Tropical America
Program & Concept

Zoological Society of Florida
Miami Metrozoo

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Introduction

This document represents the findings of a six-month effort to program Miami Metrozoo's proposed Tropical America exhibit. Defined within this program are the proposed regions of Tropical America that will be designed, exhibit sequence, animal lists, general interpretive storyline, major plant species, and exhibit and structure sizes with related construction costs for $11,000,000 and two options for $25,000,000 exhibits. Additionally, future phases of Tropical America were generally programmed and sited to establish placeholders and to create a continuous geographic sequence and storyline, linking this area to the rest of the Zoo.

This work was jointly generated by members of the Zoological Society of Florida and the Miami Metrozoo and their advisors, with the Consultant Team and its advisors. Five consultant visits were made to the Zoo: one data-gathering trip, two comprehensive workshops, one interpretive workshop, and one visit to review the draft program document. The springboard for this Program Document was a well-defined "Program Statement" prepared by the client which provided the framework for subsequent work.

Over the course of the two comprehensive workshops, an original list of six regions was narrowed to four contrasting habitats, and then further distilled into three geographic regions with input from members of the Scientific Advisory Team and other experts who visited during the workshops.

From four preliminary circulation schemes, one was chosen that includes a River Outpost as its hub, with a new monorail station approximately 200' from the hub. Loops from the River Outpost hub connect each of the three potential Phase I zones (Amazonia, with either Mesoamerica or Atlantic Forest/Pantanal). Place names such as "Amazonia" were selected in order to give a geographic reference to the exhibit area. Individual exhibits will all be replications of native habitats. Mixed species exhibits are a goal with compatible species. Where venomous reptiles and sensitive or extremely aggressive species are displayed, layered exhibits will often be designed to create the necessary separation.

Introduction

Because of budget limitations and the need to create exhibit continuity between the existing south monorail station near the Colobus Exhibit and the area around the existing concessions stand at the north end of the lake, Tropical America now stretches more in a north-south direction than had been conceived in prior schemes. Corresponding expensive air-conditioned exhibit public "cool zones" would be strategically located at appropriate intervals along the public pathway. Future exhibit ties at the north and south ends of Tropical America respectively are the Caribbean and Temperate South America zones. The proposed sequence from north to south would then mirror the progression from North to South America beginning with the Caribbean followed by Mesoamerica, Amazonia, Atlantic Forest & Pantanal, and Temperate South America. The easternmost seven-plus-acre rectangle of land has no programmed use at this time.

Overall species selection will be ongoing; however, the client is committed to several key animal species, including the Jaguar, Giant river otter, Anaconda, Orinoco crocodile, and possibly the Woolly spider monkey. Acquisition of several of these "key" species requires two to three years of lead time. The remaining mammals, birds, reptiles, amphibians, insects, fish, and major plants are outlined in this document. There is also a possibility of creating a night animal exhibit experience during the summer months.

Elements for children's play and education will be dispersed throughout the site. An extremely important element is animal contact, which will only be provided with domesticated or extremely durable species where little staff supervision is required. Contact such as touching a fur pelt or eating Mayan chocolate may provide alternate experiences. As presently conceived, the River Outpost will include a restaurant, gift shop, small plaza, amphitheater, and adjacent area for special performances. Also part of the Outpost, a Finca or South American ranch will provide an appropriate setting for contact opportunities as well as an ethnobotanical garden. Multi-use classrooms with restrooms will be located in different public zones.

Interpretive themes link natural and cultural stories. The impacts of habitat destruction provide a compelling story and need to be discretely reinforced. Creating a fun and informative scientific experience while motivating the public to act responsibly after leaving the Zoo is a major goal. The interpretive experience will be informal and not highly structured as is typical with Disney. Viewing of behind-the-scenes experiences will be offered to the public at large and to special small groups; the optimal locations and experience will be determined in design.

Introduction

Goals of research and conservation in-situ and ex-situ programs are not fully defined at this time but are high priorities for this exhibit. Scientific Advisors from World Wildlife Fund and Conservation International will contribute their knowledge to these issues.

It is expected that the portions of the exhibit that will be unconditioned will have extensive vegetative shade and constructed cover along with varied uses of water, which will provide comfort and relief from the Zoo's subtropical environment. In order to maximize the effects of the vegetative tree cover it has become a goal to have 20–30 significant trees planted within the proposed exhibit by July of this year. Additionally, it is expected that 30–50 trees will be purchased, stored, and kept at the zoo for planting at appropriate times during construction. These Tropical America native trees will be planted close to future pathways for maximum impact. Other future backdrop plantings may not all be true Tropical America natives but will replicate the respective exhibited zones. Drought and hurricane resistance will be a consideration in all selections. Between vegetated and shaded zones, conditioned spaces will be located at strategic intervals to provide visitor comfort.

A boat ride and bridge across the lake may become part of future phases although these are not part of the proposed construction. The boat ride would link the north and south portions of the lake with the River Outpost.

The overall animal collection at Miami Metrozoo will significantly increase with the addition of numerous tropical species, and at present the quarantine facilities are not adequate to house the introduced animals. The animals will likely be quarantined immediately prior to the exhibit opening, so an allowance was created for these off-exhibit animal containment areas.

Sustainable and green designs have been important client goals for the project, and the team is presently set to pursue a LEED (Leadership in Energy and Environmental Design) Certification. The LEED Organization is the national certifying body on green and sustainable design. At present, there are no LEED Certified projects in South Florida, although several projects there are in the process of making applications.

The Expectation of Probable Construction Cost projects an overall buildout in excess of $25,000,000 for all three zones, with options to bring the construction budget into the range of $11,000,000 to $25,000,000 for Amazonia and either the Atlantic Forest & Pantanal or Mesoamerica, but not both. The projected construction completion date for Tropical America is prior to Christmas 2005 for the $11,000,000 option and Spring 2006 for the $25,000,000 option.

Introduction

Thematic Organization

Animals and plants do not recognize political boundaries. They are sensitive to transitions from one habitat to another, but not to the flags and languages of people. Yet increasingly their survival is determined by the decisions of nations as people determine what landscapes will be protected and which will be developed. Thus as one considers the flora and fauna of tropical America, it is useful to think in terms of cultural-political geography as well as biomes and habitats.

Three regions have been proposed for the Miami Metrozoo's Tropical America exhibits: Mesoamerica, Amazonia, and the Atlantic Forest & Pantanal. Each has distinct cultural and ecological characteristics. Each evokes a sense of place with all its cultural, geographical, and biological diversity. All include a wide range of landscapes and habitats. Reproduced on-site in Miami, these three regions will offer visitors a greater understanding of the diversity of the tropics as well as a fun and enriching experience.

In Tropical America, visitors will appreciate that this huge and important region of the world is not a generic, undifferentiated rain forest. Indeed, it is a fascinating place to visit, a place full of surprises: habitats greatly different from one another, animals large and small, myriads of plants and peoples who have lived in these lands for millennia. Yet it is also a region undergoing enormous changes, a region looking to them for their care and concern.

In undertaking this project, the Miami Metrozoo and the Zoological Society of Florida have established a number of clear goals. Tropical America needs to be innovative and exciting, and to entertain and enchant with educational experiences that captivate visitors and inspire interest. It should demonstrate that the Zoo is a scientific institution committed to research and conservation. It should promote an understanding of the broadest range of natural animal behaviors and biology.

Thematic Organization

To accomplish these goals, three major interpretive themes have been articulated. Visitors will understand the great biodiversity of Tropical America and its importance to the future of the region and the globe. This understanding will be built on an appreciation for the marvelous processes of natural and cultural adaptation. Finally, visitors will comprehend the fragility of these processes and this great diversity in the face of development and modernization. The exhibit will include references to cultural values and cultural understanding of place. The exhibits will also empower and impel visitors to work for conservation.

Following are brief descriptions of the location, habitats and biomes, animals and plants, and cultural diversity that characterize the three regions. Most of this information was drawn from three books by Mittermeier et al.: *Megadiversity* (1997), *Hotspots* (1999), and *Wilderness* (2003), as well as one book by Leopold called *Wildlife of Mexico* (1972). In this document, the Narrative describes how one may experience the exhibit at the Zoo, and the Interpretive Program explores in further detail each region for its potential interpretive stories. Extensive lists of animals, primates, and plant species are in Section II.

Thematic Organization

Mesoamerica is considered one of the most diverse places on earth. It covers Central America and Mexico. It includes tropical and subtropical habitats and biomes from Panama through Costa Rica, Nicaragua, Honduras, El Salvador, Guatemala, and Belize, extending into southern and central Mexico as far north as northern Sinaloa on the Pacific coast of Mexico and as far as the middle of the Sierra Madre on the coast of the Gulf of Mexico. It includes tropical and subtropical moist and dry forests.

The region ranks high on the list of hotspots for its biological diversity. It rose above sea level about five million years ago, connecting North and South America and creating a major transition zone in which evolved endemic flora and fauna. It is extremely rich in plants, vertebrates, reptiles, amphibians, and resident birds and is a major highway for a multitude of migratory species of birds and butterflies. Part of this richness is due to the mix of fauna and flora from the northern and southern continents.

Montane tropical moist forests, also called Cloud Forest, originally covered the region. There, indigenous people practiced agriculture and burnt stretches of forest to create savannas and attract game animals. The Cloud Forest is mainly made up of pine-oak forest and tropical undergrowth of low trees, shrubs, herbs, vines, and epiphytes. This forest is characterized by a heavy tropical understory rather than by its canopy.

The Pacific Dry Forest includes the tropical deciduous forest growing on the humid foothills below the pine-oak uplands, and the thorn forest found near the coast. In general this forest is open, low, and stocky. Deciduous thorny leguminous trees characterize the thorn forest. In the tropical deciduous forest there are broadleaf trees draped with epiphytes and vines. This area is the home of the Mixteca and Zapoteca peoples.

Mesoamerica is mostly threatened by widespread deforestation, population growth, and livestock production. The region is presently populated with about 127 million people: descendants of Europeans, Afro-Caribbeans and indigenous groups such as the Maya, the Aztec, and the Chibchá. Huge tracts of lowland and highland forests have been converted into crops and pasture for coffee, bananas, oil palm, and beef cattle. Ecotourism and non-timber forest products may be the answer to the opposing needs for economic development and conservation in Mesoamerica.

Thematic Organization

About 80% of **Amazonia** is still intact, although enormous areas are being rapidly modified by development and industrialization. Much of this region is still well preserved, and some of the areas that had been clear-cut in the 1980s have demonstrated rapid regeneration. Amazonia is extremely rich in freshwater fish, birds, and terrestrial invertebrates.

The region supports a huge biodiversity of habitats and biomes: *terra firme* or dryland forests make up most of the greater Amazonia; the *várzea* or floodplain of the white water rivers; the *igapó* or permanently flooded forests of the black water rivers; the savanna enclaves in the middle of the *terra firme;* a variety of smaller formations; and the montane forest.

The *terra firme* forests of the interfluvial regions grow on the Guyana and Brazilian Shields and are not affected by seasonal flooding. The flooded forests of Amazonia are seasonally inundated by three major kinds of Amazonia rivers: "white water" rivers, "black water" rivers, and "clear water" rivers.

The rivers of the Amazon support unparalleled aquatic richness. Nearly 20% of the world's river water flows through Amazonia. At Manaus, in the center of the Brazilian Amazon, the black waters of the Rio Negro flow into the white waters of the Amazon, creating an extraordinary spectacle of bicolored river for many kilometers downstream.

The white water rivers carry a heavy silt load, which gives it its "café au lait" color. Each year, the white waters fertilize the soils of the forest on the wide *várzea* floodplain, wide expanses of treeless savannas. These rivers carry only about 12% of Amazonia's water but nearly 82% of the suspended solids discharged.

The black and clear water rivers carry almost no suspended silt. The black water rivers originate from the poor soils of the Guyana and Brazilian Shields; their color can be compared with strong tea. A poorly defined shore covered with a permanently or periodically flooded swamp forest, called *igapó* by the Brazilians, characterizes these rivers. Although these waters are poor in biomass, they support a high diversity of species endemic to the *igapó.*

There are many indigenous peoples in Amazonia. Among the best-known groups are the Kayapó, who live in the region of the Xingú River, a clear water river, in southwestern Amazonia. These people are known for their feather work and political activism. Their traditional enemies are the Karajá, who live on the biggest fluvial island in the world, Bananal Island, on a southern tributary of the Amazon. They are best known for their *litjoko* or clay dolls. The Tapirapé, another group, is known for its large *cara grande* or *upé* masks.

Thematic Organization

The **Atlantic Forest**, or *Mata Atlântica,* extends along the coast from the northeast of Brazil, through the southernmost state of Rio Grande do Sul into the northeastern tip of Argentina and in Paraguay. It comprises a complex of habitats and biomes, including: lowland humid tropical forest; cool and humid montane forest; lower montane forest with deeper soils, a marked dry season, and lower humidity; inland semi-deciduous or dry forests; and *Araucaria* pine forest.

After the five-times-larger Amazonia and the northern Andes, the Atlantic forest is biologically the most diverse region in South America. The wide latitudinal range contributes to this diversity. The Atlantic forest is essentially montane, and the altitudinal variation in forest types, soils, and climate are also important factors. The forests are especially rich in tree ferns, epiphytes, bromeliads, and orchids.

Vertebrate diversity is extremely high. The fishes, amphibians, reptiles, and birds are rich and highly endemic. There are about 262 species of mammals of which 74 are endemic. Twenty of the 24 primates that occur in the region are endemic, for example the dramatic lion tamarins and the muriquis or woolly spider monkeys, the largest of the New World primates.

Globally, the Atlantic Forest ranks as one of the most devastated and highly threatened ecosystems. Less than 8% of its original vegetation remains intact, and the large majority of that is in small fragments. At least 70% of Brazil's population lives in the region, which includes such mega-cities as São Paulo, Salvador, and Rio de Janeiro.

Urban, agricultural, and industrial pressures have resulted in the loss of well over 90% of what once existed. Enormous areas of the forest have been converted to cocoa, coffee, eucalyptus, sugar cane, and rubber plantations, as well as cattle pasture, and have otherwise been destroyed for charcoal, timber, and firewood. In the northeast, historical records testify to the widespread destruction of the forests right from the first decades following the discovery of Brazil in 1500.

Amerindians were of course widespread in the Atlantic forest in Pre-Columbian times but were rapidly eliminated and displaced in the early centuries of the colonization of the region. An important indigenous group is the cannibalistic and warlike Tupi or Tupinambá. Fear of these Indians resulted in the Europeans felling and burning large areas of forest in the earliest days of their colonization.

Thematic Organization

The **Pantanal** region is located in central-western Brazil and in adjacent portions of Paraguay and Bolivia. It is one of the best-known regions of Brazil and is the world's largest swamp. Its vegetation is a diverse variety of wetlands, gallery forest, and several different kinds of open grasslands. Much of the area is flooded from December to June, and there are large permanently flooded areas. The Pantanal-Cerrado region was recently identified as one of the top threatened hotspots on Earth.

The Pantanal has abundant and highly visible fauna. It is probably the most important area in South America for wetland birds. It is the home of species such as the Rhea, Screamer, and Hyacinth Macaw. It is also an important migratory bird stopover point and wintering ground. The Pantanal is also known for its abundance of mammals and reptile species. Examples of flagship species are the Capybara (the world's largest rodent), the Tapir, the Giant anteater, and the Paraguayan caiman. Those animals are usually difficult to find in Amazonia but are more likely to be encountered in the Pantanal.

In the upper reach of northern Mato Grosso State is the two-and-a-half million hectare Xingú National Park. Several completely different cultural and linguistic groups of indigenous peoples live there.

The principal economy of the Pantanal is cattle-raising and the associated grassland burning in the dry season. These practices have affected the vegetation, little of which remains undisturbed. Tourism and sport fishing are also popular activities. Threats to the Pantanal include sugarcane that encourages drainage of the Pantanal. The Hydroid, which involves dredging and channeling of the Paraná River, allows transportation of grains and soybeans from Mato Grosso and central Brazil but drastically alters the hydrology of the region.

