The Utila Spiny-Tailed Iguana, *Ctenosaura bakeri*, in its natural habitat and in captivity

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INTRODUCTION

Black Iguanas of the genus *Ctenosaura* are medium to large sized herbivorous lizards from the subfamily Iguaninae. These lizards live in the arid parts of Mexico and Central America. The systematic relationships of Spiny-Tailed Iguanas have been rather obscure for a long period of time. Little knowledge has been added since the revision of the genus by Bailey (BAILEY, 1928). The activities of Gunther Köhler and his co-workers changed that situation dramatically during the last decade, although the picture is still far from complete.
At present 14 species of Black Iguanas are described and arguments have been presented to support the validity of these species. The existence of 12 species is generally accepted (KÖHLER, 1995a). The four largest species (snout-vent-length greater than 350 mm), which are found throughout the total range for Ctenosaurs are *Ctenosaura similis, C. hemilopha, C. acanthura* and *C. pectinata*. Arguments have been raised to unify these species into the subgenus *Ctenosaura* (KÖHLER, 1995b). *C. hemilopha* can be divided into a couple of subspecies that occasionally are considered as genuine species. In this respect the names *C. conspicuosa, C. macrolopha* and *C. nolascensis* may be encountered in the relevant literature (GRISMER, 2002).

Ctenosaura bakeri, adult male in its natural habitat.

The three species living in Guatemala and Honduras can be grouped into the subgenus *Loganiosaura* from the Greek word loganion, which means dewlap. That group is comprised *Ctenosaura palearis, C. bakeri* and *C. oedirhina*. A few years ago a species, *C. melanosterna,* was described that is related to *C. palearis*. This species would also belong to the same subgenus, *Loganiosaura* (BUCKLEY & AXTELL, 1997). The species was described before via this very webzine (BOONMAN, 2000).
The remaining five species of Black Iguanas, which are dispersed throughout the total range, can be grouped into the subgenus *Enyaliosaurus*, a name known from the earliest publications (BAILEY, 1928). The group comprises *Ctenosaura clarki*, *C. quinquecarinata, C. alfredschmidti, C. defensor* and *C. flavidorsalis*. Recently arguments have been provided to consider the Mexican representatives of *C. quinquecarinata* as a separate species. The name *C. oaxacana* was proposed (KÖHLER & HASBUN, 2001).

UTILA

The island of Utila is part of the Republic of Honduras. It is one of the Bay Islands (Islas de la Bahía) situated in the Caribbean Sea, some 40 km from the coast of the mainland. It is the smallest and western-most of the three large islands (Utila, Roatán and Guanaja) measuring only 6x12 km. Together with three smaller islands (Helen, Morat and Barbareta) and 52 rocks (cays or cayos) these make up the outstanding spurs of the Bonacca Ridge, the chain of mountains on the mainland. This chain outstands the Barlett Deep. Almost the entire island is only a few meters above sea level. It consists mainly of corallite. There are some hills at the eastern part of the island, the highest of which, Pumpkin Hill (80 m), is of volcanic origin. At the south side of the hills the only settlement on the island is situated, housing some 1500 inhabitants. Naval facilities and an airstrip are located there as well.

Utila with the settlement and Pumpkin hill in the back.

Utila with the canal seen from the air.

The island has a tropical climate with an average precipitation of about 1800 mm annually and a rainy season lasting from October through January. It lies in the trade winds coming from the east to the Southeast. These winds transport hurricanes every autumn causing considerable damage every ten years on average (JACOBSON, 1992).

The most severe hurricane of the last decades, Hurricane Mitch, passed through the area from October 26-November 4, 1998 and entered the mainland via the Bay Islands. It caused an estimated 11,000 casualties, 6500 of which were in Honduras; a damage of more than five billion dollars is reported, four billion of this being in Honduras (NCDC REPORT, 1999). The infrastructure on Guanaja was largely destroyed and damage on Roatán was considerable. Utila however was spared miraculously. Via the Internet the mayor reported on Monday October 26 at 7:11 PM that only the airstrip was rendered useless due to the huge waves.

A sandy beach, a potential egg laying area.

