

INTERIM REPORT ON THE MARINE IGUANA SITUATION IN THE AFTERMATH OF THE 1982-3 EL NIÑO

by

Andrew Laurie

Department of Zoology, University of Cambridge, Downing Street, Cambridge CB2 3EJ

Dr. Laurie has been studying the population dynamics of the Marine Iguana since 1980, as reported in Noticias 35-39. His original three-year research programme, supported by the Leverhulme Trust and The Royal Society was disrupted by the unprecedented severity of the 1982-83 El Niño phenomenon which drastically reduced the various iguana populations scattered across the archipelago (see Noticias 38). His research project was extended for a fourth year to permit him to study the effects of the cataclysm and his interim observations are summed up in this report. He is returning to Galapagos for a fifth year, this time funded by the Max Planck Institute at Seewiesen, in order to follow up further developments in the breeding of this unique Galapagos lizard. The fact that he was already studying the animal under normal conditions puts him in a particularly strong position to assess the changes due to this climatic catastrophe and emphasises the advantages of long-term research.

The sea level and sea-surface temperatures in Galapagos had returned to the normal range for the time of year by September 1983, and the dense mat of *Giffordia* algae had begun to disappear by early November and was almost completely gone by December. The response of the marine iguanas was almost immediate. There was no more than normal mortality after August 1983 and the adults had returned to an average of ten per cent below their pre-El Niño weights by November. Overall mortality over the previous 12 months was estimated at 65% on Santa Fe, with the 1982 hatchlings suffering the highest mortality (90%). On other islands the overall mortality rate varied from 45% to 70% and was lowest of all at Caleta Webb, Isabela. It appears to have depended to some extent on the relative importance at each site of sub-tidal and inter-tidal feeding, with the sub-tidal feeders generally surviving better than the inter-tidal feeders. Higher sea levels made inter-tidal feeding relatively more difficult than sub-tidal feeding, and the invading indigestible algae were more abundant in the inter-tidal zone.

At our control station, on Santa Fe island, where there are no complications due to introduced predators, David Harris and I prepared to watch the iguanas as usual through the breeding season, but it very soon became apparent that the course of events was going to be very different from normal. There were only 25% of the normal number of territorial males, despite large numbers of non-territorial males nearby, and each territorial male defended a larger territory than normal but gained access to about the usual number of females. Many of the previous years' territorial males had died during El Niño but, in the main colony, the most successful male from the 1981-1982 season returned to his former, prime, territory after spending the 1982-1983 season as a bachelor male, and seven of the males from inferior territories returned for the third consecutive season to the same territories.

Territorial defence was less intense than normal, with fewer extended fights; but the main difference was in the reactions of the females, who consistently avoided the males' approaches. Not a single copulation was observed although almost continual surveillance of the main colony was maintained during daylight hours. In each of the two previous years about 60 copulations were observed within a much shorter time. In the 1981-82 and 1982-83 seasons the males finished mating by early January, but in the 1983-84 season territorial defence continued right through until early March, with the difference that the territory holders fed more frequently and lost significantly less weight than in a normal year.

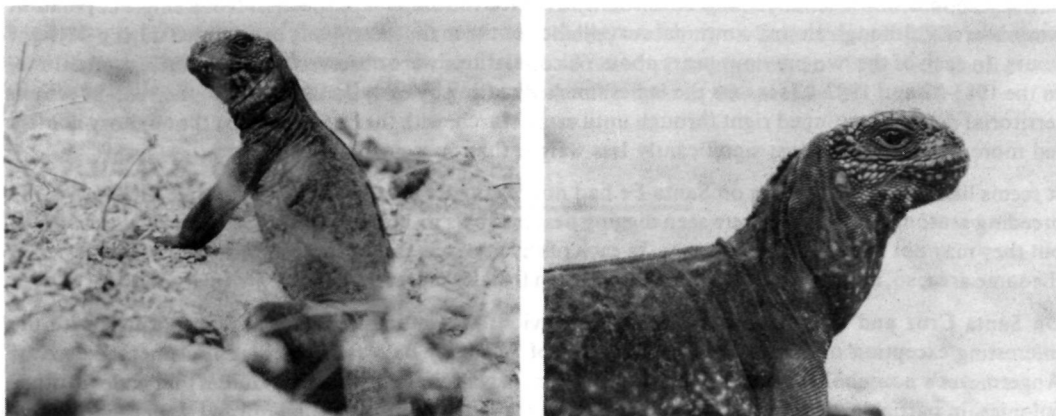
It seems likely that the females on Santa Fe had not regained breeding condition in time for the 1983-84 breeding season. Ten females were seen digging nest burrows in January, which is the normal time for it, but they may not have actually laid eggs. In each of the previous three years about 1,800 females nested in the same area, so, allowing for 65% mortality, the ten females represent only 1.7% of a normal year's total.

