Volume 6, Number 1 Winter 1986

BOSTID DEVELOPMENTS

Board on Science and Technology for International Development

Office of International Affairs / National Research Council

NEWS IN BRIEF

John Gibbons

BOSTID MEMBER JOHN GIBBONS HONORED

The Tennessee Technology Foundation has honored John Gibbons among 14 outstanding scientists and engineers with ties to the state. The ceremonies, held in Knoxville, are part of Tennessee's Homecoming '86, a statewide program designed to encourage former residents to return during the year-long celebration.

A committee of the Foundation, an organization chartered by the state to develop technology-based business, selected the scientists and engineers from among former Tennesseans who have distinguished themselves by making major contributions in the areas of research, education, or management within their respective disciplines. Gibbons, a BOSTID board member, worked at Oak Ridge National Laboratory for 19 years. He is now director of the Office of Technology Assessment, the agency charged with advising the U.S. Congress on issues involving the impact of science and technology on society.

The ceremonies included a public discussion on "Perspectives on U.S. Technology" and a slide presentation highlighting the careers of the honorees. The awards were presented at a banquet attended by more than 800 engineers, scientists, business people, and civic leaders. ■

INSIDE

Iguana Management in Central America

By Dagmar I. Werner

Much of the rural population of Central and South America suffers from protein deficiency. This is largely due to the low productivity of tropical soil, once deforestation has taken place. As has often been stated, deforestation is continuing at an alarming rate, and the dependent wildlife is disappearing at the same pace. Game animals constitute a main protein source for both indigenous tribes and the rural poor. Protein deficiency and unsuitable land use could be counteracted by management techniques. These techniques would result in profitable exploitation of wildlife, and, at the same time, maintain or reestablish a productive ecological equilibrium.

The green iguana is one of the important game species throughout Mexico, Central America, and northern South America. A traditional food source (meat and eggs) for the past 7,000 years, it is now threatened with extinction in many parts of its habitat.

The Iguana Management Project aims to develop management techniques that will result in profitable, rational exploitation of this renewable natural resource. Iguana management, if successful, will not only improve the quality of life of the poor who depend on the meat and eggs of this prolific reptile for protein, but will also ensure the survival of this endangered species.

Because of the economic potential of iguana management, efforts to preserve tropical forest, the natural habitat of iguana, as well as reforestation will be encouraged. Indeed, habitat improvement, reforestation, and the preservation of tropical forest are essential for successful iguana management.

The Iguana Management Project was proposed by the Smithsonian Tropical Research Institute through A.S. Rand, and began in 1983 with funding from the W. Alton Jones Foundation. The James Smithson Society and the International Foundation are also contributing funds to this project.

Iguana Survival

Profitable management of iguanas is thought to be feasible if iguana survival is increased through captive raising of hatchlings. Juveniles will be released into the wild at an age when their mortality is low compared with that estimated for the first months of their life in the wild.

Continued on p. 4

The Office of International Affairs of the National Research Council serves the international interests of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine

Iguana Continued from p. 1

Iguanas would be raised for six to nine months and then released into forests, farmland with trees, or in the backyards of farms where they feed primarily on leaves, flowers, and fruits that are of little or no use for other animals or man. Investment would thus be limited to a short time span. If the costs of raising these iguanas can be kept lower than the value of an adult iguana, iguana management will be feasible. Iguanas can be harvested at three to five years of age; harvesting schemes must be developed and recruitment secured through continued raising and releasing of the juveniles.

During the two-and-a-half years of research on the biological feasibility of iguana management, we have developed techniques that accomplished our stated goals and are ready to proceed with field experiments.

We have also established maintenance schemes for hatchlings in captivity that result in an equal or even faster growth rate compared with natural populations, and that, in addition, allow a 90–95 percent survival rate compared with 5 percent or less in nature. Moreover, through controlled incubation, we duplicate hatching success. All in all, we can multiply iguana survival 20 to 40 times with the management techniques developed in the project.

Managing for Eggs

In Latin America, iguana eggs are commonly believed to be aphrodisiacs. Campesinos will capture gravid females at communal nest sites and kill them, mainly for their eggs, with catastrophic effects on iguana populations. We have designed an artificial nest in which females lay in captivity. This nest permits easy collection of eggs without killing females. We have increased hatching success 100 percent through installation of these nests and through innovative incubation techniques in captivity. Once functional in the field, this design will allow for collection of half the eggs for consumption while the other half is incubated in artificial nests or in incubation boxes to secure natural recruitment.

