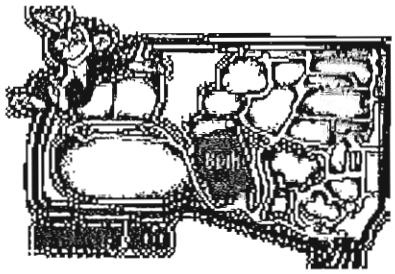
# Burger's Bush at BURGERS' ZOO interpreted by ZooLex



**Location**
Schelmseweg 85, NL-6816 SH Arnhem, Netherlands
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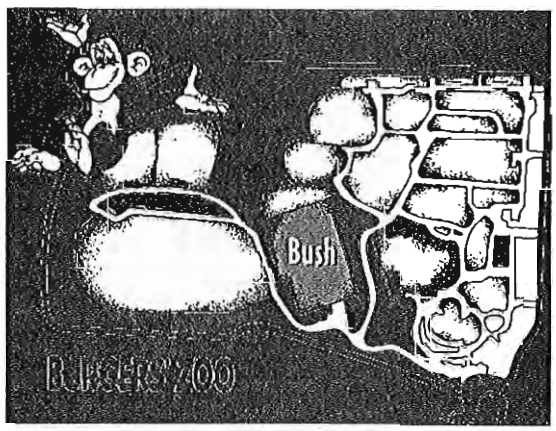
URL: http://www.burgerszoo.nl

**Key words**
Tropic Hall, Immersion, Ecosystem

**Animals**

| Species | Common Name |
|---|---|
| *Zosterops* spec. | White-eye |
| *Tauraco leucotis* | White-cheeked tauraco |
| *Dendrocygna fluviata* | Whistling Duck |
| *Euphonia violacea* | Violaceous Euphonia |
| *Opopsitta diophthalma* | Two-eyed fig parrot |
| *Dacnis cayana* | Turquoise dacnis |
| *Eurypyga helias* | Sunbittern |
| *Puntius tetrazona* | Sumatran Barb |
| *Colius striatus* | Speckled Mousebird |
| *Cotinga cayana* | Spangled Cotinga |
| *Eudocimus ruber* | Scarlet Ibis |
| *Potamotrygon brachyrrus* | River Ray |
| *Callonetta leucophrys* | Ringed Teal |
| *Cyanerpes cyaneus* | Red-legged Honeycreeper |
| *Colossoma brachyponum* | Pacu |
| *Astronotus ocellatus* | Oscar chichlid |
| *Caloenas nicobarica* | Nicobar pigeon |
| *Moenkhausia sanctae filomenae* | Moenkhausia |
| *Pericrocotus brevirostris* | Minivets |
| *Trichechus manatus* | Manatee |
| *Loriculus vernalis* | Malay Lorikeet |
| *Pteropus lylei* | Lyle's flying fox |
| *Aegithalos concinnus* | Long-tailed Tit |
| *Arachnothera longirostra* | Little spiderhunter |
| *Tragulus javanicus* | Lesser Malay Mouse Deer |
| *Clarias grabinus* | Labyrinthic Catfish |
| *Guttera pucherani* | Kenya Crested Guineafowl |
| *Jacana jacana* | Jacana |
| *Aburria pipile grayi* | Gray's Piping Guan |
| *Trichoglossus goldiei* | Goldie's lorikeet |
| *Chloropsis aurifrons* | Golden-fronted leafbird |
| *Tangara arthus* | Golden Tanager |
| *Irena puella* | Fairy Bluebird |
| *Epomophoreus gambianus* | Epauletted Fruit Bat |
| *Anhinga rufa* | Darter |
| *Rollulus roulroul* | Crested wood partridge |
| *Botia macracanthus* | Clown Loach |
| *Hydrochoerus hydrochaeris* | Capybara |
| *Pitta sordida* | Black-headed Pitta |
| *Argusianus argus* | Argus |
| *Protopterus dolloi* | African Lungfish |
| *Orycteropus afer* | Aardvark |