All of these regions are rich and diverse; however, the exhibit at the Miami Metrozoo will concentrate on illustrating a few key biomes and habitats for each region. A biome is a major regional or global biotic community, mainly characterized by the dominant forms of plant life and the prevailing climate. A biome is composed of many habitats, which are the physical environments in which organisms normally live. Mesoamerica will be illustrated by the Pacific Dry Forest and Cloud Forest. Amazonia will depict the Flooded Forest, rivers and confluences (fluvial regions), and *terra firme.* Atlantic Forest & Pantanal will reveal the stories of the Atlantic forests, savannas, and the Pantanal.

Key animals species and plant materials will be placed in each region to help the Miami Metrozoo accomplish its program goals and objectives. Those include interpretive and education goals, visitor experience, animal husbandry and management, scientific research, and conservation and preservation.

Narrative—Experience

Tropical rainforests are the world's oldest terrestrial living ecosystems. Covering two percent of the Earth's surface, six percent of its landmass, rainforests house over half the millions of plant and animal species on Earth. Goals for the visitor's experience of Miami Metrozoo's new Tropical America exhibit include understanding the large biodiversity of the tropics of the Americas, observing natural animal behavior, understanding the complexity and interdependence within the tropical rainforest, and fostering awareness and action toward this endangered environment.

Miami Metrozoo's new Tropical America exhibit will take visitors on a trek of exploration and discovery through the tropical Pacific Dry Forest and Cloud Forest of Mesoamerica, the Flooded Forest, Rivers and Confluences, and *Terra Firme* of Amazonia, and the Forests and Savanas of the *Mata Atlântica,* the Atlantic Forest of South America, as well as the Pantanal. The design for these exhibits not only allows for a complete immersion by the Zoo visitor into these amazing habitats, but also provides for the social and behavioral enrichment of the animals that reside there.

The new Tropical America exhibit can be reached one of three ways. One, we can reach the area on foot through an introductory immersion path. Two, we can take the monorail to Tropical America, traveling through a changing landscape, we catch glimpses of nearby landmarks, cultural references that announce the arrival at the tropical forest, and reach the river outpost. Three, at the north lake concessions building, by special arrangement, we can take a boat ride to the Tropical America river outpost, where we continue our journey on foot.

We decide to walk first, returning via riverboat or monorail. We begin our journey on foot at the small buildings along the north end of the lake. Here we find a small plaza with modest buildings, flowering canopy trees, and plenty of seating. While we orient ourselves, we enjoy a bite to eat. After gathering our belongings, we cross a bridge at the stream and journey along the shore. Shaded by lush canopy above, we stop occasionally to sit and enjoy the view across the water. Around a bend in the path we arrive at the Tropical America river outpost.

1. See the Rainforest Action Network website at www.ran.org/info_center/about_rainforests.html and the World Resources Institute website at www.wri.org/biodiv/tropical.html.

Narrative—Experience

Whether we arrive by boat, by monorail, or on foot, our journey of Tropical America begins once we arrive at the bustling riverfront outpost carved out of tropical rainforest. Individuals, families, and school groups gather to orient themselves, thankful for the cooling canopy trees overhead. At the water's edge, slender stilts echoing tree stumps support a boat dock and connect the river to solid ground. Simple awnings extend in greeting and offer refreshing shade underneath. Here we discover a restaurant and gift shop with regional merchandise. We make a mental note to return for lunch and shopping after our journey. At the opposite edge of the plaza are small shelters clustered informally around a clearing of red earth. Inside one of these shelters, lined with photographs and artifacts, a docent hands us a copy of a naturalist's journal. There is an explorer's map inside. Our journey begins!

Into the Rainforest

Some may choose to take the promenade for a quick overview of all three biomes. For the more adventurous, according to our explorer's map we can choose from three loop trips or choose any combination for an in-depth experience. Three trails enter the rainforest from the outpost clearing, each framed by a gateway. We begin with Mesoamerica.

Narrative—Experience

Mesoamerica: Central American Dry Forest, Cloud Forest Canopy Walk

We enter Mesoamerica: the red earth path is crossed several times with various animal tracks disappearing mysteriously into the vegetation. Ahead, the sounds of birds and other animals draw us deeper into the forest. Several colorful birds eye us from overhead. Dappled sunlight from above highlights ferns on the forest floor. The smells are intoxicating. A lush, watery habitat is home to the Baird's tapir; here we find a mother and spotted calf feeding among the aquatic grasses and palms along the river's edge. Wrapped around a branch above us is a Yellow eyelash viper, its spots blending with the vegetation. Coming to a wooden footbridge, we cross a stream with several small waterfalls. Again we catch sight of a Baird's tapir; this time we discover a male Tapir lounging in the dappled light along the water's edge…a sandy stretch of beach seems to be an appealing place for a nap. The sound of water ahead pulls us around the next bend, where the path disappears behind a forest waterfall. The cool mist from the waterfall overhead is a delight as it passes over us. Clinging to trees and rock crevices are epiphytic orchids and bromeliads. A crevice in the rock allows a unique view of the pool above the waterfall. Here a Giant palm salamander skims the water's surface; another clings to a tree limb above the water.

The sound of rushing water fades; the forest becomes drier. Several trees are in bloom, the fragrant flowers attracting an array of species. A pair of Ocellated Turkeys scurry across our path, disappearing into the thicket beyond. Helmeted iguanas bask on sunlit rocks, while a Beaded lizard travels along a branch in direct view. A beautiful Neo-tropical snake makes its way across a downed tree while a False coral snake hides in the shadows. A true Coral snake warms itself on a rock nearby, its stripe pattern almost indistinguishable from its false cousin's. Further exploring our surroundings we spy an enormous Hog-nosed pit viper eyeing us from a ledge above. Gently climbing, we round the next bend in the path. Peering into a tree hollow we view a nest of Mexican red-legged tarantulas. They are huge! We pause to rest in the shade of an enormous Ceiba, its beautiful red flowers attracting many birds and insects. Haunting calls sound deep in the forest, enticing us forward. Just ahead, an Armadillo scurries through the underbrush. To our amazement the armored animal slips into a small pond and swims across. Another Armadillo is digging in the ground, possibly looking for a treat. More tracks emerge from the forest. We notice several tracks are of the Jaguar.

Narrative—Experience

Continuing our climb, we come to a large rock outcrop. Here there is a split in the path. We can either continue around or enter the cave before us. We choose to enter.

The light recedes as we gradually descend. Inside are several species of bats hanging from above; occasionally one stretches its wings…a disturbance sends several flying to another corner of the cave. It is delightfully cool here, and we sit to rest and watch. Emerging from the cave we catch sight of a colorful Toucans perched in the trees and beautiful Razor-billed Curassows meandering across the path. Continuing our gentle climb, we notice our surroundings gradually changing from dry forest to a wetter environment of palm, bamboo, philodendron, and bromeliads. Ahead, the chatter of monkeys rings through the forest. Again there is a split in the path. We can either continue around or enter an aviary.

Inside the aviary, many species of birds surround us. We are immersed in a world filled with color and sound. Standing still, we observe several Ruby-topaz Hummingbirds sipping nectar from red tubular flowers. Brugmansia and Hamelia are in bloom. The air is filled with wonderful scents and activity. We pause to rest in the cool shade nearby and take it all in. A small waterfall drops from a higher pool to a lower one, disappearing into the lush vegetation. Leaving the aviary behind, we find ourselves eye-level with several Poison-arrow frogs. Their brilliant colors warn other species to beware. Keel-billed Toucans squawk as we pass. The forest is alive with the chatter of monkeys and the calls of rainforest birds.

Leaving the ground behind we continue our journey on a wooden walkway, an ascending canopy walk into the cloud forest. Spider monkeys hop from branches to lianas hanging from the canopy above as a slow-moving Sloth descends a fig tree. The boardwalk winds its way higher into the canopy; ample shady rest stops with seating are provided along the way. All around us are wonderful sights, sounds, and smells to enjoy. The sounds of the jungle engulf us: chirping, cooing, rustling, rattling, pecking, growling. The boardwalk turns again, and we find ourselves suspended in the misty canopy. A waterfall cascades into a pool below. In the canopy we spot a pair of Cottontop tamarins playing while the magnificent Morpho butterflies flutter through the leaves. The overlook is spectacular…we pause to take it all in before returning to earth.

Narrative—Experience

Descending through the canopy, we are drawn to a tree scarred by lightning. On closer view we see a Tree frog inside. Moving around the tree we find a nest among the epiphytes. A low growl resonates somewhere deep in the forest. Startled, we stop to listen. Just ahead, a pair of Tree frogs clings to a beautiful Brugmansia. Rejoining land once again we spot mysterious tracks in the red earth path—did a Jaguar cross here? Above us another Tree frog clings to a tree, its red eyes glowing. As we round a bend, a picturesque panorama comes into view. Here, among the mixed grassland, scattered shrub, and tree habitat along a meandering stream, we view a pair of Jaguar cubs playing in the grasses. Nearby, at a slumped section of red earth, we catch sight of a female Jaguar leaping into the water in pursuit of a fish. The fish scatter between the rocks below just in time. Here we can see an intricate labyrinth of tunnels in a cut bank along the water. A Central American river turtle suns itself along the water's edge while its companion dives. Tracks in the red earth path pull us around the next bend. Draped across a tree limb before us is another magnificent Jaguar, tail twitching, eyes fixed on us. This time it is a solitary male. We pause to rest and share in this amazing experience.

We are excited to continue—more awaits us as we journey to Amazonia.

Narrative—Experience

Amazonia: The Terra Firme, The Flooded Forest, and The Confluences

Passing beneath the enormous sprawling canopy of a giant Kapok tree, we hear a bird squawking loudly above as we pass. We enter a high canopy forest. A damp mist rises from the forest floor as we descend. Overhead, a fallen log reveals a huge Green anaconda. Amazed at its length, we stand in awe and watch as it stretches its enormous body across the tree. The path weaves along the river, crossing in several places.

Spectacular ten-foot leaves of Astrocaryum above cast giant shadows across our path. A low growl from the forest ahead causes the hair on the back of our necks to rise.

We descend further, half above earth, half below. The red earth bank with its tangle of roots and cavities gives way to an amazing underground world. Deeper into the earth we go. Iridescent beetles wind their way between roots above us. It is darker now, revealing creatures mostly nocturnal. A snake slithers overhead, scales shining in the low light. Gently climbing, we round a bend and are startled to come eye-to-eye with an Orinoco crocodile stealthily swimming towards us. A growl, louder now, startles us.

Crossing a stream we stop abruptly. There before us is a Jaguar. We stop to observe the magnificent cat swimming across a dark pool, emerging from the water with a shake. To our surprise, two Jaguar cubs dart from the grasses and reeds along the shore. They playfully pounce on the Jaguar's tail. She seems not to care, climbing up to a grassy ridge for a better view of us. What an incredible sight she is! We pause to sit and rest in the comfortable shade and take in the amazing sights, sounds, and scents.

A giant Blomberg's toad croaks from a huge six-foot diameter Victoria amazonica. This giant Amazon water lily is an iconic plant of both the Orinoco and Amazon waters. We are fortunate as many of the lilies are in bloom. It is a spectacular sight.

A screech from the trail ahead entices us to continue our journey. Leaving the river's edge, we go deeper into the forest. Sets of prints in the red earth path disappear around a bend. We decide to follow. A group of Squirrel monkeys chatter in the canopy above as we pass. Here there is a split in the path. We can either continue around or enter an aviary. We choose to enter.

Narrative—Experience

Shimmering in the dappled light is a myriad of butterfly species, busy collecting nectar from flowering plants. We stand still as several butterflies settle on us for a moment, wings gently fluttering. We pause to rest along the stream and enjoy our surroundings. The song of several forest birds entices us forward. We stop to listen and locate them in the forest canopy, their brilliant colors revealed in flight. Continuing our journey through the forest, we view many species of philodendron, heliconia, monstera, palms, and flowering trees.

At the base of a magnificent Brazil nut tree, Agouti tracks in the red earth signify a recent feast. The sound of water ahead pulls us forward.

Again we rejoin the river. Here the view allows us to see many creatures not only above water level, but also below. We can see the rise and fall in seasonal water, indicated by a series of lines in the red earth bank. A Tropical water snake winds its way through the aquatic plants. A Mata mata breathes under water. A beautiful, strikingly striped Green vine snake clings to the trunk of a rubber tree. A Surinam toad hides under a water lily pad, while a Liana snake hangs from a tree limb above. As we approach, an Amazon racerunner scurries under a rock just ahead, while above a Calico snake slithers over a fallen tree. Below we spot a brightly colored Red-pipe snake burrowing in the ground. A troop of Emperor tamarins swings through the canopy as a flock of birds chatters above.

Here the water becomes deeper. Several fish species, including Pacu, Peacock bass, catfish, Tetras, Arrawana and the huge Arapaima eye us from the watery shadows, dappled light flashing off silvery scales. A Freshwater stingray gracefully swims near the water's surface. Thorny-tail lizards scurry between rock crevices. A False water cobra glides through a small pond, while a Bushmaster coils in a tree hollow nearby. Iridescent blues and reds are but two of the many colors of Cichlids swimming through watery shadows between the buttress roots of the Pachira aquatica. A Caiman lizard blends in with a branch above the water's surface, while the leaf litter moves with the scuttling of Giant cockroaches.

Narrative—Experience

The sound of rushing water grows louder as we round the next bend where Giant river otter playfully chase a school of fish. Cleverly avoiding capture, the fish hide in the safety of aquatic plants and rock crevices. We pause to rest and watch the otters play. One pair chase each other through a series of stepped pools and small waterfalls, while a mom and her kits curl up for a nap in a nearby den. Frogs sit motionless, their red eyes glowing in the low light of the forest. A fish skips across the water's surface.

A Goliath bird-eating spider waits, its silvery web shimmering in the low light of the forest. A magnificent Harpy Eagle is perched beyond. Several tamarin species chatter in the canopy above as more butterflies flit among the flowers. A pair of Red-billed Toucans squawk overhead. Crossing a footbridge, we see several Pygmy marmosets enjoying a feast of ripe fruits. They scatter through the trees, chattering at our passing. Hair rises on the back of our necks as again we hear a low growl somewhere deep in the forest. We continue our journey, enjoying the scents of many spice and fruit trees, arriving again at the river outpost.

Heading towards the Atlantic Forest & Pantanal, we wander through the adjacent medicinal garden. We are amazed by the variety of plants that have given us medicines we use to cure disease. Only a fraction of these rainforest species have even been catalogued! We wonder what else might be discovered in the rainforest with further research.

Excitedly we move on—more awaits as we journey into the Atlantic Forest & Pantanal.

Narrative—Experience

Atlantic Forest & Pantanal: Water's Edge

Passing under an arbor overhead, we leave the river outpost. The path meanders through pasture, where we view a small group of Coatimundi at a Finca. Continuing, pasture gradually returns to forest. We enter, welcoming the coolness. The Atlantic Forest contains many palm species, the strange Aurucaria, the giant Albizia saman, and many beautiful flowering trees, including Jacaranda, Erythrina, Cassia, and Tabebuia. Birds chatter in the canopy above as we enjoy the sights, sounds, and smells around us.

Crossing a stream, we wind our way through the forest. Just ahead Golden lion tamarins swing through the canopy above, screeching excitedly. As we wander along the languid water's edge, the sweet scent of vegetation, fruits, and flowers surrounding us attracts many butterflies and insects. We forge another river crossing where the water has cut a deep bank. Ahead, the loud call of a Howler monkey resonates through the forest. We pass under a fallen tree overhead. Hearing a distant growl in the forest, we stop for a moment. Crossing our path are several animal tracks disappearing into the underbrush. High in the canopy, several colorful birds cry out. As the ground rises, we descend. Water crashes overhead as we pass beneath the falls. The cooling mist here is a delight. Winding our way through the forest, we discover a section of red earth broken away to reveal crawling Rhino beetles and creeping Scorpions. As we gently climb, the sound of water grows louder. Again, we cross a stream in the forest. High above, a King Vulture soars from treetop to boulder below, displaying its awesome wingspan. We journey forward. A line of Giant walking sticks makes their way across a fallen tree overhead as we descend through the forest. And now we spot the noisy Howler monkeys, swinging from lianas hanging from the canopy above.

