



Tropical America Program & Concept



Zoological Society of Florida
Miami Metrozoo



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Contents

program

Introduction	1
Thematic Organization	5
Narrative—Experience	11
Illustrations	
\$11 Million and \$25 Million Options Diagrams	22
Concept Diagrams	24
Illustrative Boards	29
Interpretive Strategies	33
Exhibit Program	65
Expectation of Probable Construction Cost	91

supporting documentation

Goals of the Tropical America Experience at Miami Metrozoo	97
Animals	
Animal List	99
Primates of Tropical America	103
Plants	
Recommended Trees and Shrubs for Tropical America	119
Mayan Plants for Tropical America	123
Meeting Minutes	125
Resources	147
References	149

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

2

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

4



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

6

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

8

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.

Narrative—Experience

12

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, Arawana 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!

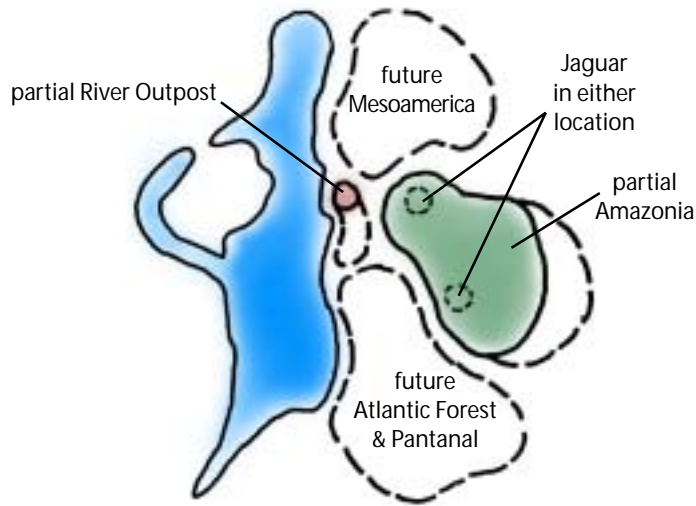
We look forward to experiencing much more at our Miami Metrozoo!

Illustrations

\$11 Million and \$25 Million Options Diagrams

Base Option

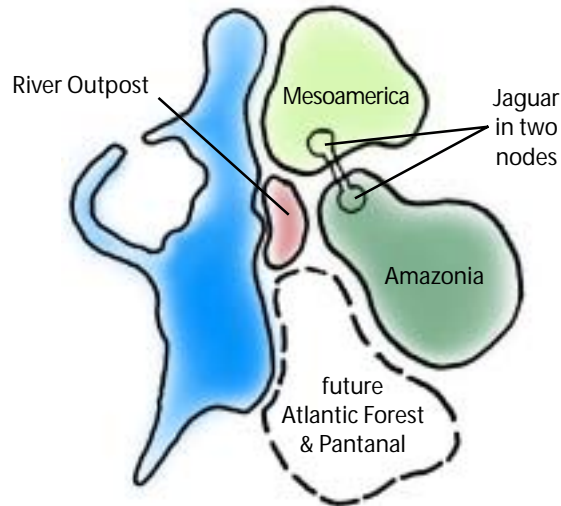
Amazonia
with money presently appropriated



\$11 million capital construction

Option A

Amazonia and Mesoamerica

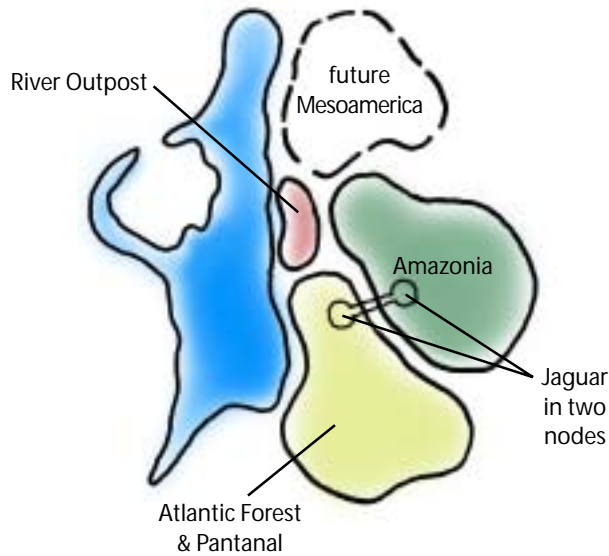


\$25 million capital construction

Illustrations

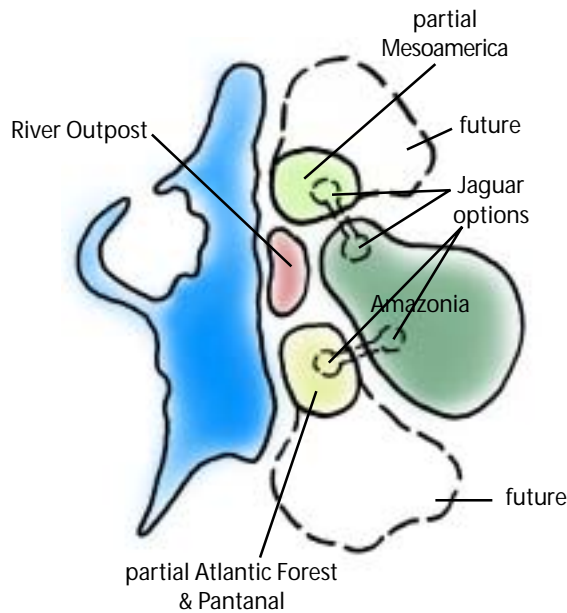
\$11 Million and \$25 Million Options Diagrams

Option B Amazonia and Atlantic Forest & Pantanal



\$25 million capital construction

Option C Amazonia with partial Mesoamerica and partial Atlantic Forest & Pantanal



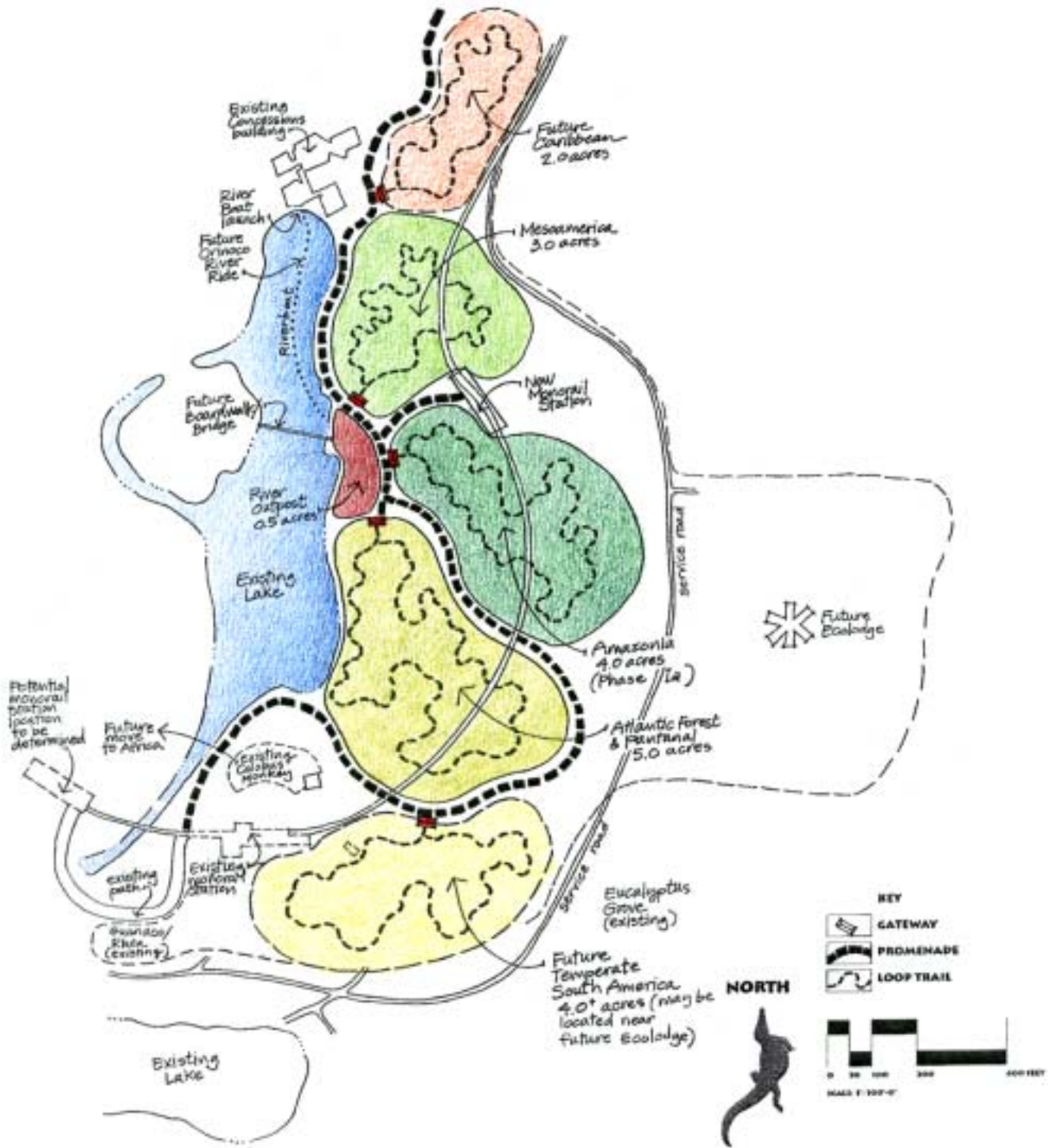
\$25 million capital construction



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: Mexico, Costa Rica
References:

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: Brazil, Peru, Surinam
References:

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: Coastal Brazil, Paraguay
References:

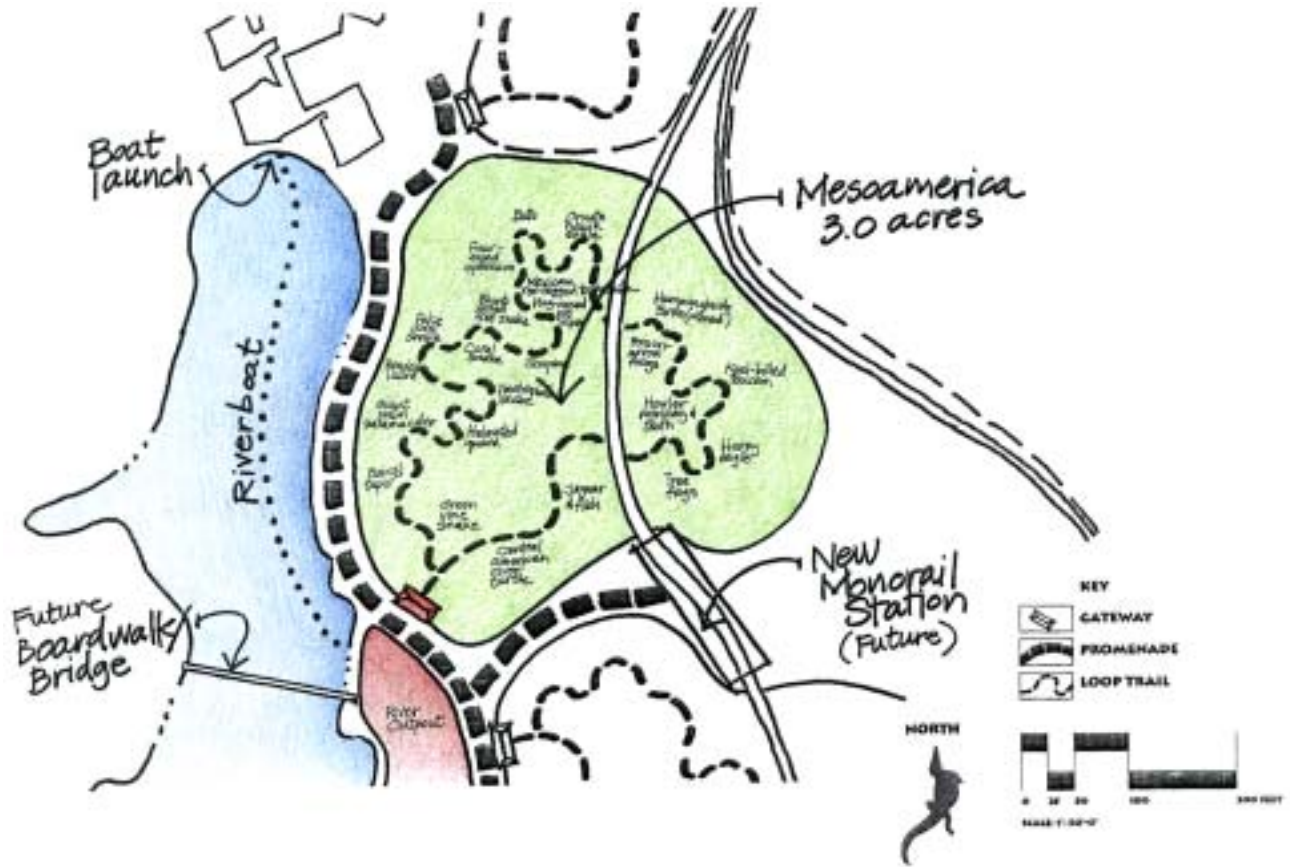
Key Fauna: Golden lion tamarins, King Vulture, Giant walking stick, Capybara, Giant anteater, Butterflies, Reptiles, Amphibians, Insects, Fish, Scorpion, Ornate Hawk Eagle, Howler monkey, Jabiru Stork, Macaws