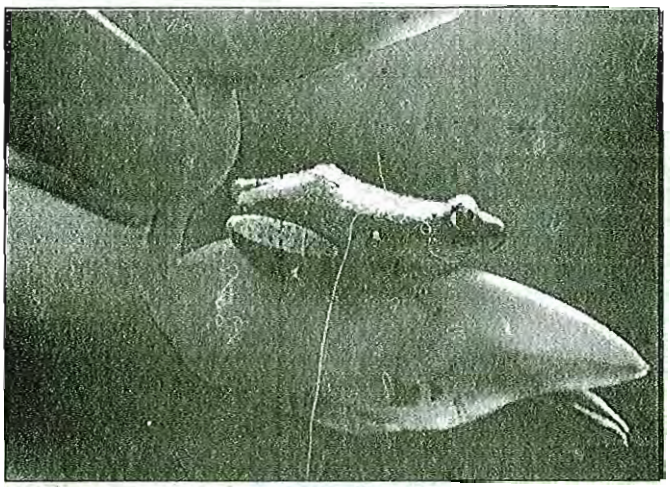



Entrance to Berger's Zoo, Netherlands

Visitors search for wildlife

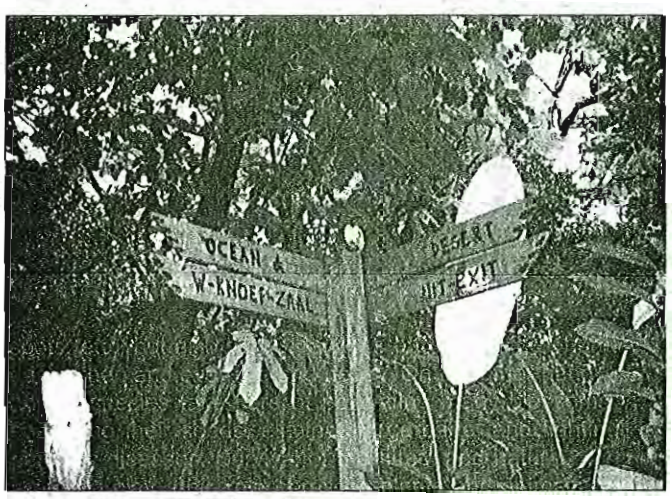
**Description**
For the first time in the history of zoos, a widely-functioning ecosystem similar to a tropical rainforest was attempted to be created. That means that the plants compete for light and nutrients, the animals have to share food, territory, nesting

spots, etc., but also that organisms eat each other, harm each other, and even die and decay. On the other hand, animal species take care of pollinating many blossoms, spreading their seeds, eliminating garbage, and fighting parasitic diseases. Survival of the fittest and natural selection play a big role here; the plants and animals are supposed to thrive with each other with minimal human interference. A healthy equilibrium between predators and prey is very important for the BUSH. This type of exhibitry is called eco-display.



**Visitors have to observe carefully, or they may miss some of the thousands of amazing creatures lurking in the Bush.**

In Burger's Bush, plants and animals from the tropical rainforests of South America, Africa, and Asia were combined. There are also traces of different cultures: a hut of the Asmat Papuas, a pygmy hut, a rope suspension bridge,




**From the Bush, visitors have access to the Desert by way of a long underground tunnel, as well as to the Ocean**

and rice fields with a watering system.

The health management of the Bush residents has had few problems. Since the animals have a lot of freedom and opportunities to move around, and can choose their food, their health is usually very good and their stress level is usually low. The immune system functions optimally in such an environment. The density of animals is low, and therefore the danger of contagious infections is smaller than in a conventional animal enclosure.

The roof consists of 765 cushions which are 3 by 6 meters. The cushions are made from Hostaflon layers which are transparent and permeable for all light wave lengths. The whole roof is suspended from eight giant beams which rest on heavy concrete blocks in the ground. An experimental building was erected in 1984 to test the construction of a free span building. Six ovens heat the air which flows in from both sides along the roof. The target temperature is between 22 and 24 degrees Celsius. In summer, the air circulation is achieved by openings in the roof and by doors and windows in the walls. Two large fans and a 17-meter high waterfall control vertical air circulation granting an equal distribution of warmth. The waterfall also raises humidity.