Everything else was in order and no losses were to be mourned. Damage to nature was very limited (HONDURAS.COM, 1998).
The relatively abundant precipitation leads to a wealth of vegetation on Utila. Without a doubt the most prominent vegetation is the mangrove. Although it is not completely clear how many mangrove forests exist (the larger part of the island, west of the canal that separates the island from north to south in two parts, is hardly mapped), several areas can be located from the air. Mangrove forests cover the majority of the coastline and the shores of the numerous bays, lagoons and the canal. However, it is not clear how broad these areas are. Sandy beaches are restricted to only a limited number of places. There are no mangrove forests in those areas; classical tropical beach vegetation predominates, consisting of coconut trees and thick leafy, salt tolerant brushwood. The more elevated parts of the island are covered with other thick forests, which originally possess the characteristics of a tropical rain forest. At present however these mainly consist of (semi-) cultivated plants.
In the direct vicinity of the human settlement, banana and other plantations are located together with pastures for cattle. It is not clear what the vegetation is on the internal part of the west end of the island. People call it savannah and indeed from the air the resemblance is striking. Paved roads are only to be found close to the village although their number is growing continuously. The only other infrastructure consists of some unpaved tracks and ruts. The vast majority of the island is hardly accessible.
Three large vegetarian iguanas are living on Utila: the Green Iguana (*Iguana iguana*), the common Black Iguana (*Ctenosaura similis*) and the endemic Black Iguana from Utila (*Ctenosaura bakeri*). The former two species are described elsewhere (BOONMAN & VAN DEN HEUVEL, 1997a). This article deals with *Ctenosaura bakeri* and is a summary and an extension of data that have been published before (BOONMAN & VAN DEN HEUVEL, 1997b).

CTENOSAURA BAKERI IN THE WILD

Habitat and activity

Adult *C. bakeri*, high up in a mangrove tree.

On the swampy floor of the mangrove forest juvenile *C. bakeri* are difficult to spot.

The most remarkable aspect of the habitat of *Ctenosaura bakeri* is the fact that it differs from that of all other species of Spiny-Tailed Iguanas. Ctenosaurs usually can be found in dry, hot sun-exposed areas, while *C. bakeri* lives in mangrove forests. Of course they frequently take the opportunity to bask in the sun, but they also can be found much lower in the forest or even on the ground. In the shady regions of the forest the maximal air temperature is about 30°C during daytime and drops down to a minimum of 25°C at night. The average relative humidity is 85-95%. The forest floor is often explicitly wet and a human being can easily sink in the mud up to their knees or even further. As is frequently encountered with arboreal iguanas, the older specimens usually live in the higher regions of the trees whereas youngsters can be found on or close to the floor (VAN DEN HEUVEL & LEENDERS, 1998). In the mangrove forest, areas with old hollow tree trunks are favoured. Up to 50 adults per acre can live there (Alexander Gutsche in SCHUTZPROJECT UTILA-

Mating within the borders of Utila village.

LEGUAN, 2001). The holes in those old trees are defended by animals of both sexes and all ages; the animals are very much stay-at-home. The home range from a living tree is about 30 m.

Although the mangrove forest is the usual habitat of *C. bakeri* the animals can be found in other places as well, even outside the mating season. I encountered the animals in between the buildings of Utila village without any notable shyness. It turned out to be possible to observe a mating from a short distance. In contrast to *C. similis,* I never envisaged the animals in cultural areas. *C. similis* is not found in mangrove forests making the overlap between the areas of the two species of Spiny-Tailed Iguanas very limited. *C. similis* might be restricted to the inhabited regions - both species are some kind of opportunists - and possibly the beach areas. Nevertheless a natural hybridisation between the two species has been reported although it is not clear whether the offspring is fertile (KÖHLER & BLINN, 2000).

The floor of mangrove forests does not provide a suitable substrate for animals that need to burrow their eggs for hatching. Its moisture content is much too high to guarantee a successful breeding. The species has adapted to this unfavourable situation. When the time comes gravid females migrate to the sandy beaches or to nearby areas where the structure of the soil is much better for laying eggs. As far as possible they travel in a straight line, although it is not known how orientation occurs (KUTTLER, 2000). Only a limited number of beach areas are available for egg deposition (the greater part of the coastline consists of coral rocks and some additional mangrove). Therefore sometimes a number of females are busy laying eggs at the same piece of beach simultaneously. Whether they hinder each other as reports on Green Iguanas suggest (RAND & DUGAN, 1983), is not known. A joint use of nesting systems by Black and Green Iguanas was reported from Costa Rica (MORA, 1987) but was not seen here. Apparently there is enough room for these individual animals, although the total area of sandy beaches does not seem to be terribly large.