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



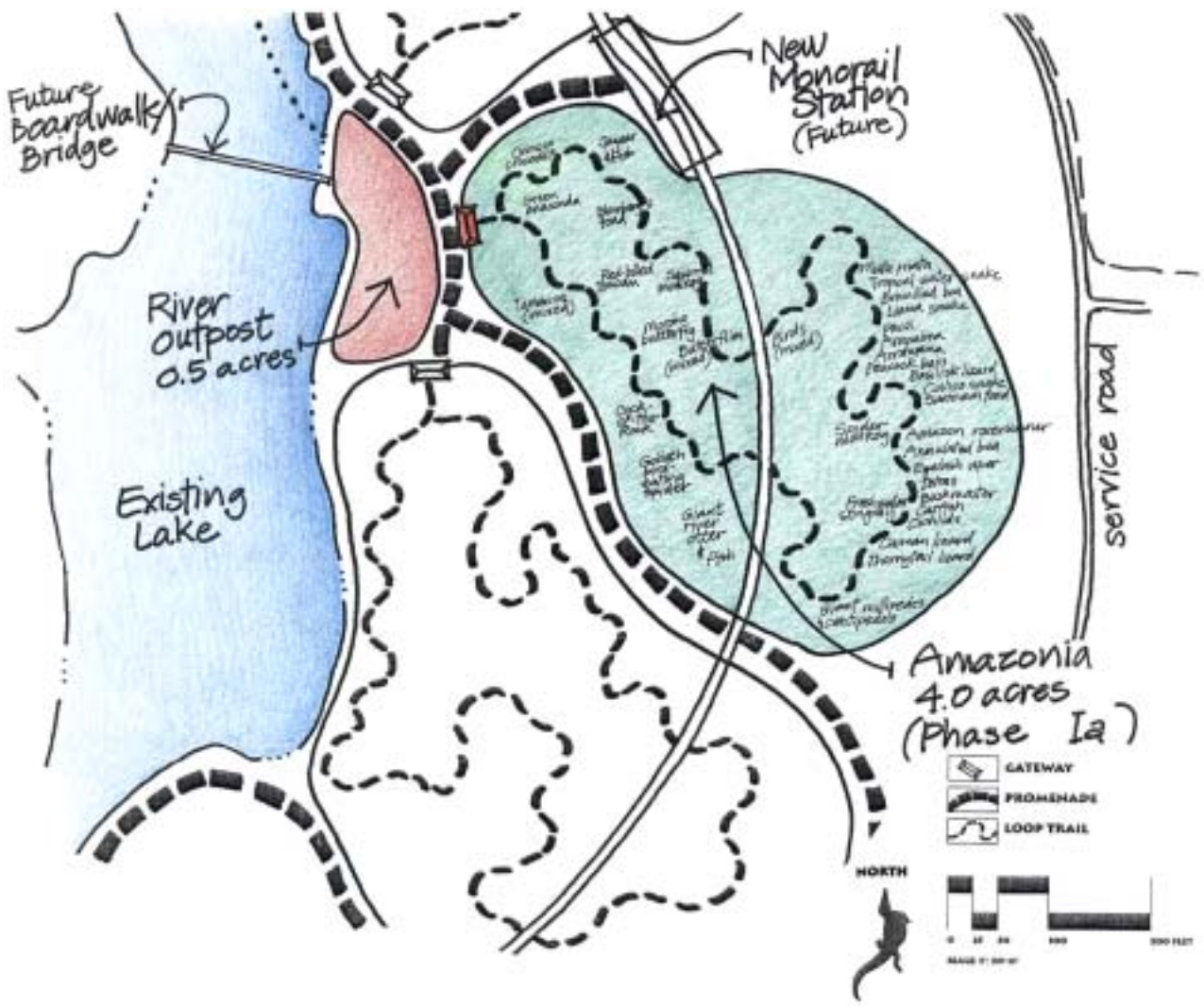
Illustrations

Concept Diagrams



MESOAMERICA—DETAIL

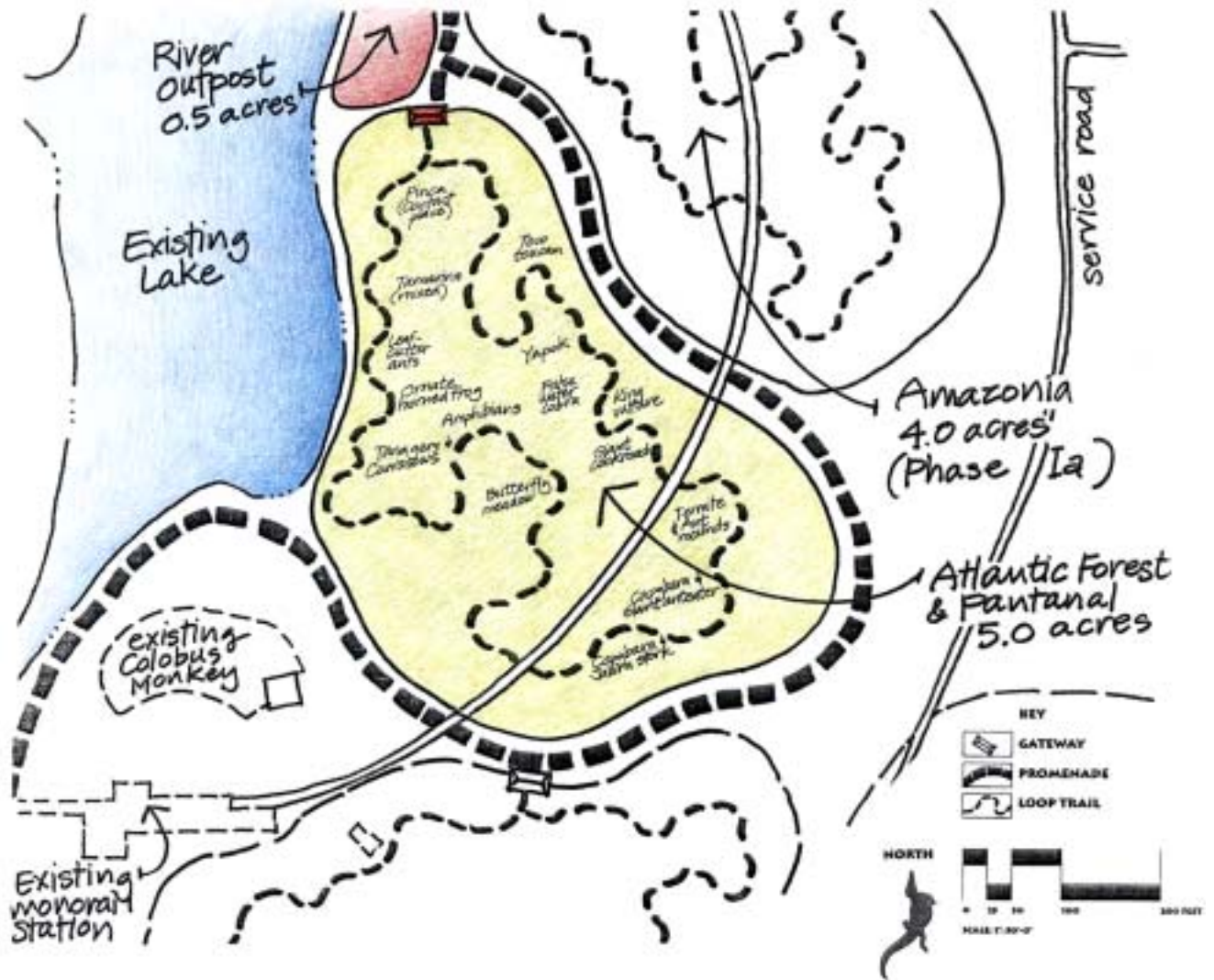
Illustrations Concept Diagrams



AMAZONIA—DETAIL

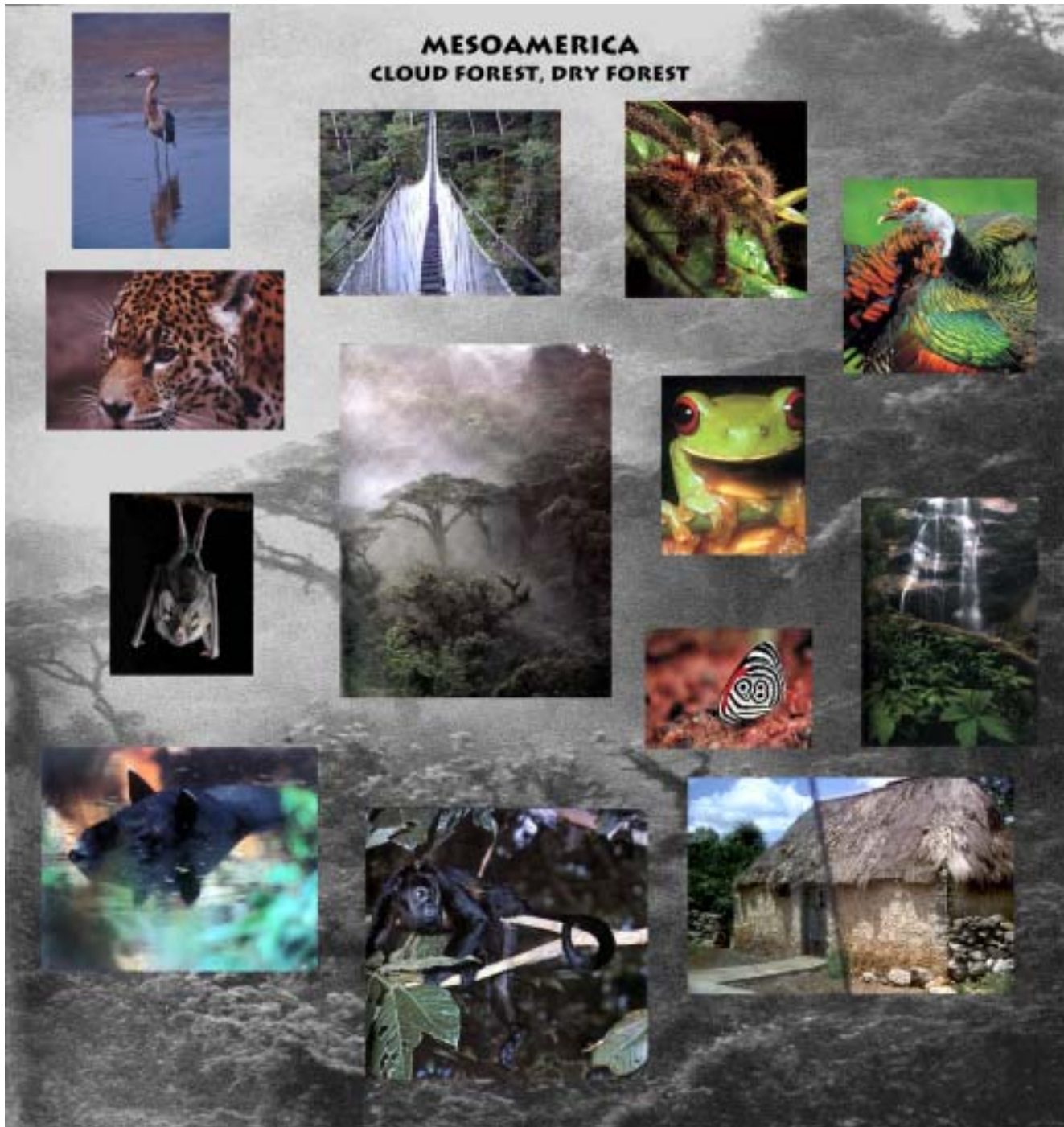
Illustrations

Concept Diagrams



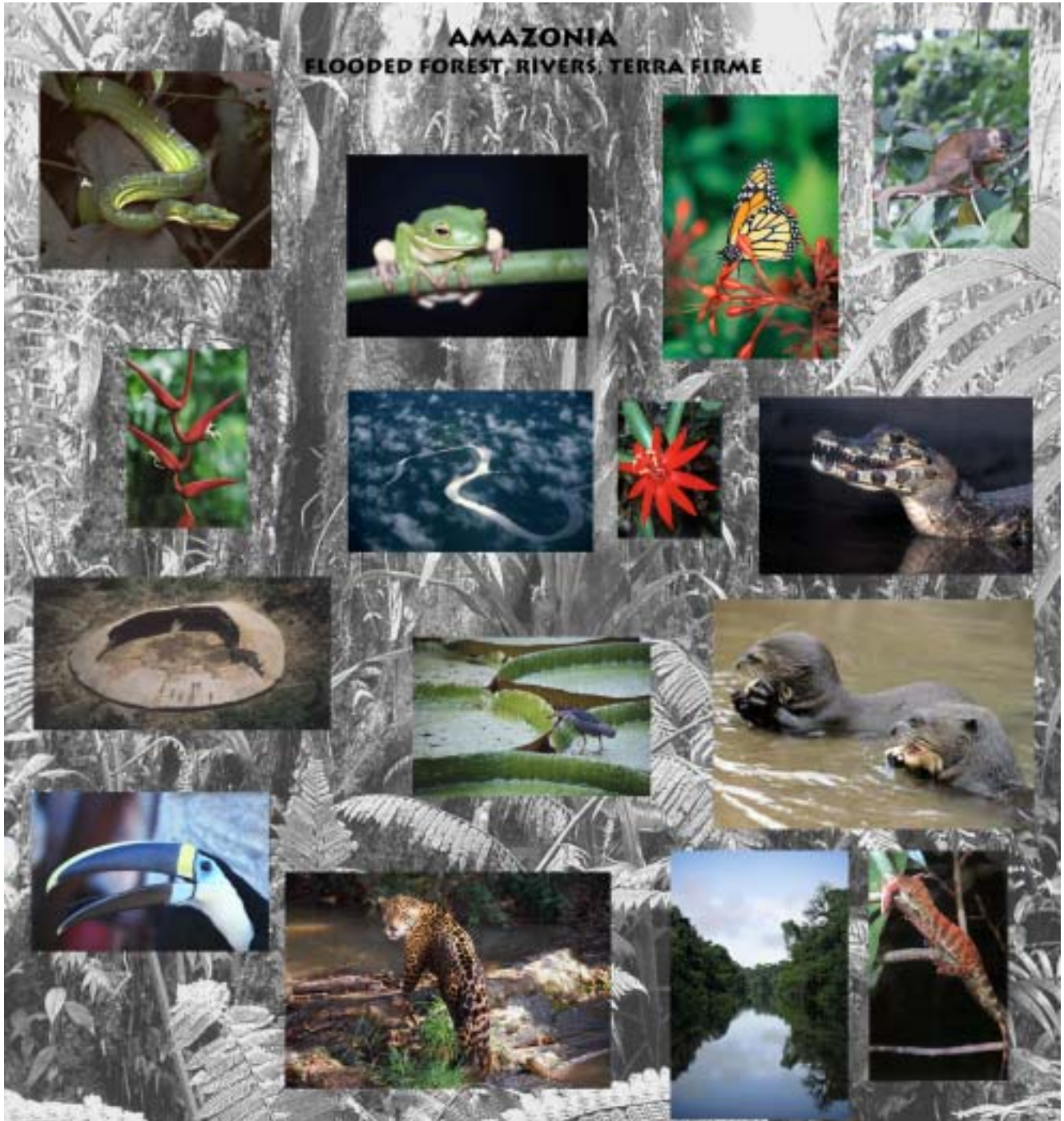
ATLANTIC FOREST & PANTANAL—DETAIL

Illustrations Illustrative Boards

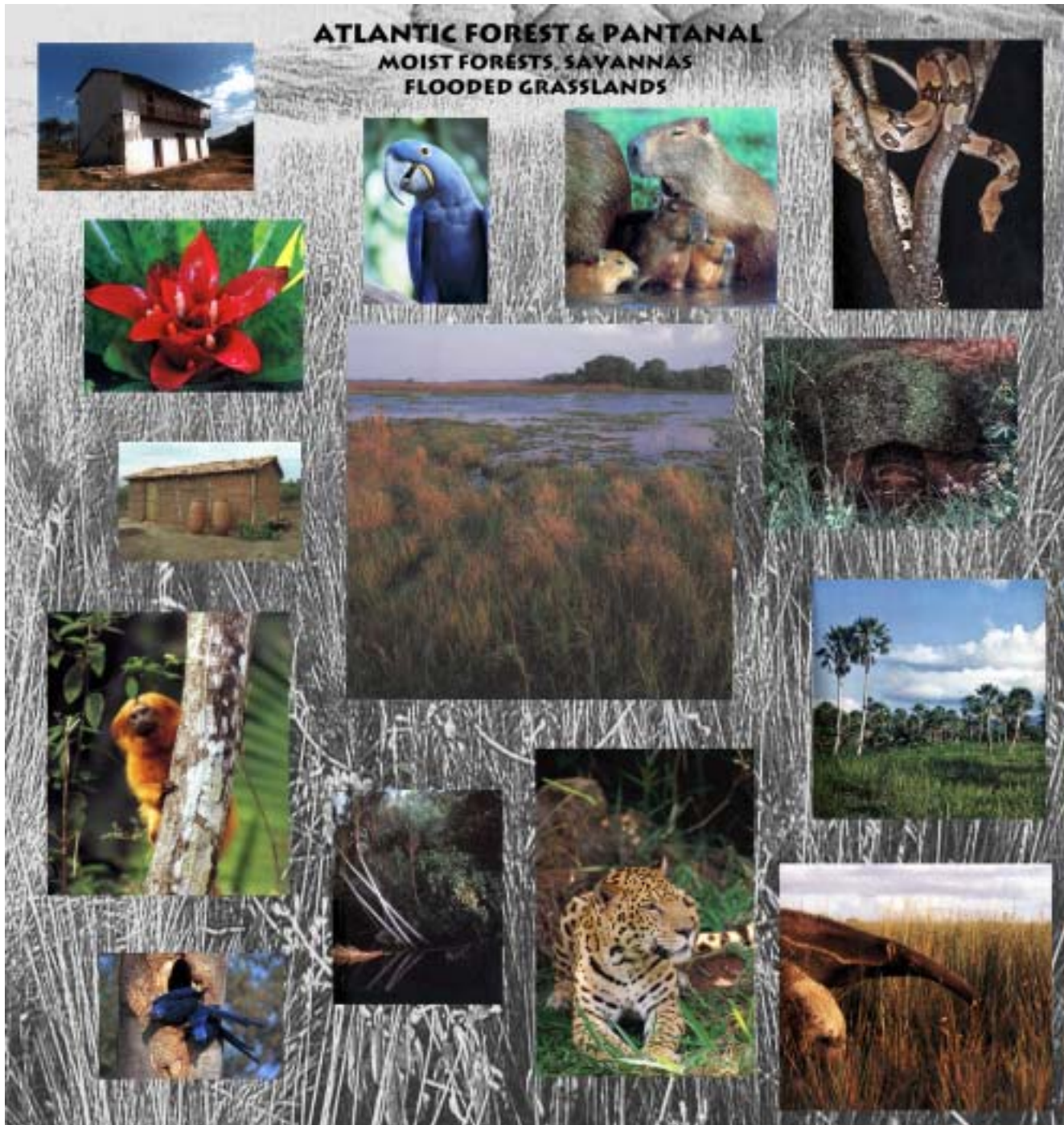


Illustrations

Illustrative Boards

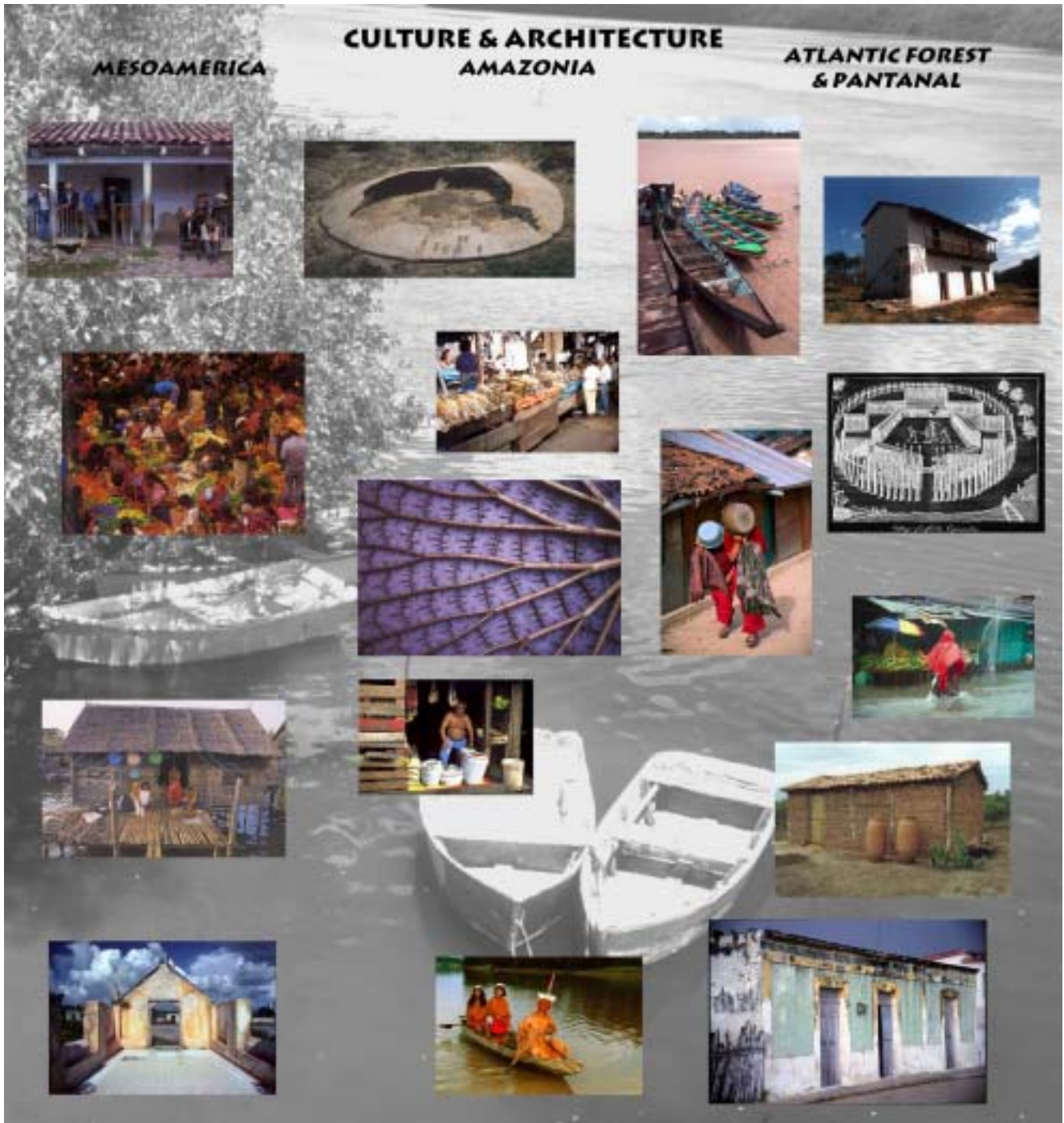


Illustrations Illustrative Boards



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.

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

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.

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.

“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.”

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.

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.

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.

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.

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.

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

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.

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.

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.

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.

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.

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.

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.

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

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

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

- 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.

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.

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.

Interpretive Strategies

Immersion Environments: Man-Made

In addition to the immersion in plant and animal environments that are customary to the zoo experience, we would suggest that MMZ consider integrating one to several “man-made” immersion environments within each biome that provide a cultural presence within the storyline. Making the connection between people, animals, and ecosystems underscores the role of policy-making and empowers visitors to make a difference in conservation.

These animal/cultural immersion environments could be natural outdoor zones or structures. Each will be developed as a vehicle or setting for the collections considered important to set the story and provide a moment in time or specified observation. The immersion experiences will be enhanced with sound, air movements, lighting effects, and environmental design appropriate to the content. These immersions may provide an initial introduction to the content and frame the range of storytelling experiences that will be addressed throughout Tropical America.

As part of the physical program there may also be classrooms, a small amphitheater, theater-like settings, behind-the-scenes opportunities—all of which can be themed immersions or stylistically significant in setting a tone for the experience. These environments may include scientific viewing stations, research cabins in wilderness regions, perhaps a large dug-out or canoe on a water bank, caves or underground areas, an oversized animal den, or hollowed out tree form. These all need to be derived and developed within the touring locations and used to create specific experiences or enhance the setting.

The character of these environments will vary from region to region in the use of constructed interiors or natural formations. Each can be developed as a vehicle or setting for the collections to set the stage and provide a moment in time or specified observations as a focus. Areas can easily be augmented with dynamic media projections to explore animals or zoom in for details. As with the natural systems that provide immersion, there are environmental design guidelines needed to make these appropriate to the content.

Environments

- scientific viewing stations
- wilderness research cabins
- large dug-out or canoe on a water bank
- caves
- underground areas,
- an oversized animal den
- hollowed out tree form



Interpretive Strategies



Fun and engaging activities allow visitors to use several parts of the brain to process information. Hands-on activities teach important scientific concepts that are remembered long after the visitors leave the zoo.

Activity Exhibits

Observations, activities and physical exhibits that convey focused messages will be used to attract visitors to an idea about animal and plant collections. These can be simple or elaborate constructions that relate size, quantity, color, movements of animals, or sounds. These exhibits are attractors for all ages to a topic and a window into more structured storytelling. These elements are custom designed interactive elements. Examples include:

- creating a 400-pound “anaconda” that is 25' long. Weighted with interior sand-bags, soft foam interiors, and a snake-like skin, the “anaconda” may be picked up by 15 children to understand its scale.
- Developing a shallow giant lily pad pool that allows visitors to walk across the floating pads. Simple moving mechanical elements along the side of the pool illustrate photosynthesis exchanges on the pads surface.
- A visual calendar showing twelve months of the year is juxtaposed to twelve blooming plants each initiating a bloom or change in a particular month or perhaps changes to an animal's den or changes in the way the animals adapt in various seasons. One might also hear changes in sound over the course of a year to determine seasonality. Visitors are asked to survey changes in the field of images to determine other plants that follow similar calendar changes. A secondary set of images taken from space of South America illustrates a year. Visitors are challenged to organize sequences to gain an understanding of what changes actually occur.

Many opportunities exist within the numerous animal selections, habitats on view and overarching dynamics of life in the tropics for these activity exhibits. The number offered will be in part a budget issue. Opportunities to code types of messages delivered are possible and styles and scale of exhibits can also denote age related learning opportunities. Additional activity exhibits that are media based are described further in the program.

Interpretive Strategies

Audio Tours

For a significant percentage of the zoo's visitors, audio tours offer an added value to interpretation. It is possible to offer a device that would allow visitors to point at plants and animals and click the personal hand held remote button to then request tracks in multiple languages on animal facts and information. Entries can include anything produced in digital audio formats from cultural music to storytelling by scientists, children and zookeepers to sounds of animals at close range. Sound cabins of environmental mixes can also be played as visitors tour MMZ. Added charges for multilevel programming can offset costs in equipment and productions. These systems can be designed to also be additive in program values over time. The amount of content can be programmed to be limitless in some systems design. Personal messaging between units and the park and "eavesdropping" on what a partner is listening to can also be featured. In addition ADA requirements for simultaneous screen reading messages and media synching enables visitors seamless touring within a personal discovery mode of access. Programming for classes and allowing teacher overrides through microphone-sensitive units distributed to classes is another added value.

In addition to audio tours there is a need to produce "sound cabins" throughout each of the regions. These are randomly sequenced sounds that broadcast habitat specific sound layers of specie vocalizations. A rich layering of animal sounds from primates to birds to insects and reptiles fills the trail experience.

Media Elements

Innovative technologies available today make it increasingly possible for visitors to customize their interpretive experience. Using these systems to deliver stories and content will position MMZ on the cutting edge of interpretive programming. Though these are not inexpensive elements, they allow a visitor to choose from layers of information and interpretation according to his or her own interests.

Many of these new technologies are unobtrusive. Infra-red silent controls that "read" the presence of a transmitter worn by a visitor can be cued in the visitor's control unit to automatically select the language and information level without additional input. This has less interactivity than the audio unit described above but it is nearly as versatile.

Audio Tours

- Audio tours offer visitors pathways through Tropical America that are random-access.
- Visitors choose what they want to learn and when.
- Audio can create a dramatic narrative.
- Language options allow for the recording of many languages.
- Peer-to-peer and specialist-given tours can be programmed.

Audio Tours are an added-value purchase that provides MMZ an income stream.

An example of a possible media production integrating several technologies is described here.

New technologies enable multiple interpretive layers, zoos within the zoo for visitors to discover.

Interpretive Strategies

Real-time media

Allows visitors to virtually move extremely close to animals.

- Under water and cameras inside tanks
- Night vision films for viewing after-dark movements
- Mounted cameras at treetop locations
- Microphones to communicate low-level sounds
- Use of lenses for microscopic investigations

Interactive large-scaled mapping systems can be created to communicate dynamic geographical information about land formations and environments over time. Projected animation sequences impart information about natural systems. These theatrical elements can be projected onto physically shaped or cast landscapes to provide visitors with a contextual basis for the ecological histories of Tropical America. Visitors will learn about changes in South America and the region's influence on the world's ecosystems. Numerous theatrical techniques, modeling, and projections work together to create an inspirational three-dimensional context to unravel vast movements of history over time. Viewers will grasp the need for future conservation, understand potential impacts on biodiversity, and see the implications of human management of ecological zones.

Everyone has some direct experience with new and emerging technologies. By developing interactive databases linked to images, voice, oral histories, documents, and place, interactive learning tools might also augment collections. This is more likely to be successful within enclosed spaces that reduce glare and reflections from glass surfaces. It is possible now to deliver layers of zoos one on top of the other, all to be accessed at random within a prescribed discovery path, language group, or other stratifying entry code. These layers might also include peer discussions, docent readings, zoological specialist tours, or special-interest investigations.

New technologies allow us to program an environment without relying on keyboards and screens. Physical objects that respond when touched connect to computers and launch programs. Signals generated by a device worn by the visitor enable access to assembled layers of information on playback screens. One person, for example, might select a Jaguar icon and obtain images, maps, and cultural references in response. Another visitor, following a different layer of investigation, might hear interviews with scientists or local villagers talking about where the Jaguar roams and his feeding habits in the wild. Close-up images of a den appear at the same time. What these technologies offer MMZ is a visitor experience that is custom-shaped by the viewer and may change in repeat visitations.

Overall, technology must convey options for the following:

- Public/private delivery systems
- Layering and redistribution of content
- Database access to collections, content, and resources
- Text augmentation
- Voice/image control

Interpretive Strategies

Technology tools will enable the design team to create dramatic movement and change in environments—through lighting and media effects in the use of sound cabins and sound pathways—all harnessed to direct the visitor's attention and increase understanding. These systems are best when deployed indoors—on the monorail and in controlled-light situations. However, it could be interesting to have imagery reflected in marine biology tanks, visible as "ghost" elements inside tanks, or to witness digital words trace across the sand as a visitor selects a fact or the name of a specimen.

44

What is critical here is the need to define how this can work without creating an entertainment environment for the sake of using media. If MMZ develops a hierarchical strategy for the timely use of these tools then information can better move from a request by the visitor—almost as a silent thought—to an answer that magically appears in step with his investigation. When this occurs it is easy to understand how searching for answers can be engaging while the technology serves as a tool.

A strong recommendation is to use media systems for close up photography and scanning of species and providing large screen platforms for public viewing as visitors examine environments. Multiple points of camera views of various pre-determined zoom settings, joystick controlled cameras, and cameras on motorized tracking systems can be employed to provide real-time investigations. Underwater cameras inside tanks, use of night vision films for viewing after dark movements, mounted cameras at treetop locations, and uses of microscopic lenses all have tremendous potential to place the visitor next to animals and within habitats for unique viewing.

Interpretive Strategies

Behind-the-Scenes Tour

- research
- zookeeper contact
- direct animal contact
- observation and interaction with collaborative efforts in South America
- participatory observations as data collecting

This program is an elective program to be developed as budgets and special opportunities allow during the ongoing operations plan of MMZ.



Science Labs / Participatory Investigation

Where possible, behind-the-scenes tours, observation locations within zookeeper areas, and programs to record observations will be carefully planned and developed to include passive and active participation. This part of an overall interpretive program would underscore the goal of informing the public on research activities associated with MMZ. Linkages to sites for research outside the zoo could be viewed as an added feature for visitors to learn of collaborative ventures.

Comparisons between what happens in the natural habitats of the animals and what is necessary to monitor and provide in-the-zoo habitats reveal to our audiences the complexity of change and sustainability. Creating an overall layer of interpretation that allows visitors to observe in almost a Discovery Channel method of interaction and observation will reinforce personal discovery, provide training and educate through doing.

In addition to the behind-the-scenes opportunities, one of the educational team's ideas is to include science data as a level of interpretation as part of the general tour. There can be developed a system of finding data on what a specimen ate during the day, an animal's heart rates, respiration, weight, and almost any fact desired to be related. Comments and observations by visitors can be left for others to examine and added to the database. This can be accomplished as simply as leaving a written message to interactive media elements where visitors and scientists can touch and image to record themselves discussing what they are witnessing and recording for immediate playback for other viewers.