On Santa Cruz and Caamaño the territorial behaviour was much less intense than normal, with the interesting exception of a colony on the west side of Academy Bay whose diet is supplemented by Karl Angermeyer's household scraps. I received reports from National Park Tourist Guides that males in other colonies, in particular the one at Punta Espinosa, were much less active than normal. Later, hardly any nesting took place at Punta Espinosa, and elsewhere on Fernandina the amount of nesting was

considerably below normal, taking into account the depletion of the population. There was no appreciable nesting at James Bay, but at Cabo Berkeley extensive nesting had already finished when we visited the area in mid-March, and at Caleta Webb normal nesting was in progress. On islands such as Santa Fe and Fernandina where nesting is normally early (completed in February) the females, still under their pre-El Niño weights at the start of the mating season, failed to breed; whereas on islands such as Española and Isabela, where breeding is normally late (nesting completed by late March or early April), they had presumably recovered breeding condition, and nested normally. On islands such as Santa Cruz, North Seymour and Caamaño, where the time of the nesting season is intermediate (completed by early to mid-March) there was less nesting than in a normal year but considerably more than on Santa Fe and Fernandina. However, it appeared that at Punta Nuñez and on Caamaño many females were digging nests but not laying eggs. One female who died while excavating her burrow was found not to be carrying eggs, and hand examination of other digging females suggested that they were egg-less. Subsequent excavation of some nest burrows failed to uncover any eggs, and a large number were left unfinished. Some females undoubtedly did lay eggs, and hatchlings have already been reported from Academy Bay and North Seymour by various helpful informants. Interestingly, no hatchlings have been recorded from Fernandina or Santiago but some have been seen on Española.

Back in Britain experiments have been carried out in Colin Orpin's laboratory at the Institute of Animal Physiology, Babraham, to compare the digestibilities of samples of algae collected during and after El Niño. As it was impossible to use the digestive fluids of marine iguanas the experiments were done with artificial saliva and sheep rumen fluid so that at least a comparison could be made between the different species of algae. The main, and very striking difference which emerged was in the organic matter digestibility of *Giffordia* (21% in November 1983) compared with the other species, all of which were over 50% and several of them over 70%. The reason for this difference is not known and further analyses are planned. Veterinary examination by John Cooper, at the Royal College of Surgeons, of marine iguanas which died during and after El Niño show that apart from being generally much fatter with expanded digestive tracts, those which died after El Niño had accumulated considerable fat deposits in their livers.

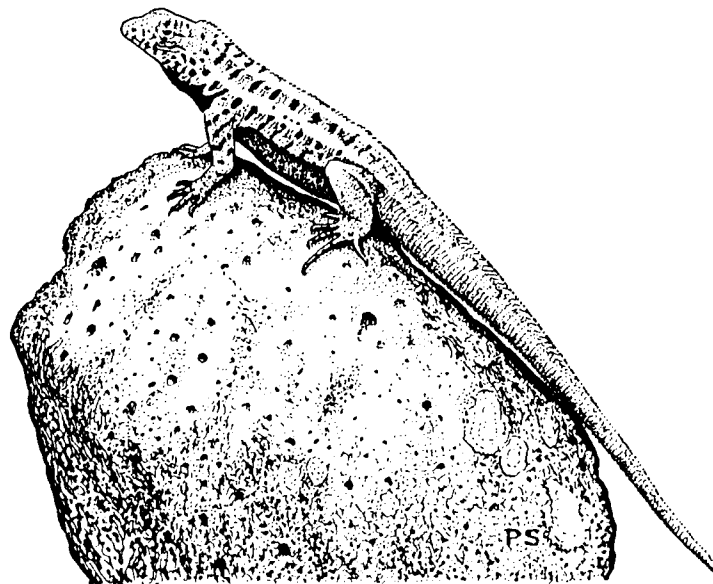
The original aims of the project have been frustrated to some extent by El Niño; very unusual growth and survival rates have been recorded and many of the marked individuals whose reproductive histories were being followed died last year. However, the importance of El Niño in population regulation has emerged, and useful comparisons can be made between the 'normal' year (1981-82) before El Niño and the very exceptional El Niño year (the last El Niño of comparable severity is thought to have been that of 1877-78). Recovery of the population from such heavy mortality in a species with such a low reproductive rate would be expected to take a long time. Using growth rates and reproductive rates recorded on Santa Fé in 1981-82, calculations indicate that the population would take well over one hundred years to return to its 1982 size. However, there are already indications that the reduced population density, possibly through reduced competition for food, has led to increased growth and survival rates and will bring forward the age of sexual maturity. For example, the 1981 hatchlings grew an average of 40mm in their first year and increased an average of 81gms in weight compared with 46mm and 132gms for the 1983 hatchlings.



A baby Marine Iguana emerging for the first time from the burrow where it hatched — a rare sight in 1983, a year when so few were born. Body length about 10 cm, tail 15 cm, weight about 60 grams.

The effects of El Niño on the 1983-84 breeding season were considerable and to complete the study another season of fieldwork is planned for 1984-85. Observations on Santa Fe may provide the first unequivocal data on female sexual maturity, as next season is likely to be the first in which the marked 1981 hatchlings nest. Other islands will be checked for the presence of 1984 hatchlings, the 1985 nesting season will be monitored, and data will be collected on clutch size and egg weights in an attempt to answer the question why large females such as those on Isabela do not appear to lay considerably larger clutches of eggs (as would be expected from energetic considerations) than the smaller females on other islands. It is also hoped to collect data on nest-burrow temperatures and humidity on various islands. There is not, as is stated in the literature, a clear trend from west to east in onset of breeding season: Santa Fé has the earliest season, followed by Fernandina; and southern Isabela and Española have the latest seasons. The fact that the females on early-breeding islands did not breed later this year after recovering their pre-El Niño weights implies that there is a cut-off date after which females refuse to mate. It is possible, but by no means clear exactly how, that differences in incubation conditions between islands might account for differences in timing of breeding seasons. If any readers have any thoughts on the matter, or any other iguanine matter, I would appreciate hearing from them.

I am very grateful to all those, too numerous to mention by name here, who have helped in the past by sending me notes of their observations in the islands and in particular to Teresa Kineke for collecting her and others' observations together and sending me regular bulletins.



Male Lava Lizard
Drawing by Peter Scott