The forest changes gradually from tropical rainforest to a succession of forest clearings, occasional trees, thickets, and grasses. The available light allows varied plant species to grow, including several flowering trees. We rest in the shade of a Peltophorum dubium, its spectacular yellow flowers in bloom. Here the red earth has formed mounds, home to ants and termites. An Anteater approaches. Extending its two-foot long sticky tongue, the anteater quickly scoops up a line of ants. Children squeal with delight for this close-up view inside the anthill.

A necklace of clear pools dots the grassland. This wetter grassland creates a habitat rich in aquatic plants, attracting many species. Placidly feeding on aquatic plants nearby is a herd of Capybara, the world's largest rodent. We spy a Giant anteater in the brush. Hitching a ride, its offspring clings to the back of the parent.

Narrative—Experience

Several Jabiru storks wade along the shoreline in search of food. The red earth path is punctuated with stretches of boardwalk winding through the aquatic plants. Here a pair of Capybara swim to the opposite shore, joining others in their herd resting on a sand bar. A Jabiru stork wades into the water, searching for fish. We hear a strange sound ahead.

We seem to be following the perimeter of a butterfly meadow, a low wet marshy area of fine grasses and reeds alive with activity. Insects and colorful butterflies move between masses of meadow flowers. The song of many birds surrounds us. Looking over the meadow, we view the river beyond. Here we stop to rest under an Albizia saman, enjoying the view. Chattering from the forest edge entices us to continue.

The landscape gradually changes from grassland to a mix of thicket and trees, returning finally to dense forest. It is cooler here. The sound of water ahead draws us forward. At the next bend we come to a footbridge. Here we view many amphibians, some swimming and some basking in streams of sunlight along the shore. There is a rustling in the grasses just beyond the stream. A pair of Red-legged Seriema emerge. In the canopy above, a pair of brightly colored Macaws are grooming each other. Rounding a bend in the path, we stop to observe several Ornate horned frogs squatting; after we pass, their croaking resumes. We pause to sit and rest in the comfortable shade and take in the amazing sights, sounds, and scents. Again, we share a view of the upper pool. Here a graceful snake winds through the underwater vegetation. Fish scatter for the safety of rocks at the pool bottom. A small waterfall cascades under our footbridge, disappearing into the forest. Another long view across the river, this time more narrow, catches our eye. A screech from the trail ahead entices us forward. Sets of prints in the red earth path disappear around a bend. We decide to follow.

The tracks lead us to a reminder of a culture long ago. A small structure covered with vines emerges out of the under story. An enormous tree frames our view ahead, providing shade and a fine roosting place for many chattering forest birds. Marmosets cling to the tree trunks high above. Several lizards crawl from crevices in the stone, basking in the sunlight. A Waxy monkey frog is perched on dried-out branch, motionless. The coolness of the forest is a treat. We pause to rest and wonder about the people who lived here long ago and those that live here now. As we continue on our journey, the path winds its way through forest to a lush environment, eventually returning to pasture. In the shade of a Finca shelter, a docent allows us to touch a Tortoise and a Chinchilla. We learn of their importance to the people of the region. Just beyond is the river outpost where we began our journey. Stopping at a tropical treat stand for refreshments, we rest in the shade.

Narrative—Experience

River Outpost Return

Emerging once again from the forest, we arrive back where we began—the river outpost. We head for the river station restaurant to have lunch; menu items from the many cultures of Tropical America are available to enjoy. After lunch we purchase a zoo membership in the gift shop along with several other rainforest products such as chocolate, coffee, and tagua nut buttons. Partial proceeds go back to the people in a rainforest village. We feel good that we can make a difference in our global community.

This has been a most remarkable trip through Miami Metrozoo's new Tropical America exhibit. We come away with a greater appreciation of the mammals, birds, reptiles, amphibians, insects, fish, plants, and people of this magical place. It has been a memorable experience to visit this incredible place, to talk with docents, to participate in the research that takes place at our Miami Metrozoo, to visit the medicinal garden and learn more about the many things the rainforest gives us. We are encouraged to find ways we each can help ensure these magnificent creatures, and their native habitats, continue to thrive for generations to come.

We plan to return in the coming weeks for one of several discovery classes offered in one of the new innovative classroom spaces. Here we will be able to have close contact with animals and meet keepers and education specialists for behind-the-scenes views. What fun for kids and adults alike! In subsequent visits we plan to attend one of Tropical America's evening performances on the lawn offered by our Miami Metrozoo. Music and wine under the stars—just for adults!

We look forward to experiencing much more at our Miami Metrozoo!

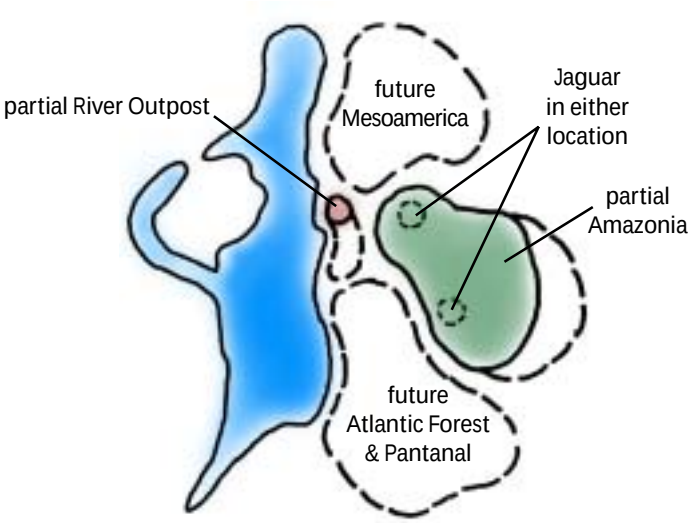
Illustrations

$11 Million and $25 Million Options Diagrams

Base Option

Amazonia

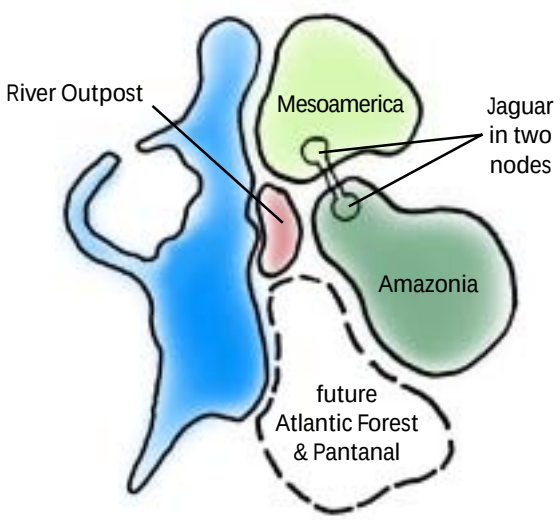
with money presently appropriated



$11 million capital construction

Option A

Amazonia and Mesoamerica



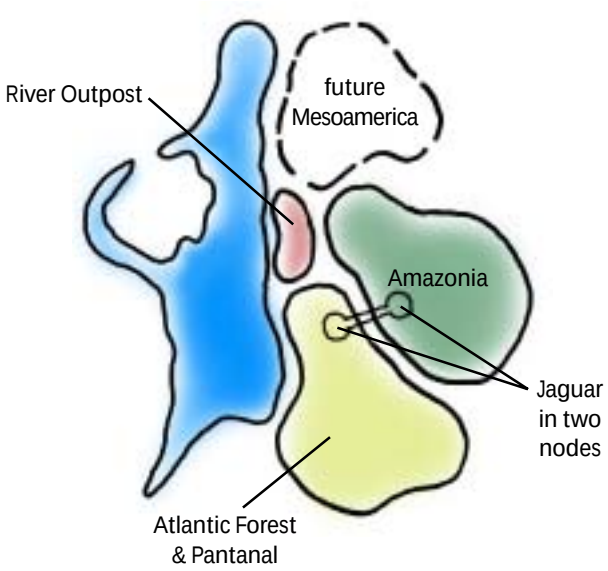
$25 million capital construction

Detail of linkages and off-site items not included for graphic clarity

Illustrations
$11 Million and $25 Million Options Diagrams

Option B

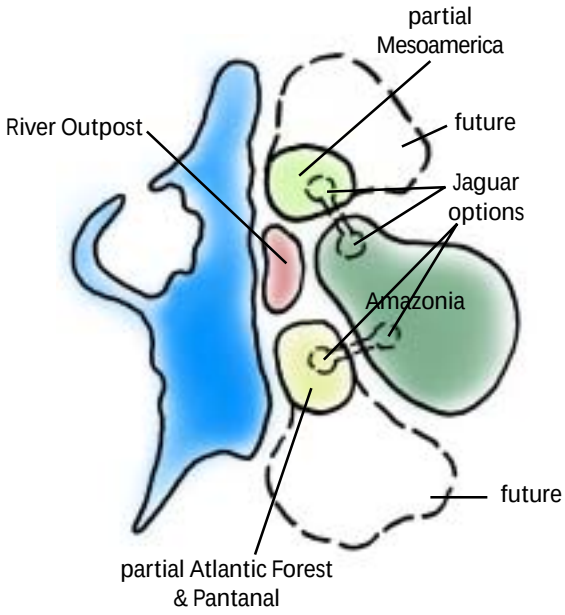
Amazonia and Atlantic Forest & Pantanal



$25 million capital construction

Option C

Amazonia with partial Mesoamerica and partial Atlantic Forest & Pantanal



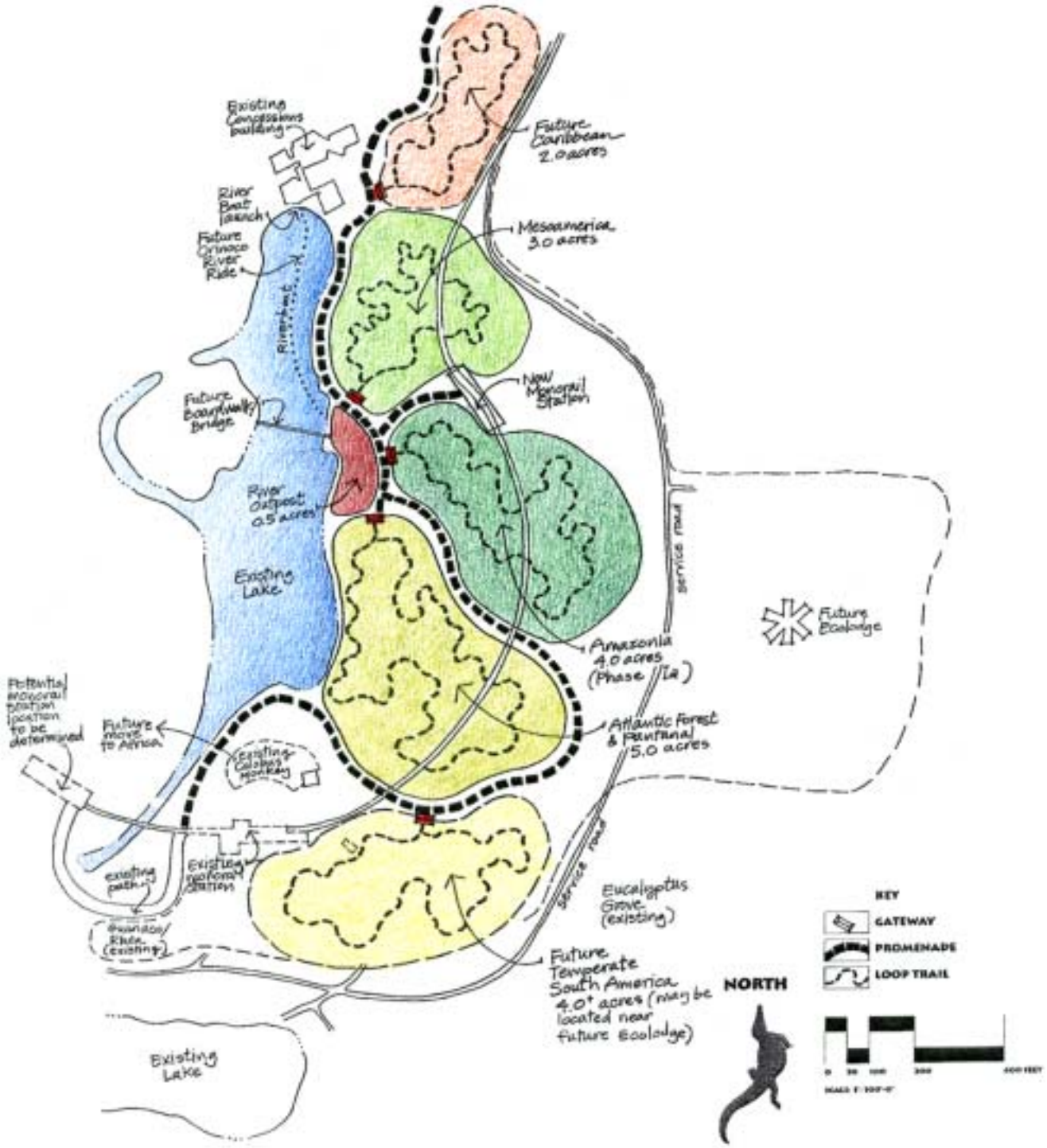
$25 million capital construction

First Subsequent Option: Buildout remaining third node

Second Subsequent Option: Buildout Caribbean & Temperate South America

Illustrations

Concept Diagrams



GATEWAY/PROMENADE & LOOPS

Illustrations
Concept Diagrams

Mesoamerica
Pacific Dry Forest, Cloud Forest

Geographic References: Mexico, Costa Rica

Key Fauna: Baird's tapir, Green vine snake, Giant palm salamander, Helmeted iguana, Beaded lizard, Neotropical snake, Morpho butterflies, Bromiliad boa, False coral snake, Coral snake, Hog-nosed pit viper, Basilisk lizard, Mexican red-legged tarantula, Bats, Spider monkey, Hummingbirds, Annulated boa, Eyelash viper, Birds (mixed), Giant millipedes & centipedes, Poison-arrow frogs, Keel-billed Toucan, Sloth, Jaguar, Fish, Central American river turtle

Key Flora: Moist tropical forests: epiphytic orchids, bromeliads, Brugmansia, mosses, tree ferns, philodendrons

Dry forests: Tabebuia, Bombax, Enterolobium, Guadawa (bamboo), Hymenaea, papaya, avocado, pineapple

Amazonia
Flooded Forest, River and Confluences, Terra Firme

Geographic References: Brazil, Peru, Surinam

Key Fauna: Green anaconda, Orinoco crocodile, Blomberg's toad, Jaguar, Fish, Squirrel monkey, Butterflies (mixed), Birds (mixed), Mata mata, Tropical water snake, Liana snake, Water cobra, Pacu, Arapaima, Arrawana, Leaf-cutter ants, Peacock Bass, Calico snake, Surinam toad, Tamarins (mixed: emperor, pied), Amazon racerunner, Tetras, Bushmaster, Catfish, Cichlids, Freshwater stingray, Caiman lizard, Thornytail lizard, Giant river otter, Goliath bird-eating spider, Harpy Eagle

Key Flora: Gallery & varzea forests (buttress roots common), figs, bromeliads, philodendrons, lianas, palms, kapok tree, Victoria amazonica (giant water lily), Chorisia, Brazil nut tree, rubber tree