Storytellers

Person-to-person storytelling and close-up sharing of animal display tremendously enhance the zoo experience. Beyond the obvious ability for casual questions and answers that allow for a custom experience, visitors can observe the nature of an animal in ways that distance viewing does not allow. MMZ is currently adept at creating, scripting, and orchestrating situations in many locations now around the zoo. Opportunities are many-fold as programs develop to create theatrical elements showcased weekly, monthly, or at selected times of the year. Annual or semi-annual productions over a month's interval that are promoted and advertised would open additional audience markets. Night time shows, costumed over-scaled animal performers, music, and theatrical staging with lighting could be marketed for events venues.

Interpretive Strategies

Overview of Content and Interpretive Approaches

Understanding the Tropics

From Mazatlan in Mexico south to Sao Paulo, Brazil, the region bounded by the Tropic of Cancer in the north and the Tropic of Capricorn in the south is known as Tropical America or the Neotropics. It's a complex region of multiple ecosystems shaped by climate, landscape, and history. It is a region rich in biodiversity, the home of nearly half of all the living species of plants and animals on earth, despite occupying only 4% of the Earth's surface.¹

46

Life in Tropical America, however, is far from settled. Over millions of years, plants and animals have been engaged in an endless and feverish evolutionary race, adapting to one another in an effort to promote their own species and survive. For the last five hundred years, however, the pace of change has accelerated as modern humans have cleared forests and imposed their own domesticated plants and animals to collect raw materials and produce food for the demands of consumers around the world.

Interpretive Themes

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.

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.

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 and an abundance of life. That diversity reflects processes of evolution and adaptation. To preserve this region's unique diversity, 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.

1. See Kricher, p. 1. Calculated by taking Neotropics 57% of all tropical forests against tropical forests 7% of the Earth's surface. Estimate that tropical forests harbor as much as 50% of the world's biodiversity.

Interpretive Strategies

Biodiversity

People from northern latitudes are often overwhelmed by the sheer abundance of life in the tropics. Like Columbus, they see only a wall of green in a rainforest. In reality, biomes in tropical America represent a tremendous range of habitats: stark and fragile alpine tundra in the highest mountains in the Andes, lush grasslands in the Pantanal and the Pampas, dry forests in the Brazilian highlands and along the Pacific slope of Mesoamerica, a rich variety of rainforests in the river basins of the Amazon, the Orinoco, and the Magdalena. MMZ would like visitors to appreciate this diversity of habitats and landscapes.

The variety of habitats combined with plenty of sunshine and rain in many parts of tropical America have fueled a tremendous biodiversity. A simple comparison makes the point. A lush forest in southeastern Appalachia might contain as many as 30 species of trees in a single hectare; by contrast, 300 hundred species have been counted in a single hectare in the Peruvian Amazon. In the Ecuadorian Amazon, the number of frog species counted at one site equals all of the frog species living in the United States. Visitors need to understand this sheer abundance of lifeforms. Yet at the same time, they need to appreciate a paradox of this abundance. In lowland tropical America most species exist in small numbers and many are actually quite rare. (Kricher, p. 34-36)

Adaptation and Selection

Tropical America's high biodiversity is the result of a feverish process of biological evolution. Some ecologists have even called this "megadiversity." Charles Darwin was the first to realize that biodiversity declines as one moves further from the equator. Later biologists have suggested that a more benign climate in the tropics, with fewer environmental stresses, has permitted a greater number of species to survive. Many of these species are extremely "specialized," having found a very particular place in the ecosystem. (Kricher, p. 86-87) An ecosystem is a biological community together with its environment, functioning as a unit.

To understand this process, MMZ would also like visitors to perceive the connection between biodiversity in tropical America and evolutionary biology. Without being overly didactic, the interpretive program will strive to highlight the building block concepts of evolutionary biology: the genetic diversity inherent in all species; the processes of anatomical, physiological, and behavioral adaptation; and the mechanisms of natural selection.

Interpretive Strategies

Visitors should also appreciate that the evolutionary process takes place within a dynamic ecosystem. Relationships between various species are complicated. Prey seek to elude predators. Plants evolve to attract pollinators and even protectors. Species co-evolve, each adapting to changes in the other. While an earlier generation of biologists focused on competition in the ecosystem, MMZ would like visitors to appreciate the dynamics of mutualism as well. Overall, visitors should be awed and amazed by the intricacy of the ecological system.

Conservation & Culture

Accustomed to fewer species, many people from the north ask if preserving biodiversity is important. The health of the planet and of many individuals may depend on it. Scientists in pharmaceuticals and other industries are constantly discovering uses for plants only recently discovered. Seen in this light, the destruction of a single acre of rainforest can lead to the extinction of a species and the possible elimination of a potential cure for some painful disease.

Preserving both the abundance and the richness of species in tropical America depends on people. Humans have been a part of the ecosystems of tropical America for thousands of years. Oral histories and archaeological research record the traditions of the region's indigenous communities, as well as the relationship of people to the flora and fauna. Thousands of years ago, people began to practice environmental management, domesticating some plants and animals, using fire to clear parts of the forest. The human impact on the environment today is enormous.

Since the arrival of Europeans more than five centuries ago, man's influence on tropical America has increased dramatically. Forests were cut and burned to make way for plantations for sugar, coffee, and corn. In the process, habitat and food supplies for various species was eliminated. Non-native animal and plant species have been introduced, competing with and sometimes overwhelming native species. Mining and dams restructured the flow of rivers.

*'The land is one great, wild, untidy,
luxuriant hothouse, made by Nature
for herself.'*

—**Charles Darwin**

(Newman, p. 12)

Interpretive Strategies

In recent years, many people have worked to preserve and protect the habitats of tropical America. The economic value of the region's biodiversity has become apparent in the growth of ecotourism. Land has been protected in national parks and reserves. In some areas nature has demonstrated a remarkable resilience as forest trees have reestablished themselves in areas that have been slashed and burned for agriculture or grazing.

Still the resources and collective efforts of the world must be marshaled if these unique animals and environments are going to be protected for future generations. Economic development needs to provide the people in tropical America with opportunities to improve their quality of life without having to resort to the destruction of habitat. By allowing visitors to the Miami Metrozoo to enjoy the amazing qualities of some of the plants and animals that come from tropical America, this new exhibit area will help to promote that conservation ethic.

Fun Facts & Narrative Opportunities

Information about animals, plants and culture will reinforce the three main cognitive themes of Tropical America, but visitors will also get to learn fun facts and hear stories that do not specifically relate to the themes. By linking the majority of interpretive elements to the themes, visitors will walk away with the main messages. Presenting information not tied to the themes, however, will enliven the experience.



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 Peninsula 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

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)

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.

ADAPTATION STORY

BIODIVERSITY INTERPRETIVE



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

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)

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)



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)

BIODIVERSITY/ ABUNDANCE STORY

ADAPTATION STORY

CONSERVATION AND CULTURE STORY

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 crocodylian 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 Mamirauá 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

58

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

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

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

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)

INTERPRETIVES

ADAPTATION

CONSERVATION AND CULTURE

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

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)

60

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)

CONSERVATION AND CULTURE STORY

CONSERVATION INTERACTIVE



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 miquiqui, 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

62

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).

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.

ADAPTATION STORY

ADAPTATION INTERPRETIVE

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. (Swartz; 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; Jeffrey S. Wade, "Brazilian Pantanal . . .," 1996)

Jabiru Stork: A Glorious Wingspan

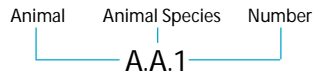
If birds played basketball, the Jabiru Stork might play center. Standing five feet tall, one of the largest flying birds in the New World, the Jabiru has a wingspan ranging up to twelve feet. A distinctive band of naked, red skin appears on its neck. Locals call it the "tuiuu." It feeds on insects, fish 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

NOTES ON ESTIMATE:

INDEX/SHEET KEY



Species:

- A Amphibians
- B Birds
- F Fishes
- I Invertebrates
- M Mammals
- R Reptiles
- P Public Structures
- K Keeper Zone

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: Amphibians #1	No. of Structures/Units: (3) 50-gallon aquariums	Index • Sheet: A.A.1
Description: Toads and Caecilians		Zones: R.A.
Notes: All Fill and Dump Systems		Costs: (3) 3'-0" x 17'-0" x \$275.00/s.f. x 1.1 MB \$46,300
Plan/Graphics:		

Animal/Structure: Amphibians #2	No. of Structures/Units: (2) 300-gallon aquariums	Index • Sheet: A.A.2
Description: Poison Arrow Frogs		Zones: M.A.
Notes: Fill and Dump System: Bromeliads		Costs: (2) 9'-0" w x 17'-0" x \$275.00/s.f. x 1.1 MB \$92,600
Plan/Graphics:		

Exhibit Program

Animal/Structure: Amphibians #3	No. of Structures/Units: (3) 250-gallon aquariums	Index • Sheet: A.A.3
Description: Tree Frogs		Zones: R.A.
Notes: Fill and Dump		Costs: (3) 6'-0" w x 17'-0" x \$275.00/s.f. x 1.1 MB \$92,600
Plan/Graphics:		



Animal/Structure: Amphibians #4	No. of Structures/Units: (3) 550-gallon aquariums	Index • Sheet: A.A.4
Description: Miscellaneous Frogs		Zones: AF&P.
Notes: Dump and Fill (Little Water)		Costs: (3) 11'-0" w x 22'-0" x \$275.00/s.f. x 1.1 MB \$219,600
Plan/Graphics:		

Exhibit Program

Animal/Structure: Birds (Mixed Species Exhibit)	No. of Structures/Units: 0	Index • Sheet: A.B.1
Description: Blue-billed Toucan Plush-capped Jay Blue and Gold Macaw Currasow Sparrow Scarlet Ibis Tinamou Sparrow Crested Screamer Gray-winged Trumpeter Maguari Stork Sunbittern Puna Ibis Orinoco Goose Black-bellied Whistling Duck Chilean Flamingos (Future Phase: Ringed Teal Temperate S.A.—Patagonia) Collared Aracari		Zones: Costs: (3) 11'-0" w x 22'-0" x \$275.00/s.f. x 1.1 MB \$219,600
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.		
Plan/Graphics:		

Animal/Structure: Raptors	No. of Structures/Units: 1	Index • Sheet: A.B.2
Description: King Vulture Potential Mixed Species: With anteater, spider monkey, squirrel monkey, sloth, agouti, capybara, and/or tamandua?		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 @ Perimeter = \$70,000 \$1,290,000
Notes:		
Plan/Graphics:		

Exhibit Program

Animal/Structure: Raptors	No. of Structures/Units: 1	Index • Sheet: A.B.3
Description: Ornate Hawk Eagle		Zones: M.A.
Notes:		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 <hr/> \$347,000
Plan/Graphics:		



Animal/Structure: Raptors	No. of Structures/Units: 1	Index • Sheet: A.B.4
Description: Andean Condor (Currently in Collection)		Zones: A.F. & P. "Close to temperate South America (future phase)"
Notes:		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 <hr/> \$600,000
Plan/Graphics:		

Exhibit Program

Animal/Structure: Raptors	No. of Structures/Units: 1	Index • Sheet: A.B.5
Description: Harpy Eagle (Currently in Collection)		Zones: R.A.
Notes:		Costs: Aviary Structure & Mesh 3,200 x 60/s.f. = \$192,000 Exhibit Design & Catch 3,200 x 65/s.f. = \$192,000 Public Walkways 10'x100'x 70/s.f. = \$70,000 Immersion Allowances @ Perimeter = \$70,000 <hr/> \$474,000
Plan/Graphics:		

Animal/Structure: Fish	No. of Structures/Units: (2) 1,350-gallon aquariums (1) 4,800-gallon aquariums (2) 17,000-gallon aquariums	Index • Sheet: A.F.1
Description: Large Tank #1: Pacu (<i>Myloessona duriventre</i>) Red Tailed Catfish (<i>Phractocephalus hemiliopterus</i>) Other Catfish (three species) Large Tank #2: Arapaima (<i>Arapaima gigas</i>) Peacock Bass (<i>Cichla ocellaris</i>) Arawana Medium Tank: Pallata Small Tank #1: Freshwater Stingray (<i>Potamotrygon</i> sp.) Tetra (four species) *Other cichlids (four species) Small Tank #2: Undetermined		Zones: 80% RA 20% AF&P 20% MA Costs: A: (2) 15' w x 22.5' x \$275/s.f. x 1.1MB = \$204,200 B: (1) 25' w x 25' x \$275/s.f. x 1.1MB = \$189,000 C: (2) 29' w x 35' x \$275/s.f. x 1.1MB = \$438,600 Total = \$831,800
Notes:		
Plan/Graphics:		

Exhibit Program

Animal/Structure: Invertebrates	No. of Structures/Units: 10	Index • Sheet: A.I.1
Description: Miscellaneous Invertebrates in "Jewel Boxes" that do not look like jewel boxes		Zones: 40% RA 30% AF&P 30% MA
Goliath bird eating spider Mexican red-legged tarantula Brachypelma smithi Scorpion sp. Giant centipede Scolopendra gigantea Peru (Bristol Zoo) Giant millipede	Peripatus? Leaf-cutter ant Giant walking stick Leaf mantid Goliath or rhinoceros beetle (Cincinnati) Morpho butterfly (Mixed species?) "Other" butterfly 6 to 10 species (Mixed species?)	Costs: (10) 2'-0" w (overlap) x 17'-0" x \$275/ s.f. x 1.1 M.B. = \$102,900
Notes:		
Plan/Graphics:		



Animal/Structure: Invertebrates	No. of Structures/Units: 1	Index • Sheet: A.I.2
Description: Mixed Species (See prior sheet on Invertebrates)		Zones: 27.25% RA 36.375% AF&P 36.375% MA
Notes:		Costs: 25'-0" w x 17'-0" x \$275/ s.f. x 1.1 M.B. = \$128,600
Plan/Graphics:		

Exhibit Program

Animal/Structure: Tamarins & Mixed Species	No. of Structures/Units: 4 or 5 (4 estimated)	Index • Sheet: A.M.1
Description: Three to four exhibits. Exhibits w/ Tetras, perhaps Spider Monkey; Sakis, Birds, Capuchin: (4 to 5) species possibly/ exhibit.	Zones: (2) RA (2) A.F.&P.	
	Costs: Animal & Keeper 26'-0" w x 10'-0" x \$225/ s.f. x 1.25 I.B. = \$73,125 Public (Semi-enclosed) 26'-0" w x 10'-0" x \$175/ s.f. = \$45,500	
Notes:	Subtotal \$118,625 x 4 = \$474,500	
Plan/Graphics:		

Animal/Structure: Spider Monkey	No. of Structures/Units: 1	Index • Sheet: A.M.2
Description: Spider Monkey (4 monkeys): See below. (Could have Muriqui here) Also potential for arawana, pacu, and catfish in water.	Zones: R.A.	
	Costs: All Interior Spaces 46'-0" w x 31.5' (average) x \$300/s.f. x 1.1 MB = \$478,200	
Notes:		
Plan/Graphics:		

Exhibit Program

Animal/Structure: Bear	No. of Structures/Units:	Index • Sheet: A.M.3
Description: Spectacled Bear 1.1.1	Zones:	
Eliminated from exhibit	Costs: Holding 36'-0" w x 21' x \$300/s.f. x 1.1 M.B. = \$249,500 Exhibit w/ path 200'-0" w x 60' x \$100/s.f. x 1.25 I.B. x 1.33 factor for moat = \$1,995,000 Total = \$2,244,500	
Notes:		
Plan/Graphics:		



Animal/Structure: Ocelot (Nocturnal)	No. of Structures/Units: 1	Index • Sheet: A.M.4
Description: Ocelot (3 assumed)	Zones:	
Eliminated from exhibit	Costs: All Interior Spaces 46'-0" w x 31.5' (average) x \$300/s.f. x 1.1 MB = \$478,200	
Notes: Chutes and Squeeze not shown. Should we have them?		
Plan/Graphics:		

Exhibit Program

Animal/Structure: Howler Monkey and Three Toed Sloth	No. of Structures/Units: 1	Index • Sheet: A.M.5
Description: 1 Mixed Species (Howler Monkey Pair and Three Toed Sloth) also w/ Agoudi & Trumpeters		Zones: A.F. & P
Alternately: This could be Muriqui (Woolley Spider monkey) - This would be an important exhibit to the zoo as there are only 20 in captivity.		Costs: Holding 16'-0" x 13'-0" x \$300/ s.f. x 1.1 M.B. = \$68,600 Exhibit & semi enclosed public 20'-0" w x 25'-0" x \$250/ s.f. x 1.25 I.B. = \$156,300 Subtotal \$224,900
Notes:		
Plan/Graphics:		

Animal/Structure: Anteater and Toucan	No. of Structures/Units: 1	Index • Sheet: A.M.6
Description: 1 Mixed species (Anteater and Toucan) Pair of Anteaters		Zones: R.A. (M.A. second choice)
Notes:		Costs: Holding 13'-0" x 25'-0" x \$250/ s.f. = \$81,200 Exhibit 25'-0" w x 12.5' x \$300/ s.f. x 1.25 I.B. = \$117,200 Public 25'-0" w x 10'-0" x \$175 (semi-encl.) x 1.25 I.B. = \$54,700 Subtotal \$253,100
Plan/Graphics:		

Exhibit Program

Animal/Structure: Bats, Opossum (Nocturnal) & Two Toed Sloth	No. of Structures/Units: 1	Index • Sheet: A.M.7
Description: Fruit Bats and Fishing Bats Four Eyed Opossum Two Toed Sloth	Zones: M.A.	
Notes: Concealed red downlighting in "cave."		Costs: 31'-0" w x 21'-0" x \$325 x 1.1 M.B. = \$232,700
Plan/Graphics:		

Animal/Structure: Capybara or possibly Tapir	No. of Structures/Units: 1	Index • Sheet: A.M.8
Description: Capybara (4 to 6) Tapir (2) 1.1.0	Zones: M.A. (R.A. preferred however)	
Notes: Other species could be included in this exhibit		Costs: All Spaces: 150'-0" x 85'-0" x \$60/s.f. = \$765,000
Plan/Graphics:		



Exhibit Program

Animal/Structure: Jaguar	No. of Structures/Units:	Index • Sheet: A.M.9
Description: Jaguars (2-4)	Zones: R.A. alternate M.A. or A.F.&P.	
	Costs: Holding 63'-0" x 22'-0" x \$300/ s.f. = \$415,200 Exhibit (w/ long transfer) 2000 x \$300/ s.f. x 1.25 I.B. = \$750,000 Public (2 shelters & open) (2) 16'-0" x 10'-0" x 1.25 I.B. x \$225/s.f. = \$90,000 Path + IB (allow) \$30,000	
Notes:	Subtotal \$1,285,800	
Plan/Graphics:		

Animal/Structure: Giant River Otter	No. of Structures/Units: 1	Index • Sheet: A.M.10
Description: Giant River Otter (1.1.3)	Zones: A.F.&P. (although R.A. preferred)	
	Costs: Holding 18'-0" x 29'-0" x \$300/ s.f. = \$156,600 Exhibit 30'-0" x 50'-0" x \$300/ s.f. x 1.25 I.B. = \$562,600 Public (semi-enclosed) 50'-0" x 10'-0" x \$175/s.f. x 1.25 I.B. = \$109,400 Total \$828,500	
Notes:		
Plan/Graphics:		

Exhibit Program

Animal/Structure: Reptiles—Snakes (Hot)	No. of Structures/Units: 6	Index • Sheet: A.R.1
Description: Potential Species: Green Vine Snake Coral Snake Mimic Coral Snake Black-tailed Montane Pit-Viper Hognosed Pit-Viper Other Pit-Vipers		Zones: 1/3 to each RA, MA & AF&P
Notes:		Costs: (6) 6'-0" w x 19'-0" x \$275/s.f. x 1.3 c.f. x 1.1 MB = \$268,900
Plan/Graphics:		



Animal/Structure: Reptiles—Snakes (Hot)	No. of Structures/Units: 2	Index • Sheet: A.R.2
Description: 1 Bushmaster 1 Neotropical Rattlesnake		Zones: 50% R.A. 50% M.A.
Notes:		Costs: (2) 10'-0" w x 23'-0" x \$275/s.f. x 1.3 c.f. x 1.1 MB = \$180,900
Plan/Graphics:		

Exhibit Program

Animal/Structure: Reptiles—Snakes (Hot)	No. of Structures/Units: 1	Index • Sheet: A.R.3
Description: 1 Unspecified Hot Snake	Zones: “(A.F.&P.) on summary”	
	Costs: 9'-0" w x 21'-0" x \$275/s.f. x 1.3 c.f. x 1.1 MB = \$74,400	
Notes:		
Plan/Graphics:		

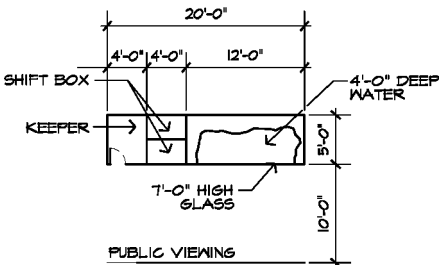
Animal/Structure: Reptiles—Snakes (Hot)	No. of Structures/Units: 2	Index • Sheet: A.R.4
Description: 1 False Water Cobra 1 Unspecified Hot Snake	Zones: 50% R.A. 50% M.A.	
	Costs: (2) 6'-0" w x 23'-0" x \$275/s.f. x 1.3 c.f. x 1.1 MB = \$108,500	
Notes:		
Plan/Graphics:		

Exhibit Program

Animal/Structure: Reptiles—Snakes	No. of Structures/Units: 3	Index • Sheet: A.R.5
Description: 1 Calico Snake 1 Liana Snake 1 Red Pipesnake		Zones: 66.6% R.A. 33.3% M.A.
Notes:		Costs: (3) 6'-0" w x 17'-0" x \$275/s.f. x 1.1 MB = \$92,600
Plan/Graphics:		

Animal/Structure: Reptiles—Snakes	No. of Structures/Units: 2	Index • Sheet: A.R.6
Description: 1 Bromeliad Boa with unspecified Boa (arboreal) 1 Tropical Water Snake (1 ft. deep water)		Zones: A.F. & P.
Notes:		Costs: (2) 9'-0" w x 18'-0" x \$275/s.f. x 1.1 MB = \$98,000
Plan/Graphics:		

Exhibit Program

Animal/Structure: Reptiles—Anaconda (Mixed Species)	No. of Structures/Units:	Index • Sheet: A.R.7
Description: Anaconda with: Peacock Bass Tanagers Hummingbirds For schematics, increase animal enclosure to 20' wide x 7' deep	Zones: R.A.	
	Costs: Average : 21'-0" x 16'-3" x \$250/s.f. = \$85,400	
Notes: Two Anacondas, 15 ft. long (100#/each) Also infrared heat		
Plan/Graphics: 		

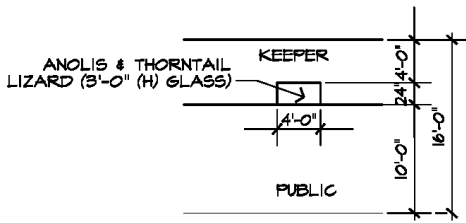
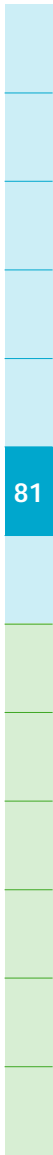
Animal/Structure: Reptiles	No. of Structures/Units: 2	Index • Sheet: A.R.8
Description: 1 Anolis Lizard 1 Thorntail Lizard	Zones: 50% R.A. 50% M.A.	
	Costs: (2) 6'-0" w x 17'-0" x \$275/s.f. x 1.1 MB = \$61,700	
Notes:		
Plan/Graphics: 		