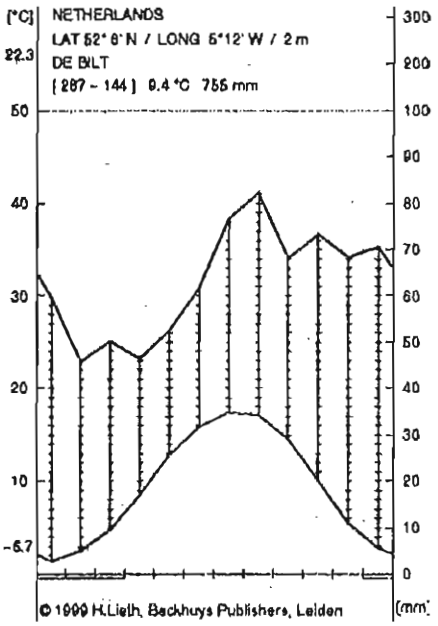
**Awards:**
2001 King William III Award for Innovations and Challenge Daring (for the Zoo)
1989 European Steel Award (for BUSH)
1988 National Steel Award (for BUSH)
The BUSH is 150 meters long, 95 meters wide and 20 meters high.

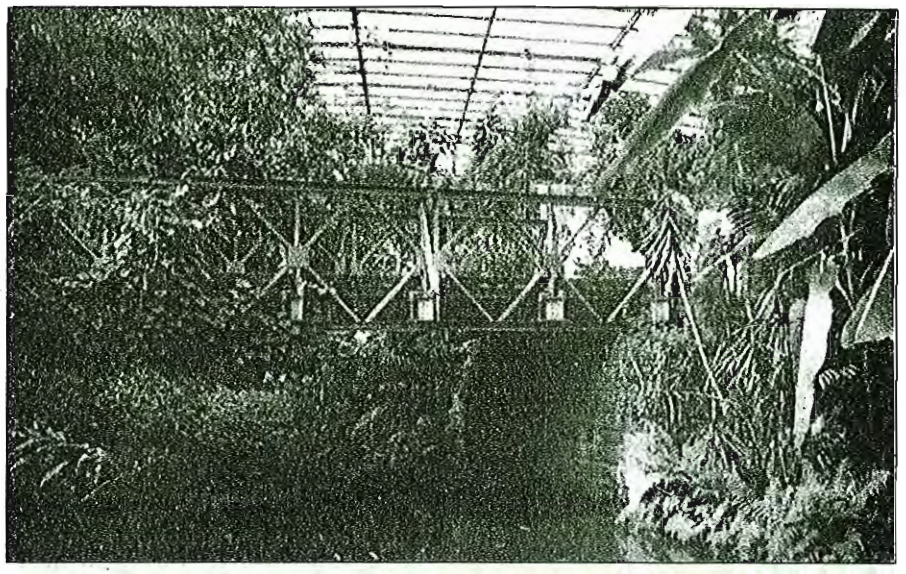
**Costs**
EUR 9,200,000 including 0.2% for design.
**Opening Date:** June 1, 1988
**Design:** Beginning: 1984. Planning and design: Burgers' Zoo staff


**Turns on automatically when glasses are held beneath it, to prepare them for the humid atmosphere inside.**

**Construction:** Beginning: August 1, 1986
· Construction: BAM, Arnhem, Netherlands
· Roof: Bouwstaalbau, Barneveldt, Netherlands
· Roof: Texlon, Bremerhaven, Germany
· Statics: ABT, Velp, Netherlands

**Local Conditions:** This is a climatic diagram for the closest weather station.

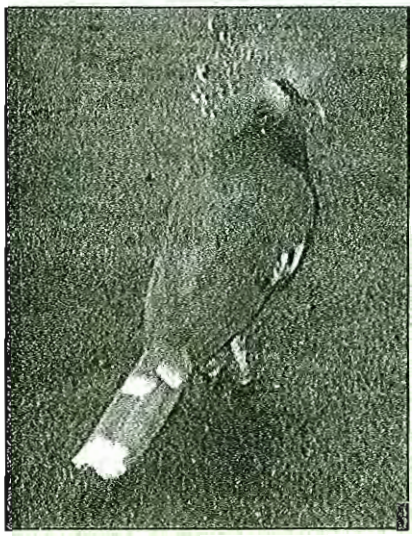


From the Baylay Bridge, visitors can see the larger lungfish, African catfish, and nile-perch that swim in the waters below.