Raising Hatchlings

We have developed two approaches towards raising hatchlings in captivity: (1) high density, labor intensive, or (2) low density, low labor intensive schemes. In the high density scheme, we keep as many as 30 hatchlings in a "multi-storied dwelling" of one cubic meter, whereas in the low density conditions we keep one individual per three square meters. Food must be offered on a daily basis in the high density condition, whereas in the low density enclosures, beans, chayote, maracuya, and other horticultural plants are grown from which iguanas consume the leaves. In this maintenance scheme, iguanas must be transferred between enclosures so that the plants will still produce crops for the farmer to harvest.

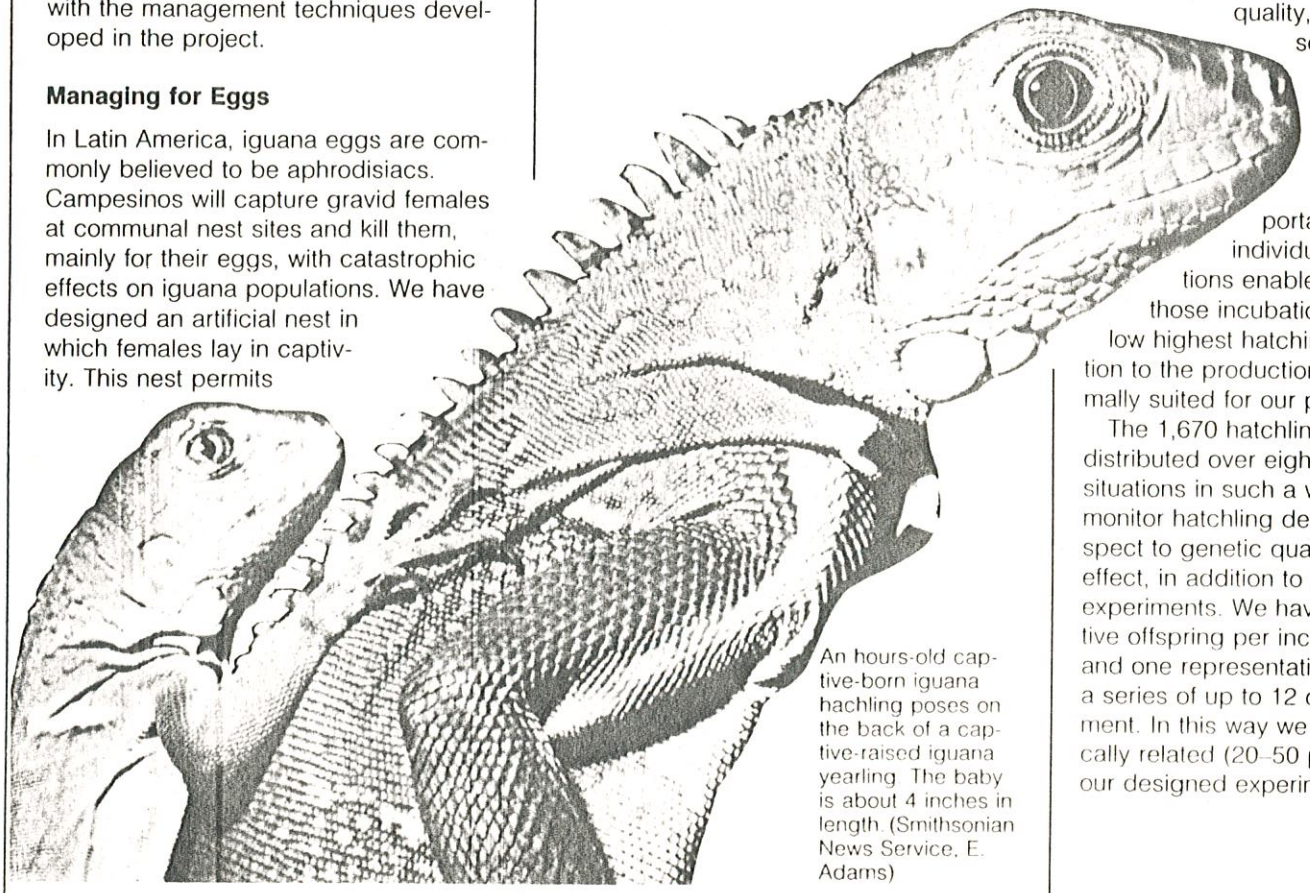
Captive Reproductive Colony

With the iguanas raised in the project we are establishing reproductive colonies. These will allow us to obtain information on reproductive aspects, growth, behavior, and the influence of population density and sex ratio on these and other aspects. We also will be able to produce a predictable number of offspring and select for genetically superior individuals. In 1985, of 60 2-year-old females, 4 laid normal-sized, fertile clutches. The reproductive colonies serve as a model for a production center from which young iguanas can be distributed to interested individuals.