Exhibit Program

Animal/Structure: Reptiles	No. of Structures/Units: 1	Index • Sheet: A.R.9
Description: Helmeted Iguana Amazon Racerunner		Zones: 50% R.A. 50% M.A.
Notes:		Costs: 9'-10" w x 18'-0" x \$275/s.f. x 1.1 MB = \$54,000
Plan/Graphics:		



Animal/Structure: Reptile	No. of Structures/Units: 1	Index • Sheet: A.R.10
Description: Camian Lizard Basilisk		Zones: 50% R.A. 50% M.A.
Notes:		Costs: 14'-0" w x 21'-0" x \$275/s.f. x 1.1 MB = \$88,900
Plan/Graphics:		

Exhibit Program

Animal/Structure: Reptiles—Turtles	No. of Structures/Units: 1 Enclosure Depicted on this Sheet	Index • Sheet: A.R.11
Description: Giant Amazon Sideneck Turtle (in 30 ft. long mixed species tank) Argentine Snake-necked Turtle (also in 30 ft. or 20 ft. mixed species tank) 1 Central American River Turtle (below)		Zones: 50% R.A. 50% M.A.
Notes:		Costs: 14'-0" w x 21'-0" x \$275/s.f. x 1.1 MB = \$88,900
Plan/Graphics:		
<p>(WATER) TURTLE EXHIBIT (5'-0" HIGH GLASS)</p> <p>KEEPER</p> <p>10'-0"</p> <p>5'-0"</p> <p>5'-0"</p> <p>10'-0"</p> <p>CURTAIN</p> <p>20'-0"</p> <p>10'-0"</p> <p>PUBLIC</p>		

Animal/Structure: Reptiles—Orinoco Crocodile	No. of Structures/Units:	Index • Sheet: A.R.12
Description: Orinoco Crocodile with Peacock Bass or possibly Large sideneck Turtle		Zones: R.A.
Notes:		Costs: Holding 16'-0" x 26'-0" x \$200/s.f. = \$39,400 Exhibit 25'-0" x 25'-0" x \$300/s.f. x 1.25 I.B. = \$234,400 Public 40'-0" x 10'-0" x \$175 x 1.25 I.B. = \$87,500 Total = 405,100
Plan/Graphics:		
<p>60'-0" EXHIBIT</p> <p>15'-0"</p> <p>25'-0"</p> <p>20'-0"</p> <p>SHIFT W/ POOL</p> <p>EXHIBIT</p> <p>KEEPER</p> <p>1'-0" HIGH GLASS</p> <p>PUBLIC</p> <p>29'-0"</p> <p>1/2 WATER</p> <p>1/2 LAND</p> <p>10'-0"</p>		

Exhibit Program

Animal/Structure: Interpretive Functions in Mixed Species Building	No. of Structures/Units: 1	Index • Sheet: P.1
Description: <u>Assumed Space Allowances (Space Holders):</u> 300 sq.ft. Orientation 500 sq.ft. Seven (7) "Nooks" for Interpretation 200 sq.ft. Storage for Interpretive Props and Carts ??? sq.ft. Multi-Function Room		Zones: NA.
Notes:		Costs: 1400 x \$200/s.f. x 1.25 M.B. = \$350,000 w/ 400 s.f. multi-function room
Plan/Graphics:		



Animal/Structure: Restaurant	No. of Structures/Units: 1	Index • Sheet: P.2
Description: Themed Restaurant (Space Holder) Boat Option (for Gift Shop & Restaurant)—assume oversized hull, manufactured at site by barge constructors: 8000 s.f. x \$80/s.f. = \$640,000 Allowance for pilings, hookups, shore access: \$150,000 Total \$790,000 not included in total		Zones: NA.
Notes:		Costs: Interior Space 3000 x \$275/s.f. w/ M.B. = \$825,000 Deck 1500 x \$100/s.f. x 1.25 I.B. = \$187,500 Total = \$1,012,500
Plan/Graphics:		

Exhibit Program

Animal/Structure: Gift Shop	No. of Structures/Units: 1	Index • Sheet: P.3
Description: Themed Gift Shop		Zones:
Boat Option (for Gift Shop & Restaurant)—assume oversized hull, manufactured at site by barge constructors: 8000 s.f. x \$80/s.f. = \$640,000 Allowance for pilings, hookups, shore access: \$150,000 Total \$790,000 not included in total		Costs: 500 x \$275/sf w/M.B. = \$137,500
Notes:		
Plan/Graphics:		
<p>The plan shows a rectangular layout. On the left side, there is a vertical strip labeled 'ACTIVE STORAGE (100 S.F.)' with an arrow pointing to the right. To its right is a larger rectangular area labeled 'GIFT SHOP (400 S.F.)'.</p>		

Animal/Structure: Special Events Lawn	No. of Structures/Units: 1	Index • Sheet: P.4
Description: Shaded Lawn with Opportunity for Mid-Sized Performances		Zones: Any
19,200 x \$25/sf w/trees = \$480,000 Trellis Allowance = \$100,000 Total = \$580,000		
Notes:		
Plan/Graphics:		
<p>The plan shows a large square area labeled 'INFORMAL GRASSY AREA FOR SPECIAL EVENTS 140' X 140''. The perimeter of the square is lined with trees, indicated by circles with a cross inside. A trellis structure is shown along the right side of the square, labeled 'TRELLIS'. A note 'TREES, TYP' points to one of the trees.</p>		

Exhibit Program

Animal/Structure: Miscellaneous Public Spaces and Features #1	No. of Structures/Units: 1 ea.	Index • Sheet: P.5
Description: Boat Dock, 1,200 sq.ft. at \$40.00/sq.ft. = \$48,000 Bridge (Eliminated for a future phase?) Plaza/Esplanade, 16,000 sq.ft. at \$40.00/sq.ft. = \$640,000 Medicinal Plant Garden, 2,500 sq.ft. at \$80.00/s.f. = \$200,000		Zones:
Notes:		Costs: Dock = \$48,000 Plaza = \$640,000 Garden = \$200,000 Total = \$888,000
Plan/Graphics:		



Animal/Structure: Miscellaneous Public Spaces and Features #2	No. of Structures/Units: 1 ea.	Index • Sheet: P.6
Description: Domestic Animal Yards (to be determined), Allow \$100,000.00 Monorail Station L.S., allow \$1,000,000.00 Public Stream and Bridges N.I. Water (allow \$250,000.00)		Zones: N.A.
Notes:		Costs: 1,350,000
Plan/Graphics:		

Exhibit Program

Animal/Structure: Multi-Use (Classroom) and Amphitheater	No. of Structures/Units:	Index • Sheet: P.7
Description: • Multi-Use Classroom (200 People) x 10 s.f./person = 2000 s.f. • Covered Amphitheater (Space Holder for 250 People) Client's request for Schematic Design: Design multi-use (classroom) as a themed facility with space for 50-100 people. Used as group sales, special events with storage, sink, bathroom, projection, animal viewing (possibly nocturnal).	Zones: N/A	
	Costs: Classroom 3400 x \$225/ s.f. w/ M.B. = \$765,000 Amphitheater 1,500x \$150/ s.f. x 1.25 I.B. = \$281,250 Stage/Storage 400 x \$25/s.f x 1.25 I.B.\$ = \$125,000 Total \$1,171,200	
Notes:		
Plan/Graphics:		

Animal/Structure: Horticulture Shed and Bins	No. of Structures/Units: 1	Index • Sheet: K.1
Description: Horticulture Materials, Fertilizers and Tool Storage	Zones: N/A	
	Costs: 150/ s.f. Shed x \$150/s.f. = \$22,500 Bid allowance w/ Paving = \$3,500 Total \$26,000	
Notes:		
Plan/Graphics:		

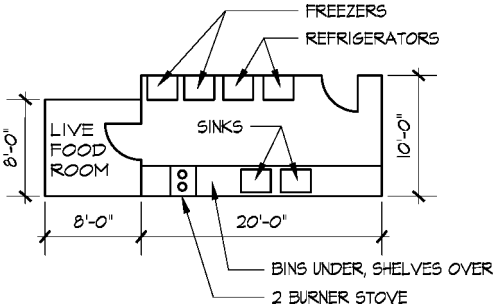
Exhibit Program

Animal/Structure: General Storage	No. of Structures/Units: 1 (Could Be Divided into 2 Bldgs)	Index • Sheet: K.2
Description: Miscellaneous Items including Small Vehicle (Also see Horticulture)		Zones: N/A
Notes:		Costs: \$200/s.f. x \$150/s.f. = \$30,000
Plan/Graphics:		



Animal/Structure: Curatorial Core at Multi-Species Buildings	No. of Structures/Units: 1 (Could Be Divided)	Index • Sheet: K.3
Description: <u>Curatorial Core Includes:</u> Multi-Purpose Break Room Office with Computer Hook-Up Storage Room Bathroom and Showers		Zones: Undetermined
Notes: Location and Adjacencies Undetermined		Costs: 700/s.f. (Gross) \$250/s.f. w/ M.B. = \$175,000
Plan/Graphics:		

Exhibit Program

Animal/Structure: Animal Diet Prep Core at Multi-Species Buildings	No. of Structures/Units:	Index • Sheet: K.4
Description: <u>Animal Diet Prep Includes:</u> 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: Quarantine	No. of Structures/Units:	Index • Sheet: K.5
Description: Behlen cages, Aquariums Cyclone type containment Pre-fabricated metal buildings	Zones: N.A. Costs: Quarantine Allowance = \$150,000	
Notes:		
Plan/Graphics:		

Miami Metrozoo—Tropical America • Revised April 21, 2003

Water Treatment Systems—Expectation of Probable Cost Matrix

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



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
	<hr/>	<hr/>	<hr/>
	\$3,035,159.00	\$9,823,060.00	(SUBTOTALS)
Interpretives	\$800,000.00	\$800,000.00	
	<hr/>	<hr/>	<hr/>
	\$3,835,159.00	\$10,623,060.00	(SUBTOTALS)
Linkages (Pathways) and Supporting Immersion Landscape	\$191,757.95	\$531,153.00	5%
	<hr/>	<hr/>	<hr/>
	\$4,026,916.95	\$11,154,213.00	(SUBTOTALS)
Utilities, Service Drives, and External Barriers	\$805,383.39	\$2,230,842.60	20%
	<hr/>	<hr/>	<hr/>
	\$4,832,300.34	\$13,385,055.60	
Program Level Contingency	\$1,449,690.10	\$4,015,516.68	30%
	<hr/>	<hr/>	<hr/>
	\$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%
	<hr/>	<hr/>	<hr/>
	\$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

Expectation of Probable Construction Cost Option B—Amazonia and Atlantic Forest/Pantanal

	Amazonia	Atlantic Forest/Pantanal	Costs
ANIMAL—AMPHIBIANS			
A.A.1 Amphibians #1	\$46,300.00		\$46,300.00
A.A.2 Amphibians #2			\$92,600.00
A.A.3 Amphibians #3	\$92,600.00		\$92,600.00
A.A.4 Amphibians #4		\$219,600.00	\$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
A.B.4 Andean Condor		\$600,000.00	\$600,000.00
A.B.5 Harpy Eagle	\$474,000.00		\$474,000.00
ANIMAL—FISHES			
A.F.1 5 Large Aquariums	\$665,440.00		\$831,800.00
ANIMAL—INVERTEBRATES			
A.I.1 Small Invertebrate Aquariums	\$41,160.00	\$30,870.00	\$102,900.00
A.I.2 Large Invertebrate Aquarium	\$35,044.00	\$46,778.00	\$128,600.00
ANIMAL—MAMMALS			
A.M.1 Tamarins (mixed species)	\$237,250.00	\$237,250.00	\$474,500.00
A.M.2 Spider Monkey w/ Fish	*	\$297,300.00	\$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	\$224,900.00
A.M.6 Anteater & Toucan	\$253,100.00		\$253,100.00
A.M.7 Bats & Opossum		*	\$232,700.00
A.M.8 Capybara & Tapir			\$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	\$828,500.00
ANIMAL—REPTILES			
A.R.1 Hot Snakes	\$89,633.00	\$89,633.00	\$268,900.00
A.R.2 Hot Snakes	\$90,450.00		\$180,900.00
A.R.3 Hot Snakes		\$74,400.00	\$74,400.00
A.R.4 Hot Snake	\$54,250.00		\$108,500.00
A.R.5 Snakes	\$61,733.00		\$92,600.00
A.R.6 Snakes		\$98,000.00	\$98,000.00
A.R.7 Anaconda	\$85,400.00		\$85,400.00
A.R.8 Misc. Reptiles	\$30,850.00		\$61,700.00
A.R.9 Misc. Reptiles	\$27,000.00		\$54,000.00
A.R.10 Misc. Reptiles	\$41,750.00		\$83,500.00
A.R.11 Turtles	\$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



Expectation of Probable Construction Cost Option B—Amazonia and Atlantic Forest/Pantanal

	Amazonia	Atlantic Forest/Pantanal	Costs
PUBLIC ZONE			
P.1 Program Building space	\$175,000.00	\$87,500.00	\$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	\$580,000.00
P.5 Misc. #1	\$640,000.00	\$48,000.00	\$888,000.00
P.6 Misc. #2	\$1,125,000.00	\$125,000.00	\$1,350,000.00
P.7 Classroom/Amphitheater	\$382,500.00	\$382,500.00	\$1,171,200.00
KEEPER			
K.1 Horticulture/Tools	\$13,000.00	** \$13,000.00	\$26,000.00
K.2 Storage	\$15,000.00		\$30,000.00
K.3 Curatorial	\$87,500.00	** \$87,500.00	\$175,000.00
K.4 Kitchen	\$90,000.00		\$90,000.00
K.5 Quarantine	\$100,000.00		\$150,000.00
LIFE SUPPORT			
LS.1/LS.2 Water Systems	\$555,000.00	\$231,900.00	\$929,700.00
X Allow 25% for Enclosures	\$138,750.00	\$57,975.00	\$232,425.00
	<hr/>	<hr/>	
	\$9,823,060.00	\$4,141,006.00	(SUBTOTALS)
Interpretives		\$800,000.00	\$800,000.00
	<hr/>	<hr/>	
	\$10,623,060.00	\$4,941,006.00	(SUBTOTALS)
Linkages (Pathways) and Supporting Immersion Landscape	\$531,153.00	\$247,050.30	5%
	<hr/>	<hr/>	
	\$11,154,213.00	\$5,188,056.30	(SUBTOTALS)
Utilities, Service Drives, and External Barriers	\$2,230,842.60	\$1,037,611.26	20%
	<hr/>	<hr/>	
	\$13,385,055.60	\$6,225,667.56	
Program Level Contingency	\$4,015,516.68	\$1,867,700.27	30%
	<hr/>	<hr/>	
	\$17,400,572.28	\$8,093,367.83	
*** Art in Public Places 1.5% of Construction plus Design & Approximate Related Costs	\$212,100.00	\$98,626.00	Allow
Inspector General	\$43,501.43	\$20,233.42	0.25%
Independent Private Sector Inspector General	\$130,504.29	\$60,700.26	0.75%
Construction Contingency	\$1,740,057.23	\$809,336.78	10%
TOTALS	<hr/>	<hr/>	
	\$19,526,735.23	\$9,082,264.29	

* 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

Expectation of Probable Construction Cost Totals—Amazonia, Mesoamerica, and Atlantic Forest/Pantanal

TOTALS	Amazonia, Mesoamerica, Atlantic Forest/Pantanal (Less than \$36,000,000.00 and therefore within Budget)	\$35,659,008.91	
OPTION A: Amazonia & Mesoamerica			
	\$1,576,744.62 over \$25,000,000.00 budgeted	\$26,576,744.52	
Example approaches to reduce estimate to less than \$25,000,000.00:			
	1. Defer construction of:		
	• Monorail		-\$24,750,000.00
OR	2. Defer construction of:		
	• Amphibians #3 Amazonia (A.A.3)		-\$25,000,000.00
	• Harpy Eagle (A.B.5)		
	• Anteater & Toucan (A.M.6)		
OR	Any combination that will reduce construction costs before mark-ups by at least \$856,926.00 which translates to \$1,576,744.62 with mark-ups.		-\$25,000,000.00
OPTION B: Amazonia & Atlantic Forest/Pantanal			
	\$3,608,999.52 over \$25,000,000.00 budgeted	\$28,728,608,999.52	
Example approaches to reduce estimate to less than \$25,000,000.00:			
	1. Defer construction of:		
	• Special Events Lawn (P.4)		-\$24,850,000.00
	• King Vulture (A.B.2)		
	• One of the 4 Amazonia Large Aquariums (A.F.1) (Five Total with Mesoamerica)		
OR	2. Defer construction of:		
	• \$382.5K of Classroom/Amphitheater Budget (P.7)		-\$24,950,000.00
	• Andean Condor (A.B.4); Could Become Temperate South America		
	• Monorail (Part of P.6)		
OR	Any combination that will reduce construction costs before mark-ups by at least \$1,961,421.00 which translates to \$3,608,999.52 with mark-ups.		-\$25,000,000.00
OPTION C: Amazonia with Partial Mesoamerica & Partial Atlantic Forest/Pantanal			
	\$25,000,000.00 buildout for high impact in three zones		-\$25,000,000.00
Example:			
	• Build all of Amazonia (see items in Amazonia column in estimate). Shared Jaguar with Mesoamerica		
	• Build Mesoamerica exhibits for Capybara/Tapir, Bats/Opossum; plus limited public zone and animal exhibits (e.g., primates)		
	• Build Atlantic Forest exhibits for Giant river otter, plus limited public zone and animal exhibits (e.g., primates)		



Expectation of Probable Construction Cost



Goals of the Tropical America Experience at Miami MetroZoo



GOALS FOR TROPICAL AMERICA AT MIAMI METROZOO

The Tropical Americas will be an innovative and exciting exhibit and educational experience which will enthrall and entertain visitors and inspire interest in and enthusiasm for the tropics.

- The experience will be designed to maximize attendance and revenue.
- The experience will demonstrate MMZ's and ZSF's commitment to and involvement in conservation and research projects.
- The experience will promote an understanding of zoo animal behavior and biology crucial to saving their conspecifics in the wild.
- The experience will empower every visitor, young and old, rich and poor, to make a difference in preserving wildlife.
- The experience will feature enclosures designated to replicate the animal's natural habitat, which will promote the broadest range of natural behaviors.
- The experience will incorporate innovative techniques in research and conservation in order to demonstrate the conservation and education role of the modern zoo.
- The experience will help visitors understand that the MMZ is a scientific institution committed to the welfare of all wildlife.
- The experience will provide opportunities for scientific research.
- Each species on exhibit will be selected for its specific conservation, research, or educational role.
- There will be opportunities for the public to contact the animals.
- Visitors will gain an appreciation of the Tropical American region.

Goals of the Tropical America Experience at Miami MetroZoo



Animals Animal List

	In Collection	To Be Acquired	Difficult	In Budget	WOW Level	Conservation Level	CITES	Husbandry	SSP
Anchor Species									
Jaguar (MA and AM)		X	2	X	3	2	X	1	X
Giant river otter (AM and MA)		X	3	X	3	2	X		
Caribbean									
Jamaican rock iguana		X	2		2	3	X	2—difficult to breed	X
Cuban amazon parrot	X				2+	2	X	1—can mix w/Jamaican rock iguana	X
Anegada iguana		X	1		1+	3	X	1—do not mix w/other iguanas	X
Caiman blue iguana		X	3		2.5	3	X	1—do not mix w/other iguanas	X
Rhinoceros iguana	X				2.5	2	X	1—do not mix w/other iguanas	X
Criteria:									
BIODIVERSITY									
CONSERVATION									
EXHIBIT VALUE									
Mesoamerica (MS)									
DRY FOREST									
Baird's tapir	X			X	2	3	X	1	PMP
bats (w/ armadillo)		X	1 to 3	X	3			2	
armadillo (w/ bats)		X	1		1			1	
eyelash viper		X	1		2			1	
terrestrial caecilians		X	1	X	1			2	
3 hot snakes		X	1		2 to 3			1	
4 non-ven snakes		X	1		1 to 2			1	
4 turtles		X	1		1			1	
basilisk lizard		X	1	X	2			1	
coral snake		X	2	X	2			2	
coral snake, mimic		X	1	X	1 to 2			1	
ocellated turkey		X	2		2	2		1	
curassow		X	1		1+	2, 3	X	1	PMP
beaded lizard		X	1		2 to 3		X	1	PMP
Cottontop Tamarin		X	1	X	2+	2		1	X
Spider monkeys		X	1	X	2+		X	1	PMP
coatimundi (finca)		X	2		1			1	
hog-nosed pit viper		X	2	X	2			1	PMP
neotropical rattlesnake		X	1	X	3			1	
fer de lance		X	1	X	3			1	
helmeted iguana		X	1	X	1			2	
mexican red-legged tarantula		X	1	X	2	2	X	1	

Animals

Animal List

	In Collection	To Be Acquired	Difficult	In Budget	WOW Level	Conservation Level	CITES	Husbandry	SSP
CLOUD FOREST									
red-eyed treefrogs		X	1	X	2			1	
annulated boa		X	2		1		X	1	PMP
centipedes		X	1	X	3			1	
keel-billed toucan		X	2	X	3			1	PMP
salamander, giant palm		X	2		1			2	
poison arrow frogs	X	X	1	X	2		X	3 species in collection	
leaf mantid		X	2	X	2			1	
2-toed sloth		X	1	X	1			1	PMP
millipedes, giant		X	2	X	2			1	
morpho butterflies		X	1	X	3			2	
tanagers (w/ trogons)		X	1		2			1	PMP
trogons (w/ tanagers)		X	2		1			1	
gold scarab beetle		X	3?		3			ask Eric Dinerstein	
bromeliad boa		X	2	X	1		X	1	
more frogs		X	1		1 to 2			1	
more turtles		X	1		1			1	
Amazonia (AM)									
leaf cutter ants		X	3	X	3			3	
harpy eagle	X			X	3		X	1	X
callimico		X	1		1 to 2			1	X
arawana	X	X	1	X	2			1—one in collection	
arapaima		X	3	X	3		X	1	
pacu	X			X	2			1	
freshwater stingray		X	1	X	3			1	
cichlids		X	1	X	1			1	
tetras		X	1	X	1			1	
Suriname toad		X	1	X	2			1	
anaconda		X	1	X	3		X	1	
bird-eating spider		X	1	X	3			1	
orinoco croc		X	2	X	3		X	1	
caiman lizard		X	2	X	2			2	
G sideneck river turtle	X			X	3		X	1	
4-eyed possum		X	2	X	1			2	
mata mata	X				2			1	
agouti		X	1		1			1	
yapok		X	3+		2			3—nocturnal	
wooly monkey (w/ saki)		X	2		2			1	PMP
wh faced saki (w/ wooly)		X	2		2+			1	PMP
dwarf caiman	X	X	1		1		X	1	
electrical eel		X	1		3			2	
peacock bass	X			X	1			1	
pygmy marmoset (w/ emp)		X	1		2+			1	PMP
emperor tamarin (w/ pygmy)	X			X	2			1	PMP
catfish, redtailed	X	X	1	X	2			1—may need more	

Animals Animal List

	In Collection	To Be Acquired	Difficult	In Budget	WOW Level	Conservation Level	CITES	Husbandry	SSP
squirrel monkeys		X	1		1			1—very old group	PMP
ped tamarin		X	2+		1	2		1	PMP
Blomberg's toad		X	3	X	2+			1	
water cobra		X	2	X	2			1	
bushmaster		X	1	X	3			1	PMP
Amaz. Racerunner		X	1	X	1			1	
green vine snake		X	2	X	2			1	
G cockroach		X	2		2			1	
tropical water snake		X	1	X	1			1	
red-pipe snake		X	2	X	2			2	
thorny-tailed lizard		X	3	X	1			2	
3 hot snakes		X	1		2			1,2	
4 turtles		X	1		1			1	
calico snake		X	2	X	2			1	

Mata Atlantica (AT)

Lion tamarin (GHLT)		X	1	X	3	3		1	X
tamandua		X	1		2			2—arboreal	
ornate hawk eagle		X	3	X	2+		X	1	
Goefrey's marmoset		X	2		1+	3		1	X
King vulture	X	X	2		3		X	1	PMP
paca		X	1		1+			1	
macaws (also in Finca)	X	X	1	X	2		X	1	
scorpion (w/ rhino beetle)		X	1	X	2+			1	
rhino beetle (w/ scorpion)		X	2	X	2			2	
velvet worm (peripatus)		X	3	X	1			2	
walking stick		X	1+	X	2				
tinamou		X	2	X	1				

Pantanal (P)

capybara (w/ anteater)		X	1+	X	2			1	
G. anteater (w/ jabiru stork)		X	2	X	3			2	PMP
jabiru stork		X	3		2+			1	
red-legged suryama	X				2			1	
black howler monkey	X			X	2			1	PMP
waxy monkey frog		X	1		2			2	
crested screamer	X			X	1			1	
black bellied whistling duck		X	1	X	1	2	X	1	
puna ibis		X	1	X	1			1	
A. snake necked turtle		X	2	X	1			1	
(Orinoco goose)	X			X	1			1—AZA wants to work with O.G.	
ornate horned frog		X	1	X	2			1	
anolis lizard		X	1	X	1			1	

Animals

Animal List

	In Collection	To Be Acquired	Difficult	In Budget	WOW Level	Conservation Level	CITES	Husbandry	SSP
Finca (F)									
macaws (MS)	X	X	1	X	2		X	1	
chinchillas		X	1		1			1	
guinea pigs	X	X	1		1			1—need more	
tortoise	X				1			1	
armadillo (MS)		X	1		2			1	
3-toed sloth (AT)	X			X	3			three animals	
boa constrictor	X			X	2		X	1	
green iguana	X				2		X	1	
kinkajou		X	1		2			1	PMP
coatimundi		X	2		2			1	PMP
In Budget, but not on list above									
Andean Condor				X	3	3	X	1	X
Central American river turtles				X	1	2	X	1	
Treefrog, monkey legged				X	2			1	
Black-tailed mont. pit viper				X	2			2	
many small birds				X	1 to 2			1	

Animals

Primates of Tropical America

Potential primates to be considered for inclusion or research

by Anthony B. Rylands

Conservation International

April 2003

Primates

There are approximately 330 species, and 640 species and subspecies of primates worldwide.

