should be used only as occasional treats or supplements. Fruits are low in most nutrients including protein and calcium, and have high levels of phosphorus. Fruits dilute the good nutrients found in leafy greens and vegetables. The following may be offered: figs, papaya, melon, apple, peaches, plums, strawberries, banana (with skin), grapes, and kiwi.

5. Vitamin and mineral supplementation is advised. Vitamin and mineral deficiencies are common in iguanas. However, calcium and fat-soluble vitamins (A, D, E, and K) can be oversupplemented as well as undersupplemented. To avoid oversupplementation, natural sources from a varied diet are the best choice, with moderate vitamin/mineral use to balance the diet. To date, no documented studies address specific requirements for any lizard species.

Many commercial supplements are available for reptiles, but none of these products is required to prove potency or safety. Products vary widely in levels of ingredients. Look for a ratio of roughly 100 parts Vitamin A to 10 parts Vitamin D3 to 1 part Vitamin E. Human products with Vitamin D3 (rather than D2) may also be used. For minerals, use powdered calcium carbonate (cuttlebone shavings is one source) or calcium gluconate.

Vitamin powder on top of the salad may make it unpalatable. The powder should be mixed in thoroughly. If you can see the powder, you probably used too much.

An emaciated Green Iguana acquired by the Mid-Michigan Reptile Rescue. *Photograph by Stephanie Beiser.*

Green Iguanas, especially hatchlings, in retail outlets are often anorexic, underweight, and weak. They may weigh less than 10 g and have a sunken abdomen and a bony pelvic girdle. These lizards should be force-fed an appropriate vegetarian diet such as a commercial tube feed mixture for rabbits or a gruel of rabbit pellets, as opposed to a liquid diet for carnivorous dogs and cats, at 1–3% of their body weight every two days. At the same time, the juvenile lizards should be offered a finely chopped diet, as described in the accompanying Table, until they are eating on their own.

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A healthy Exuma Islands Iguana (*Cyclura cychlura figginsi*) enjoys a properly prepared meal. *Photograph by Juliann Sweet.*