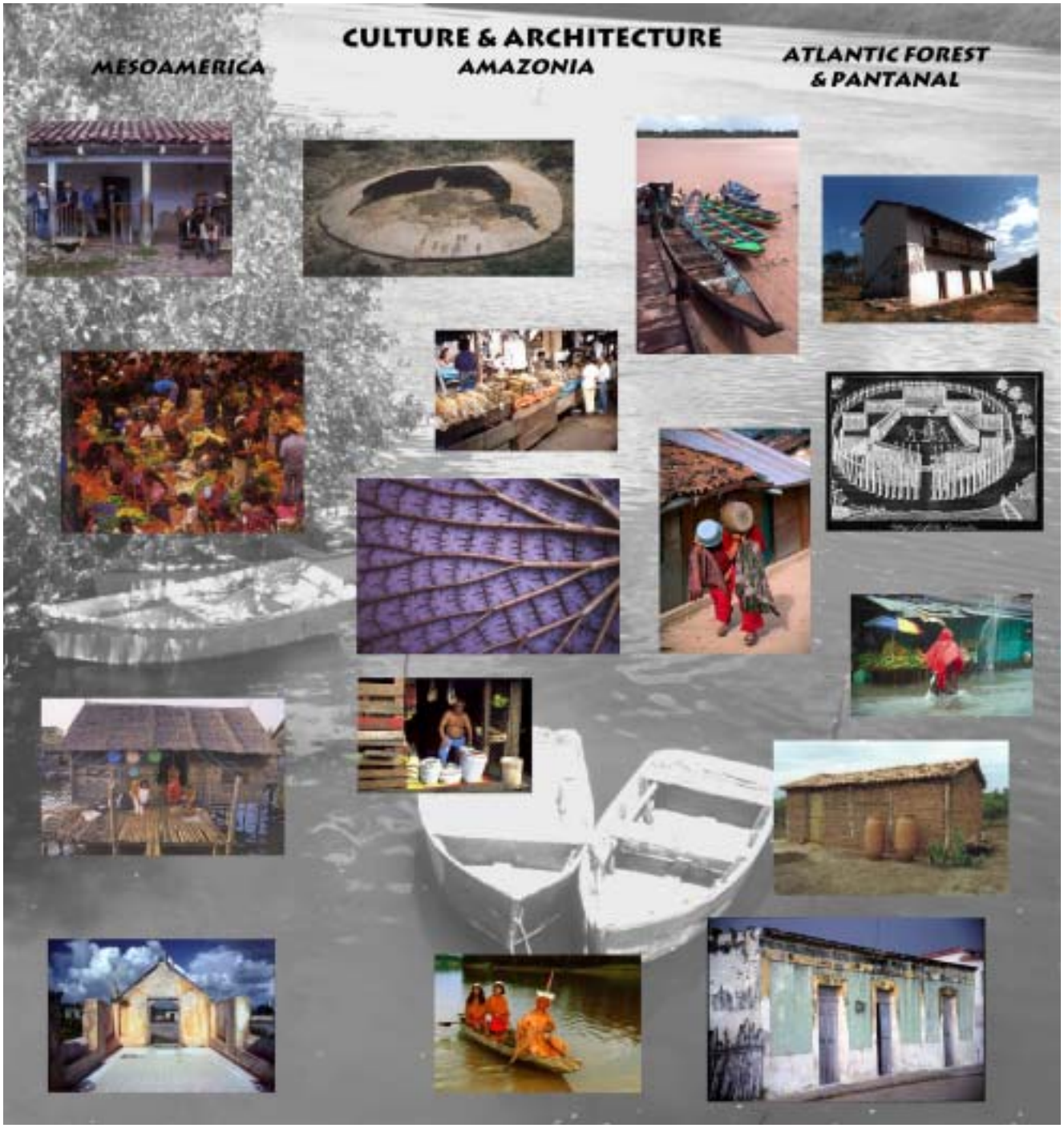
Atlantic Forest & Pantanal
Atlantic Forests, Pantanal, Savannas

Geographic References: Coastal Brazil, Paraguay

Key Fauna: Golden lion tamarins, King Vulture, Giant walking stick, Capybara, Giant anteater, Butterflies, Reptiles, Amphibians, Insects, Fish, Scorpion, Ornate Hawk Eagle, Howler monkey, Jabiru Stork, Macaws

Key Flora: Palms, Albizia, Araucaria, Cassia, Bougainvillea, Caesalpinia, Cordia, Erythrina, Tipuana, Jacaranda, Peltophorum, mango, banana, scrub thickets, sedges, grasses

Illustrations
Illustrative Boards



Interpretive Strategies

Introduction

Visitors come to zoos to see live and unusual animals and watch them behave as they would in the wild. Without any other interpretation, the animal and the environment provide an exciting, memorable, and educational experience. This is the baseline experience at the Miami Metrozoo, and some zoo visitors want little more, except to have the opportunity to socialize and be comfortable with one another within the zoo's exotic and exciting surroundings. For many people, however, watching these amazing animals ignites a desire to learn more about them and the environments in which they live.

The constraints of the zoo experience also feed the visitor's desire to know and see more. Although zoos are learning more about how to keep animals stimulated and engaged, the animals are not always active when the public comes to visit. Also, it is often not possible to create environments that allow animals the space for a full range of their natural behaviors. Even though visitors can come relatively close to animals in the zoo setting, people often want to get closer. Therefore, interpretative experiences are key to fully engaging audiences and offering them a richer, fuller perspective on the natural world. Interpretation opens a window to stories and insights that are not available by casual viewing.

Feeding the visitor's desire is a tricky job that may extend over the period of a single visit or a long association as a member of the zoological society. The interpretive program should provide opportunities to explore and learn without being overly didactic, overwhelming the visitor, or intruding on the core experience with the animals. Good interpretive design makes learning fun and easy. It goes hand in hand with the basic design of the visitor environment. If people are comfortable, they will take more time to explore and learn. They will also stay longer, spend more dollars, and develop a deeper attachment to the institutional mission of the zoo. Interpretation is thus a part of the process of building a relationship with the visitor.

Consistent with the goals of the program planning phase of exhibition development, this document provides an overview of interpretive opportunities available to MMZ as the team works to develop Tropical America. Readers should understand that it represents a list of possible ingredients and not a description of a particular meal to be served. At this point in the process it is important to provide MMZ with a range of options that can be selected and developed based on interpretive priorities, institutional goals, and budget.

Interpretive Strategies

Readers will find that this interpretive program is divided into two sections. The first focuses on the parameters that frame the interpretive experience: audience, physical environment, interpretive goals. Given these parameters, we explore a variety of interpretive delivery options. The second half of this document is devoted to an overview of the interpretive content. Rather than present this material as a bullet-point outline, we have chosen to flesh out the information and content in sample overviews of animals, interpretives, and concepts.

Readers should keep in mind that the content text is meant to be representative. At this point, the selection of specific interpretive elements remains to be done in schematic design in collaboration with MMZ staff and scientific experts. Information in this content overview has been drawn from sources recommended by MMZ (referenced in the text) and other reputable authorities, but it has not been vetted, cross-checked with other sources, or screened in a collaborative way with MMZ and its scientific panel.

Audiences

As the Project Statement explains, MMZ's core audience is comprised of visitors from the tri-country area (74%) who come as families or school groups with pre-adolescent children. These visitors are both English and Spanish-speaking, and the zoo would like to increase the share of Spanish-speaking visitors to reflect the demographic makeup of Miami-Dade County. The zoo also attracts a significant number of senior groups, particularly in cooler months, and their needs and desires need to be addressed as well.

Although different from one another, each of these audience groups comes to the zoo expecting to see live animals up close, to be entertained by the experience, to learn something about the natural world, to have an opportunity to socialize with one another, and to feel comfortable during their visit to the zoo. As much as possible, MMZ would like to meet these expectations and, at the same time, inspire visitors to help conserve the natural environment. The physical environment and the interpretive program must be designed to meet these various objectives, to make the conservation ethic the outcome of a fun and exciting experience. In the best scenario, these "take-away" messages would be remembered a day, a week, or a month later and would be associated by members and visitors with a consistent MMZ "brand."

Audiences

- Children
- Families
- School groups
- Lifelong learners
- Tour groups
- Tourists
- Zoo members
- Specialists

Bi-lingual titles, text, and audio are necessary

Interpretive Strategies

The climate in Miami sets a design directive to provide shaded cover, water features, and air conditioning to ensure comfort.

MMZ Physical Environment

Miami's climate also poses a challenge for landscape architecture and interpretive design. For a number of months each year, Miami is very warm and humid. Visitors will find it uncomfortable to walk long distances. Visitors will need interludes where they can relax and cool down either in air-conditioned or shaded environments.

These moments suggest opportunities to offer visitors interpretive experiences or study environments. More detailed or fine-grained exhibits of insects, smaller reptiles, invertebrates, or amphibians might best be exhibited within some of these specially designed enclosures. Lower light levels might assist in adding qualities of coolness and change from outside intensity of the sun. We also see the possibility for developing learning stations where visitors can find greater levels of information to satisfy their curiosity. Finally, these environments can introduce cultural themes related to human interaction with the natural environment, a critical step if we want to motivate visitors to conservation and action. Introducing these ideas in immersive environments, behind- the-scenes locations, and throughout the zoo experience will help motivate visitors to conservation and action.

Climate-controlled or specialized shaded enclosures offer visitors opportunities to rest, cool down, study and reflect.

Interpretive Strategies

Interpretive Goals

In developing the Project Statement and in collaboration with the design team MMZ has articulated a variety of goals for Tropical America. Some of these are experiential and visceral, relating to how visitors feel about the experience. Others are cognitive and address specific learning outcomes. Underlying both categories is a desire to increase interest in the zoo and encourage repeat visitation.

Experiential Goals

MMZ would like every visitor who leaves Tropical America to say that they had a great time, were amazed by what they saw, and want to do something to help protect the species and environments they encountered within the zoo.

"We had such an amazing experience today at the zoo. We saw and did so much, it was just such a great day . . . . I had never realized how involved they are in conservation and research."

Cognitive Goals

MMZ would also like visitors to leave Tropical America understanding that an amazingly complex system of ecological interrelationships has created a region with extraordinary biodiversity (defined as both abundant and species rich—see John Kricher, *A Neotropical Companion,* p. 33). Visitors will understand that this diversity of species reflects processes of adaptation and selection. To preserve this region's unique biodiversity, people must come together to promote conservation. Within each of these three broad cognitive themes, visitors should be able to learn about animal behavior, plant adaptation, habitat systems, and scientific research.

Cognitive goals

- Biodiversity
- Adaptation
- Conservation

Addressing Learning Styles

Embracing both the experiential and cognitive goals, the interpretive team has begun to develop concepts that address multiple intelligences and learning styles. Howard Gardner points out that as educational institutions, zoos, and museums offer children and adult learners the opportunity to cultivate a variety of intelligences within an open-ended learning environment. Music and sound combine with kinesthetic activities. Problem-solving that incorporates logical reasoning can go hand-in-hand with spatial puzzles. The group character of most zoo visits encourages the development of interpersonal skills as well as an intuitive relationship towards nature.

Learners in this environment, however, must be able to find ways to constantly expand their knowledge. By mixing delivery strategies and creating multiple pathways into the interpretive experience MMZ seeks to address a variety of age-related, culturally-bounded and individually-defined learning styles. Information layering, using both hands on investigations and/or high-tech delivery systems, will allow visitors to customize their experience according to their own needs and interests.

Learning Styles

MMZ seeks to employ multiple strategies that engage visitors on many learning pathways. These include hands-on activities, play, humor, analytical investigation, audio-enhanced opportunities, visual comparisons, physical movement, mathematical reasoning and others. Layering experiences in different formats will enhance learning and group sharing.

Interpretive Strategies

Discussion of Interpretive Palette

To provide a seamless experience for fun and learning and build on the main messages many delivery systems will be necessary. A description of each of the main approaches is provided here.

Orientation Methods

Visitors begin to understand overarching messages as they approach Tropical America on

- walking paths
- monorail
- boat tour

Each of these entry points offers similar but different messages.

Orientation Pathways

Visitors can choose to enter Tropical America by walking along the lake path, riding the Monorail, or cruising in from the Water Tour. Each of these experiences should provide a basic introduction to the lands of Tropical America and yet offer a distinctive approach to differentiate it from the other choices.

Walkers who make their way from the entrance paths will experience changes in sights, sounds and smells as they skirt the lake and approach Tropical America. Visitors feel a growing sense of anticipation as vistas and turnouts offer glimpses of the village in the distance or boats passing on the way to the dock. They stop occasionally to read markers, notice signs announcing destinations, and orient themselves with a map depicting Tropical America's biomes. Sounds of wildlife become more abundant and frequent as visitors approach. The landscape changes and the forest canopy becomes dense as the trail narrows as visitors near the village.

On foot, visitors experience sounds and smells and are aware of changes in the terrain and vegetation.

Riding the monorail provides visitors with an overview of MMZ's entire campus. There are five main stops along the tour. Each highlights different regions and continents. Visitors will be getting on board the monorail at all of these locations. For that reason as this system is developed in the future, MMZ must take into account a fresh introduction to the rail tour at each of the entry and departure points. Messages here can be overarching and comparative from region to region. Media components and audio-enhanced messages forecast changes to the landscape, habitat zones, and animal groups that can be viewed along the journey. Messages here can be more complex, delivered by media systems that illustrate each of the world's continental and eco regions. This production could be scripted to provide an overview of the earth and its formation as viewed from space through Landsat imaging. Film footage could zoom close, providing flybys of bio-regions, herds of wildlife running, flocks of birds taking flight. Prior to stopping at the portals into each of the lands, visitors will gain a broad understanding of evolution and adaptation, setting the stage for deeper investigations.

On the monorail, visitors see an overview of the earth, geologic formations, global patterns of climate and change followed by detailed flybys of regions deliver messages about adaptation, diversity, and the need for conservation during the monorail tour.

Interpretive Strategies

Finally, visitors who take the Water Tour, like the monorail, will encounter other regions along the route. This tour, however, has a focus on cultural encounters, sounds, and vistas into other lands at ports of entry. This experience can be enhanced by docent storytellers/interpreters or a scientific tour guide. Language and music can accompany the tour. Visitors who arrive by boat can have the sense that they have arrived at a dock in Tropical America. This tour also identifies the journeys and regions to explore in Tropical America but may illuminate cultural myths about animals and the tropics. Icons, objects for trade, labeling on storage crates, maps, and many other clues suggest places to explore.

Touring the lake by boat immerses the visitor in cultural references, language, customs, and music from the peoples of Tropical America.

Overall, each of these approaches must underscore the main themes: biodiversity, adaptation, and conservation. Each of these approaches offers opportunities to introduce visitors to the main messages and set up their immersion into Tropical America.

Visitors will want to experience each method of entry, an incentive for repeat visits.

Village

The Village on the water's edge forms a junction where all paths converge to a center. Messages here include subtle themes of architectural design to suggest a location near the headwaters of the Amazon. Several architectural styles combine to suggest influences from the various regions to be explored. Materials for construction of the dock and buildings are those of the regions. Messages are present within the dock, inside structures, on posted maps of the tours with images of what to explore. Layers of languages, iconography, and suggestions of research groups that use the village as an outpost allow us to deliver messages of conservation, overarching themes, and build a sense of anticipation for the experiences that lie ahead.

The village messages include overviews of the regions while providing a sense of immersion in a different cultural landscape.

Exhibit Information Systems

A hierarchy of information delivery systems that move beyond the relatively simple interactive messages will be deployed. Signage elements will play a large roll in providing the multiple levels of information that include gateways, assist in wayfinding, introduce key ideas in thematic panels, and deliver details of information to those interested in research or more discovery in reader rails, flipbooks, pull tab panels, and smaller labeling systems. Over the course of the design phases MMZ staff and consultants will define appropriate length and active writing styles for text. A Spanish-language guide standard will need to be defined.

- gateways
- thematic panels
- signage systems
- reader rails
- interactive stations
- flipbooks
- earth forms and land cuts for graphic deliveries
- embedded trackway messages

Interpretive Strategies

Another challenge is to develop a signage delivery system that does not distract from the immersive qualities of the natural environments. The design team will work to create berms, cut-outs, and "blind" systems that allow for aesthetic vistas yet provide carve out areas for interpretation.

In addition to signage, we envision a number of other simple, environmental interpretives. Animal tracks, leaf impressions, and surface roots embedded into walkways highlight the presence of the animals and offer opportunities for subtle interpretation, reinforcing the themes of biodiversity and abundance.

Immersion Environments: Animal

One primary tool for interpretation is to immerse visitors in a controlled environment that offers many visual and auditory clues central to the theme of the content. For the zoo, animal immersion environments range from open-air animal exhibits to enclosed air-conditioned structures. These can be total immersion into bioregion settings such as a Rain Forest, a Flooded Forest. They can also be a cave, water environment, clusters of trees and understory, cliffs and overhangs, or other natural settings to offer a special moment for reflection while on the journey.