Suborder Stepsirrhini

Infraorders: Adapiformes (extinct), Lemuriformes (lemurs), Chiromyiformes (aye-aye), Loriformes (lorises).

Suborder Haplorrhini

Infraorders: Tarsiiformes (tarsiers), Simiiformes (monkeys and apes)

Extant Simiiformes divided into:

Catarrhini (a narrow nasal septum = the nostrils are close together). Old world monkeys and apes.

Platyrrhini (a broad nasal septum = the nostrils are well separated). New World monkeys

Collectives for South and Central American primates: New World monkeys, New World primates, Neotropical monkeys, Neotropical primates, platyrrhine primates, platyrrhine monkeys.

New World Primates

There are five extant families:

Callitrichidae: Subfamily Callitrichinae (pygmy marmoset, marmoset, tamarin, lion tamarin) and Callimiconinae (Goeldi's monkey).

Cebidae: Subfamily Cebinae (capuchin monkeys), Subfamily Saimiriinae (squirrel monkeys)

Aotidae: Subfamily Aotinae (night monkeys—the only nocturnal monkeys of the New World).

Pitheciidae: Subfamily Callicebinae (titi monkeys) and Subfamily Pitheciinae (saki monkeys, uakari monkeys, and bearded saki monkeys)

Atelidae: Subfamily Alouattinae (howling monkeys) and Subfamily Atelinae (spider monkeys, the yellow-tailed woolly monkey, and the muriqui or woolly spider monkey).

There are 18 genera—all but two occur in Amazonia. Muriqui (*Brachyteles*) and lion tamarins (*Leontopithecus*) are endemic to the Atlantic forest.

Animals

Primates of Tropical America

AMAZONIAN PRIMATES

There are 82 species of primates in Amazonia (*sensu lato* but excluding the Tropical Andes)

69 species (85%) are endemic to Amazonia

There are 135 species and subspecies of primates in Amazonia

123 (91%) species and subspecies are endemic.

Species	Species and subspecies	Endemic species and subspecies
Callitrichidae—29	Callitrichidae—48	Callitrichidae 47
Cebidae—8	Cebidae—23	Cebidae—18
Aotidae—6	Aotidae—7	Aotidae—4
Pitheciidae—29	Pitheciidae—39	Pitheciidae—39
Atelidae—10	Atelidae—18	Atelidae—15
Total—82	Total—135	Total—123

Family Callitrichidae (endemic in bold)

1. *Cebuella pygmaea pygmaea* (Spix, 1823)
2. *C. pygmaea niveiventris* (Lönnerberg, 1940)
3. *Mico argentatus* (Linnaeus, 1766)
4. *M. leucippe* (Thomas, 1922)
5. *M. melanurus* (É. Geoffroy in Humboldt, 1812)
6. *M. intermedius* (Hershkovitz, 1977)
7. *M. emiliae* (Thomas, 1920)
8. *M. nigricaps* (Ferrari & Lopes, 1992)
9. *M. marcai* (Alperin, 1993)
10. *M. humeralifer* (É. Geoffroy in Humboldt, 1812)
11. *M. chrysoleucus* (Wagner, 1842)
12. *M. mauesi* (Mittermeier, Schwarz & Ayres, 1992)
13. *M. humilis* (Van Roosmalen, Van Roosmalen, Mittermeier & Fonseca, 1998)
14. *Mico saterei* (Silva e Sousa Jr & Noronha, 1998)
15. *Mico manicorensis* (Van Roosmalen, Van Roosmalen, Mittermeier & Rylands, 2000)

Common name (a)

- Pygmy marmoset
- Silvery marmoset
- Golden-white bare-ear marmoset
- Black-tailed marmoset
- Aripuanã marmoset
- Snethlage's marmoset
- Black-headed marmoset
- Marca's marmoset
- Black and white tassel-ear marmoset
- Golden-white tassel-ear marmoset
- Maués marmoset
- Black-crowned dwarf marmoset
- Sateré marmoset
- Manicoré marmoset

Animals

Primates of Tropical America

16. *Mico acariensis*. (Van Roosmalen, Van Roosmalen, Mittermeier & Rylands, 2000)
17. *Mico sp. (a)*
18. *Saguinus nigricollis nigricollis* (Spix, 1823)
19. *S. nigricollis hernandesi* (Hershkovitz, 1982)
20. *S. graellsii* (Jiménez de la Espada, 1870)
21. *S. fuscicollis fuscicollis* (Spix, 1823)
22. *S. fuscicollis fuscus* (Lesson, 1840)
23. *S. fuscicollis avilapiresi* (Hershkovitz, 1966)
24. *S. fuscicollis cruzlimai* (Hershkovitz, 1966)
25. *S. fuscicollis leucogenys* (Gray, 1866)
26. *S. fuscicollis lagonotus* (Jiménez de la Espada, 1870)
27. *S. fuscicollis primitivus* (Hershkovitz, 1977)
28. *S. fuscicollis illigeri* (Pucheran, 1845)
29. *S. fuscicollis nigrifrons* (I. Geoffroy, 1850)
30. *S. fuscicollis weddelli* (Deville, 1849)
31. *S. fuscicollis melanoleucus* (Miranda Ribeiro, 1912)
32. *S. fuscicollis crandalli* (Hershkovitz, 1966)
33. *S. tripartitus* (Milne-Edwards, 1878)
34. *S. mystax mystax* (Spix, 1823)
35. *S. mystax pileatus* (I. Geoffroy & Deville, 1848)
36. *S. mystax pluto* (Lönnerberg, 1926)
37. *S. labiatus labiatus* (É. Geoffroy in Humboldt, 1812)
38. *S. labiatus thomasi* (Goeldi, 1907)
39. *S. labiatus rufiventer* (Gray, 1843)
40. *S. imperator imperator* (Goeldi, 1907)
41. *S. imperator subgriseus* (Lönnerberg, 1940)
42. *S. midas* (Linnaeus, 1758)
43. *S. niger* (É. Geoffroy, 1803)
44. *S. inustus* (Schwarz, 1951)
45. *S. bicolor* (Spix, 1823)
46. *S. martinsi martinsi* (Thomas, 1912)
47. *S. martinsi ochraceus* (Hershkovitz, 1966)
48. *Callimico goeldii* (Thomas, 1904)

Rio Acarí marmoset

Rondonia marmoset

- Spix's black mantle tamarin
- Hernández-Camacho's black mantle tamarin
- Graell's black-mantle tamarin
- Spix's saddle-back tamarin
- Lesson's saddle-back tamarin
- Ávila Pires' saddle-back tamarin
- Cruz Lima's saddle-back tamarin
- Andean saddle-back tamarin
- Red-mantle saddle-back tamarin
- Saddle-back tamarin
- Illiger's saddle-back tamarin
- Geoffroy's saddle-back tamarin
- Weddell's saddle-back tamarin
- White saddle-back tamarin
- Crandall's saddle-back tamarin
- Golden-mantle saddle-back tamarin
- Spix's moustached tamarin
- Red-cap moustached tamarin
- White-rump moustached tamarin
- Red-bellied tamarin
- Thomas' moustached tamarin

- Black-chinned emperor tamarin
- Bearded emperor tamarin
- Golden-handed tamarin
- Black-handed tamarin
- Mottled-face tamarin
- Pied bare-face tamarin
- Martin's bare-face tamarin
- Ochraceous bare-face tamarin
- Goeldi's monkey

Animals

Primates of Tropical America

Family Cebidae (endemic in bold)

1. *Saimiri boliviensis boliviensis* (I. Geoffroy & de Blainville, 1834)
2. ***S. boliviensis peruviansis*** (Herskovitz, 1984)
3. ***S. boliviensis pluvialis*** (Lönnerberg, 1940)
4. ***S. boliviensis jaburuensis*** (Lönnerberg, 1940)
5. ***S. vanzolinii*** (Ayres, 1981)
6. ***S. sciureus sciureus*** (Linnaeus, 1758)
7. *S. sciureus albigena* (Von Pusch, 1941)
8. ***S. sciureus cassiquiarensis*** (Lesson, 1840)
9. ***S. sciureus macrodon*** (Elliot, 1907)
10. ***S. ustus*** (I. Geoffroy, 1843)
11. *Cebus apella apella* (Linnaeus, 1758)
12. ***C. apella fatuellus*** (Linnaeus, 1766)
13. ***C. apella macrocephalus*** (Spix, 1823)
14. ***C. apella peruanus*** (Thomas, 1901)
15. ***C. apella tocaninus*** (Lönnerberg, 1939)
16. ***C. libidinosus juruanus*** (Lönnerberg, 1939)
17. ***C. libidinosus pallidus*** (Gray, 1866)
18. *C. albifrons albifrons* (Humboldt, 1812)
19. ***C. albifrons cuscinus*** (Thomas, 1901)
20. *C. albifrons yuracus* (Herskovitz, 1949)
21. ***C. olivaceus olivaceus*** (Schomburgk, 1848)
22. ***C. olivaceus castaneus*** (I. Geoffroy, 1851)
23. ***C. olivaceus kaapori*** (Queiroz, 1992)

Family Aotidae (endemic in bold)

1. ***A. trivirgatus*** (Humboldt, 1812)
2. *A. vociferans* (Spix, 1823)
3. *A. miconax* (Thomas, 1927)
4. ***A. nancymae*** (Herskovitz, 1983)
5. ***A. nigriceps*** (Dollman, 1909)
6. ***A. azarae boliviensis*** (Elliot, 1907)
7. *A. azarae infulatus* (Kuhl, 1820)

Common name

Black-headed squirrel monkey
Peruvian squirrel monkey

Common squirrel monkey

Humboldt's squirrel monkey
 Ecuadorian squirrel monkey
Golden-backed squirrel monkey
 Guianan brown capuchin

Large-headed capuchin
Peruvian tufted capuchin

Tambopata tufted capuchin
 White-fronted capuchin
Shock-headed capuchin
 Andean white-fronted capuchin
Wedge-capped capuchin
 Chestnut capuchin
 Ka'apor capuchin

Common name

Douroucouli, owl monkey, night monkey

Andean night monkey
Ma's night monkey
Black-headed or Peruvian night monkey
Bolivian night monkey
 Feline night monkey

Animals

Primates of Tropical America

Family Pitheciidae (endemic in bold)

1. *Callicebus modestus* (Lönnerberg, 1939)
2. *C. donacophilus* (D'Orbigny, 1836)
3. *C. olallae* (Lönnerberg, 1939)
4. *C. oenanthe* (Thomas, 1924)
5. *C. cinerascens* (Spix, 1823)
6. *C. hoffmannsi* (Thomas, 1908)
7. *C. baptista* (Lönnerberg, 1939)
8. *C. moloch* (Hoffmannsegg, 1807)
9. *C. brunneus* (Wagner, 1842)
10. *C. cupreus* (Spix, 1823)
11. *C. caligatus* (Wagner, 1842)
12. *C. dubius* (Herschkovitz, 1988)
13. *Callicebus bernhardi* (Van Roosmalen, Van Roosmalen & Mittermeier, 2002)
14. *Callicebus stephennashi* (Van Roosmalen, Van Roosmalen & Mittermeier, 2002)
15. *C. torquatus* (Hoffmannsegg, 1807)
16. *C. lugens* (Humboldt, 1811)
17. *C. regulus* (Thomas, 1927)
18. *C. lucifer* (Thomas, 1914)
19. *C. purinus* (Thomas, 1927)
20. *Pithecia pithecia pithecia* (Linnaeus, 1758)
21. *P. pithecia chrysocephala* (I. Geoffroy, 1850)
22. *P. monachus monachus* (É. Geoffroy, 1812)
23. *P. monachus milleri* (Allen, 1914)
24. *P. monachus napensis* (Lönnerberg, 1938)
25. *P. irrorata irrorata* (Gray, 1842)
26. *P. irrorata vanzolinii* (Herschkovitz, 1987)
27. *P. albicans* (Gray, 1860)
28. *P. aequatorialis* (Herschkovitz, 1987)
29. *Chiropotes albinasus* (I. Geoffroy & Deville, 1848)
30. *C. satanas* (Hoffmannsegg, 1807)
31. *C. chiropotes* (Humboldt, 1811)
32. *C. utahicki* (Herschkovitz, 1985)
33. *C. sagulatus* (Traill, 1821)
34. *Cacajao calvus calvus* (I. Geoffroy, 1847)
35. *C. calvus ucayalii* (Thomas, 1928)
36. *C. calvus novaesi* (Herschkovitz, 1987)
37. *C. calvus rubicundus* (I. Geoffroy & Deville, 1848)
38. *C. melanocephalus melanocephalus* (Humboldt, 1811)
39. *C. melanocephalus ouakary* (Spix, 1823)

Common name

- Beni titi monkey
Andean titi monkey
- Hoffmann's titi monkey
- Prince Bernhard's titi monkey
- Stephen Nash's titi monkey
- Collared titi, widow monkey
- Widow monkey
- White-faced saki
Golden-faced saki
Geoffroy's monk saki
Miller's monk saki
Napo monk saki
Gray's bald faced saki
Vanzolini's bald-faced saki
White saki, buffy saki
Equatorial saki
White-nosed bearded saki
Black saki
Bearded saki
Uta Hick's bearded saki
Guianan bearded saki
White bald-headed uacari
Ucayali bald-headed uacari
Novaes' bald-headed uacari
Red bald-headed uacari
Humboldt's black-headed uacari
Spix's black-headed uacari

Animals

Primates of Tropical America

Family Atelidae (endemic in bold)

1. *Alouatta seniculus seniculus* (Linnaeus, 1766)
2. ***A. seniculus ssp.***
3. ***A. seniculus amazonica*** (Lönnerberg, 1941)
4. ***A. seniculus juara*** (Elliot 1910)
5. ***A. seniculus puruensis*** (Lönnerberg, 1941)
6. *A. sara* (Elliot, 1910)
7. *A. belzebul belzebul* (Linnaeus, 1766)
8. ***A. belzebul discolor*** (Spix, 1823)
9. ***A. belzebul ululata*** (Elliot, 1912)
10. ***A. nigerrima*** (Lönnerberg, 1941)
11. ***Ateles chamek*** (Humboldt, 1812)
12. ***A. paniscus*** (Linnaeus, 1758)
13. ***A. marginatus*** (É. Geoffroy, 1809)
14. ***A. belzebuth*** (É. Geoffroy, 1806)
15. ***Lagothrix lagothricha*** (Humboldt, 1812)
16. ***L. cana cana*** (É. Geoffroy in Humboldt, 1812)
17. ***L. cana tschudii*** (Pucheran, 1857)
18. ***L. poeppigii*** (Schinz, 1844)

Common name

- Red howling monkey
Guianan red howling monkey
- Bolivian red howling monkey
 Red-handed howling monkey
- Black howling monkey**
Black-faced black spider monkey
Red-faced black spider monkey
White-whiskered spider monkey
White-bellied spider monkey
Humboldt's woolly monkey
Geoffroy's woolly monkey
- Poeppig's woolly monkey

ATLANTIC FOREST PRIMATES

There are 24 species and subspecies of primates in the Atlantic forest, 20 of them endemic.

1. *Callithrix jacchus* (Linnaeus, 1758) Common marmoset
2. *Callithrix penicillata* (É. Geoffroy, 1812) Black-tufted-ear marmoset
3. ***Callithrix kuhlii*** (Wied-Neuwied, 1826) **Wied's black-tufted-ear marmoset**
4. ***Callithrix geoffroyi*** (Humboldt, 1812) **Geoffroy's tufted-ear marmoset**
5. ***Callithrix flaviceps*** (Thomas, 1903) **Buffy-headed marmoset**
6. ***Callithrix aurita*** (E. Geoffroy, 1812) **Buffy-tufted-ear marmoset**
7. ***Leontopithecus rosalia*** (Linnaeus, 1766) **Golden lion tamarin**
8. ***Leontopithecus chrysomelas*** (Kuhl, 1820) **Golden-headed lion tamarin**
9. ***Leontopithecus chrysopygus*** (Mikan, 1823) **Black lion tamarin**
10. ***Leontopithecus caissara*** (Lorini & Persson, 1990) **Black-faced lion tamarin**
11. ***Cebus nigrurus*** (Goldfuss, 1809) **Black-horned capuchin**
12. ***Cebus robustus*** (Kuhl, 1820) **Crested capuchin**
13. ***Cebus xanthosternus*** (Wied-Neuwied, 1826) **Yellow-breasted capuchin**
14. *Cebus libidinosus* (Spix, 1823) Bearded capuchin
15. ***Callicebus personatus*** (E. Geoffroy, 1812) **Northern masked titi**
16. ***Callicebus nigrifrons*** (Spix, 1823) **Black-fronted titi**
17. ***Callicebus melanochir*** (Wied-Neuwied, 1820) **Southern Bahian masked titi**
18. ***Callicebus barbarabrownae*** (Hershkovitz, 1990) **Northern Bahian blond titi**
19. ***Callicebus coimbrai*** (Kobayashi & Langguth 1999) **Coimbra-Filho's titi monkey**
20. ***Alouatta guariba guariba*** (Humboldt, 1812) **Northern brown howling monkey**
21. ***Alouatta guariba clamitans*** (Cabrera, 1940) **Southern brown howling monkey**
22. *Alouatta belzebul belzebul* (Linnaeus, 1766) Red-handed howling monkey
23. ***Brachyteles arachnoides*** (E. Geoffroy, 1806) **Southern muriqui**
24. ***Brachyteles hypoxanthus*** (Spix, 1823) **Northern muriqui**

Animals

Primates of Tropical America

MESOAMERICAN PRIMATES

Nine species occur in Mesoamerica, 22 species and subspecies.

Four species and 18 species and subspecies are endemic to Mesoamerica.

1. ***Saguinus geoffroyi* (Pucheran, 1845)**
2. *Aotus lemurinus* (l. Geoffroy, 1843)
3. *Aotus zonalis* (Goldman, 1914)
4. ***Saimiri oerstedii oerstedii* (Reinhardt, 1872)**

5. ***Saimiri oerstedii citrinellus* (Thomas, 1904)**

6. ***Cebus capucinus limitaneus* (Hollister, 1914)**
7. ***Cebus capucinus imitator* (Thomas, 1903)**
8. ***Alouatta palliata palliata* (Gray, 1848)**
9. ***Alouatta palliata mexicana* (Merriam, 1902)**
10. *Alouatta palliata aequatorialis* (Festa, 1903)
11. ***Alouatta palliata coibensis* (Thomas, 1902)**
12. ***Alouatta palliata trabeata* (Lawrence, 1933)**
13. ***Alouatta pigra* (Lawrence 1933)**
14. ***Ateles geoffroyi geoffroyi* (Kuhl, 1820)**
15. ***Ateles geoffroyi azuerensis* (Bole, 1837)**
16. ***Ateles geoffroyi frontatus* (Gray, 1842)**
17. ***Ateles geoffroyi griseescens* (Gray, 1866)**
18. ***Ateles geoffroyi panamensis* (Kellogg & Goldman, 1944)**
19. ***Ateles geoffroyi ornatus* (Gray, 1870)**
20. ***Ateles geoffroyi vellerosus* (Gray, 1866)**
21. ***Ateles geoffroyi yucatanensis* (Kellogg & Goldman, 1944)**
22. *Ateles fusciceps robustus* (= *rufiventris*) (Allen, 1914)

Dry Forest

23. ***Saguinus oedipus***

Geoffroy's tamarin

Lemurine night monkey

Black-crowned Central American squirrel monkey

Gray-crowned Central American squirrel monkey

White-faced capuchin

Panamanian white throated capuchin

Golden-mantled howling monkey

Mexican howling monkey

South Pacific blackish howling monkey

Coiba Island howling monkey

Azuero howling monkey

Black howling monkey

Geoffroy's spider monkey

Azuero spider monkey

Black-browed spider monkey

Hooded spider monkey

Red spider monkey

Ornate spider monkey

Mexican spider monkey

Yucatán spider monkey

Colombian black spider monkey

Cotton-top tamarin

Animals

Primates of Tropical America

CAATINGA/CHACO/CERRADO/PANTANAL

Ten species and 11 species and subspecies occur in the Caatinga/Chaco/Cerrado/Pantanal.

Three species and four species and subspecies are endemic to the Caatinga/Chaco/Cerrado/Pantanal.