Controlled Incubation

In 1985, we tested the effect of incubation conditions on hatchling quality. We collected 1,800 iguana eggs from the artificial nests that were installed in the laying enclosures. The eggs were incubated in sun-heated boxes sunk in the ground and filled with substrate. We varied the conditions to determine whether hatching success and hatchling size and proportions are affected by factors such as incubation temperature, substrate humidity, substrate type, and egg arrangement. Not only did we find that incubation conditions affect hatchling quality, but we also observed that the incubation conditions affect hatchling growth rate and perhaps other important qualities of the individuals. These observations enable us to determine those incubation conditions that allow highest hatching success, in addition to the production of offspring optimally suited for our purposes.

The 1,670 hatchlings that emerged are distributed over eight major experimental situations in such a way that we can monitor hatchling development with respect to genetic quality and incubation effect, in addition to the results from the experiments. We have one representative offspring per incubation condition and one representative female in each of a series of up to 12 cages per experiment. In this way we compare genetically related (20–50 percent) groups in our designed experiments.



An hours-old captive-born iguana hachling poses on the back of a captive-raised iguana yearling. The baby is about 4 inches in length. (Smithsonian News Service, E. Adams)

Experiments with Hatchlings

To make hatchling production economically feasible, we are carrying out a series of interrelated experiments that should allow us to maximize hatchling growth with a minimum of investment in terms of cage space per individual, labor, and food costs. Experiments have been done to ensure that the captive-raised juveniles survive after being released.

All in all, we can multiply iguana survival 20 to 40 times with the management techniques developed in the project.

In other experiments we are testing for the following factors: Is group size, that is, the number of individuals exposed to one another, regardless of space per individual, an important factor for iguana development? Do genetically related hatchlings (brothers and sisters) preferentially form groups among themselves, or do they randomly mix with offspring from other clutches? Do genetically related hatchling groups show a faster growth rate compared with mixed groups? Do iguanas adapt better to humans if not given the opportunity to hide? Which inexpensive food supplements such as soya meal, fish meal, or bone meal support the fastest growth rate in iguana hatchlings?

We have demonstrated the importance of contact with older iguanas to hatchling growth and development, and at present are testing whether nutritive value of the excrement of older iguanas, or optical or physical contact with older iguanas, stimulates hatchling growth.

The exposure to a limited variety of high-quality food in captivity may prevent iguanas from recognizing or digesting food they find after release. In a food-conditioning experiment, we demonstrated that at the age of seven months, iguanas developed a preference for the type of food on which they were raised, but they will still quickly accept new food items. This leads us to believe that we can raise hatchlings on a diet that is different from what they will find once they are released into the wild.

In summary, we have shown that iguana survival can be greatly increased through controlled incubation and captive raising. At present, we are concentrating on making the raising schemes more efficient. Survival rates of captive-raised and released individuals and causes of mortality will determine the kind of experiments in captivity for future years.