The zoo environment offers a natural immersion in the tropics. An abundance of animals in exhibit mixes offers a level of interpretation by association. This is enhanced by introducing caves, water elements, and the key experience of getting close to the animals—encountering animals in a natural state is key.

In an immersion environment, sensory input is paramount. Details are important—from the variety and density of plant collections, to the qualities of light and sound, to the shape of the terrain and the humidity of the air. Animal sounds, insect noises, bird calls, and leaf movements as animals move through the area can all be strategically embedded in the environment to simulate a natural Tropical America state. The development of these tracks must adhere to the science and biology of species groupings. Sound cabins can also suggest a larger social setting that might include birds, frogs, insects, primates, and other species from selected habitat zones.

Interpretive Strategies

Mesoamerica

Pacific Dry Forest, Cloud Forest
Location: Belize, Costa Rica, Honduras

A bridge between continents, Mesoamerica reflects a rich diversity of plants and animals. It is also the home of some of the Americas' greatest ancient civilizations. From the alluvial coastal lowlands and flat limestone plains of the Yucatán Penninsula to the rugged highlands of the Sierra Madre and the Cordilleras of Nicaragua and Costa Rica, the region incorporates a variety of habitats and biomes.

Animal migrations from the main continents north and south have made Mesoamerica a biological crossroads, with nearly as many plant species as in all of North America—despite having less than 6 percent of the land mass of its northern neighbor. Many of the plants and animals found in this region live nowhere else in the world.

The region ranks high on the list of hotspots for its biological diversity. It rose above sea level about five million years ago connecting North and South America, creating a major transition zone on which evolved endemic flora and fauna. It is extremely rich in plants, vertebrates, reptiles, amphibians, and resident birds, and it is a major highway for a multitude of migratory species of birds and butterflies.

The ancient civilizations of this region—including the Olmec, the Maya, and the Aztec—revered the animals of this region. For all of these people, the Jaguar especially represented the power and mysticism of the gods. From the flora of the region, Mesoamericans domesticated maize, beans, squash, cacao, and other plants. Along with gold and silver from the region, Europeans who came to Mesoamerica in the 16th century brought these products back to the old world where they became tremendously popular.

Mesoamerica is mostly threatened by fast deforestation, population growth, and livestock production. Huge tracts of lowland and highland forest are converted into crops and pasture for coffee, bananas, oil palm, and beef cattle. The development of ecotourism and cultivation of non-timber forest products may help resolve competing needs for economic development and conservation in Mesoamerica.

Key Fauna

Baird's tapir
Green vine snake
Giant palm salamander
Helmeted iguana
Beaded lizard
Neotropical snake
Morpho butterflies
Bromiliad boa
False coral snake
Coral snake
Hog-nosed pit viper
Basilisk lizard
Mexican red-legged tarantula
Bats
Spider monkey
Hummingbirds
Annulated boa
Eyelash viper
Birds (mixed)
Giant millipedes & centipedes
Poison-arrow frogs
Keel-billed Toucan
Sloth
Poison-arrow frogs
Jaguar
Fish
Central American river turtle

Key Flora

Moist tropical forests:
epiphytic orchids
bromeliads
Brugmansia
mosses
tree ferns
Philodendrons

Dry forests:
Tabebuia
Bombax
Enterolobium
Guadawa (bamboo)
Hymenaea
papaya
avocado
pineapple

Interpretive Strategies

CULTURAL NARRATIVES

Mayan Empire

One of the great ancient civilizations of tropical America, the Maya occupied significant portions of Mesoamerica. At the height of their civilization (300-900 A.D.), they built great temples in the rainforests of southern Mexico, Guatemala and Honduras. The challenges of living in the rainforest, particularly to domesticated agriculture, kept the Mayan population from increasing. Anthropologists suggest that this is one reason the Maya never developed major cities. Mayan hieroglyphics are extremely complicated, and only a small percentage have been translated. It's estimated that at the height of Mayan civilization, there were never more than 30 people per square mile. With such low populations, the accomplishments of this culture are truly remarkable. (www.wsu.edu:8080/~dee/CIVAMRCA/MAYAS.HTM)

Pacific Dry Forest

Located primarily along the Pacific coast, tropical dry forests in Mesoamerica experience far less rainfall. Many of the plants are deciduous, losing their leaves at the onset of the dry season, which often lasts six to eight months. Rains come in the late summer, and many of the plants have evolved leaves that conduct water to their root systems.

CONSERVATION AND CULTURE STORY

Jaguar: Ancient Symbol of the Gods

To many of the peoples of tropical America, the Jaguar has long been a symbol of the power of the gods. Mayan royalty wore jaguar skins and sat on jaguar thrones. The Aztecs had jaguar societies including a warrior elite called the Jaguar Knights. The Olmec people sculpted figures that were half man, half jaguar. As a creature of the night, the Jaguar was associated with mysterious power and all that was unseen in the jungle. The word Jaguar comes from the Guarani, who spoke of a beast that kills with one leap, *yaguara*. (Rabinowitz, 285-286; NG501)

Jaguars are the largest cats native to the western hemisphere. They roam throughout tropical America. Some adults stretch eight feet from nose to tail and weigh more than 300 pounds. Usually solitary animals, they roam at night, a male covering a territory ranging from 10 to 60 square miles. Often born in pairs, they stay with their mother for one and a half to two years. Unlike most big cats which eat primarily hoofed prey, jaguars eat fish, iguanas, anacondas, turtles, birds, and small mammals, including monkeys. (NG501p48)

Interpretive Strategies

ADAPTATION STORY

Baird's Tapir: When Mountains Come Between Them

In geological time, the Andes are barely teenagers, but old enough to split a family. Take the case of the Tapir. Biologists believe that this hog-like animal roamed the forests of South America prior to the uplift of the Andes. With the rise of the mountains, however, Tapirs on either side of the Andes evolved differently. Today, the Baird's tapir inhabits the lowland forests to the west of the Andes and on up into Central America. The Brazilian tapir thrives in the Amazon basin. Meanwhile, a third species, the Mountain tapir lives in the montane forests at middle and higher elevations in the Andes. (Kricher, NC, p. 107-108)

BIODIVERSITY INTERPRETIVE

Bats: A Case of Too Many Cousins

There are lots of different kinds of mammals in tropical America, but many of them are bats. In fact, bats account for nearly 40 percent of all the mammal species in this part of the world. Why so many varieties of one species? Specialization. Using their unique system of radar called "echolocation" bats originally fed on insects in the air. Many still do. But over time, some bats began to prefer fruit, others nectar, some pollen, others fish. There are frog-eating, bird-eating, lizard-eating, mouse-eating, and even blood-lapping bats. Some bats even eat other bats! This process of evolution, when one organism gives rise to a variety of species, each suited to exploit a narrow niche in the environment, is what ecologists call "adaptive radiation." (Kricher, p. 87, 98-99; NG402p116)

Want to see the world from a bat's point of view? Step inside the chamber. Want to hunt the way a bat does? Try the radar gun to locate your Big Mac.

Interpretive Strategies

Cloud Forest

In the mountainous regions clouds swirl through the treetops. Cooler temperatures, different soils, and mist that reduces the amount of sunlight foster a unique variety of plants and animals. Moss grows on the bark of trees and surfaces of rocks. Many species have evolved in fascinating ways to respond to this environment. Unique varieties of mites, for example, live in each of the flowers that bloom in the Costa Rican Cloud Forest. The mites travel from plant to plant as stowaways in the nostrils of hummingbirds, leaving the bird when they smell the perfume of the plant species they have adapted to. Threatened by deforestation to make room for coffee, cardamom, and similar crops, Mesoamerican cloud forests are in need of protection.

CONSERVATION STORY

Quetzal: A Bird for History?

(Not associated with a live exhibit) Quetzalcoatl, the feathered serpent god of Mesoamerica, was believed to have bestowed corn on the people of Mesoamerica. The people believed he wore the plumes of the Resplendent Quetzal bird. Aztec and Mayan rulers wore headdresses of quetzal feathers. The feathers were taken from trapped birds. Killing a quetzal bird was forbidden and brought a death sentence. Quetzal, however, have suffered from hunting and habitat destruction. Today, these birds are extremely rare. In the Monteverde Cloud Forest Preserve in Costa Rica biologists are working to protect breeding quetzals. (NG698p45)

NARRATIVE OPPORTUNITY

Bamboo: A cure for global warming?

When the atomic bomb exploded at Hiroshima, bamboo survived closer to ground zero than any other plant or animal. Remarkable for its hardiness, more than 500 species are native to the neotropics. Brazil is home to the greatest variety of species. In Mesoamerica, bamboo grows in the understory of montane forests providing shelter and food to a variety of birds and animals. Bamboo helps the environment in many ways. It can repair soil damaged by overgrazing or abusive agricultural practices. Its complex network of roots helps to prevent soil erosion and flooding. Even when bamboo is harvested, the roots remain vibrant and the plant regenerates. Bamboo also produces 35% more oxygen than trees, absorbing enormous amounts of carbon dioxide.

Interpretive Strategies

BIODIVERSITY/ ABUNDANCE STORY

Ruby Topaz Hummingbird: Keeping Time to a Hummingbird's Heart

Hummingbirds are overwhelming tropical creatures. Of the 322 species that inhabit the New World, 16 migrate to breed in North America, but the rest spend their lives in the tropics. Among the most beautiful is the Ruby Topaz Hummingbird. Males exhibit glowing, orange throats and have "bright, metallic, crimson heads." They live in the lowland forests of Mesoamerica. Extremely active creatures, hummingbird heart rates exceed 1200 beats per minute. Hovering to reach their long bills into a blossom, a hummingbird can beat its wings 80 times per second. Alike in their basic qualities and yet differing in size, color, and other physical characteristics, hummingbirds have adapted through the process of natural selection to exploit different environmental resources and conditions. Charles Darwin originally observed this process in a study of finches on the Galapagos Islands. Today, biologists call this process "adaptive radiation." (Kricher, p. 260-262; 98)

ADAPTATION STORY

Red-Eyed Tree Frog: With Bold Eyes and Sticky Toes

With bold, bright red eyes and a neon green body splashed with blue and yellow markings, this splendid tree frog inhabits the lowland rainforests of tropical America. Feeding on crickets, moths, flies, grasshoppers, and even smaller frogs, these animals use their suction-cup toe pads to climb and to stick when they leap from branch to branch. (www.nashvillezoo.org/redeye.htm)

CONSERVATION AND CULTURE STORY

Cacao: "Food of the Gods"

When the Spanish conquistadors arrived at the court of Montezuma, they were greeted by the lord of the Aztecs and served chocolate, which they had never tasted before. Within a short time Europeans craved this new delicacy as much as the Aztecs did. The taste of chocolate has ensured that humans have worked hard to promote the survival and proliferation of the cacao plant, a native of Mesoamerica. A small tree, cacao typically grows in the understory of the rainforest. Widely cultivated prior to the arrival of the Spanish, cacao was planted by the Maya in raised beds surrounded by canals. Today, in some parts of tropical America, habitats are being destroyed to make room for fields of cacao. To combat this destruction but feed our collective craving for the "food of the Gods" some growers are cultivating plants within the understory of the rainforest. They argue that rainforest soil makes for richer, sweeter chocolate! (Kricher, p. 185-186; www.chocolatceleste.com/finechocolatetheessential.html)

Interpretive Strategies

Key Fauna

Green anaconda
Orinoco crocodile
Blomberg's toad
Jaguar
Fish
Squirrel monkey
Butterflies (mixed)
Birds (mixed)
Mata mata
Tropical water snake
Liana snake
Water cobra
Pacu
Arapaima
Arrawana
Leaf-cutter ants
Peacock Bass
Calico snake
Surinam toad
Tamarins (mixed: emperor, pied)
Amazon racerunner
Tetras
Bushmaster
Catfish
Cichlids
Freshwater stingray
Caiman lizard
Thornytail lizard
Giant river otter
Goliath bird-eating spider
Harpy Eagle

Key Fauna

Gallery & varzea forests (buttress roots common)
figs
bromeliads
philodendrons
lianas
palms
kapok tree
Victoria amazonica (giant water lily)
Chorisia
Brazil nut tree
rubber tree

Amazonia

Flooded Forest, River and Confluences, *Terra Firme*
Location: Brazil, Peru, Venezuela

From its source in the Andes, the Amazon River runs nearly 6,500 miles to its mouth at the Atlantic, draining a sixth of the earth's ocean runoff. One day's discharge into the sea—4.5 trillion gallons—could supply all U.S. households with water for more than five months. Although the Nile River is longer, the Amazon carries 60 times more water. The flow is so strong that, as Arnold Newman has written, a hundred miles out to sea you could lean over the side of a boat to fill a glass with fresh water.

Encompassing 2.7 million square miles, the region is 90% of the size of the lower 48 U.S. states. Each year, as the river swells with the rainy season, it floods, covering the *varzea*, the vast Amazon lowland. This cycle of flooding feeds the rich diversity of species that live in the Amazon basin, making it one of the most unique biomes in the world. In the waters of the river there are almost as many species of fish (around 5,000) as there are in the Atlantic Ocean. Birds proliferate. One expedition reported sighting 76 different species in the branches of a single tree in the Amazon. The forests of Amazonia have been called the oldest, richest, and largest in the world. (Newman, 48-49)

There are several vegetation regions in the Amazon basin: the *terra firme* forests of the interfluvial regions, the *várzea* or floodplain of the white water rivers, the *igapó* or permanently flooded forests of the black water rivers, the savanna enclaves in the middle of the *terra firme* and a variety of smaller formations, such as the campinas and campinaranas growing on white sand, the montane forest growing on the sandstone *tepuis* on the Venezuela-Brazil border.

About 80% of Amazonia is still intact, although parts of it are being rapidly modified by development and industrialization. This region is still in very good condition, and some of the areas that were clear-cut in the 1980s have demonstrated rapid regeneration.

Interpretive Strategies

CULTURAL NARRATIVES

Peoples of the Amazon Basin
Five hundred years ago, an estimated 6.8 million people lived in the Amazon basin. Most lived along tributaries or near the floodplain where the river's annual rise and fall restored the fertility of the soil. The European invasion after 1500 brought new diseases, genocide, slavery, and competition for resources. People living far in the interior survived the best, including the Yanomamo, the Javari, and the Xingu. Nevertheless, the indigenous population of the region fell dramatically. By the 1990s, a quarter million indigenous people remained in Amazonia, many living on reservation lands set aside by the government called *resguardos*. (Kricher, p. 172)

The Yanomamo and the Gold Miners
The largest community of traditional forest-dwelling Amazonian people are the Yanomamo who live in the highland rainforest near the border between Venezuela and Brazil. Traditional hunter-gatherers who practiced a limited agriculture on small plots cleared in the rainforest, the Yanomamo have maintained many of their traditions. New highway construction into their traditional homelands, however, has brought an influx of gold miners and tremendous environmental destruction. (Kricher, p. 172-173)

Flooded Forest

When the rainy season comes to tropical America the great rivers, the Orinoco and the Amazon, swell. As the Amazon rises between 25 and 50 feet, the river overflows its banks. The floodplain, which may extend as much as 50 miles in from the river, is called the *varzea.* Depending on location, the *varzea* may be flooded two to ten months out of the year.

The annual cycle of flooding creates a unique ecology. As the waters rise, fish enter the forest area, feeding on the forest debris. Some plants and animals have adapted to this cycle, distinguishing themselves from their land-locked relatives.

For hundreds of years, the annual cycle of flooding, which enriched the soils of the *varzea*, supported large and permanent settlements prior to the European arrival in South America. Hunting caiman, birds, manatees, turtles, and mammals, including capybara, and fishing in the waters of the Amazon, these communities enjoyed protein rich diets. They harvested wild rice, as well as beans, peppers, cocoa, and bananas. (Kricher, p. 170, 180-181, & 197)

Interpretive Strategies

ADAPTATION STORY

Giant Amazon Water Lily: The Star of the Flooded Forest

A natural floating air mattress, the Giant Amazon Water Lily rides the surface of the quiet oxbow lakes formed by the Amazon. Red spiny edges deter herbivores who might nibble on the leaf or crawl aboard for a ride. (Newman, p. 20) The lily makes huge, beautiful white flowers which are female on the first day they bloom, and then turn pink and become male on the next day. Beetles pollinate the flowers.