- | | |
|--|-----------------------------|
| 1. <i>Mico melanurus</i> (É. Geoffroy in Humboldt, 1812) | Black-tailed marmoset |
| 2. <i>Callithrix jacchus</i> (Linnaeus, 1758) | Common marmoset |
| 3. <i>Callithrix penicillata</i> (É. Geoffroy, 1812) | Black-tufted-ear marmoset |
| 4. <i>Aotus infulatus</i> (Kuhl, 1820) | Feline night monkey |
| 5. <i>Aotus azarai azarai</i> (Humboldt, 1812) | Azara's night monkey |
| 6. <i>Aotus azarai boliviensis</i> (Elliot, 1907) | Bolivian night monkey |
| 7. <i>Callicebus pallescens</i> (Thomas, 1907) | Titi monkey |
| 8. <i>Cebus libidinosus</i> (Spix, 1823) | Bearded capuchin |
| 9. <i>Cebus cay</i> (Illiger, 1815) | Tufted capuchin |
| 10. <i>Alouatta sara</i> (Elliot, 1910) | Bolivian red howling monkey |
| 11. <i>Alouatta caraya</i> (Humboldt, 1812) | Black howling monkey |

PANTANAL OF BOLIVIA AND BRAZIL

- | | |
|---|--|
| 1. <i>Mico melanurus</i> (É. Geoffroy in Humboldt, 1812) | Black-tailed marmoset |
| 2. <i>Saimiri boliviensis boliviensis</i> (I. Geoffroy & de Blainville, 1834) | Black-headed squirrel monkey (Bolivia) |
| 3. <i>Aotus infulatus</i> (Kuhl, 1820) | Feline night monkey |
| 4. <i>Aotus azarai azarai</i> (Humboldt, 1812) | Azara's night monkey |
| 5. <i>Aotus azarai boliviensis</i> (Elliot, 1907) | Bolivian night monkey (Bolivia) |
| 6. <i>Callicebus pallescens</i> (Thomas, 1907) | Titi monkey |
| 7. <i>Cebus cay</i> (Illiger, 1815) | Tufted capuchin |
| 8. <i>Alouatta caraya</i> (Humboldt, 1812) | Black howling monkey |

Seven species and eight species and subspecies of primates occur in the Pantanal region of Bolivia and Brazil.

Animals

Primates of Tropical America

SUGGESTIONS

Based on discussions during the workshop at the Miami Metrozoo, 17-20 March 2003.

AMAZONIA

Callitrichidae

Callitrichids have lots of good stories about their behavior, only monkeys which twin regularly, cooperative breeding (all group members carry the young), the (usually) single breeding female suppresses reproduction in other adult females—both physiologically (they do not cycle) and behaviorally, females manipulate the males to carry the young through uncertainty of paternity, studies have shown that they are important seed dispersers—and so on.

Suggested Options:

- ** Emperor tamarins (*Saguinus imperator subgriseescens*)—pair already in collection. Range: Upper Rio Juruá in southwestern Amazonia, in south-east Peru, northern Bolivia and the south-west of the Brazil Amazon. Normal group size 5–7 (a dominant pair and offspring of various ages). Eric Bairrão Ruivo (Lisbon Zoo) is the European studbook keeper for this subspecies (*S. i. imperator* and hybrids have been phased out).
- Saddle-back tamarins (*Saguinus fuscicollis ssp.*). Smaller than emperor tamarins. Range—upper Amazon in southern Colombia, eastern Peru, Bolivia and Brazil (south of the Rio Amazonas and west of the Rio Madeira). Saddleback tamarins and emperor tamarins naturally form mixed species groups in the wild—travelling foraging and feeding together during a good part or sometimes all of the day, they sleep (in dense vegetation and along branches) separately but nearby. Although both species have very similar diets in terms of fruits, they differ in their small animal prey foraging techniques.
- Pygmy marmosets (*Cebuella pygmaea*). They include the pygmy marmoset, which is the smallest monkey in the world (not the smallest primate—that credit goes to the mouse lemurs). A key aspect of interest is their propensity (dental, behavioral, and physiological adaptations)—with other marmosets—to chew holes in tree trunks, branches, and vines to obtain gums. Pygmy marmosets sometimes form (in Bolivia) mixed species groups with saddleback tamarins and moustached tamarins (the moustached tamarins as a group include red bellied tamarins, *Saguinus labiatus*, moustached tamarins, *Saguinus mystax*, and emperor tamarins, *Saguinus imperator*).

Animals

Primates of Tropical America

- **Goeldi's monkey (*Callimico goeldii*). An odd callitrichid in various aspects, very beautiful, and, despite giving birth to single not twin offspring and having 36 teeth rather than the 32 typical of the family, is very closely related to marmosets (more so than the tamarins). Also compatible with the above species—sometimes forming mixed groups. It is rare in the wild, occurring sporadically in southwestern Amazonian Brazil, northern Bolivia (Pando), eastern Peru, and southern Colombia. There is a studbook for the species in the USA.

Suggested Options—Threatened Species:

- The pied tamarin, *Saguinus bicolor*. An interesting and beautiful tamarin, not cute—bat-like ears, devilish little face, and a rather “aggressive nature,” I understand. Could not be kept with other tamarins. Critically endangered in the wild—restricted to a small area around the city of Manaus, and its range is being eroded (nobody knows why) by the Midas or golden-handed tamarin, *Saguinus midas*, besides loss of habitat from urban growth and farming. Not many in captivity, but there is a breeding program in Europe (Jersey Zoo, Apenheul, and others) and an International Conservation and Management Committee of the Brazilian government wildlife authorities (IBAMA). Contact for this committee, which regulates the captive population, is Dr. Andrew Baker of Philadelphia Zoo.

Recommendation. It would be possible to have all these on islands. Putting them together would require that they have semi-free-ranging space. The emperor tamarins travel high in the forest, the saddleback tamarins lower (most of their time below 10 m), Goeldi's monkey and pygmy marmosets lowest. Together they would form a number which would guarantee the visibility of some if not all on such as the gibbon/siamang island. All, I believe, are available from other zoos, both in the USA and Europe. *Callimico*, *Saguinus imperator* (Europe at least), and *Cebuella* (USA) have studbooks that I know of.

Recommendation. From a welfare/enrichment point of view, cage sizes would need to be larger than that currently housing *S. imperator*. Devra Kleiman is an authority on these aspects.

Animals

Primates of Tropical America

Cebidae

Comprising two genera, *Cebus* (the capuchin monkeys) and *Saimiri* (the squirrel monkeys). No Amazonian species are considered threatened.

Suggested options:

- *Cebus spp.* There are two species of tufted capuchins in the Amazon: *Cebus apella* (from the Guianas and western Amazonia) and *Cebus macrocephalus* (from the upper Amazon—Peru, Colombia, western Brazilian Amazon). They occur in bands of 6–25 in general, usually with one male who monopolizes breeding (is more muscular and robust than other males) with four, five, or more females. The male restricts access to food sources of the females and their offspring who are not compliant with his hegemony. They are active, intelligent, destructive and creative manipulative foragers. The most omnivorous of the New World primates: crush seeds, fruits, eat insects, nestlings, crabs (some hunt in coastal mangroves), bash hard fruits, and in some populations use stones to do so. They are entertaining. They are a problem in Brazil, for example, because they are so frequently taken as pets, and then get too big and troublesome, and they breed well in zoos, which means that many zoos have too many. The taxonomy is problematic so often different species/subspecies are put together and hybridize. They are not compatible in a zoo context of relatively confined areas with callitrichids, which are afraid of them.
- *Saimiri ssp.* There are a number of species and subspecies in the Amazon. They typically occur in a large groups along rivers and in flooded forests. They are cute, active insect eaters and fruit eaters, and breed well in the right conditions. They occur in mixed species groups with tufted capuchins in the wild—nobody is quite sure why—but undoubtedly this is linked with protection from predation (more eyes and ears) and possibly also benefiting from the rummaging of the capuchin monkeys above them, picking up bits, scraps, and insects disturbed by them.

Recommendation. These monkeys are active, form relatively large groups, and require space. Gibbon/siamang type island would be best. Care should be taken to evaluate if they are hybrids—because the taxonomy of both is complex and, in the 1970s, unrecognized or ignored. *Saimiri* have been (are) extensively used for biomedical research and undoubtedly hybrids abound, *Cebus* less so but no doubt many in captivity are hybrids. These should not be allowed to breed—and genetic testing would be required to establish their hybrid or pure status. *Saimiri* are incompatible with callitrichids due to their susceptibility to *Saimiri* herpes.

Animals

Primates of Tropical America

Pitheciidae

Four genera: *Pithecia* (the saki monkeys), *Cacajao* (the uakaris), *Chiropotes* (the bearded sakis), and *Callicebus* (titi monkeys).

Suggested options:

- The white-faced saki, *Pithecia pithecia*, from the Guiana Shield. A quiet, very beautiful monkey—male is black with a white face, female grizzled-brownish. They are seed predators: educational-informative stories of its secretiveness and feeding habits. Would be compatible with *Cebus*, *Saimiri*, and the callitrichids on an island. In zoos often kept in relatively small cages (tall), with apparent success. There is a North American studbook for this species. Males tend to look after young, in quite small groups of a pair up to four or five animals. To exercise they need a lot of space and vertical supports (they do a lot of vertical clinging and leaping).
- Bearded sakis, *Chiropotes*. A dramatic animal, unusual and beautiful. Very active and wide-ranging in the wild—occurs in groups of 20 or more. This would require an island situation. Seed predators. Not common in captivity. *C. sagulatus* occur in the Guianas, and it may be possible to import *C. utahickae* from the Belém Primate Center who have some as a result of the flooding of the Tucurui dam.
- Titi monkeys, *Callicebus*, form small monogamous groups of no more than four (up to two young of different ages): quiet, very attractive animals, the pair make little bird-like twitters sounds, and in the mornings duet dramatically (if they have a reason to do so, e.g. a neighboring group) and often sit together with their tails twined. Some *Callicebus cupreus* (upper Amazon in Peru and Brazil) recently sent to Europe from California. Compatible with callitrichids and, with enough space, possibly the cebids.

Other species for a mixed exhibit with the primates:

- Could include agouti, trumpeter, collared peccary, sloth (*Bradypus*), tamandua (*Tamandua tetradactyla*), forest deer (*Mazama*), capybara, tapir, perhaps even an armadillo or two (*Dasybus*).
- If they are to be in an aviary—risky—nestlings and eggs are fair game to most of the primates (probably not spider monkeys or pitheciids—but you can't be sure). I have seen toucans attack marmosets.
- **Not:** Coati, tayra, cats, skunks, or kinkajous for obvious reasons (coatis may be OK with the bigger primates but are believed to be predators of the smaller primates. I have seen them mobbing and they have been taken to trial regarding the loss of golden lion tamarins in the Poço das Antas Biological Reserve).

Animals

Primates of Tropical America

ATLANTIC FOREST

Callitrichidae

Suggested options:

- ** Lion tamarins, *Leontopithecus*. Highly attractive animals, and very well-known, symbols (flagships) for the conservation of the Atlantic forest, due to the conservation programs set up for each. EAZA has just completed a very successful two-year fund-raising campaign on behalf of these animals. Numerous zoos have golden lion tamarins, *Leontopithecus rosalia*, a large number have golden-headed-lion tamarins, *L. chrysomelas*, and a few have the black lion tamarin. Breeding in captivity is carefully monitored and controlled through the International Conservation and Management Committee of the Brazilian government wildlife authorities (IBAMA). Contact for this committee is Dr. Devra Kleiman. Populations of both *rosalia* and *chrysomelas* are controlled—so breeding would probably not be allowed. Frugivorous and insectivorous—advantage should be taken to house them with bromeliads, one of their favourite foraging and resting sites—although they typically sleep in tree holes.
- Wied's black-tufted-ear marmoset. These marmosets from southern Bahia in Brazil are sympatric with *L. chrysomelas* and mingle more than occasionally, especially at fruiting trees, and lion tamarins occasionally chase them (but do not form the mixed species groups to the extent of the saddleback tamarins and moustached tamarins). These are unusual and attractive marmosets. Dr. Jeffrey French (University of Nebraska at Omaha) has animals for research, on breeding loan (I believe) from the Rio de Janeiro Primate Center. They breed perfectly well. It is possible Dr. French wishes to manumit excess stock.

Recommendation: A mixed species exhibit, requiring a large cage or, better, an island.

- Geoffroy's or white-faced marmoset, *Callithrix geoffroyi*. Very attractive marmoset from Espirito Santo and Minas Gerais. They are available in captivity in the USA (some behavioral research being done on them at least) but not often seen in zoos. Very cute babies. They are not sympatric with lion tamarins—but a mixed exhibit with them may work. Mello Leitão Museum, Santa Teresa, and the Rio de Janeiro Primate Center have them in captivity.
- The common marmoset, *Callithrix jacchus*, occurs in the Atlantic forest of the north-east of Brazil. It is not threatened, it is common and easy to keep in captivity. In Europe, widely used for physiological and biomedical research. It is the most exudativorous of the marmosets, and is attractive as marmosets are attractive. Not common in zoos in the USA, I believe.

Animals

Primates of Tropical America

Cebidae

Suggested option:

- Yellow-breasted capuchin, *Cebus xanthosternos*, and the robust tufted capuchin, *Cebus robustus*. These are two attractive Atlantic forest capuchin monkey species for which there is an International Conservation and Management Committee of the Brazilian government wildlife authorities (IBAMA). Contact for this committee, which regulates the captive populations, is Dr. Andrew Baker of Philadelphia Zoo. The need for a structured captive breeding program (many animals being kept as pets in southern Bahia and northern Espírito Santo where they occur) resulted in a recommendation by the Committee that zoos would organize a program for the yellow-breasted capuchin, *Cebus xanthosternos* (critically endangered), which is already underway in Europe, with the Rio de Janeiro Primate Center being the key source), and that American zoos would organize a captive breeding program for the mahogany-coloured, robust tufted capuchin, *Cebus robustus* (vulnerable). While the program for *xanthosternos* is meeting with some success, that for *robustus* has yet to be set up.

Recommendation: Miami Metrozoo could take a lead for *Cebus robustus* and begin a captive breeding program in collaboration with the Rio de Janeiro Primate Center. It would need good cages, quarantines, and a number of return flights to Rio de Janeiro, research expeditions within its range (Espírito Santo, north of the Rio Doce), and all that is involved in establishing a conservation program.

Recommendation: Miami Metrozoo could collaborate with the *xanthosternos* program, which could be very high-profile, due to the highly endangered status of the species. *L. chrysomelas*, *C. kuhlii*, and *C. xanthosternos* are all sympatric in Bahia, and there are active, successful, and attractive research and conservation programs with local NGOs there, Cecília Kierulff (Conservation International do Brasil) in southern Bahia is carrying out surveys of *C. xanthosternos*, a student of the Federal University of Minas Gerais, Belo Horizonte (to be supervised by Anthony Rylands), will be carrying out a survey of *C. robustus*, and James Dietz (University of Maryland) and K. de Vleeschouwer (Antwerp Zoo) are studying *C. kuhlii* and *L. chrysomelas*. Miami Metrozoo could adopt a conservation program or set up its own collaboration with local NGOs in southern Bahia, with these species as flagships for their efforts.

Animals

Primates of Tropical America

Atelidae

Suggested options:

- *Brachyteles spp.* Two species of murrelet or woolly spider monkey, the largest of the extant New World monkeys, are threatened. Would require a large area, preferably island habitat, or a very large cage. Two captive populations, the Rio de Janeiro Primate Center (hybrids of *arachnoides* from São Paulo, Rio de Janeiro and Paraná, and *hypoxanthus*, from Minas Gerais, and Espírito Santo: it was formerly considered a single species) and Curitiba Zoo, Paraná, Brazil. Highly attractive animal: folivore/frugivores. Would require a considerable investment in the breeding program, but the conservation message and support would be very high profile. Never kept or bred outside of Brazil. There is an International Conservation and Management Committee of the Brazilian government wildlife authorities (IBAMA). Contacts for this committee, which regulates the captive population and research in the wild, are Dr. Claudio Valladares-Padua (Brasília) and Marcelo Marcelino (IBAMA). Very big conservation story goes with the species. With the lion tamarins, one of the best-known of the South American primates due to long-term research by Karen B. Strier and colleagues (University of Wisconsin—Madison).

Animals

Primates of Tropical America

MESOAMERICA AND DRY FORESTS

- Cotton-top tamarin, *Saguinus oedipus*, moist and dry forests of northern Colombia. Very attractive animal, enchanting babies. Endangered in the wild. Excellent multidisciplinary conservation program underway in northern Colombia, led by Anne Savage (Disney's Animal Kingdom). Team up with Disney to help support the conservation program in Colombia? There are plenty of them in captivity, and probably there are restrictions on breeding. Widely used for biomedical research (colon cancer especially). As I understand, they do not mix well with other callitrichids—obstreperous.

Cebidae

- The white fronted capuchin, *Cebus capucinus*. I do not know of the status of these monkeys in captivity in the USA. See comments for *Cebus apella* above.

Atelidae

- Spider monkeys, *Ateles geoffroyi*, *Ateles fusciceps*. Available in captivity in USA and Europe—studbooks for both. But there are problems of hybrids. Care would need to be taken to avoid getting hybrids. The taxonomy of the variable and numerous taxa of *Ateles geoffroyi* is still confused—even despite molecular genetic studies.

Recommendation: Cotton-top tamarins would be sufficient.

PANTANAL

Callitrichidae

- The black-tailed marmoset, *Mico melanurus*. Occurs in Bolivia, Paraguay (Chaco), and the southwestern Amazon in Brazil (Rondônia and Mato Grosso). Not at all common in captivity, but a widespread species, not threatened. In the past, at least, they were kept in the Jersey Zoo. Stewart Muir (Shaldon Wildlife Trust) is carrying out a global survey of captive *Mico melanura* and *M. argentatus*.

Atelidae

- The black howling monkey, *Alouatta caraya*. A wide-ranging species through the Cerrado (bush savannah) of Central and southern Brazil, extending into the Chaco of Paraguay. A pair already part of the zoo collection.

Plants

Recommended Trees and Shrubs for Tropical America

South American Plantings for the Miami Metrozoo

Recommendations by Mike Maunder, PhD

Director of Horticulture, Fairchild Tropical Garden

April 2003

Amazon/Orinoco

PALMS

Alphanes—low elevation forests of eastern Andes—striking spiny palms—cold-sensitive

Astrocaryum acuale—NE Colombia, north and central Brazil, spectacular 10-foot leaves

Astrocaryum murumuru—thickets in swamp forest—cold sensitive

Bactris sp., *B. gasipaes*—edible fruit, ancient domesticat, both Central America and Amazon

Copernicia tectorum—N Colombia, Venezuela—Ilanos species

Elaeis oleifera—American Oil Palm—found in both Central America and Amazon—huge, quick growing species that is spectacular—cold-sensitive.

Manicaria sp.—thatch and weaving species

Mauritia sp.

Phytelephas sp.—Andes slopes and lowland rainforest of Amazon

Syagrus sp.

FLOWERING TREES

Brownea capitella, *B. grandiceps*—Rose of Venezuela

Chorisia insignis—Silk Floss Tree—spiny trunk

ECONOMICS

Bixa orellana—source of red food dye

Bertholettia excelsa—Brazil Nut—agouti story

Cinchona sp.—Quinine

Hevea brasiliensis—Rubber

Monstera

Philodendron

Heliconia

Victoria amazonica—Giant Amazon Water Lily—difficult to grow but an iconic plant of the Orinoco and Amazon waters

Pachira aquatica—buttress roots, rainforest tree—plant as soon as possible as key landscape feature

REFERENCE SITES

www.odi.org.uk/tropics/projects/3241.htm

www.amazonconservation.org/home/biodiversity.html

www.mma.gov.br/

www.rainforest-alliance.org/programs/research/floods.html

usuarios.lycos.es/mastachelopez/AMAZONAS.html

Plants

Recommended Trees and Shrubs for Tropical America

Dry Forest of Central America

PALMS

- Acoelorrhaphes wrightii*—Atlantic coastal plain of Central America—clumping palm
- Acrocomia aculeata*—Yucatan
- Attalea* species
- Brahea dulcis*—edible fruit

FLOWERING TREES

- Bauhinia aculeata*—white flowers
 - B. divaricata*
 - Bombax ceiba*—Red Silk Cotton—wonderful, quick growing tree, big red flowers—can get over 100 feet tall
 - Bulnesia arborea*—yellow flowers—good structural plant, dry areas of Colombia—Venezuela
 - Caesalpinia pulcherrima*—Pride of Barbados
 - C. vesicaria*—good winter flowers
 - Calliandra haemetocephala*—red powder puff flowers—small tree
 - Cochlospermum vitifolium*—spectacular yellow blossoms
 - Cordia sebestana*—red flowers
 - Jacaranda jasminoides*
 - Lonchocarpus violaceus*
 - Plumeria* sp.—“Frangi-Pangi”
 - Pseudobombax ellipticum*—30-40 ft, big pink flowers
 - Tabebuia chrysantha*—bright yellow
 - T. ochracea*
 - Tecoma stans*
- Key trees for region—*Enterolobium cyclocarpum*, *Hymenaea coiurbaril*

CLIMBERS

- Antigonon leptopus*

OTHERS

- Agave* sp., *Bursera* sp. Use native Gumbo Limbo, cacti

ECONOMICS

- Tomato, papaya, pineapple, avocado

REFERENCE SITES

- Guanacaste National Park—virtual dry forest walk: www.acguanacaste.ac.cr/bosque_seco_virtual/bs_web_page/b_s_todo.html
- publish.uwo.ca/~rgthorn/Guanacaste.html
- www.geh16.dial.pipex.com/news/nl0199.pdf
- www.earthwatch.org/expeditions/olson_02/theproject.html
- Forest restoration in Costa Rica: www.teaching.ag.iastate.edu/aec1535/janzen.htm

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

Plants

Mayan Plants for Tropical America

Mayan Rubber
Horse Balls Stem
Peach Palm
Lipstick Plant
Vanilla
Ice Cream Bean
Canistel
Guiana Chestnut
Balsa
Guanacaste
Sabalero

Sandbox Tree
Logwood

Castilla elastica
*Stemmadenia Donald-Smithii**
Bactris gaspaes
*Bixa orellana**
Vanilla planifolia
*Inga spp.**
*Pouteria cammmpechiana**
*Pachira aquatica**
*Ochroma lagopus**
Enterolobium cyclocarpum
Piper auritum
Cassia grandis
Hura cripitans
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 Connors, 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?