This primitive suspension bridge allows visitors to interact with the papyrus swamp in a unique way.

**Plants**
Animals and plants listed are just a selection of species found in the BUSH at any given time. There are ongoing introductions and losses of species. The ground in the BUSH is made of coarse sand. This is nutrient-poor and lets water percolate well. Lack of nutrients is representative of almost all tropical rainforest floors. Most reused nutrients are stored in the plants themselves, not in the ground. In order to make the ground nutrient-rich in a natural way and to protect it from drying out or overheating, a layer of dried leaves, twigs, and bark was brought in. Dutch wood lice, ticks, springtails (*Collembola*) snails and millipedes take care of the decomposition of materials in the humus. They are aided by a few purchased tropical representatives of these organisms. Countless mineralizing fungi and bacteria came into the BUSH with the mulch. These irreplaceable organisms transform humus to useable plant



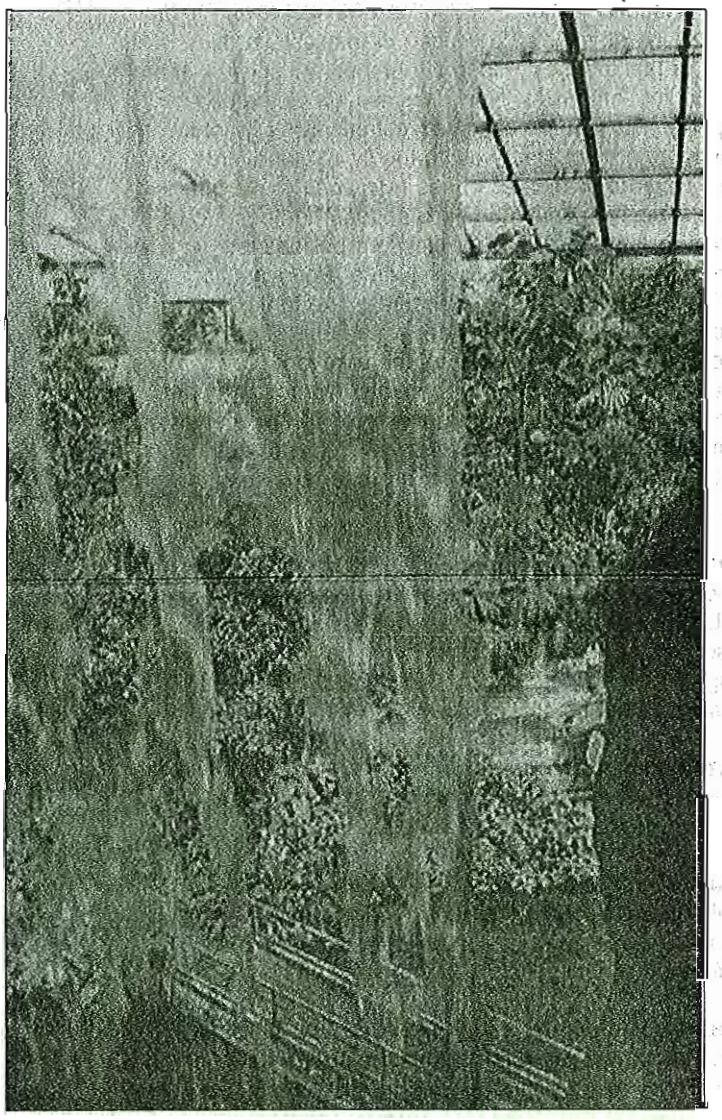
Lucky visitors get an up-close view of free-ranging birds.

Water hyacinths are not only beautiful, but can be used as food for manatees.

nourishment. In addition to that, mushrooms live in symbiosis with plant roots and serve an important function in the nourishment of trees. After an introductory period, the tropical plants provide foliage and twigs so that the humus production continues. When necessary, horticulturists also fertilize the soil with elephant dung from the zoo.