Suitable egg laying areas are characterised by a soil consisting of loosely packed sand and by the presence of palm trees or their remnants wherein gravid females like to bask during periods of rest between episodes of digging and egg laying or while in the midst of it. The nests consist of simple tunnel structures of a modest size, usually ending underneath a plant or stone. Eggs are deposited during the dry season beginning at the end of March

and continuing through June. Assuming an incubation period of three months, a usual pattern for iguanas, hatching will take place between June and September, before or at the start of the rainy season. The various stages of the reproductive cycle seem to be less sharply separated compared to other iguanas. Clutches contain 5-15 eggs measuring approximately 18x33 mm (KÖHLER, 1995c). After egg deposition females immediately return to the mangrove forest (sometimes more than 1 km away).
Because of its unusual habitat, which contains vegetation of only limited variation, *C. bakeri* primarily thrives on the leaves of mangrove trees (*Laguncularia racemosa* and *Rhizophora mangle*). Crabs, present in abundance, and insects are also consumed (VAN DEN HEUVEL & LEENDERS, 1998). Drinkable surface water is not available although raindrops are licked up occasionally. Whether the animals have adapted to high salt consumption is not known, however, experiences in captivity did not show any prerequisite in this respect (see below).

Female in dead palm tree on the egg-laying beach.

Gravid female, vulnerable on a palm trunk.

Threat

A limited number of predators prey on *Ctenosaura bakeri*. Without a doubt adults are ambushed occasionally by *Boa constrictor*, a Turkey Vulture (*Cathartes aura*), or another carnivorous bird. The threat to juveniles additionally comes from other birds and reptiles, notably large specimens of *Basiliscus vittatus*.
However, like many other iguanas, the threat to the Spiny-Tailed Iguana from Utila comes from the local people who used to consume the animals as food. For that very reason the Green Iguana has become scarce on the island. It is remarkable that *Ctenosaura similis* is not in danger. Obviously it is not very highly rated in the local cuisine.
Because of its peculiar, inaccessible habitat, one would expect *C. bakeri* to be sufficiently well protected for hunting by humans to not have very dramatic consequences. Few animals are captured in the mangrove forests. However, during the breeding seasons the animals are rather vulnerable as they move to the beach areas where they come into direct contact with the hunters. If only females were the victims it would be a disaster in itself but when gravid females are involved, a complete generation may be destroyed. The dramatic consequences to the population are beyond discussion. How serious the situation was, is demonstrated by the observations of Gunther Köhler in the first years of his study in Utila (KÖHLER, 1995a). He

only encountered females that laid eggs for the first or second year; older females were not present on the beach. In the mangrove forests he found many more males than females.
The conservation project that is described in the sections to come did alleviate the pressure on the population that was caused by hunting activities. In 2000 the number of animals had increased up to 10,000, the number of females had grown considerably as well (KUTTLER, 2000). However a new threat appeared in the last couple of years. For many years tourism has offered some kind of income to the people of Utila. Notably low-budget travellers interested in diving near the coral reefs have found their way to the island.

Activities in the mangrove forest.

Photo: W. van den Heuvel

The scale of activities used to be rather moderate, the capacities of airstrip and port limited and only a few beds for visitors. Recently over-active travel agencies have discovered the possibilities of the island, especially for the wealthy mainlanders, and various accommodations are being erected at a high pace, the one even more luxurious than the next. Since those lodgings must be accessible, the construction of roads is an inevitable consequence. If all these activities would take place in cultivated areas the damage would have been more or less limited, but as could be expected, the most beautiful spots on the island are the places of choice for constructing hotels: the coastal areas with mangrove swamps and sandy beaches, exactly the areas where *C. bakeri* lives. On top of this, probably because the Hurricane Mitch donations had to be spent, developers have reclaimed an oversized area to construct an international airport with direct connections to the US. Hopefully developments will reach their limit soon, as otherwise things will irreversibly go wrong and not just as concerns *C. bakeri*.