Meeting Minutes

- How does Tropical America insert itself in the whole storyline? Does the Zoo know what kind of story it wants to tell? TH also recommended that we should know the number of school kids in the 15–20 miles radius around the Zoo and the differences in seasonal attendance.
20. CK proposed an aquatic/terrestrial interface, creating layers of experiences and various perspectives.
 21. SC reminded the group that tropical insects such as Walking Sticks can be really big
 22. EK would like to have animals of small size visible. Having an exhibit in the form of a donut is great because people can stand in the middle and get a close look at the animals.
 23. The story line should be interpreted through multiple layers and parts so that it is encourages people to come back to the Zoo. There could be an insect's view of the exhibits such as the Leaf-Cutter Ant and the Jaguar.
 24. TH suggested enhanced exhibit viewing that could be offered at an extra charge.
 25. ES said that the Zoo had the idea of a Mayan temple, but the Zoo was reluctant to chose a particular culture, being afraid of offending people. Focusing on the Jaguar seemed to be a good idea as it is found in many different countries, and it emphasizes the animal-cultural interface. Wanting an icon like the temple is maybe putting the cart before the horse.
 26. SM asked if we were missing any animal in the list in order to create the right story.
 27. KL mentioned the lack of Giant River Otters and avian species on the proposed species list.
 28. Others talked about having a more technological exhibits that include insects, TV camera, and touch-screen, without compromising its natural feel. The Zoo is presently lacking many premier reptile exhibits. Donors will be interested in funding such exhibits.
 29. KL introduced EAS from EAS Engineering on the design team
 30. Water management: with the new Tropical America exhibit, the Zoo can't increase its water usage to more than 10% because of the regional impacts, including overflow. An application will have to be made to the state. It is not possible to substantially expand the waterways for now because state approval would be required and a new environmental document would have to be generated. An internal ride system might be possible if it is not tied to the existing waterways, giving the impression of one lake but with independent water.
 31. TH suggested to make the Monorail interpretive and create a script for it while augmenting views.
 32. SM said that the Monorail station could be integrated with the exhibit and serve several purposes.
- Break**
33. The Zoo will provide species compatibility list for mixed species exhibits.
 34. EK asked the design team for a list of deliverables.
 35. KL asked for applicable images to incorporate into the programming report. The PowerPoint prepared by the ZSF contains most of their images; more can be scanned and sent to J&J.
 36. TH: the deliverables should include a plan that includes themes, adjacencies to concepts and materials, identifies animals and plants exhibits by exhibits, delineates learning pathways and criteria for the visitor's experience, link existing pathways, and address transitions between lobes. The exhibit may include interactive devices, readers, and field books. The program should be tied to local school curriculum. A summary with a plan could point at potential stops there could be information on and about the monorail ride. There should be signage from the roadway to the Zoo. The team should determine the sequence and the relationship between exhibits and lobes of the Zoo.
 37. GE: Only the Asian and African wings from the Master Plan were completed.
 38. TH: an experience around the lake could create and overarching storyline. Views of the African Elephants should not be visible from a South American village. Night facilities could be added to the program.
 39. KL asked if there was ever a delineation of cool zones?
 40. ES responded that no, but maybe the cool zones were those buildings at each "village" in the Master Plan that have yet to be built.
 41. Issues to address: boat transportation, operations and maintenance storage.
 42. TH suggested that the outdoor pathway could be for investigation, and that research discoveries could be inside building. There could also be animal vistas only seen from the water.
 43. CK said that this would make the water a more usable space.
 44. EK wants to engage visitors in a challenging storyline, but avoid the Disney experience where people are put on a ride and force-fed the experience.
 45. TH continued: the exhibits will feed research programs and welcome science students. The kind of research experiment that they will be doing will have to be thought through; every discovery drawer does not have to be for everybody, there could be a difference in what you learn at the exhibit and behind the scene. This behind the scene view can be attractive to donors and have great fundraising power. These exhibits should be an integral part of the planning and design process. Behavior and research can be demonstrated in the exhibit. For example, an exhibit of snakes can reveal what is of interest to the scientist and induce knowledge of the animal. It could be possible to have visitors record what they see and later compile the results.
 46. EK said that the Zoo must be very educational and make people feel good about learning. Teaching should target individuals and education areas should be functional spaces in which kids are engaged, can crawl and climb safely.
 47. The group agreed that the design team and the client would talk about the classrooms and theater on Day 2.
- Plant Collection Discussion
with Tom Trump (in Charge of the Horticulture and Maintenance of the Zoo):
48. Plants grow fast in Miami and that sometimes leads to problems in paved areas. Plumbing needs to be accessible. Cleanable surfaces are an asset, although there is not a lot of vandalism. There are no recycled water lines for now, but the Zoo should consider them, as it uses a lot of water. Water is an environmental issue that the Zoo should address. Cisterns could be included in the site organization. Plants need to be irrigated in the winter, it is dry from October to May, but they rarely need watering in the summer time from June to September.
 49. The Zoo is interested in environmentally sensitive buildings and alternate sources of energy, since it is consistent with the conservation message.
 50. CK explained that there are different levels of LEED certification; rainwater management could help us in gaining certification. CK will give the

Meeting Minutes

client a LEED certification presentation. LEED certification does not require the buildings to be “platinum,” the highest level. There are only 3 of those in the Nation.

51. GE qualified the plan for “Phoenix Great Desert of the World” as a good interpretive and site planning example. It includes a whole chapter about building forms and designing for shade and climate control using the landscape and prevailing breeze. If the investment is made now, the Zoo could cut its future electrical costs in half. Green design and LEED certification could give the Zoo leverage in fundraising and motivate corporate donors.
 52. KL asked if there were any other fundraising issues to talk about.
 53. TT noted the needs for cooling water play areas.
 54. There are no problems in using misters as in Tiger River in San Diego and Busch Gardens.
 55. EK felt the master plan for the Zoo had aged as soon as it was finished. The idea of a village was popular at that time and many Zoos have such destination points, and may be out of date now. A stationary boat, offering water viewing along with a linear experience around the lake or river may be more compelling.
 56. ES stated the importance of congregation places and destination points without copying other Zoos. To come to the MMZ and enter the jungle is the kind of experience that the Zoo wants to achieve.
 57. CK observed that on the site there is a breeze at the top of berm and that it may be valuable to leave some open raised areas for natural airflow.
 58. CR: marketing ideas. There should be nameplates at exhibit entrances. People’s experience needs to be a clearly communicated: children’s interaction and closeness to the animals, the Zoo’s education and conservation message as well as the entertainment experience. What will people enjoy at the Zoo? How close will they get to the animals? How does the Zoo’s work relate to worldwide conservation issues? The Zoo needs to excite people and children and bring them close to the animal; the more of these opportunities, the more positive responses there will be. Ideas for enriching the exhibit and the visitor’s experience include 2 or 3 levels of activities and interactivity, such as the “Adopt Program” at the exhibit itself. People could sign up for it with their credit card. Giving names to an animal to create a personal relationship and informs the visitor of the individual character or story of the animal. Important donors tend to like great naming opportunities and the positive results of the Zoo’s involvement with the community (for inter-city children). The keepers’ talks are great and should be more of an attraction. Another promotion idea is to dedicate one year to the conservation of one animal, such as “the Anaconda Year,” building programs within which people can help the animal and making them feel good about helping a very specific animal.
 59. J&J asked SC to provide a more complete list of animals. This list should differentiate animals that the Zoo owns and the ones to obtain, including individual justification of the choice of each species, which bio-geographical area each belongs to, the plants as food for specific insects and animals, and a list of combination-of-species possibilities. If butterflies are included, the Zoo should remember that they will have to be replaced every few weeks.
 60. SC: the great back-of-house opportunities for behind-the-scene visits include looking at alarm and containment systems against the evasion of snakes, incubators, hatching, feeding with mice and rabbits. The Giant River Otter might be really expensive to acquire.
 61. EK: since there is nothing written on tropical marsupial such as husbandry manuals, marsupials may provide new research and publication opportunities.
 62. Exhibits of amphibians should be considered because of the conservation issues related to them and the possible partnership with aquariums.
 63. The issue was raised about designing exhibits for specific species and the risk of not being able to obtain these.
 64. Contact with the animals is important. There could be several contact areas, not only at the Children’s zoo, with more than sheep and goats but with boa constrictors for example. Opportunities for contact can be at keepers’ talks or with on-site volunteers.
 65. To add a sound canopy to Tropical America, more birds are crucial, or there could be recordings of insects and frogs activated by motion. An important donor favors birds.
 66. GE said that there are many colorful birds, but that few of them have important conservation issues, and there is “Parrot Jungle” not too far from the Zoo.
 67. CK related her conversation with the bird curator Jeff Sailer: there are a couple of species that can mix in well with people, birds would not require specific exhibit.
 68. TMC described the interesting effect of having Leaf-Cutter Ants moving in tubes around people and the possibility of an exhibit of insects and reptiles viewed from underneath.
- Review of Previous Discussion for Tom Trump
69. TT: Including endangered plant species can illustrate conservation messages. There are many plant lovers in the area who are potential donors.
 70. KL described Tropical America as potentially having an entire layer of interpretation devoted to plant and botanical tours.
 71. Chris Rowland is a specialist in the area who cultivates specimens that grow around Mayan temples.
 72. The design team will explore setting up a database for the project for common information and file exchanging.
 73. TH would like to see more information about the cultural groups’ sustenance practices and medicine in the tropical environment.
 74. BT said that the most significant piece of Tropical America is the rainforest and that it should be the core of the exhibit from which everything branches off. There is not need for mediocre Mayan ruins when the goal is teaching people how to conserve their native land.
 75. GE affirmed that there should be more ethnic representation in the programming design process of Tropical America.
 76. CR said that FIU would have resource people to work with.
 77. KL responded that these participants should be brought in early to help the team generate ideas.
 78. TH asked what is driving the schedule.
 79. EG explained that the schedule is a given. The money comes from a bond measure and many projects in the zoo need to be done soon or funding will be lost. Since the Zoo is opening its aviary, the goal is to keep up with the momentum and work on the programming and design of Tropical America in the next 9 months. The term Tropical America very generally designates the geographic area roughly between the Tropic of Cancer and the Tropic of Capricorn.

Meeting Minutes

WORKSHOP #1, DAY 2—UNABRIDGED MINUTES

Date: 12 February 2003, 8:00 a.m. to 5:00 p.m.

Location: Zoological Society of Florida, Miami, Florida

Subject: Tropical America, Miami Metrozoo

Attendees:

Adam Stern, ZSF (AS)

Carol Lang, ZSF (CL)

Elisabeth Koncza, ZSF (EK)

Jessica Swanson Carcerano, ZSF (JC)

Nancy Wielert, ZSF (NW)

Chad Douglas, MMZ (CD)

Kathleen Turner, MMZ (KT)

Caroline Kreiser, J&J (CK)

Mario Campos, J&J (MCC)

Steven Wheeler, EDSA (SW)

Bill Gallwey, ZSF (BG)

Dan Licciardi, ZSF (DL)

Glenn Ekey, ZSF (GE)

Maria "Gucci" Saino, ZSF (MGS)

Paul Vrooman, ZSF (PV)

Dave Jimenez, MMZ (DJ)

Maggie Tawil, Parks & Recreation Department (MT)

Maren Coleman, J&J (TMC)

Tom Hartman, IQM (TH)

Ed Swakon, EAS Engineering (EAS)

Carla Baker, ZSF (CB)

Cristina Heredia, ZSF (CH)

Jennifer Getz, President ZSF (JG)

Marlene Hawkins, ZSF (MH)

Bill Tuttle, MMZ (BT)

Eric Stephens, MMZ (ES)

Anne-Émilie Gravel, J&J (AÉG)

Keith Larson, J&J (KL)

Bob Dugan EDSA (BD)

Meeting Notes:

The Vision, The Natural and Cultural Worlds lead by TH and MCC

- GE was pleased with the first day of the workshop and requested more feedback from the design team on the Project Statement.
- MCC said that the storyline needs to dramatically reveal to visitors nature and the cultures that lived from southern Mexico to northern Argentina. These recognizable stories need to be delineated and developed with the Zoo. The Zoo can interpret nature, and J&J has experience in interpreting peoples. J&J has worked for many years with Native American tribes. He also noted that the MMZ should not assume the role of an anthropology museum, but concentrate on animals, places, and plants as seen through ancient and modern values of those people.
- TH asked where should the story start? What is the sequence of events from the parking lot to the Zoo? The design will emerge from the visitor's experience. We should determine who the story is being told to and how.
- MCC gave the example of the Detroit Zoo, where they made the conscious decision not to tell anything that can be learned on the Web or grade school books. Storytelling is challenging, and it has to feel and be real.
- ES suggested that the story may start with the animals that the Zoo wants in its exhibits.
- MCC suggested starting with the natural world and weave in culture. There are multiple stories but often the tribes only want to talk about one in particular. In the Smithsonian Museum of the American Indian, the consensus among many tribes was to tell "the way of the people."
- ES reminded the group that the animals are the hidden treasures of Tropical America, but questioned if this is a valid approach encompassing enough of the cultural aspects of the region.
- MCC said there are stereotypes that include treasure hunts in the jungle with Indians and monkeys as in the Book of the Jungle. This is the Disney approach and at the Zoo it should be less about treasures and more about the animals and nature! Many indigenous peoples valued the jaguar and many plant species.
- EK said that science is about discovery and the animals are the treasures. Children love to discover, and this makes their parents feel really good. Conservation, animal behavior, and habitats are science for the Zoo. The idea of separating main exhibit areas from an experience from behind the scenes can create opportunities for more education. However, particular science and research topics need to be narrowed down. Visitors should feel that what they have discovered can only be learned at the Zoo. EK emphasized the importance of spending time with the animals in order to understand their lives and to a certain extent their personal dramas. Several stories can teach the micro and macro worlds.
- TH liked the idea of drama because it personalizes the exhibits.
- BG asked if it is the science that drives the story or the story that drives the science.
- ES noted that the story can have science built into the story for fun education.
- DJ said that words "culture" and "journey" are used a lot, but the word adventure was missing from the discussion. He emphasized the importance of keeping the visitors in suspense while they may be following the jaguar. Making them understand the conservation messages in a fun way.
- MCC warned the group about the word science. One can learn about the earth and rediscover the treasures and drama of life. Some stories could be lighter and some could be more scientific but should include discovery, drama and adventure.
- KL suggested that the group elaborate on "adventure" throughout the exhibit to keep visitors engaged.
- MCC suggested that a way to organize the story would be by Tropical biomes of America, then by species and finally adding a cultural layer. There are several biomes in Tropical America, some dry, some wet, there are lakes and mountains, big rivers and small ones. This can dictate where animals, plants and cultural references go.
- NW had been an educator for 20 years and is interested in teaching why and how animals and people adapted in this habitat.
- MCC wanted to focus on habitats that are clearly communicable to people by selecting climates and regions that are distinct and focus on telling successful adaptation and conservation stories and not to depress people.

Meeting Minutes

19. TH concluded that this exhibit is not an "Amazon.com." The concern about conservation could be expressed by looking at the earth from a satellite photo and zooming in to the rain forest, putting it under a microscope, highlighting jewels such as bioregions, plants, animals, and insects. This would be an invitation to start your own individual investigation. Each individual could take a unique path. There could be some images from earlier times and some from now to show the drastic differences in environmental quality.
 20. DJ warned about mixing conservation and education, because of the risk of losing people's emotional connection. The conservation message will be missed if it is only told on signs, but it will work if the exhibit initiates a change in the person. The more the person is moved, the more they have learned. This is not the traditional approach to education.
 21. ES reinforced that people do not read signs but they look at TV monitors and respond to flames and smoke in the background and the sound of chainsaws, like at Disney's Animal Kingdom.
 22. BG suggested that a portion of the exhibit could portray a burned down Amazon forest. Cousteau once said that it is because indigenous peoples need to feed their families that burning the rainforest furthers their survival.
 23. MCC said that a well-depicted habitat that is awe-inspiring can make people understating its value and people are ready to protect what they know about. By immersing them in the habitat, visitors leave inspired.
 24. TH restated the importance of showing changes in the environmental conditions, telling the drama of the story, and bringing people behind the scenes to see the science and giving them a way to connect with the animal by adopting one.
 25. The experience at the Zoo should not be too comfortable and realizing that you are looking through glass decreases the immediacy.
 26. MCC summarized the important concepts: Discovery-Drama-Adventure-Tropics as jewels. Different spaces in the exhibit should have specific names that speak of the biome they are portraying. There are about 5 distinct places that could be used to organize animals and cultures: One tropic, 5, places and 1,000 stories.
- Break**
27. NW liked the idea of interpreting Tropical America from the global perspective down to areas of focus.
 28. TH suggested another approach to interpretation: starting with the replica of a tree and zooming out to the bigger picture. Trees are the homes of hundreds of species and are ecosystems of their own kind.
 29. EK commented that a vertical sequence experienced horizontally is hard to understand.
 30. MCC proposed six biomes:
 - a. Manglar & Cenote of the Coast
 - b. Dry mountains and Tropical dry forest
 - c. Cloud Forest
 - d. River(s) and Amazon Basin
 - e. Desert and Northern Andes
 - f. Chaco and Pantanal
 31. EK added that there are National Parks and research center or reserves with which the Zoo can create partnership, developing relationships and explaining in the exhibit that real people are working towards conservation now.
 32. ES talked about getting to Tropical America: maybe one could enter through the Cuban Amazon and see the Jamaican Iguana that the Zoo already possesses. This would be a logical jump from Miami to the Caribbean, down to Belize, and so on.
 33. TH suggested that sounds could unite the whole exhibit. One could hear recordings of tracks, music and voices of the different cultures without seeing them, and without anthropological facts.
 34. The group reviewed key species and geographic areas for each biome:
 - a. Manglar & Cenote: coast of Yucatan and Belize, with species such as the Parrot, Iguana, and Flamingo and trees such as the Mangrove
 - b. Dry mountains of the Oaxaca Coast with animals such as the Iguana and Ocelot
 - c. Cloud Forest of Central America, with animals such as the Jaguar and Eagle
 - d. River(s) of the Amazonian basin with animals such as the Giant River Otter, the Anaconda, Fish, and plants such as the Lily pad
 - e. Chaco and the Pantanal on the coast of Paraguay and Pantanal with animals such as the Capybara, the Tapir, and the Bromeliad boa
 - f. Desert of northern Chile and Ecuador (Galápagos) with animals such as the Condor and Turtle
 35. ES Said that snakes appear throughout each area and could connect them while the Zoo satisfies donors particularly interested in snakes. Of course, it is important to avoid construction of a "reptile house," and having snakes in each biome would require several support areas. Birds could be included throughout the exhibit. Some species can mix well with people. Another option could be to have a film about tropical birds in a more scientific section of the exhibit at the scene or behind the scene.
 36. MCC asked that the Zoo think about existing and potential animals and continue detailing the species list and what stories could be told to whom.
 37. TH added that the system of classification through bio-regions will allow the Zoo to tell many stories.
 38. JG said that the exhibit should provide places where children and parents can settle for a while, take a break, sit, read, and learn about people's sustenance and nutrition habits while they are themselves snacking.
 39. MCC said that there could be 3 layers of food concession and retail and that for every animal there could be 2 to 3 stories.
 40. EK encouraged places where the public can get involved and identify with the animals, the use of colors.
 41. TH suggested humor with a "Iguana Café," "Walking Stick Theater."
 42. DJ and EK said that the biggest visitor population is women between 25 and 39. To make mothers feel comfortable is important business to get families to come back. While kids need to have a great time, moms need to sit down. A successful plaza in front of Dr. Wilde's World allows mothers and guardians to watch their kids play safely.
 43. TH thought that creating a partnership with the book *Nature Cross-Section* could add to the interest. Books and videos related to the exhibits could be sold on site. Full reference: Richard Orr, *Nature Cross-Section* (New York: Dorling Kindersley, 1995).
- Lunch**
44. MCC summarized the morning session for the World Wildlife Foundation (WWF) representatives, Ginette Hemley and assistant.
 45. Ginette Hemley explained the WWF "eco-regional conservation" approach in looking at the big picture, entire landscapes and

Meeting Minutes

land use planning. WWF has identified 25 out of about 200 eco-regions that are their priority for conservation. Some of which she saw on our tentative biome map: Mezzo-American reef, Northern Andes, Galapagos, Atlantic Coastal of Brazil (threats to the coastal forest) and the Amazon. WWF wants to establish 10% of the Amazon as protected area. This is their biggest conservation project ever undertaken. They have commitments from the World Bank and the Government (of Brazil?), and this would benefit local people. With the Amazon, there are still conservation opportunities, whereas some of the Asian forests are already completely gone. This is an ambitious project that WWF would like to showcase, maybe in this exhibit? WWF already has 2 traveling exhibits: "Biodiversity 911" launched a year ago and "Cargo to Extinction" which has been very popular for 20 years. WWF invests roughly \$20 million a year in Latin America and would like to publicize this effort.

46. MCC said that Tropical America could tell some WWF conservation stories.
47. GE suggested that some exhibits could go even further with a partnership with WWF. This is new territory to be explored further.

Education and Marketing:

48. MCC laid out the potential cultural layers:
 - a. The Mayan in the Yucatan and Belize
 - b. The Mixtec people in the Oaxacan Coast
 - c. Indigenous people of the southern portion of Central America (other than the Maya)
 - d. Different types of river villages of the Amazon (Amazonicas, Chanes)
 - e. The Chaquenses and Chulupies in Chaco and Pantanal
 - f. Pre-Inca and Puna cultures of the Andes Desert
49. TH warned of the danger to stereotype place and freezing places and peoples in time.
50. MCC suggested that an alternative could be to talk about the people that are presently invested in conservation in their native places. This could illustrate conservation from different perspectives. The Zoo would endorse their effort and relate the interesting stories of those people. Use this approach to include the cultural reference in the exhibit. This can be the subject of the March workshop and breakout sessions.
51. TH: we could tell the story about living patterns that have changed and are changing now. He asked the Zoo to identify its audiences and the

needs of the users at the Zoo.

52. The audience:
 - a. School children: how many are there and how many schools are there within 5–10–15-mile radii around the Zoo? This should include elementary schools, junior and high schools, junior colleges and universities. How can school's curricula intersect with the exhibit?
 - b. Families.
 - c. Tourists: where are the tourists going when visiting the Greater Miami Area? How many are there and how long do they stay? It is important to grab revenue from tourism.
 - d. Tour buses circuits: may be addressed by creating audio programs to make the population understand the zoo's program and mission.
 - e. Partnership with hotels to let tourists know about the Zoo.
53. What are the user's needs, what are they attracted to when they get to the Zoo, what do they need, how do they memorize the exhibition, what are they doing at the Zoo, and how far do they have to go from one destination to another:
 - a. Individuals.
 - b. Families.
 - c. School groups.
 - d. Touring tourists.
54. The different tours in the Zoo:
 - a. Getting familiar with the animal.
 - b. Investigating things in more details.
 - c. Meeting the keepers behind the scene.
55. Creating life-long learning opportunities:
 - a. Tracking the growth of learning visitors and students at the zoo.
 - b. Online updates on experiments and research.
 - c. Reaching out to master's students and younger students.
 - d. Linking issues to the politics of the areas.
 - e. Providing community of events and learning opportunities.
 - f. Addressing water sustainability.
 - g. Creating a course work on how a Zoo is operated.
 - h. Creating partnerships, with WWF for example.
 - i. Designing pathways through the zoo that are interdependent and independent of each other.
 - j. Promoting sustainable and ecological thinking.

- k. Encouraging behavioral changes for a better planet.
 - l. Creating games, getting school kids to team up, wander about the zoo, and come back with reports for the class.
 - m. Creating a sound track on the Monorail and allowing people to learn accidentally, casually.
 - n. Having extended family from youngsters to elders participate in maintenance, internships, and volunteer programs.
56. MCC added that television and the media have changed behaviors and the education at the Zoo should respond to children's attention span.
 57. MCC asked what the audience wants to do and see at Tropical America.
 58. NW wanted more interaction and more opportunities to identify with the animals, and some benches to sit and watch the animals. Exhibits do not necessarily have to include electronics, but could include paper to write down behavioral observations or simple buttons to be pushed such as computer monitors and touch-screen.
 59. GE said that there should be a dedicated focus group about the use of technology that can sit down with high school teachers and college students to learn from them and to make the exhibit work for them.
 60. ES asked if the Zoo should choose its audiences first and then create focus groups or if it should be done the other way around.
 61. TH said that educational programs and debates could benefit the Zoo and make students do things for the Zoo; for example, students know how to do films and could track the behaviors of animals.
 62. MCC added that there could be an interactive web link with the schools where one could follow an expedition, dialog and understand who is doing what and why.
 63. There will have to be cost discussions about the need for an amphitheater and theater at Tropical America.
 64. TH said that it would be possible to make visitors think globally about the Zoo from the parking lot and gradually focus their experience. There are ways to put somebody into an experience from inside their car by separating them from the urban fabric. For example: the River could start at the parking lot, ethnic music could be piped in, iconography and animal forms could be visible.
 65. GE mentioned the front entry complex.