As the water rises with the annual flooding of the Amazon, the stems of the lily, embedded in the floor of the *várzea,* can rise rapidly, as much as ten centimeters a day. (http://spot.colorado.edu/~stallard/Victoria.htm) According to Brazilian legend, a young Indian girl who had fallen in love with the moon drowned when she pursued the moon's reflection in the water. The warrior moon took pity on her. Though he could not revive her, he transformed her into a star on Earth, the white flower of the Giant Amazon Water Lily. (www.cantaremusic.com/stories/amazon.htm)

ADAPTATION STORY

Fish and Forest

An unusual relationship exists between fish and trees in the flooded forest. The annual flooding cycle means that fish play a key role in the recycling of decaying leaves and dead trees—the kind of role that insects play on dry land. Catfish, for example, act as termites, processing the forest litter. They also eat fruit, passing the seeds out unharmed. The adult tambaqui, who swims in the blackwater rivers bordering the *igapo* forest, has specially developed molars to grind and crush palm nuts and rubber tree seeds. Fish also help distribute seeds. Monkey fish explode from the water, leaping as much as a meter into the air, to grab fruit from low-hanging branches. (Kricher, p. 204)

CONSERVATION STORY

Black Caiman: Saving the Black Caiman of South America

(Not associated with a live exhibit) Purses, wallets, and shoes have driven South America's largest crocodilian almost to extinction. Once plentiful throughout the Amazon basin, the Black caiman, which often grows to more than 12 feet long, was hunted extensively from the 1950s to the 1970s and is still poached today despite being listed as an endangered species. The species survives throughout the Amazon basin, but its numbers remain low. In Brazil's largest protected wetland, the Mamiraua Ecological Reserve, however, the Black caimans are proliferating, giving hope to many who enjoy this spectacular animal. (Strieker, Gary, www.cnn.com/2000/NATURE/11/16/brazil.caiman/; see also www.flmnh.ufl.edu/natsci/herpetology/act-plan/mnige.htm)

INTERPRETIVE

Why Are The Tropics So Wet?

The sun's radiation falls directly and constantly on the tropics, heating the air and evaporating water. Trade winds from the Atlantic carry additional moisture into the region. As this warm moist air rises, it cools and condenses, producing lots of rain—as much as 118 inches a year in some parts of the Amazon. (Kricher, p. 5)

Interpretive Strategies

Rivers and Confluences

The Amazon, the Orinoco and the other major rivers of tropical America teem with marine life. Freshwater dolphins and giant river otter ply the waters along with the largest freshwater fish in the world. Along the banks, gallery forests grow and from the forests, capybara, caiman, and anaconda come to feed. Many unique bird species live along the rivers, some feeding on the more than 2,400 species of fish who live in the Amazon's waters. At its mouth, the Amazon pours into the Atlantic with such strength that the river does not form a true delta. At the ocean, the river is nearly 200 miles wide. Sediment from the Andes and the river's 6,500-mile journey washes 100 miles out to sea. (NG295)

How Water Mixes at the Confluence of Rivers

INTERPRETIVES

Where rivers meet, at the confluence of the Amazon and the Rio Negro, for example, the difference between these waters is evident. (In this interactive, three different colored solutions are under a plexiglass cover. Over the top is etched a map of the rivers confluence.)

The Waters of the Amazon Basin

Different soils color the waters of the tributaries of the Amazon in different ways. From the Andes, a relatively young mountain range, streams erode the soil, and the water resembles café mocha. From older geological regions such as the Guianan Highlands, the water is colored by the decomposition of leaves rather than the erosion of soil, and the water is black or tea-colored.

Leafcutter Ants: Sanitation Engineers of the Neotropics

ADAPTATION

Inhabiting all of the New World Tropics, Leafcutter ants remove 15% of the leaf production of the rainforests each year. Insect farmers, they cultivate the fungus on which they feed, communicating with one another by scent and sound. "Scaled to human dimensions, each worker runs the equivalent of a four-minute mile for 30-some miles, with 500 pounds slung over her shoulders." (NG795)

Giant River Otter: Facing an Uncertain Future

CONSERVATION AND CULTURE

In the slow-moving waters of the Amazon tributaries the largest otters in the world dine on catfish, crabs, frogs, and even an occasional anaconda. From nose to tail, the Giant river otter grows to six feet long. A social and playful animal, the otter can often be seen in a group of up to seven family members. Unfortunately, its velvety brown fur has long attracted hunters. Laws to protect the otter have helped, but environmental degradation from gold mining, deforestation, and pollution now pose a continued threat. As a top predator in its aquatic habitat, the fate of the Giant river otter may forecast the future of other animals and plants as well. (www.worldwildlife.org; www.amazonia.net/Articles/24.htm; Kricher, p. 207)

Interpretive Strategies

Terra Firme

Elevated above the floodplain of the Amazon, the vast forests of *terra firme* occupy more than 95% of the Amazon basin. Separating the Amazon basin from the waters of the Orinoco River and the northeastern Atlantic, the Guianan Highlands or "shield" is a vast plateau of ancient Precambrian rock. Related to the Brazilian Highlands to the south, these tablelands rise like a set of steps for a giant, each plateau separated by a sheer escarpment. Semi-deciduous tropical rainforests rich in fauna dominate the region. Giant waterfalls—including Angel Falls, the highest in the world—make for spectacular scenery.

Old in terms of geology, these highlands shed few soils in erosion. As a result, the rivers that feed the Amazon from the north are black or tea-colored by the decay of plant material. A poorly defined shore covered with a permanently or periodically flooded swamp forest called *igapó* by the Brazilians characterizes these rivers. Although those waters are poor in biomass, they support a high diversity of species endemic to the *igapó*. Giant river otters, Jaguars, Black spider monkeys, and Giant armadillos all live in this region. It is also home to one of the largest remaining populations of Harpy Eagles. The Blue poison dart frog is found only in Suriname.

For centuries, the people of the *terra firme* regions practiced slash-and-burn shifting cultivation. Manioc—known to many North Americans as tapioca—was a basic food. But its cultivation depleted the nutrients from the soil, so every five to seven years the people would move their villages to another area. According to local custom, these moves were often preceded by the death of an adult in the community. (Kircher, p. 181)

INTERPRETIVE

Rainforest Symphony Listening Station

To the untrained ear, the rainforest can be a noisy place. The sounds of insects, dripping water, Howler monkeys, and boisterous birds make for a cacophony of sound. In reality, animals and insects find their place in the soundscape, like a violin complements the sound of a cello or trumpet in a symphony. As one ecologist puts it, "A complex vital beauty emerges that the best of sonic artists in Western culture have yet to achieve." The Jivaro and other people of the Amazon Basin learn to distinguish one creature from another, and even one mini-habitat from the next, by listening to particular and collective sounds in the rainforest. See if you can separate the calls of different animals from the backdrop of sound or listen to the microphones hidden in the exhibit in front of you. (Bernard L. Krause, Ph.D., "The Niche Hypothesis," *Soundscape Newsletter* 6 [June 1993]; http://interact.uoregon.edu/MediaLit/wfae/readings/niche.html)

Interpretive Strategies

CONSERVATION AND CULTURE STORY

A Tropical Pharmacy
A small flowering plant from the island of Madagascar produces a substance that scientists discover fights Hodgkin's disease and leukemia. An antibiotic critical for patients allergic to penicillin is derived from a tropical fungus. Natives of the Amazon rainforest used more than 1,300 plant species for curing various diseases and maladies. The rainforests of the world offer potential cures for a variety of illnesses. But scientists have not classified, much less screened, all of the estimated 90,000 plant species in Latin America. The potential cures that wait to be discovered offer a compelling reason to protect the biodiversity of tropical America. (www.nwf.org/keepthewildalive/periwinkle/bigpicture.cfm)

CONSERVATION INTERACTIVE

Harpy Eagle: Knowing What You Eat Can Determine How You Survive
In the highlands of Guiana a naturalist climbs up 100 feet into the branches of a kapok or silk-cotton tree to gather the bones of monkeys, sloths, macaws, parrots, and other unfortunate prey. At one time, the nest belonged to the earth's most powerful raptor—the Harpy Eagle. Named by early explorers who thought these creatures resembled the half-woman, half-bird predatory monsters of Greek mythology, the Harpy Eagle is threatened by deforestation. Naturalists seeking to persuade the government of Guyana to create a biosphere reserve to protect the Harpy's habitat use the bones of the eagle's prey to help determine the size and type of habitat that should be protected. Look at these bones and see if you can match them with the photographs of the animals you see. (NG295p40)

Can You Lift an Anaconda?
With your friends or your family, try to lift this sand-filled "anaconda." Adult Anacondas are big—especially the females, who can weigh as much as five times the average male. Although popular myths about man-eating Anaconda abound, we actually know less about how this reptile lives in the wild than many other animals. In tropical America, the Green anaconda inhabits much of the Amazon basin, while the Yellow anaconda lives in the Pantanal. (NG199p69)

Interpretive Strategies

Key Fauna

Golden lion tamarins
King vulture
Giant walking stick
Capybara
Giant anteater
Butterflies
Reptiles
Amphibians
Insects
Fish
Scorpion
Ornate Hawk Eagle
Howler monkey
Jabiru Stork
Macaws

Key Flora

Palms
Albizia
Araucaria
Cassia
Bougainvillea
Caesalpinia
Cordia
Erythrina
Tipuana
Jacaranda
Peltophorum
mango
banana
scrub thickets
sedges
grasses

Atlantic Forest & Pantanal

Atlantic Forests, Pantanal, Savannas
Location: Coastal Brazil, Paraguay

Along the southeast coast of Brazil, as it slides west towards Uruguay, the Atlantic Forest once dominated the landscape. Looking down, a passenger flying westward would see a solid forest of green sweeping across the Brazilian highlands towards the dry plateau known as the Mato Grosso. From this plateau the rivers drain south and west into an enormous basin in the south central portion of South America. This vast and watery grassland is known as the Pantanal, one of the richest ecological regions in the world. Continuing west and south, beyond Brazil, and into the savanna, or grasslands known as the Gran Chaco of Bolivia, Paraguay, and Argentina. Together, these two ecosystems represent an ecological treasure.

The Atlantic Forest is disappearing rapidly. Urban, agricultural, and industrial pressures make the Atlantic Forest a highly endangered region that has lost well over 90% of what once existed. Sao Paulo and Rio de Janeiro are in the Atlantic Forest region where at least two thirds of Brazil's population live. Agriculture and cattle-grazing pose threats to the Pantanal.

Atlantic Forest

Before the arrival of Europeans in South America, the Atlantic Forest once covered most of the coastal region of southeastern Brazil. Landscape, wind patterns, and ocean currents shaped the climate that allowed a remarkably diverse forest to evolve over millions of years.

Visitors will learn that only 8% of this forest remains today, yet it is still the most diverse ecosystem on the planet. In some parts of the Atlantic Forest one can find as many as 800 species of trees, more than half of which are endemic, meaning they can only be found in this forest. (Dean, p. 346) The forests are especially rich in bromeliads and orchids; their rivers host fish communities that are very poorly known. Vertebrate diversity is high: about 80% of the 25 primate species and subspecies found within the region are endemic. There are about 261 mammal species compared with about 353 in the five-times-bigger Brazilian Amazon. The two endemic genera are the lion tamarin and the muriqui, the largest of the New World monkeys. The most spectacular bird of the forests is called the Alagoas Curassow or Mitu Mitu Mitu that has not been seen in the wild for nearly three decades. Culturally, an important indigenous group is the warlike Tupinambá, who originally dominated the Brazilian coast from the mouth of the Amazon to Cananeia in Sao Paulo State.

Interpretive Strategies

ADAPTATION STORY

Bromeliads: The World as an Epiphyte
In an environment as rich as a rainforest, a feverish competition for water, light, and nutrients takes place. Some plants have evolved to flourish by piggy-backing on taller species. Without roots in the ground, these plants, known as epiphytes, seem to live on air. Actually, they have evolved to capture water and nutrients falling from the sky or the canopy overhead. Bromeliads, for example, have an overlapping rosette of daggerlike leaves that funnels organic matter and water to the base of the plant. Animals and insects that inhabit the canopy of the rainforest drink the water captured by the bromeliads' leaves and thus avoid the need to brave the dangers of predators on the ground. There are an estimated 15,500 species of epiphytes in tropical America. (Kricher, NC, p. 30-32).

ADAPTATION INTERPRETIVE

Giant Walking Stick: In Plain Sight—A Story of Camouflage
Many animals have evolved to protect themselves from predators or hide from prey by blending into the background of the environment. Among the most remarkable is the Giant walking stick, which looks like a twig on the branch of a tree. Biologists call this kind of camouflage "cryptic coloration." These disguises force visitors to Tropical America to look carefully. Who can you see in this exhibit?

Savanna

Grass is the dominant plant species on the savanna, also known as the *cerrado* in Spanish-speaking America. Unlike the wet pantanal, however, savanna grasses have adapted to warmer, drier climates and seasonal droughts. In the Savanna, only an occasional Caesalpinia or Acacia tree breaks the horizon.

Plants struggle in this region, parched for water at certain times of the year and straining for nutrients from soil that lacks sufficient elements such as calcium, phosphorous, sulphur, zinc, and nitrogen. Conserving energy and water, many of the plants of the cerrado concentrate their biomass close to the ground.

Within the landscape of the *cerrado*, there are oases of vegetation called *capões*. Started by termites and ants who make mounds of loose soil, these plants grow when birds deposit seeds. Animals of the *cerrado* take refuge in these dense thickets, including Capybara, Armadillos, Antbears, and even Jaguars. (Banks, p. 18-19)

A biodiversity hotspot, the *cerrado* is home to many unusual species. Two very large birds, the Rhea and the Seriema, inhabit this region, along with the threatened Passerine Bird. Among the mammals who roam these grasslands the large-eared, long-legged, fox-like Maned wolf stands out with its golden-red fur marked by a black stripe running from the top of its head to the middle of its back. The Giant armadillo and the Giant anteater are also native.

Interpretive Strategies

ABUNDANCE STORY

Capybara: Don't Catch This Guy in Your Kitchen

The giant among rodents, the Capybara can grow to more than 100 pounds. It lives near waterways. With a body and feet that are adapted for swimming, the Capybara uses the water to escape predators and to keep its skin from drying out. Its toes are partly webbed for paddling. Capybara travel in herds. Sentinels keep an eye out for danger. To alert the others, they let out a bark. Females give birth to a brood of up to eight young, and within the herd, females will take turns caring for the young. (Elizabeth Schleichert, "The rodent rules!", Ranger Rick (Sept 1999).)

Pantanal

Located in central-western Brazil and in adjacent portions of Paraguay and Bolivia, the Pantanal is the world's largest wetland. Like a giant sponge, this 200,000 square kilometer area absorbs waters from three rivers: the Paraguay, the Taquari, and the Cuiabá. Larger than France, this beautiful and exotic region encompasses swamps, gallery forests, and several different kinds of open grasslands. During the rainy season from October to March the Pantanal is a vast flooded plain with islands of vegetation. (Swartz, p. 4)

Comprised of two principal regions, the low-altitude floodplain and the elevated highlands of the Gran Chaco, the Pantanal has more animals per square mile than any other region in the New World. Home to species such as the Rhea, Screamer, and Hyacinth Macaw, the Pantanal is an important migratory bird stopover point and wintering ground. Among the many mammals and reptiles who live in the region are the Capybara—the world's largest rodent—the Tapir, the Giant anteater, and the Paraguayan caiman. Those animals are usually difficult to see in Amazonia but are more likely to be encountered in the Pantanal.

One of the top threatened hotspots on Earth, the ecology of the Pantanal is threatened by cattle ranching and associated grassland burning in the dry season. These practices have affected much of the vegetation of the Pantanal. Forty-six mammal species are considered rare or endangered in the Pantanal.