A natural tropical rainforest is the product of an often centuries-long development. The different stages (from pioneer forest to secondary forest to primary forest) are marked by the special tree species, that are found in an increasingly higher, darker, moist, and wind-free forest, in which the micro-climate becomes more and more constant. In the BUSH, elements from all three stages of development were planted at the same time. A mosaic of quickly growing, broad-leaved pioneer species like umbrella trees (*Cecropia*) balsa trees (*Ochroma*) bananas (*Musa*) and papayas (*Carica*) were combined, which quickly provided shade and protection for other delicate plants. Different fast-growing plants also live in the secondary forest, such as kapok (*Ceiba*) and cedar (*Cedrela*) which were also planted, creating a dynamic and dense high forest after only two years. Diverse trees of the primary forest developed in the shade of these trees. In the deep darkness on the floor of a natural rainforest (only 1% of sunlight reaches the forest floor) young trees grow slowly, if at all. Significant growth of height will happen only when a hole appears in the leaf cover. In the BUSH, there was enough light to guarantee that trees like durian (*Durio*) rambutan (*Nephelium*) shorea (*Shorea*) and revea (*Revea*) quickly grew to be a few meters. In six years, the forest was so thick that lack of light made the natural growth of pioneer species impossible. As the artificial forest developed, not only the micro-climate but also the combination of species changed. Herbs that need light only grow along the sides of the paths or on the banks of wide bodies of water. Conversely, the number of species that prefer shade increases. Suitable spots for new plant species occur when trees mature. Epiphytes such as ferns, bromiliads, orchids, and others find their places on trees. They have to compete with creepers and vines. These "boisterous" quickly

**In the bush at Burger's Zoo, a rainforest trek is accessible to all, complete with waterfall.**



growing plants are introduced only with the greatest care.

In 1988, 15,000 individual plants of 1500 species representing 148 families were introduced.
The plant list specifies the Latin names of the plants used for this exhibit.

**Features dedicated to animals**
When introducing animals into the BUSH, management has to think carefully about the ecological consequences. What and how much does each animal eat? By which other animals can it be eaten? Are there opportunities for nest building? Is the animal an egg-stealer or a nest-destroyer? Does it dig or gnaw? Will it endanger the visitors? Is it territorial, nocturnal, or diurnal? Again and again, they have to consider if a niche, a place in the ecosystem, is available. Many of the introduced species have a biological function as food for other animals or pest control, others pollinate flowers, clean the water, or clean the ground of dead matter. To reduce the spread of disease-causing germs as much as possible, every new resident spends a quarantine period in an acclimation cage. Here, the animal can be observed for a few days and examined by a veterinarian. After it is released, the acclimation cage is still available. The animals can always find food there. This way, keepers can always dispense medication in the animal's food, if necessary.
As a consequence of the introduction of insect-eating birds, the population of insects decreased dramatically at first. This went so far that the loss of food threatened the survival of the lizards, turtles, and frogs. Now, flies are supplemented weekly. The flies that are used are mutants that cannot fly, and therefore are not of interest to the fly-catching birds. The different types of stinger-less bees (*Melipona*) have been able to survive the hunt of the birds so far. The bees are very important to the ecosystem as blossom pollinators.
The yellow-spotted Amazon River turtles *(Podocnemis unifilis)* share their pond with manatees. The turtles like to eat the manatees' poorly-digested excrement. The Asian small clawed otter *(Aonyx cineria)*, the aardvark (*Orycteropus afer*), and the capybaras (*Hydrochoerus hydrochaeris*) are held in separate enclosure. The enclosure of the spectacled caiman (*Caiman crocodylus*) is also covered with a net to protect the birds. All other animals are free ranging in the hall.