Field Experiments

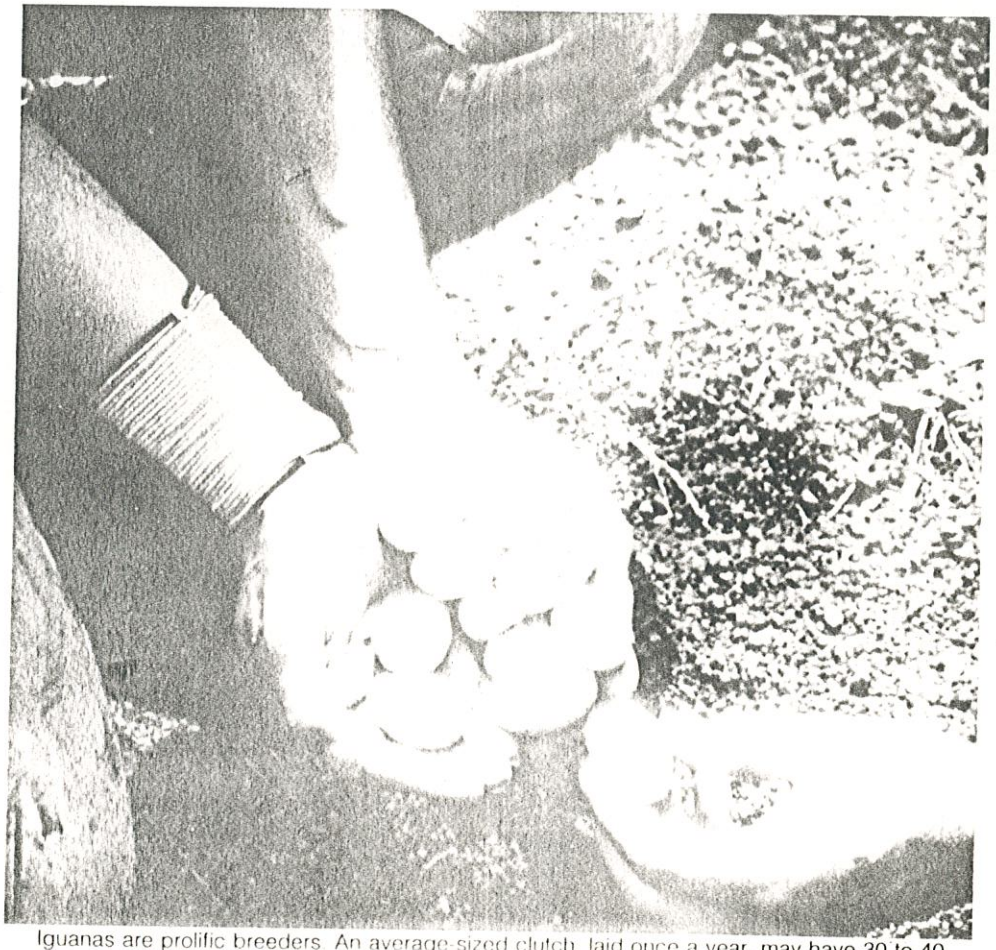
During May and June 1984, 300 hatchling and 25 yearling iguanas were collected from the wild and released at four sites adjacent to a small river on a farm on the Azuero Peninsula where iguanas are virtually extinct. Unfortunately, the local landowner fumigated his pasture, including the experimental area, with a herbicide (2, 4-D). Within four weeks of fumigation, no iguanas could be found in the experimental area, although some were present 200–550 meters away from the release spots. Apparently, the iguanas moved because of the fumigation. In spite of this, the experiment can be considered a success, because some iguanas returned to the release site, demonstrating that the habitat repopulated with juvenile iguanas. We learned that a repopulation experiment must be accompanied by an education program, in order to minimize the probability of human interference. The funds for an education program were recently donated to the Pro Iguana Verde Foundation by the Inter-American Foundation.

A major aspect of the field experiment will be reforestation with trees useful for iguanas in addition to their value as food and cash crops. If the experiment is successful, income can be expected from iguana harvesting within 3–5 years.

Collateral Research

Collateral research is planned on three important aspects:

1. Research on the social, economic, and cultural situation of the representative social groups in all of Panama in conjunction with Stephen Kellert, biologist and sociologist from Yale University.
2. Development of a medical program to prevent loss of captive iguana populations due to epidemics. In collaboration with Elliott Jacobson, from the J. Hillis Miller Health Center, University of Florida, Gainesville, we will carry out research on iguana health aspects in the Iguana Management Project in order to elaborate preventive measures.



Iguanas are prolific breeders. An average-sized clutch, laid once a year, may have 30 to 40 eggs. (Smithsonian News Service, R. K. Hofmeister)

3. Research on nutritional aspects to determine which food sources yield the highest growth rate in hatchlings and which are economically feasible. Determining the nutritional requirements of adult iguanas is essential for designing combinations of tree species that can be proposed for reforestation. The trees should be useful for wood, or fruits, or both, in addition to being consumed by iguanas. The research is planned in conjunction with Mary Allen, a nutritionist from the Washington Zoo, and Duane Ullrey, a nutritionist from the University of Wisconsin.

The Iguana Management Project is pursuing three goals simultaneously: (1) rational exploitation of a renewable natural resource, (2) conservation of an endangered species, and (3) habitat preservation, and/or improvement through reforestation of tropical forests.

We believe that this project can serve as a model for many other wildlife species and environments and is applicable on a worldwide range. ■

Dagmar Werner is a research scientist with the Smithsonian Tropical Research Institute. At present, her experiments with iguanas are being carried out in Panama.

Dagmar Werner of the Smithsonian Tropical Research Institute poses with a female green iguana. (Smithsonian News Service, R. K. Hofmeister)