CONSERVATION PROJECT

Hunting

Already during the first years of research it became clear that actions would be necessary to prevent the Utila Iguana from extinction. As early as 1994, when the total number of animals was estimated to be not more than a few hundred – the total global population – a conservation project was started (SENCKENBERG, 2000). Initially the project was aimed at actual prevention of hunting the animals. Volunteers, mostly from Europe, in co-operation with the Bay Island Conservation Association (BICA) took actions to make the people aware of the situation. The presentations in schools were an especially interesting and probably successful part of the whole project. Those who were involved in the conservation

project made the authorities proclaim a ban on hunting the iguanas. With such a decision in hand the next step of the project could be commenced with more arguments. During the egg-laying season (and later, all year round) volunteers are busy on the island performing research or other activities. The presence of these observers has diminished the hunting of these lizards in the last few years, especially during the egg-laying season. Originally the volunteers were housed in hotels and comparable facilities, but since 1998 the Iguana Research and Breeding Station has been available, a two story high wooden building on a concrete basement in the settlement of Utila.

The author gives a presentation on one of the schools.

Photo: W. van den Heuvel

Breeding locally

As its name indicates the Research and Breeding Station is used for all kinds of scientific research and for breeding iguanas in semi-captivity. It is necessary to pay attention to this aspect of conservation since it is risky to become dependent solely on management measurements in a governmentally labile society. The basis of this by now essential part of the project is the following strategy: as many gravid females are collected as possible. These are transported to special cages on the station where they can lay their eggs in an undisturbed setting. The “empty” females, of less value for the poachers, are returned immediately to the places where they have been caught. These lizards returned shortly thereafter to the mangrove forests. Eggs are bred artificially under controlled conditions as described elsewhere (KUTTLER, 2000). In order to maintain the population structure as close to natural as possible, half of the hatchlings are reintroduced immediately after birth. The other half is raised in the station for one year and released afterwards.

In the first year (1998) four females produced 28 eggs, 26 of which hatched under rather primitive conditions (due to regular electricity failures). According to plans 13 hatchlings were released at once, the remainder was kept in captivity for another year. For that purpose a number of outdoor enclosures were used. They were hexagonal, 350 cm in diameter, 300 cm high and made of wood and wire netting.
Unfortunately these cages turned out to be very vulnerable to ants, which caused a lot of damage. Therefore no reliable results for 1999 are available. In 2000 the enclosures were made ant-proof and consequently the results were impressive: 21 females produced 233 eggs, 189 of them were bred (the remainder were damaged, partially because of the females hindering each other and uncovered or detroyed each others eggs). There were 126 hatchlings and 63 were released immediately (SCHUTZPROJECT, 2001). The remaining ones were raised in captivity for a year and then released. At first sight all the released animals behave in a comparable fashion as their wild couterparts. Definite evaluation will follow in due time.

Breeding elsewhere

In order to create a genetic reserve for cases of emergency (hurricanes that come through or something like that) a subproject was started for studying *C. bakeri* in captivity outside its own region. An additional aim of this side road of the project was to gather more knowledge of the animals and to investigate the possibilities of reintroduction.

Blue coloured adult male of *C. bakeri*.

In that respect in 1999 five clutches were bred containing a total of 62 eggs (mostly in the Frankfurt Zoo). From that group 54 animals hatched. After being cured under the highest possible hygienic conditions, 43 animals were transported back to Utila. Transportation of these animals occurred without any problem or casualty, as did their raising in special cages on the spot. As a result in July and August of 2000 a total of 33 animals, measuring 11-13 cm in snout-vent-length, were released in the mangrove forest. The remaining 10 stayed at the station for scientific and educational purposes. At first sight the introduced animals do not differ from the “wild“ ones or the ones that have been raised in captivity on the spot. Of course it is too early for definite conclusions.

Other conservation activities

In addition to the activities directly focused on the animals, campaigns aimed at providing information and creating awareness are being continued, and directed at tourists as well. Recent activities are primarily focused on the direct pressure laid on the habitat of the Utila Iguana by developers and by the construction of the large airport. Therefore negotiations are being conducted with local and national authorities continuously with the ultimate goal to create a National Park Utila. In order to have a reasonable chance of success the plan is embedded in a development plan for the island as a whole. A broad approach like this makes great demands on many people but is inevitable for the future.