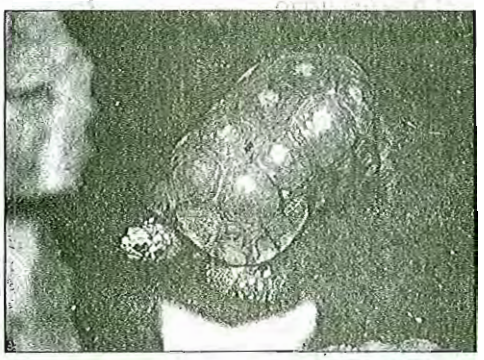
**Features dedicated to keepers**
Four horticulturists are in charge of the Bush.
The BUSH-keepers care for approximately 50 bird species by observing the feeding stations. Even the number of nestlings and fledglings is fairly well known. Such control is important in small populations in order to avoid inbreeding.

**Features dedicated to visitors**
The visitor is an explorer; he must find his way himself. The visitor goes on the search for animals without much help of wayfinding signs, and sees only a small part of the available spectrum of animals. This type of searching, finding, and observing the animals in their surroundings that they belong in is not only thrilling, but also highly treasured. It is a powerful form of emotional pedagogy.

The restaurant in the middle of the tropics hall is Asian in design, and can be reserved for groups. The terrace lies among lusciously growing plants. The meals, which are

Identifying birds and butterflies

This hut was built in the Asmat style and surrounded with plants native to New Guinea, like sugarcane and sago palm.



Red-footed tortoise

often rice-based with tropical fruits, fit the environment.

**Interpretation**
Awareness and appreciation of the tropical ecosystem is raised in visitors through the enjoyment of the BUSH. Only a few signs were erected in the BUSH to leave the landscape undisturbed. There is information available at special information spots and in an extensive exhibition on the Amazon in a small building next to the entrance.

Special tours and brochures are offered to those with more interest.

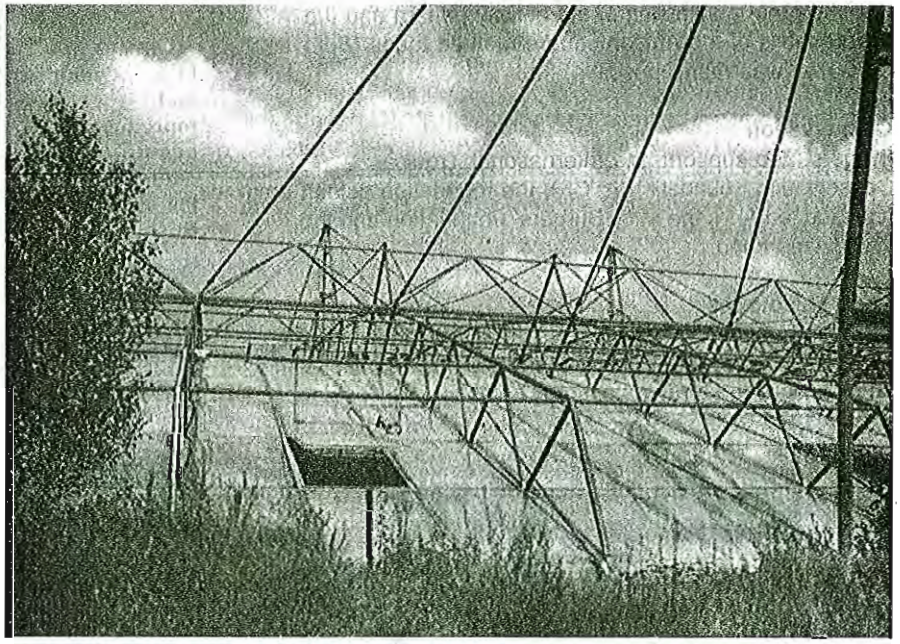
**Management**
Unlike other projects, like Biosphere II in Tucson, Arizona, the BUSH is an open system: the visitors produce varying amounts of carbon dioxide daily. On warm days, the inside of the building is cooled with outside air. Some animals need outside nourishment to survive. Water is also supplemented from outside, because the water used to water the plants just runs through the ground and isn't used again. The nightly drizzling of water (about 200 mm/year) occurs with the help of a sprinkler system that is installed in the ceiling.

In order to preserve the biological diversity of plants and protect the sensitive roof, about 20,000 kg of plant material are removed from the "leaf ceiling" each year, with the knowledge that these holes will be filled again within a few months. But the cutting-back in the winter allows extra light for the undergrowth. The clippings are spread over the ground to keep the nutrient cycle going.