Striving to protect the region, the governments of Brazil, Paraguay, and Bolivia have created parks and reserves within the Pantanal. Xingu National Park, a large indigenous reserve in the upper reaches of northern Mato Grosso state in Brazil, encompasses two and a half million hectares. Brazil created the Pantanal National Park in 1981. (Swarts; Banks)

Interpretive Strategies

Partner Parks: the Everglades and the Pantanal
As two of the world's most important freshwater wetlands the Everglades and the Pantanal have a lot in common. Development, however, has taken its toll on the Everglades. Today, the people of Florida and the United States are working to restore portions of this ecological treasure. The Pantanal, by contrast, faces the early stages of large-scale human exploitation, and policymakers are hoping to learn from the Florida experience. To recognize their common effort to save these two important wetlands, the United States and Brazil in October 1997 declared the Everglades National Park and Pantanal National Park "partner parks." The declaration has promoted a number of joint efforts to address wetland issues.
(Swarts, p. 16; Jeffry S. Wade, "Brazilian Pantanal…," 1996)

Jabiru Stork: A Glorious Wingspan
If birds played basketball, the Jabiru Stork might play center. Standing five feet tall, one of the largest flying birds in the New World, the Jabiru has a wingspan ranging up to twelve feet. A distinctive band of naked, red skin appears on its neck. Locals call it the "tuiuiu." It feeds on insects, fish and other animals. The Jabiru make huge nests. Although it inhabits many wetland areas of tropical America, the Jabiru is a symbol of the Pantanal. (www.belizezoo.org)

Exhibit Program

Index/Sheet Key

Animal | Animal Species | Number

A.A.1

Species:

A Amphibians

B Birds

F Fishes

I Invertebrates

M Mammals

R Reptiles

P Public Structures

K Keeper Zone

Notes on Estimate:

Legend (Costs)

"MB" is Mechanical Burden, and is a factor for air conditioning and mechanical rooms.

"IB" is Immersion Budget, and is a factor to provide extra plantings and related habitat features surrounding the exhibit.

"CF" is Containment Factor which increases the Keepers' areas to allow for extra room and containment with venomous snakes.

Dimensions (Costs)

- Dimensions of exhibits are usually gross and include wall thicknesses.
- Aquarium units are dimensioned with varying amounts of extra width (w) in the cost column. This extra wall space will accommodate interpretives and Keeper functions.

Not Programmed are the Following (non-inclusive list):

- Greater Rhea (currently with Guanaco)
- Galapagos Tortoise (currently in collection)
- Dwarf Caiman (opportunity in mixed-species exhibit?)
- Maned Wolf
- Coati (need to add)
- Any connecting exhibitry, especially south of the site, connecting to the present monorail station which is programmed for demolition.

Exhibit Program

Animal/Structure:	No. of Structures/Units:	Index • Sheet:
Amphibians #1	(3) 50-gallon aquariums	A.A.1

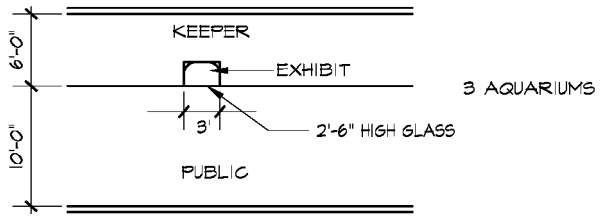
Description:
Toads and Caecilians

Zones:
R.A.

Costs:
(3) 3'-0" x 17'-0" x $275.00/s.f. x 1.1 MB
$46,300

Notes:
All Fill and Dump Systems

Plan/Graphics:



Animal/Structure:	No. of Structures/Units:	Index • Sheet:
Amphibians #2	(2) 300-gallon aquariums	A.A.2

Description:
Poison Arrow Frogs

Zones:
M.A.

Costs:
(2) 9'-0"w x 17'-0"
x $275.00/s.f. x 1.1 MB $92,600

Notes:
Fill and Dump System; Bromeliads

Plan/Graphics:

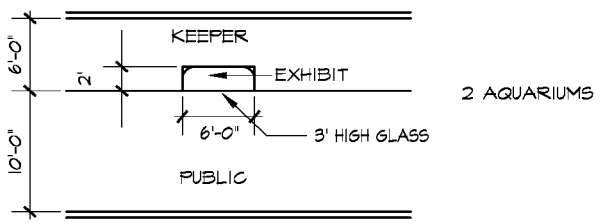


Exhibit Program

Animal/Structure:	No. of Structures/Units:	Index • Sheet:
Amphibians #3	(3) 250-gallon aquariums	A.A.3

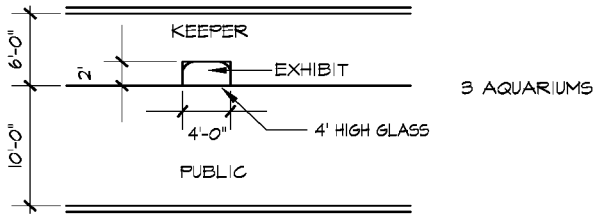
Description:
Tree Frogs

Zones:
R.A.

Costs:
(3) 6'-0"w x 17'-0" x $275.00/s.f. x 1.1 MB $92,600

Notes:
Fill and Dump

Plan/Graphics:



Animal/Structure:	No. of Structures/Units:	Index • Sheet:
Amphibians #4	(3) 550-gallon aquariums	A.A.4

Description:
Miscellaneous Frogs

Zones:
AF&P.

Costs:
(3) 11'-0"w x 22'-0" x $275.00/s.f. x 1.1 MB $219,600

Notes:
Dump and Fill (Little Water)

Plan/Graphics:

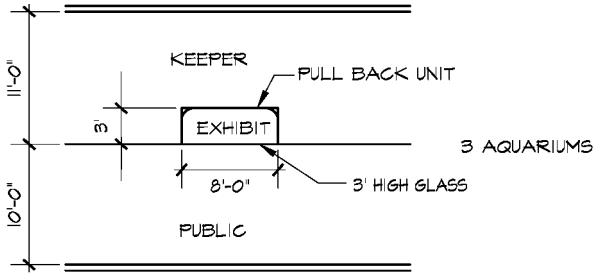


Exhibit Program

Animal/Structure:	No. of Structures/Units:	Index • Sheet:
Birds (Mixed Species Exhibit)	0	A.B.1

Description:

Blue-billed Toucan
Blue and Gold Macaw
Scarlet Ibis
Crested Screamer
Maguari Stork
Puna Ibis
Black-bellied Whistling Duck
Ringed Teal
Collared Aracari
Plush-capped Jay
Currasow Sparrow
Tinamou Sparrow
Gray-winged Trumpeter
Sunbittern
Orinoco Goose
Chilean Flamingos (Future Phase: Temperate S.A.—Patagonia)

Notes: Could be with Sakis & Marmosets in general, and lots of other species including some tortoises & small turtles, however, no larger primates. All of these birds are assumed to be part of mixed species exhibits already programmed in this document. However, no provision for special holding or catch assemblies are programmed.

Zones:

Costs:

(3) 11'-0"w x 22'-0"
x $275.00/s.f. x 1.1 MB $219,600

Plan/Graphics:

Animal/Structure:	No. of Structures/Units:	Index • Sheet:
Raptors	1	A.B.2

Description:

King Vulture

Potential Mixed Species: With anteater, spider monkey, squirrel monkey, sloth, agouti, capybara, and/or tamandua?

Notes:

Zones:

R.A.

Costs:

Aviary Structure & Mesh 10,000 x 55/s.f. =	$550,000
Exhibit Design 10,000 x 65/s.f. =	$650,000
Public Allowances =	$20,000
Immersion Allowances @ Perimeter =	$70,000
	$1,290,000

Plan/Graphics:

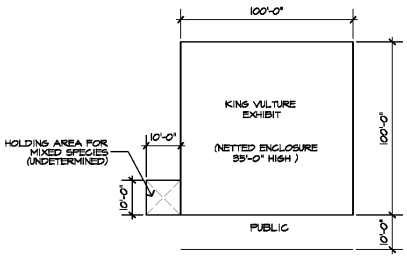


Exhibit Program

Animal/Structure:	No. of Structures/Units:	Index • Sheet:
Raptors	1	A.B.3

Description:
Ornate Hawk Eagle

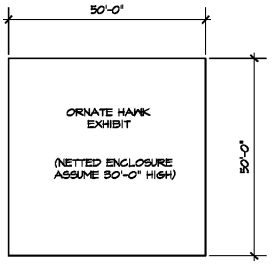
Zones:
M.A.

Costs:

Aviary Structure & Mesh 2,500 x 60/s.f. =	$150,000
Exhibit Design 2,500 x 651/s.f. =	$162,000
Public Allowances =	$15,000
Immersion Allowances @ Perimeter =	$20,000
	$347,000

Notes:

Plan/Graphics:



Animal/Structure:	No. of Structures/Units:	Index • Sheet:
Raptors	1	A.B.4

Description:
Andean Condor (Currently in Collection)

Zones:
A.F. & P."Close to temperate South America (future phase)"

Costs:

Aviary Structure & Mesh 4,000 x 60/s.f. =	$240,000
Exhibit Design 4,000 x 65/s.f. =	$260,000
Public Walkways 1,000 s.f. x 70/s.f. =	$70,000
Immersion Allowances @ Perimeter =	$30,000
	$600,000

Notes:

Plan/Graphics:

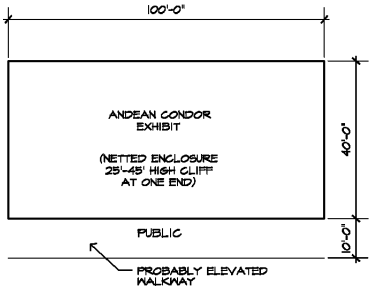


Exhibit Program

Animal/Structure:	No. of Structures/Units:	Index • Sheet:
Animal Diet Prep Core at Multi-Species Buildings		K.4

Description:

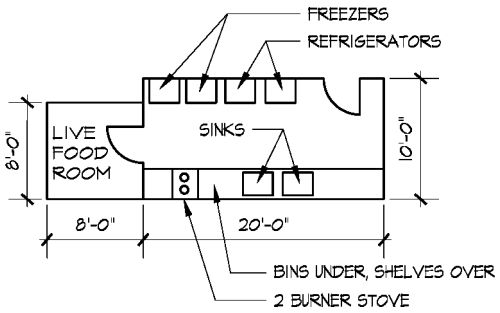
Animal Diet Prep Includes:
2 Refrigerators
2 Freezers
Large Counter with Carts Under
Two-Compartment Sink
Stove
8' x 8' Live Food Room

Zones: Undetermined

Costs:
360/s.f. (Gross)
x $250/s.f. w/ M.B. = $90,000

Notes:

Plan/Graphics:



Animal/Structure:	No. of Structures/Units:	Index • Sheet:
Quarantine		K.5

Description:

Behlen cages, Aquariums
Cyclone type containment
Pre-fabricated metal buildings

Zones: N.A.

Costs:
Quarantine Allowance = $150,000

Notes:

Plan/Graphics:

Water Treatment Systems—Expectation of Probable Cost Matrix **Miami Metrozoo—Tropical America • Revised April 21, 2003**

Exhibit Category	Exhibit Tank or Displays	Size or Volume	Species	Description of Water Treatment System	Cost of Water Treatment System	Associated Electrical Costs	Total Cost
Animal - Amphibians	A.A.1 Amphibians #1	3 @ 50 gallons	Amphibians	Small Package Re-circulating Water Treatment Systems Supplied from Central R.O.Water Make-up System.	3 x $1,000 = $3,000	3 x $300 = $900	$3,900
	A.A.2 Amphibians #2	2 @ 300 gallons	Amphibians	Small Package Re-circulating Water Treatment Systems Supplied from Central R.O.Water Make-up System.	2 x $1,500 = $3,000	2 x $400 = $800	$3,800
	A.A.3 Amphibians #3	3 @ 250 gallons	Amphibians	Small Package Re-circulating Water Treatment Systems Supplied from Central R.O.Water Make-up System.	3 x $1,500 = $4,500	3 x $400 = $1,200	$5,700
	A.A.4 Amphibians #4	3 @ 550 gallons	Amphibians	Small Package Re-circulating Water Treatment Systems Supplied from Central R.O.Water Make-up System.	3 x $2,000 = $6,000	3 x $500 = $1,500	$7,500
Aquarium Fish Tanks	A.F.1 Tropical Fish Aquariums	2 @ 1350 gallons	Tropical Fish	Life Support Systems Supplied from Central De-chlorinated Water System	2 x $20,000 = $40,000	2 x $3,000 = $6,000	$46,000
	A.F.1 Tropical Fish Aquarium	1 @ 4800 gallons	Tropical Fish	Life Support System Supplied from Central De-chlorinated Water System	1 x $35,000 = $35,000	1 x $5,000 = $5,000	$40,000
	A.F.1 Tropical Fish Aquariums	2 @ 17,000 gallons	Tropical Fish	Life Support Systems Supplied from Central De-chlorinated Water System	2 x $100,000 = $200,000	2 x $12,000 = $24,000	$224,000
Aquarium Invertebrates	A.I.1 Small Aquariums	Not known	Invertebrates	Package Life Support Systems Supplied from Central De-chlorinated Water System	Allowance = $10,000	Allowance = $2,000	$12,000
	A.I.2 Large Aquariums	Not known	Invertebrates	Life Support Systems Supplied from Central De-chlorinated Water System	Allowance = $20,000	Allowance = $4,000	$24,000
Animals - Mammals	A.M.2 Spider Monkey + Fish	3,800 gallons	Monkeys + Fish	Life Support System Supplied from Central De-chlorinated Water System	1 x $30,000 = $30,000	1 x $4,500 = $4,500	$34,500
	Spectacled Bear ELIMINATED	—	—	—	$00	$00	$00
	A.M.8 Capybara	1,800 gallons	Capybara	Re-circulating Filtration System	1 x $15,000 = $15,000	1 x $2,500 = $2,500	$17,500

Water Treatment Systems—Expectation of Probable Cost Matrix

Miami Metrozoo—Tropical America • Revised April 21, 2003

Exhibit Category	Exhibit Tank or Displays	Size or Volume	Species	Description of Water Treatment System	Cost of Water Treatment System	Associated Electrical Costs	Total Cost
	A.M.8 Tapir	1,800 gallons	Tapir	Re-circulating Filtration System	1 x $15,000 = $15,000	1 x $2,500 = $2,500	$17,500
	A.A.9 Jaguar with Fish	2 @ 3,000 gallons	Jaguar + Fish	Life Support Systems Supplied from Central De-chlorinated Water System	2 x $30,000 = $60,000	2 x $5,000 = $10,000	$70,000
	A.M.10 Giant River Otter	36,000 gallons	Giant River Otter	Life Support System Supplied from Central De-chlorinated Water System	1 x $200,000 = $200,000	1 x $20,000 = $20,000	$220,000
Animals - Reptiles	A.R.4 Hot Snake	1 @ 300 gallons	Snakes	Small Package Re-circulating Water Treatment System Supplied from Central R.O.Water Make-up System.	1 x $1,500 = $1,500	1 x $400 = $400	$1,900
	A.R.6 Snakes	1 @ 150 gallon	Snakes	Small Package Re-circulating Water Treatment System Supplied from Central R.O.Water Make-up System.	1 x $1,200 = $1,200	1 x $400 = $400	$1,600
	A.R.7 Snakes	1 @ 1,300 gallons	Anaconda	Package Re-circulating Water Treatment System Supplied from Central R.O.Water Make-up System.	1 x $20,000 = $20,000	1 x $3,000 = $3,000	$23,000
	A.R.10 Reptiles	1 @ 660 gallons	Miscellaneous Reptiles	Small Package Re-circulating Water Treatment System Supplied from Central R.O.Water Make-up System.	1 x $4,000 = $4,000	1 x $800 = $800	$4,800
	A.R. 11 Turtles	1 @ 1,000 gallons	Turtles + Fish	Small Life Support System Supplied from Central De-chlorinated Water System	1 x $12,000 = $12,000	1 x $2,000 = $2,000	$14,000
	A.R. 12 Orinoco Crocodiles	1 @ 12,000 gallons	Crocodiles	Package Life Support System Supplied from Central De-chlorinated Water System	1 x $70,000 = $70,000	1 x $8,000 = $8,000	$78,000
Public Stream	-	3,000 gallons	-	Re-circulating Filtration System	1 x $25,000 = $25,000	1 x $4,000 = $4,000	$29,000
Central R.O Systems	-	-	-	2 – R.O. Water Make-up Storage and Supply Systems	2 x $12,000 = $24,000	2 x $2,000 = $4,000	$28,000
De-chlorinated Water Systems	-	-	-	2 – Central De-chlorinated Water Supply Systems (Granulated Active Carbon Filters)	2 x $10,000 = $20,000	2 x $1,500 = $3,000	$23,000
Cost Totals					$819,200	$110,500	$929,700