Latest news (From: PEDERSEN, 2002):

On the positive side:

- Right now there is a rather progressive, receptive, and dare I say "honest" administration in charge, not all perfect, but way above the rest that has been in there;
- There is an up and coming generation of better educated, local adults who are now concerned for their children's future on the island.
- Basic problems are actually being addressed: Littering, waste management, delinquency, power, water...
- There is a very comprehensive Management Plan being phased in for an island marine protected area and wildlife refuge.

...and unfortunately...

- There is a foreign owned resort/development group on the island that, despite significant local opposition, has fangled their way to getting government approval to begin dredging a huge canal into the island's national wetlands. It is now being dredged past the lower lagoon and will chiefly support their aggressive real estate endeavours at Little Bight, and a half-mile or so in either direction. The benefit to the island.... none as far as I can see;
- The reefs and dive sites have been picked clean of virtually every conch and lobster, plus who knows what else;
- Several tourists have recently been slashed by a knife wielding local crackhead, just to name the most recent incident (this individual is now in jail in Roatán);
- The arrival and popularity of highly addictive drugs and the resulting crime wave;
- Another foreigner has formed a committee to promote his plans to make Utila into a cruise ship haven in theme park style with a mini zoo, Mayan village style shopping centre, etc., taking cruisers around on "trams!"

CTENOSAURA BAKERI IN CAPTIVITY

Description of the animals

Adult male, the progenitor of the off-spring at the author's.

In 2000 I obtained a couple of animals that were present in Europe and did not have a direct function in the project. The rationale behind this move was spreading the risks of breeding on only a few locations and, in addition, gathering as much as information on the animals as possible. The following creatures are involved: An adult couple, caught in the wild and at least six years of age (captured in 1996 and at least 2 years of age at that time), and an semi-adult female,

Adult female *C. bakeri* in the vivarium.

hatched in 1998 in the Research Station in Utila. In 2000, two additional animals came in that were born in the Frankfurt Zoo that same year. The older couple had already produced many offspring and the two captive-bred animals are grandchildren of the adult male but not related to either of the two females.

Upon arrival the adult male measured 52 cm in total length, was missing the tip of the tail and measured 25 cm in snout-vent-length. It weighed 702 grams. The animal possesses the usual masculine characteristics: relatively high dorsal crest and explicit markings. In the head region a prominent white coloration is present. Until now a change in colour had never been observed (blue sometimes occurs). At the under side of the lower jaw an extending bony ridge is present. It is said to be a characteristic of elderly representatives of the subgenus *Loganiosaura* (pers. comm. Köhler). At the moment of writing the animal is at least eight years old and still alive and kicking.

The two females don't show any special features, they are uniformly brown in colour and markings are few. Upon arrival they were 51 and 42.5 cm in total length, and 21 and 16 cm snout-vent-length, respectively. The smaller female weighed 150 gram and the larger one 316 gram. The latter was fully gravid at that time. The two captive-bred animals that arrived later were rather dull brown in colour, without any markings or other special characteristics. They were both some 16 cm in total length and some six cm in snout-vent-length. They weighed about six grams.

Adult female in a shelter place.

Housing, feeding and behavior

From the beginning the three adult animals were housed in an in-house enclosure of 300x200x250 cm (lxbxh) as described before (BOONMAN, 2000). Additional elements in the furniture are hollow trunk mimics created by cork pipes and stably piled rocks. These all provide extra hiding places. For reasons of hygiene the floor is not covered with a thick layer of moist substrate as was recommended by KÖHLER (1998a). To bring the relative humidity to a higher level a number of flat bowls filled with water are placed on the floor. Water is sprinkled daily. Lighting, consisting of spot type incandescent lamps, a halogen broad beam radiator and an Ultra-Vitalux lamp (300 W, which produces UV-light as well) are left on for 13 hours a day. Supplementary heat comes from an oil-filled, electrically heated radiator. By this system a maximal air temperature of 30-33°C is maintained. Night temperature is supposed to stay well above 22°C. The animals can approach the UV-lamps (halogen radiator and Ultra-Vitalux) up to 50 cm.