There are also some damaging species that are introduced along with the plants. Since no pesticides can be used, biological agents must be applied. Various insects and mold species are available for such purposes. Besides that, small-beaked, insect eating birds were introduced. Important representatives are white-eyes (*Zosterops*) honey creepers (*Cyanerpes*), later sunbirds (*Nectarinia*) and spider hunters (*Arachnothera*). With the help of these bird species, a stable situation, in which the plants were mostly parasite-free, was reached in the course of two

Manatee Pond

This exhibit raises up the forest floor, to offer a cross-sectional view.



Roofing material is 75% lighter than glass, so roof spans freely over the entire Bush (no columns or supports disrupt the continuity of the space).

years.

Banana moths cannot be controlled by the birds, since their eggs, larvae, and pupas live hidden in plant stems. Because of that, traps with UV lights were set up, which attract and catch the banana moths at night. The population of these parasites has remained at an acceptably low level for many years.

A short time after the opening of the BUSH, the number of ants kept growing. Ants are important scavengers, but must also be controlled. In searching for a biological enemy, it was clear that woodpeckers were not an option, since they would have ruined the system. Dragonflies (*Draco*) were not efficient enough. Toads are an important ant predator. In the BUSH, African square marked toads (*Bufo regularis*) whose young eat only ants, were introduced. Open water is necessary for breeding, but the tadpoles are also hunted by fish and birds. The toads have the best chance for survival in the water, where water lilies block the view of the fishing birds. In this way, water lilies have proven to be an important controlling agent of ants.

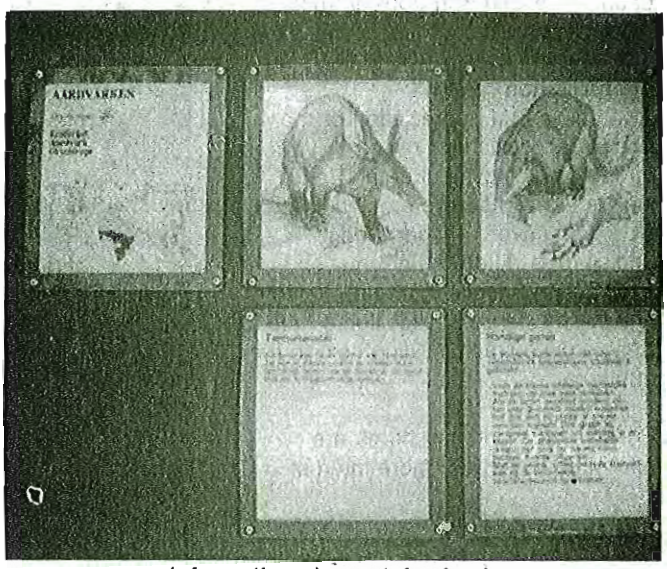
Cockroaches are useful humus-builders and provide an important food source for insectivores, especially in the winter. But they can also damage living plants, so their population cannot be left unchecked. The adult cockroaches are eaten by many game fowl, dwarf kingfishers, lizards, and turtles. Besides that, wasp species that parasitize cockroaches were introduced.

**Research**
Keepers attempt to ID as many animals as possible with a leg band or a microchip, in order to make animal inventory and research possible.

The University of Utrecht collaborates with the University of Costa Rica on research on stingless bees. With the help of the Department of Animal Ecology of the Catholic University of Nimwegen, a sampling of the activity pattern and the eating habits of the African square marked toads (*Bufo regularis*) was made possible.

**Conservation**
Burgers' Zoo supports the International Tropical Conservation Foundation (ITCF), the foundation golden arch (De Gouden Ark), the Lucy Burgers' Foundation and the World Tree Fund.

**Local Resources**
Preferably, local companies are contracted for construction works. The water for irrigating the tropics hall comes from tanks collecting storm water from neighbouring roofs



Informative signs at Aardvark


A few animal species, such as the aarvark, are kept in their own enclosures. These enclosures are open to the rest of the hall.


Living, dying, and reproducing all occur naturally for life in the Bush.

BURGERS' ZOO

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