Expectation of Probable Construction Cost
Option A—Amazonia and Mesoamerica

		Mesoamerica	Amazonia	Costs
ANIMAL—AMPHIBIANS				
A.A.1	Amphibians #1		$46,300.00	$46,300.00
A.A.2	Amphibians #2	$92,600.00		$92,600.00
A.A.3	Amphibians #3		$92,600.00	$92,600.00
A.A.4	Amphibians #4			$219,600.00
ANIMAL—BIRDS				
A.B.1	Mixed Species Birds	$0.00	$0.00	$0.00
A.B.2	King Vulture		$1,290,000.00	$1,290,000.00
A.B.3	Ornate Hawk Eagle	$347,000.00		$347,000.00
A.B.4	Andean Condor			$600,000.00
A.B.5	Harpy Eagle		$474,000.00	$474,000.00
ANIMAL—FISHES				
A.F.1	5 Large Aquariums	$166,360.00	$665,440.00	$831,800.00
ANIMAL—INVERTEBRATES				
A.I.1	Small Invertebrate Aquariums	$30,870.00	$41,160.00	$102,900.00
A.I.2	Large Invertebrate Aquarium	$46,778.00	$35,044.00	$128,600.00
ANIMAL—MAMMALS				
A.M.1	Tamarins (mixed species)		$237,250.00	$474,500.00
A.M.2	Spider Monkey w/ Fish		*	$297,300.00
A.M.3	~~Spectacled Bear~~ ELIMINATED	$0.00	$0.00	~~$2,244,500.00~~
A.M.4	~~Ocelot~~ ELIMINATED	$0.00	$0.00	~~$478,200.00~~
A.M.5	Howler Monkey & Sloth			$224,900.00
A.M.6	Anteater & Toucan	*	$253,100.00	$253,100.00
A.M.7	Bats & Opossum	$232,700.00		$232,700.00
A.M.8	Capybara & Tapir	$765,000.00		$765,000.00
A.M.9	Jaguar w/ Fish	****	$1,285,800.00	$1,285,800.00
A.M.10	Giant River Otter			$828,500.00
ANIMAL—REPTILES				
A.R.1	Hot Snakes	$89,634.00	$89,633.00	$268,900.00
A.R.2	Hot Snakes	$90,450.00	$90,450.00	$180,900.00
A.R.3	Hot Snakes			$74,400.00
A.R.4	Hot Snake	$54,250.00	$54,250.00	$108,500.00
A.R.5	Snakes	$30,867.00	$61,733.00	$92,600.00
A.R.6	Snakes			$98,000.00
A.R.7	Anaconda		$85,400.00	$85,400.00
A.R.8	Misc. Reptiles	$30,850.00	$30,850.00	$61,700.00
A.R.9	Misc. Reptiles	$27,000.00	$27,000.00	$54,000.00
A.R.10	Misc. Reptiles	$41,750.00	$41,750.00	$83,500.00
A.R.11	Turtles	$44,450.00	$44,450.00	$88,900.00
A.R.12	Orinoco Croc		$405,100.00	$405,100.00
				$1,601,900.00

* Alternate Location by Client
** Arbitrary Shift by Consultants to Get Dollars to Balance
*** Portions of This Could Be in Interpretive Budget Where Appropriate
**** Jaguar Would Also Be in This Zone

revised 3 June 2003

Expectation of Probable Construction Cost

Option A—Amazonia and Mesoamerica

		Mesoamerica	Amazonia	Costs
PUBLIC ZONE				
P.1	Program Building Space	$87,500.00	$175,000.00	$350,000.00
P.2	Restaurant		$1,012,500.00	$1,012,500.00
P.3	Gift Shop		$137,500.00	$137,500.00
P.4	Special Events "Lawn"			$580,000.00
P.5	Misc. #1 (Includes Plaza)	$200,000.00	$640,000.00	$888,000.00
P.6	Misc. #2 (Includes Monorail Station)	$100,000.00	$1,125,000.00	$1,350,000.00
P.7	Classroom/Amphitheater	$406,200.00	$382,500.00	$1,171,200.00
KEEPER				
K.1	Horticulture/Tools		$13,000.00	$26,000.00
K.2	Storage	** $15,000.00	$15,000.00	$30,000.00
K.3	Curatorial		$87,500.00	$175,000.00
K.4	Kitchen		$90,000.00	$90,000.00
K.5	Quarantine	** $50,000.00	$100,000.00	$150,000.00
LIFE SUPPORT				
LS.1/LS.2	Water Systems	$142,800.00	$555,000.00	$929,700.00
X	Allow 25% for Enclosures	$35,700.00	$138,750.00	$232,425.00
		$3,035,159.00	$9,823,060.00	(SUBTOTALS)
Interpretives		$800,000.00	$800,000.00	
		$3,835,159.00	$10,623,060.00	(SUBTOTALS)
Linkages (Pathways) and Supporting Immersion Landscape		$191,757.95	$531,153.00	5%
		$4,026,916.95	$11,154,213.00	(SUBTOTALS)
Utilities, Service Drives, and External Barriers		$805,383.39	$2,230,842.60	20%
		$4,832,300.34	$13,385,055.60	
Program Level Contingency		$1,449,690.10	$4,015,516.68	30%
		$6,281,990.44	$17,400,572.28	
*** Art in Public Places 1.5% of Construction plus Design & Approximate Related Costs		$77,000.00	$212,100.00	Allow
Inspector General		$15,704.98	$43,501.43	0.25%
Independent Private Sector Inspector General		$47,114.93	$130,504.29	0.75%
Construction Contingency		$628,199.04	$1,740,057.23	10%
		$7,050,009.39	$19,526,735.23	

* Alternate Location by Client

** Arbitrary Shift by Consultants to Get Dollars to Balance

*** Portions of This Could Be in Interpretive Budget Where Appropriate

**** Jaguar Would Also Be in This Zone

revised 3 June 2003

Plants
Recommended Trees and Shrubs for Tropical America

Central American Cloud Forest

To be expanded

Asterogyne martiana—understorey palm from mid-altitude
Bactris major—wet forest in Central America
Chamaedorea sp. Dozens of species—easily available understorey palm
Geonoma sp—understorey palm
Roystonea sp. Royal Palm
Sabal sp.
Thrinax sp.
Brugmansia—Angels Wings—flowering shrub—good hummingbird plant
Hamelia patens—flowering shrub—good hummingbird plant

Bromeliads

Aroids—*Anthurium, Philodendron*
Bamboo species

Reference Sites

www.ots.ac.cr/en/laselva/
www.strybing.org/cf/meso/index.html
www.cloudforestalive.org/
www.monteverdeinfo.com/reserve.htm

Plants
Recommended Trees and Shrubs for Tropical America

Pantanal and Atlantic Forest

Palms

Allagoptera arenaria—coast of SE Brazil
Astrocaryum aculeatissisum—SE Brazil
Butia archeri—dry savanna of SE interior Brazil
Butia capitata—southern Brazil, Uruguay
Copernicia alba—SE Brazil, N. Argentina
Euterpe edulis—Atlantic forests to NE Argentina—cold-sensitive
Lytocaryum sp—southern Brazil
Syagrus sp. E.g. *S. romanzoffianum*
Thrithrinax sp—dry savannah of SE Brazil

Trees and Shrubs

Albizia saman—wonderful wide-spreading shade tree (syn. *Samanea saman*)
Aurucaria sp.—Brazilian conifers
Bougainvillea sp
Caesalpinia ferrea—wonderful mottled bark
Cassia leptophila—spectacular yellow blooms
Cordia superba—white flowers, small tree
Erythrina crista—galli—Red Cocks Comb
Jacaranda mimosifolia
Peltophorum dubium—v. quick grower, spectacular yellow flowers
Tabebuia umbellata—15-ft yellow blossom
Tibouchina grandifolia/T. urvilleana—purple blossoms, large shrubs
Tipuana tipu—spreading, yellow flowers—foothills of Bolivian Andes?

Reference Sites

www.brazilnetwork.org/atl_forest.htm
www.oneworld.org/ips2/mar00/15_36_061.html
www.nybg.org/bsci/res/bahia/CF-Sites.html
www.pantanal.org/Mainpant.htm

Sources

Riffle & Craft. 2003. *An Encyclopaedia of Cultivated Palms.* Timber Press.
Stebbins. 1999. *Flowering Trees of Florida.* Pineapple Press.

Plants
Mayan Plants for Tropical America

Recommendations by Chris B. Rollins

Park Manager, Fruit & Spice Park

March 20, 2003

Mayan Plants

Cohune Palm	*Orbignya cohune*
Hog Plum	*Spondias mombin, Spondias purpurea*
Cecropia	*Cecropia peltata*
Bullet Tree	*Bucida buceras*
Mahogany	*Swietenia macrophylla*
Skunk Root	*Chiococca alba*
Allspice	*Pimenta officinalis*
Paradise Tree	*Simaruba glauca*
Give and Take Palm	*Crysophila argentea*
Copal	*Protium sessiliflorum**
Wild Pineapple	*Bromelia sp.**
Gumbo Limbo	*Bursera simaruba*
Cupania	*Cupania belizensis*
Pheasant's Tail	*Anthurium crassinervium*
Sapodilla	*Achras zapota*
Mamey Sapote	*Pouteria sapota*
Ceiba	*Ceiba pentandra*
Custard Apple	*Annona reticulata*
Mayan Breadnut	*Brosimum alicastrum**
Calabash	*Crescentia cujete*
Schippea Palm	*Schippia concolor*
Palmetto	*Acoelorrhape wrightii*
Cockspur	*Acacia sp.*
Monstera	*Monstera deliciosa**
Bay Leaf Palm	*Sabal morrisiana*
Coco Plum	*Chrysobalanus icaco*
Duck Flower	*Aristolochia trilobata*
Bay Cedar	*Guazuma ulmifolia**
Fiddle Wood	*Vitex gaumeri*
Pitaya	*Hylocerus undatus**
Cacao	*Theobroma cacao**

Plants

Mayan Plants for Tropical America

Mayan Rubber	*Castilla elastica*
Horse Balls Stem	*Stemmadenia Donald-Smithii**
Peach Palm	*Bactris gaspaes*
Lipstick Plant	*Bixa orellana**
Vanilla	*Vanilla planifolia*
Ice Cream Bean	*Inga spp.**
Canistel	*Pouteria cammmpechiana**
Guiana Chestnut	*Pachira aquatica**
Balsa	*Ochroma lagopus**
Guanacaste	*Enterolobium cyclocarpum*
Sabalero	*Piper auritum*
	Cassia grandis
Sandbox Tree	*Hura cripitans*
Logwood	*Haematoxylon campechianum*

Meeting Minutes

WORKSHOP #1, DAY 1—UNABRIDGED MINUTES

Date: 11 February 2003, 8:45 a.m. to 5:00 p.m.

Location: Zoological Society of Florida, Miami, Florida

Subject: Tropical America, Miami Metrozoo

Attendees:

Bill Gallwey, ZSF (BG)
Dan Licciardi, ZSF (DL)
Jessica Swanson Carcerano, ZSF (JC)
Sandy Miot, ZSF (SM)
Eric Stephens, MMZ (ES)
Caroline Kreiser, J&J (CK)
Tom Hartman, IQM (TH)
Carla Baker, ZSF (CB)
Elisabeth Koncza, ZSF (EK)
Nancy Wielert, ZSF (NW)
Bill Tuttle, MMZ (BT)
Steve Conners, MMZ (SC)
Keith Larson, J&J (KL)
Steven Wheeler, EDSA (SW)
Chip Robert, ZSF (CR)
Glenn Ekey, ZSF (GE)
Paul Vrooman, ZSF (PV)
Dave Jimenez, MMZ (DJ)
Anne-Émilie Gravel, J&J (AÉG)
Maren Coleman, J&J (TMC)
Ed Swakon, EAS Engineering (EAS)

Meeting Notes:

Introduction of the team and design process (over the next three + years) was made at a staff wide meeting held at the main amphitheater. ES, KL, TMC, KC, and TH presented.

1. Introduction of the team by KL at the commencement of the workshop at 9:40 a.m.
2. GE requested that Jones & Jones state the goals for the 3-day workshop, considering that there is a multi-headed client with different views, who has a clear program statement. Challenges of the project statement include understanding the carrying capacity for the Zoo and the monorail station. The discussion of the day will be on the big picture, the guest experience, education, conservation, entertainment, and research.
3. KL presented an agenda and summarized the objectives for the 3-day workshop.
4. In general, people agreed that they had reach a good consensus in the Project Statement and that they want new ideas from J&J and feedback on the project statement.
5. KL acknowledged that some of the Project Statement needs to be reworked, for example, it seems too focused in some areas, and the team should talk about food concessions and cost efficiency of buildings, as examples.
6. ES said that the most important thing about the new exhibit is its location in the Zoo's sequential experience. Opening the Zoo at night is not out of the question but challenges such as evening storms, high temperature, and additional staff will have to be considered.
7. ES mentioned that this is the opportunity to take care of things that the Zoo always needed such as exhibit buildings, air-conditioned spaces, exhibits of snakes and other reptiles, indoor exhibits of insects, a mandatory Jaguar exhibit, an education complex, more retail stands or shops, and creating incentives for people to come back. The Zoo has a collection of wonderful species that can create excitement and induce people to return.
8. EK commented on conservation and education approaches: conservation is the sole purpose of the Zoo where respect for animals should be taught and where people can learn the specificities of each animal ("why is this animal so cool?") The MMZ should do better than other Zoos by telling a unique story about the animal in each exhibit.
9. SC mentioned the important connection between the conservation of animals and the native culture associated with them; for example, the Jaguar is considered a deity by some tribes.
10. GE noted that exhibits should promote and help conservation of in the animals' native countries. In the Dallas Aquarium, there are fine mixed species exhibits that provide a close-up experience with the animals for adults, children, and seniors. MMZ should provide exhibits that push the envelope.
11. SM replied that there needs to be an economic balance and that the constraint is money.
12. KL mentioned certain omissions of species in the list. The theme and design for Tropical America will be animal driven starting with charismatic species as nodes and pacing the experience with shady and cool zones. KL asked if MMZ would like a to have a nighttime exhibit.
13. ES noted that Jaguars are bred in the USA and that some Jaguars are unable to be placed in Brazil. Importing them would be an opportunity to bring new blood in this country. Jaguars could be bought from Belize, which has a large preserve and is a very poor country. The Zoo needs to allow enough time to acquire them, a process that should take about 2 to 3 years. There should be no obstacles to getting the Jaguars across international borders, as long as we inform the authorities of our conservation programs. There is an animal acquisition fund.
14. Nobody in the room was opposed to having Jaguars in Tropical America.
15. SM asked KL if there was anything that the MMZ should do to be on the cutting edge of the Zoo design.
16. KL answered that to do common things uncommonly well. There is no reason to create exhibits and structures unless they are thoughtfully designed and executed and justify themselves financially.
17. EK had programmatic concerns and wanted to go over the main messages: "I had a great time; I was amazed; I will do something" and see how these messages are doable within Tropical America.
18. At the aviary, the horticulture and landscape budgets were cut. In this new exhibit the landscape should not be cut, it is an important part of the visitor's experience and has positive temperature control effects, even if it is expensive. It is important to provide shade between the exhibits. Mango trees could be planted in the background to create instant effect and reduce purchase cost. Research about native plants should be conducted; the Zoo could expand its conservation mission to interesting botanical species.
19. TH said that the MMZ has a master plan, but wondered if does the entire Zoo has a storyline that can be followed from exhibit to exhibit?

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