Initially the captive-bred animals were housed in an 80x50x50 cm vivarium. The floor of this housing was covered with a substrate consisting of a mixture of soil and peat-mould that was kept moist. Temperature and lighting conditions were comparable to the larger enclosure. Only the size was diminished with a low-tension halogen lamp and a ZooMed UV-lamp (60W). Climbing- and hiding facilities were abundantly available.
Basically the animals are fed a strictly vegetarian diet consisting of leafy vegetables selected on the basis of a favourable calcium:phosphate ratio (2:1 or higher) and on nutritional value (energy content). Occasionally the animals get sea banquet (crustaceans and shellfish), that is consumed with gusto. Grasshoppers are eagerly accepted too, again an indication that Spiny-Tailed Iguanas are more adapted to hunting than Green Iguanas. Although they probably are well suited to cope with protein-rich nutrition without the risk of kidney diseases, as is the case with Green Iguanas, I limit the amount of protein from animal sources even for them. It is quite remarkable that the animals strongly favour crispy food. Vegetables that have wilted will be refused. This might be caused by their habit of consuming rather tough (mangrove) leaves. In contrast to for instance, *C. melanosterna*, flowers of dandelion (*Taraxacum officinale*) or rape-seed (*Brassica napus*) offer no special attraction for *C. bakeri*. Extra salt is never provided and I have had no indication of any shortage, for example, by constant licking of stones or rocks.
Although individual differences exist, the animals are generally not very shy and are rather attentive. Shyness is lessened when the animals are treated “at their own level”. This expression means that animals in a large enclosure that are approached at their own level will behave in a much less disturbed manner compared to animals in vivaria in the living room, where people more or less appear to fly over them. Human beings are seen as a predator in that case. The situation in nature is quite similar (VAN DEN HEUVEL & LEENDERS, 1998).

Semi-adult female basking.

The interrelationship between animals is remarkable for how much is in harmony. One might expect Black Iguanas to be notably territorial and by times aggressive. My animals do not show this at all. The adult male doesn’t do anything in this respect and only the two females have a tiff once in a while without any negative consequence. Those troubles are always related to basking or sleeping sites. Every animal is strong on its own place and, possibly because of the large housing that is available to the animals, these individual places are distant enough from each other to maintain a stable situation. The balance is disturbed when some change in the furnishing is carried out, when a new animal is introduced (the captive-bred animals) or under the influence of the hormonal cycle. In all cases the disturbance causes minor skirmishes, however without any serious consequences to this point and with only the two adult females being involved. The introduction of new animals did not result in any reaction towards the youngsters although they were much smaller. The only change was that the available space was redistributed. In cases when animals do come too close to each other (like fast-growing hatchlings) serious consequence might occur as will be illustrated below.
Daily patterns are definitely iguana-like. For example, going immediately for the heat at first light until the preferred body temperature is reached and then trying to keep that steady by going into the shade at regular times. As well, they eat frequently. Hiding places in hollow trunks and between piled rocks are much favoured, especially for sleeping. The animals are fairly active during the daytime; at least they show up regularly. Only gravid females lead a very hidden existence and sometimes do not leave their shelter for days, completely in accordance with nature (KUTTLER, 2000). Towards the end of their pregnancy the animals grow less shy and stay almost continuously basking under a lamp. They can then be easily approached. This behaviour is in agreement with my observations that females

on the beaches using palm trunks for basking can be quite closely approached or can even be caught by hand.
I never noticed *C. bakeri* having a lower temperature preference compared to other iguanas (*Iguana iguana, C. similis, C. pectinata* or *C. melanosterna*). Living in mangrove swamps with possibly somewhat lower temperatures than the open, dry areas where other Black Iguanas live might lead to such an expectation. However Utila Iguanas seem to have much sharper temperature preferences compared to other iguanas. Activity diminishes considerably when temperatures drop a little. The maximal air temperature must not drop below 30°C for more than a few days as it will lead to a marked decrease in their eating patterns.

Propagation

Immediately after arrival an egg-laying box was offered to the gravid female, according to the proven principle: a simple wooden box with a lid measuring 20x20x10 cm (lxbxh) and a bamboo tube 50 cm long and 8 cm in diameter fitted to a hole in one of the sides. Normal soil was used as a substrate. It was kept moderately wet. Temperature was maintained at 30°C by means of a heating cable. The animal accepted the box immediately (as shown by its inspecting and digging) although the entrance tube turned out to not be critical.

Eggs in the egg laying box.

After five days (3 June 2000) eight eggs were laid without any problem, five of them nicely together, burrowed in the substrate. Together these five eggs weighed 46 gram (hence 9.2 gram as an average) and measured 38x20 mm as an average. Herewith these eggs were considerably larger than the ones described by Köhler (7,66 gram and 34.6x19.4 mm respectively) (KÖHLER, 1998). Probably the animal kept the eggs internally somewhat longer as it was lacking a suitable place to lay them due to the move. Therefore the eggs developed for a longer period than is the norm.
The other three eggs weren't burrowed: one laid on top of the box, a second one in the entrance tube and a third one laid completely outside the box and had already fallen in a little. The three loose eggs weighed together an additional 21 gram. All together the eggs weighed 67 gram, corresponding to more than 21% of the body weight of the female. That is considerably less that the 40% that sometimes occurs with Green Iguanas (KÖHLER, 1998b). This fact is in accordance with the observation that the female kept on eating up to the end of the pregnancy albeit a rather limited diet. Obviously the impact on the mother is somewhat less than that of Green Iguanas.
All eggs, except the one that already was somewhat desiccated, appeared to be fertilised (embryonic disk) and looked very firm. The two groups (five vs. three) were maintained and the eggs were incubated as such in coco peat at a maximal relative air humidity (Mary's bath) of 30°C.
Two eggs out of the group of three that had not been laid according to the rules wrinkled soon after and from the group of five, three more did the same. Within a month only three eggs were left. Because they were extremely swollen and had grown very big, it might be reasonable to think that the method of breeding was not optimal. High air humidity combined with a strongly absorbing substrate might have been the reason that the eggs absorbed too much water, with fatal consequences for the embryos. Fresh, dry substrate (again coco peat), to which the three remaining eggs were transferred, was hardly of any use. One other egg was tainted. Out of one of the two remaining eggs, from the group of five, a youngster hatched after 91 days of incubation. It did not show any infirmity. However it was considerably smaller and lighter than Köhler reported (KÖHLER, 1998a): 14 cm long (versus 15-16 cm), snout-vent-length 5 cm (versus 6,6-5,9 cm) and 4 gram by weight

(versus approx. 7 gram). The little animal was put in a housing for captive-bred animals as described before. The other remaining egg, from the series of three, contained ultimately a fully-grown but dead animal, again an indication of overly high humidity. July 16, 2000 (hence one and a half months after the first oviposition) four eggs were found, rather small ones, randomly distributed in the enclosure and already noticeably desiccated. No sign of fertilisation could be observed even after internal inspection. Although no signal had been given the speculation was that the smaller female is involved. Considering her age of hardly two years it was probably the first time that she produced eggs. These eggs were not incubated.

Hatchling, a few days old, sleeping.

April 22, 2001 the smaller female produced more eggs, eight this time, which were again randomly distributed in the housing. As occurred previously, the eggs dried out rapidly so that incubation was useless, and there was no sign of fertilisation.

May 12, 2001 the larger female produced eggs, in a manner identical to her roommate: eight eggs, distributed throughout the enclosure. The overall result was similar. Because embryonic disks were visible, breeding was attempted, this time in the much less hygroscopic substrate of river sand, but the eggs were spoiled within a few days.

The egg-laying box that was present all-year round was no longer accepted, in contrast to the first time, it was removed after the 2001 egg laying and put back again in 2002 when some mating activity could be observed. The problem is that real mating was never observed. In addition, because the number of eggs is not that high, they are not easily visible in the female's body. If changes in behaviour are also not too obvious, only the time of year remains as an indication of impending egg-laying. In any case it is clear that *C. bakeri* has a one-year propagation cycle and unlike *C. melanosterna* (BOONMAN, 2000) in captivity, a half-year rhythm. Ultimately both females produced eggs in 2002, again in the months April and May and again outside the laying box. The distribution was extremely high this time, in all thinkable corners and holes, on the most unexpected moments and at infrequent intervals. It was therefore not even clear how many there were.

Raising the hatchlings

After some months two captive-bred animals from the Frankfurt Zoo joined my original captive-bred animal. Although these two animals were a little larger than my own captive-bred animal, housing these three together did not seem to be prohibitive. At the start there were no problems. All the animals took the normal diet of the older ones easily. Gradually two of the animals disappeared out of sight. The third animal (one of the lizards from Frankfurt) grew more quickly and began to behave rudely towards the others. This phenomenon became so severe that the two other animals did not show themselves any longer. I took action too late and the second animal from Frankfurt died during a fight. In order to prevent further casualties the larger of the two remaining animals was transferred to the large enclosure at the end of October 2001. By that time it was a little more than a year of age and measured 31 cm in total length, 12 cm in snout-vent-length and 80 gram by weight. My own captive-bred animal, staying undisturbed, needed an additional half a year to make up his arrears before it was transferred to the parental enclosure in June 2002. It was almost two years old and measured 35 cm in total length, 14 cm in snout-vent-length, and weighed 100 gram.

Although both animals were much smaller than the older ones upon moving, introduction into the group never resulted in a problem. Only the fixed habits of the animals changed a little (changing of hiding and basking places). Never any aggressive behaviour was seen.

Conclusions and discussion

No special precautions deviating from other Spiny-Tailed Iguanas are required in order to keep *Ctenosaura bakeri* in captivity. Although their habitat is different, their demands related to temperature, humidity and salt are as usual. Although the breeding successes obtained up to now are not too good, these probably primarily are due to a not optimal breeding system. The quality of the eggs might also not have been optimal. These iguanas might require more protein than others. Based on the careful choice of vegetables that are provided and the constantly high level of UV-radiation it is quite unlikely that these problems are related to a calcium deficiency. Utila Iguanas are somewhat demanding in their daily needs, only fresh, crispy leaves are consumed and temperature must be kept high (air temperature over 30°C at daytime). Refusing to accept the egg-laying box might be related to the bad quality of the eggs. It is known from Green Iguanas that they simply throw their eggs away when the quality is not good and that they will look for a laying place only when the eggs meet some internal standard (KÖHLER, 1998b).

Captive bred animal, almost two years old.

Synchronisation of the breeding system of Utila Iguanas with the rainy season is comparable with other iguanas although apparently a little less stringent. Clearly all kinds of propagation activities take place outside the actual prescribed periods. Possibly *C. bakeri* is less dependent on the season for its feed: mangrove leaves and crabs are available all year round in a constant quantity.

Social relationships seem to be a little different compared to other iguanas, though the number of observations might be too low. If the space is large enough territorial behaviour and aggression will stay within limits. Adult females during some periods of their cycle are likely to behave a little rudely, especially towards other females. If disorders occur due to too little room, severe consequences might occur.

C. bakeri is extremely consistent in its habits and nothing is changed unless the environment forces it to, either by the furnishing or by other animals. Changes will be implemented smoothly and are soon fixed.

As indicated before (BOONMAN, 2000) a breeding system consisting of a large heated water basin combined with a strongly absorbing substrate will lead to an overly high humidity. Eggs often will absorb too much water and embryos will die. Therefore this species of Black Iguana requires a much drier breeding system.

SUMMARY

- *Ctenosaura bakeri* continues to be a threatened species in nature. Thanks to various conservation measurements the population on Utila has grown in the last couple of years, but new threats are pending, primarily those related to tourism.
- In nature as well as in captivity *C. bakeri* is not extremely shy, but rather attentive.

- In captivity the animals are remarkably tolerant towards each other, provided that there is enough room for them.
- Animals are able to lay eggs at the age of two, whether they are really mature at that time is not known.
- In captivity as well as in nature *C. bakeri* produces one clutch of 5-15 eggs per year.
- In nature mating season is synchronised with the rainy season, probably a little less well fixed compared to other iguanas.
- For unknown reasons the egg laying box was no longer accepted after one year of use.
- In three subsequent years eggs have been produced by both females in this study in the following numbers:

Year	Female 1 (older one)	Female 2 (younger one)
2000	8	4
2001	8	8
2002	Approx. 8	Approx. 8

- Due to an overly high humidity in the breeding system and possibly due to the lack of quality of the eggs only one hatchling has been born so far.

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