Meeting Minutes

66. MCC and TH said that there could be one layer above the exhibit, to pause and let people walk on different asphalts or gravel or growing grasses though the asphalt. This could come before the exhibits and introduce people slowly, making a transition from the outside world to the Zoo and Tropical America. It could be possible to buy a ticket and print it from the Internet. The Zoo could send out messages about Monorail stations and rides or a choice of preset routes of 2 hours (for example) worth of activities.

Education Challenges

67. Introduction of the education team, Human Resources Director, Marketing Director, and Adam Stern from the Children's Zoo

68. Challenges related to school groups: Their time spent at the Zoo averages 3 hours and sometimes there can be up to 3,000 people (teacher and kids) at one time. For a group well organized, locking out their lunches and getting ready with the help of volunteers can take a minimum of 20 minutes. They have a lot of options between classrooms programs, walking tours, going to Dr. Wilde's World. Some groups will not have booked anything and some will have booked every activity. Groups need to schedule their lunchtime and usually have one hour of experience inside the Zoo if programs are booked. The risk with Tropical America is that there would not be enough time to get to the site. If the Zoo develops relationships with specific school groups and effectively schedules programs, it should work. The Zoo also needs to accommodate passive programming. The more passive entertainment, the better. Volunteers are trained to address and design itineraries for specific audiences. There could be booths where individuals, families and groups could find help planning their visit. Groups range in size from 30 to 250 people and usually cannot fit into one classroom; there are on occasion larger groups for specific programs.

69. The notion of authenticity is important. If the exhibit is self-explanatory, it will interpret itself. At a larger scale, it would be great to create simplified tools with simple language with which to self-interpret and understand the environment at the Zoo. For example: a blank map could be filled in without the aid of a teacher or volunteer, different people can be provided with different types of tools. It seems important to let people assemble the puzzle themselves. These tools could be available before they get to the Zoo as a printout with the mission and goals of the visit.

70. MCC agreed that the 1st level of interpretation is the exhibit itself, and that the habitats, animals and cultures should speak for themselves. The next level of interpretation may consist of a simple companionship to the exhibit.

71. PV said that the effectiveness of communication is greatly enhanced by linearity. One could choose a card or an animal and identify with a specific animal or plant.

72. Small spaces, a petting yard, a children's zoo, and a theater that should be usable for multiple purposes and not become empty when there are no performances were envisioned.

73. PV agreed that education is important but expressed his dissatisfaction with the individual leisure visits. There is no big entertainment for these people. They should be able to turn a corner and have a very personal experience. The big areas only address groups of 5 or more, and the experience of an individual visitor needs to improve to create better business for the Zoo.

74. EK reinforced that there are not enough activities for chaperons and that huge unyielding school groups, families, and chaperons should be satisfied with the same product.

75. PV talked about the importance of changing parts of the exhibit so that bring people come back to the Zoo. They should come for animals and Tropical America, not for the reproduction of a village. Disney is close and they have seen it. There could be a variety of changing street performances. Seventy-five percent (75%) of the Zoo's market comes from a 10-mile radius around the Zoo as tourists tend to fly in and stay downtown and at the beach. The 3 million local people are the Zoo's major market and they should be enticed to come back to see something different or buy a different package of activities.

76. TH asked how much written info and how many languages the Zoo would like.

77. The audience responded that there should be information in Spanish, Portuguese, English and Creole before French or German. These languages could be available in handouts and audio tours, not necessarily on every sign. Radio frequency technology could be used for that purpose. People will not read signs but will read a handout in their own language.

78. TH said that people do learn by reading but that words could appear and go away within the exhibit to avoid too much signage.

79. The audience said that the Zoo needs some covered areas hosting more than hundred people, and that teacher's workshop or meetings should be possible under any weather. Some also added that the intensive learning areas do not have to be in front of the exhibits. Teachers need large covered areas.

80. EK said that air-conditioned spaces are attractive for special events, summer camps, and inside activities. But classrooms should feel like they are part of the Zoo. There will need to be some storage areas for tables, chairs, and props. Some enclosed areas could be used for nocturnal animal viewing and overnight programs. A bathroom and sink should be readily available to limit security issues when traveling to and from these facilities.

81. The tram can transport about 100 people. Spaces should accommodate 50 to 100 people when there is a presentation but should comfortably accommodate small groups.

82. MCC said that flexible spaces could be designed and that they should be part of the exhibits when no event is happening; the traditional amphitheater and classroom are not going to work.

83. PV said that there should also be a meeting space for adults, cocktails, poetry readings, and birthday parties. The top room in the aviary has this kind of flexibility of uses.

84. MCC said that the notion of classroom is challenging and that before naming the space, the group should think about what will happen in it: reading, watching a movie, or listening to music....

85. Basic access needs for large groups of people need to be addressed in the Zoo because their presence affects the experience of other visitors.

86. More ideas were expressed about the Zoo being very different from a school. It should provide interactive activities and contact with the animals, host events with live animals; offer small exhibits catered to the individuals. The Zoo should give talks and offer programs engaging children in a conversation with hands-on and self-research activity. Booklets, paper, anything that reminds children of school homework should be avoided. There should be no carpet in buildings and classrooms. It would be interesting to observe animals and exhibits from the cafeteria or classrooms.

Break

Meeting Minutes

Group Discussion on Visitor Experience and Services

87. BT summarized the group's vision and said that the design should include:
- Representation of different peoples
 - Meeting areas
 - Central focal point
 - Large room for functions and parties
 - Handsome structure of about 5–6 stories: it could be a modern pyramid built with glass acting as solar panels. There are already ruins of temples at the Zoo. The top floor could be a greenhouse for rare plants needing climate control or for butterflies. The bottom could host nocturnal animal exhibits with reptiles and a maze. It could also have research facility and classrooms.
 - The Riverboat may be for underwater viewing and could house the gift shop while providing cool resting places.
88. AS said that night events would be great but nesting, species survival, and reproduction are in time conflict with such events. Reptile exhibits could be appropriate for nocturnal viewing.
89. MT, Director of Retail Services, said that retail areas need to be close to exhibits to generate sales.
90. KT said that visitors should have the illusion of being in Tropical America. She did not like the original idea of a retail village because it is not new and visitors don't come to the Zoo for that. She would like to see an icon but one that would work in the natural environment such as a volcano. She loved the idea of the pyramid but the iconic structure needs to work for the whole Zoo, not just for Tropical America. Exhibits should rotate and the back maintenance areas should not negatively impact the animals.
91. CH said that people like ancient motifs and art and that there should be a courtyard to rest and eat. The gift shop and food areas should be themed such that they give the illusion that people are really in another place. There should be some original sounds, smells, tastes, music, and local artisans to create a destination.
92. MCC said that the design team strongly believes that it is important to be real. In fact, creating a place that is real about the real story is the one of the animals will make this exhibit successful. If people want to see pyramids, they will not come to Miami but travel to Yucatan to see original architecture or visit Walt Disney World to see replicas, or other resorts. Even while traveling, people do not have the opportunity to encounter animals in the wild. The Zoo can spend money to create those habitats and offer a unique experience. If there is \$15 million to build the exhibit, it should be spent mostly on the landscape and the animals. Because Miami has a tropical climate, there is no need to keep people mostly indoors; the weather allows for a less overpowering architecture. The power will be in the landscape. Also, the Zoo should be more modest with the cultural reference and not just duplicate and replicate real things. Cultural values and references can be made on a smaller scale. It would be possible to create a low-key plaza feeling that is built by real people today. The key is to create a real environmental story and landscape. The Zoo should not attempt to compete with entertainment venues that are already in Florida. MCC and BT gave the example of haciendas or "fincas" that can be small and fragmented enough to host different functions.
93. KL said that the design team does not want to preclude any of the client's ideas.
94. Summers in Miami are brutal, and there is a need to rest in air-conditioned interior spaces. The audience said that these areas should host people for a while because they will want to stay and cool off. Also, there should be no "dead end" in the exhibit but braided loops that heighten people's curiosity and keep them always moving forward.
95. MCC also suggested a small town square, as in Chetumal or Celestun, which are themselves local adaptations of the Spanish plaza.
96. EDSA has worked in the area and could set up short walking distances to and from shaded or climate-controlled area to give people a sense of comfort so that they extend their stay at the Zoo.
97. MCC said that the group should identify the level of tolerance of people outside in the shade and with moisture. Pathways can be narrowed to immerse people and protect them from the sun: creating opportunities for waterfalls and other features that can cool the visitor.
98. EK said that she would have to be convinced of the need for few air-conditioned spaces because Miami is never comfortable in the summer, and the first thing that people think about the Zoo is that it is too hot. Tropical America must be comfortable.
99. The audience added that a person's walking could trigger a solar-powered fan and that these devices could be also serve for educational messages.
100. EK reminded of the need for bathrooms and water close to each classroom.
101. ES said that there are space needs for retail, group sales, parties, lemonade and t-shirts, corporate picnics. If the Zoo is planning for events, the space should be close to the entrance and that maybe a second gate would could be located on the south edge of the Zoo. However this could create problems. There could also be a gate for special events only, but considering the Zoo's existing conditions the space for night events should be planned as far north in the Zoo as possible.
102. EK asked about the needs for food and retail shops and carts.
103. MCC responded that the consultant would be there in March to plan and design food specifically for the exhibit.
104. MT said that a gift shop of about 400 square feet should be big enough; people need to be able to walk in the store and touch the merchandise. Carts need to be weatherproof, especially during the rainy season, and should follow the crowd. Another option would be to have smaller (200sf) walk-in stores dispersed throughout the exhibit. Stores should be air-conditioned.
105. EK asked that the group discuss the accommodation of special events.
106. KL said that there is a request for a 250-people amphitheater and theater, a plaza, and multi-functional classrooms capable of hosting about 200 people.
107. J&J said that during the schematic design phase, ideas and alternatives will be tested with the client and specific user groups. Scenarios for each space will be run before the client: events, animal encounters, visitor experience, and animal management.
108. The audience liked that idea a lot. Most events occur during Zoo's business hours and need an indoor-outdoor alternative in case of rain. The walkway spaces should be large enough for maintenance, although having service and the public on the same paths is to be avoided. Some feel like there are more cars than animals in this zoo and that maintenance should come to the back of exhibits while being allowed to cross pedestrian paths if necessary. Maintenance vehicles that should use discrete service roads should not disturb animals. Little carts or "mules" are about 4 feet wide, but the rest of the exhibits need larger roads, and the Monorail needs to be high enough to allow truck access underneath it (10' to 11'). There should be comfortable turn-around areas. Some problems at Dr. Wilde's World include catering truck stuck in the back area and animal holding spaces next to the noisy parking lot.

Meeting Minutes

WORKSHOP #1, DAY 3-UNABRIDGED MINUTES

Date: 13 February 2003, 11:45 a.m. to 4:15 p.m.

Location: Zoological Society of Florida, Miami, Florida

Subject: Tropical America, Miami Metrozoo

Attendees:

Carla Baker, ZSF (CB)

Glenn Ekey, ZSF (GE)

Ron Medford ZSF volunteer (RM)

Fred Barnard, MMZ (FB)

Terry Webb, MMZ (TW)

Caroline Kreiser, J&J (CK)

Mario Campos, J&J (MCC)

Cecilia Betancourt, ZSF education (CBe)

Jessica Swanson Carcerano, ZSF (JC)

Eric Stephens, MMZ (ES)

Jeff Sailer, MMZ (JS)

Maggie Tawil, Park & Recreation Department (MT)

Keith Larson, J&J (KL)

Bob Dugan, EDSA (BD)

Elisabeth Koncza, ZSF (EK)

Marlene Hawkins, ZSF retail (MH)

Dave Jimenez, MMZ (DJ)

Steve Conners, MMZ (SC)

Anne-Émilie Gravel, J&J (AÉG)

Maren Coleman, J&J (TMC)

Steven Wheeler, EDSA (SW)

Meeting Notes:

Discussion on the Needs of Animals Groups in Order to Provide the Zoo with a Preliminary Cost Estimate:

1. Immediately prior to this meeting there were focus meetings between Steve Conners and Jeff Sailer with Keith Larson on opportunities for animals and exhibits, including preliminary exhibit sizes and animal counts in order to determine the preliminary cost estimate.
2. JS, the bird curator, said that birds can be part of small and specific mixed species exhibits and that there are species that are easy to manage and provide good stories to tell including some South American species that the Zoo already has.
3. MCC updated the audience on the thematic approach chosen and how it related to the WWF approach. Six eco-regions; 4 are of high priority for the WWF. The group should discuss the space needs for species and mixed-species exhibit possibilities.
5. SC said that there are many focus areas possible and that a Caribbean exhibit was projected in the Master Plan as a future phase.
6. ES responded that the Yucatan was the starting point for that region and that the group expanded it to the Caribbean exhibit.
7. MCC saw at least 4 to 6 biomes and said that focus could be put on the animals, which will inform the choice of those regions.
8. JS added that Oscillated Turkeys belong to the Yucatan and that they are gorgeous and able to walk with people; Seriemas could also be in the exhibit if there is a region in which to place them.
9. SC said that it is almost impossible to acquire animals from the Galapagos Islands.
10. MCC asked that SC take the species list and let the design team know to which bioregion each animal belongs.
11. JS said that other than raptors, birds can be mixed with other species, but that there should not be two types of Toucans in the same exhibit. The Zoo has a great pair of Condors that can serve as a conservation example. JS would like to have a goal, such as color or total visitor immersion, to choose species for the exhibit. For example, 300 Scarlet Ibis can surround people with a vivid red color and make an incredible experience. Most birds, with the exception of the raptors, can be included in mixed species exhibits. "Birds only" type aviaries may not be necessary.
12. ES said that the Flamingos could be relocated to Tropical America.
13. KL reminded the group that the plate is always too full at the beginning of the design process but that it is good to identify the goals.
14. The Harpy Eagles would need a space 80' long x 35' high x 40' wide to allow people to see the birds. There could be an elevated walkway into the tree canopy as in San Diego.
15. The Condor would need a space 100' long x 40' wide and an actual cliff in the back. But if the Zoo wants condors to fly, the space should be bigger, and that is a big attraction. Condors could be kept with other species such as large mammals like a tapir but it is not preferable.
16. The Ornate Hawk-Eagle and King Vulture would need 50' x 50' maximum and could be mixed with Spider Monkeys and birds, and maybe smaller animals. This has been successful before with trained pairs of birds.
17. TW said that King Vulture can be mixed with Spider Monkeys, and a space large enough for mammals and birds should be about 100' x 100', or a larger structure (maybe 200' long) divided in 3 sections. In that amount of space, JS could see up to 10 species of large birds, 3 mammals, 20 Squirrel monkeys, the Tapir or Capybara. The capybara could also be mixed with fish and other birds for underwater viewing.
18. MCC and TW said that having tapir and underwater viewing would be difficult because of water filtration issues.
19. KL wanted the animal specialists to give the design team all of the feasible combinations.
20. MCC and ES agreed that water conservation should be addressed and that the dump and fill technique is easy but not desirable.
21. TW said that the Capybara requires a pool sloped to 5' to 6' deep to allow gradual submersion.
22. JS talked about the Paddock Birds and Seriema that would need to be pionered if they are to be mixed outdoor with people or would need to be in a contained exhibit.
23. In one exhibit, there could be Golden Lion and Cotton Top Tamarins. The Cotton Top Tamarin are under a breeding moratorium; they are also a Brazilian conservation animal and will provide a great interpretive story.
24. A daytime exhibit for the Ocelot will not be exciting because they tend to sleep most of the day but could provide good nocturnal viewing activity.
25. KL assumed that there would be a number of "jewel boxes" for invertebrates. There could also be a series of windows creating a seamless experience with the rest of the exhibit, it could look like a riverbank.
26. GE said that butterflies could be mixed with other animals in larger exhibits and that when the anaconda is in the water it is very interesting.

Meeting Minutes

27. MCC agreed that it is a good thing to mix butterflies with other species but that they need to be contained and may be hard to see. Questions about management, hatching and growing. MCC related that recommendations were made to the Taipei Zoo to demolish their butterfly house, which was so big that butterflies were hard to see; instead, they manipulated the environment to attract butterflies that live there naturally. There could be a butterfly exhibit at the MMZ without building structures or enclosures.
28. The MMZ is a founding member of the AZA butterfly initiative.
29. One fish exhibit should be at least 10' deep x 7' x 30'. Different kind of fish could make an impressive exhibit. SA said one could listen to navigation signals of the night fish. These could be a stand-alone tank and be an interactive exhibit.
30. Tanks are smaller for Amphibians.
31. SC said that an exhibit for reptiles should not be smaller than 4' in width, 2' deep, 3' high. However, the Caiman Lizard needs a bigger space, as it is a small crocodilian. Most lizards could be combined. There could be more than one species of snake. Lizards do not mix, as it creates stress on the lizard. Pit-vipers are primarily found in the New World; there are breeding programs underway, and the habitat will make the Zoo focus on certain species. The "Hot Snakes" such as the Coral Snake, Pit-viper, and Bushmaster need to be in individual exhibits. The Bushmaster needs a large area; Coral Snakes are hard to see unless there is subterranean viewing. SC will tell the design team what to mix and what not to mix and will label snakes according to their size. The exhibit may require a couple of hot Back of House areas that would be keeper friendly with 2 layers of glass, public layer and cage layer. Keeper access to the exhibits could be from the front with "side hinged" units on rollers.
32. SC continued about Turtles that can mix well with fish. The Mata Mata needs shallow water. Reptiles need large exhibits for more activity: 4' x 4' or larger 3' high. The Caiman lizard is aquatic and needs a crocodilian-type habitat. Reptiles should have 2 layers of glass: tank and public. Orinoco crocodile is better choice than Dwarf Caiman because the Caiman can be mistaken for an alligator, would use large habitat with 15' x 20' shift cage (holding) with a pool in the back (half water, half land), exhibit 600 square feet with sacrifice fish to be replaced when needed.
33. MCC said that fish get wise and are not eaten all the time. Alternately, there could be dividing glass between the tank exhibits.
34. CBe said that too many jewel boxes are not preferable but that a few give a personal and meaningful experience, they create intimacy and allow viewing by yourself. In addition, some of these animals are little.
35. KL said that there could be a common back-of-house area, but from outside it could look spread out...reptiles could be found when not expected.
36. Greg George builds exhibits and will be at the later workshops. People will be able to go to him and tell him what they want. Jewel boxes are nicely done individual pieces, not very modern but maybe the only way to exhibit something of that size. Insects also need to be tightly contained and small, with appropriate containment.
37. EK said that the main driving force is the particular behavior of the species, and the exhibit should stimulate them.
38. The initial space requirement for the Jaguar was set at 5,800 square feet; it will ultimately be smaller. There could be underwater viewing. The Jaguar also covers different kinds of terrains. The Jaguar exhibit could be designed for travel and the square footage stretched out through Tropical America. People need to see the Jaguar. Female Jaguar can be petite and there may be more than one in a display area, but no males together. If male Jaguars are separated, it still induces stress on them; they will know each other's presence unless they have been introduced at a young age.
39. GE said that Jacksonville Zoo is planning on 6 Jaguars; they have one and may have the capacity for 10.
40. MCC said that the animal behavior consultant (Devra Kleinman) will be at a future workshop and that will be helpful on these issues.
41. TW said that the Jaguar will need holding with 4 enclosures and another one for maternity. The Zoo will be breeding if the SSP asks and their offspring can be dispersed in other Zoos. It is preferable to have one successful pair rather than a large number. TW should communicate by email about the number of bears.
- Botanical Programming: Could this be a Botanical Garden?
42. SW related the morning visit to Fairchild Gardens and said that it is not the time to focus on exact species but that there are many opportunities to simulate habitats.
43. Over many years of planning and design, J&J introduced a multitude of plant species in the San Diego Zoo. This is for both immersion effect and creating a huge botanical collection adding to the educational potential of the Zoo. We will be very specific with plants of each area. Mangrove and brackish water could be incorporated. Planning ahead with vegetation is important to guarantee a stunning immersion effect. This should include going to nurseries and tag what we want and pre-buy or have them grow some species for us to start them early and invest in about 20 trees at \$20,000 each. Some of them may be already available at the Zoo.
44. The Zoo's nearness to growers in Homestead, Florida, is a benefit to the project. Good resources of plant material. When acquiring the plants and trees local nurseries will need to be contacted to properly tag and pre-buying specimens. This will allow nurseries to contract-grow for us while we design and build the project. We should investigate using existing specimens on Zoo property. Other means of acquiring could come from donations from owners, developers, and contractors whose projects might have large specimens that the Zoo could benefit from. Imperfect specimens could be solicited from nurseries for donations. Think about establishing holding areas on grounds: we could use unused animal exhibit moats. The Zoo has a relationship with the Fruit and Spice Park nearby. Suggestion of contacting the director, Chris Rollings.
45. The rocky soil will be a challenge and it may need background work. A survey of the site will be needed. A preliminary list of plant species for each region will need to be developed for the workshop in March.
46. Is the zoo committed to maintaining the plantings we will have? They currently do not have the resources. A designated horticultural staff other than landscape maintenance crews from Parks and Recreation will be needed.

Meeting Minutes

47. Vines should be part of the palette: for convincing effect on Day One we could use a mix of artificial and real plants.
48. Permitting requirements for moving large trees will need to be investigated. See Maggie Tawil.
49. An inventory of Park and Recreation's tree nursery was requested.
50. Different irrigation techniques are needed in the rainforest areas; misters up in the tree canopy give the birds more natural behaviors and can make them more active. This would allow for a fun water interaction during that time for visitors and keep the area cool.
51. The Visitor paths and areas will be immersed with vegetation make sure the animal exhibit areas are open enough to allow them not to get lost in the plantings. The visitors want to see them.
52. MCC asked TT to think about neat species and palms that can be put in the areas to help the design team anchor the exhibit.
53. In choosing the tree species, wind tolerance/resistance will need to be considered, as well as better planting methods.
54. KL and BD conducted a staff wide exit session at 3:15 p.m. and summarized the proceedings of the three days under the following headings: Tropical America as a pivotal exhibit, storyline, key animals, immersion, cool zones, exhibit design, and visitor services. No exceptions were voiced to any of the items presented.

End of Meeting Minutes for Day 3

Meeting Minutes

WORKSHOP #2, DAY 1—UNABRIDGED MINUTES

Location: Zoological Society of Florida, Miami, FL

Subject: Fairchild Tropical Garden Visit; Zoo and Exhibit Goals; Preliminary Design Schemes

Attendees:

Carla Baker, ZSF

Glenn Ekey, ZSF

Paul Vrooman, ZSF

Jeff Sailer, MMZ

Anne-Émilie Gravel, J&J

Mario Campos, J&J

Gregory George, Petraworks

Steven Wheeler, EDSA

Dan Licciardi, ZSF

Jessica Swanson Carcerano, ZSF

Carol Kruse, MMZ

Steve Conners, MMZ

Caroline Kreiser, J&J

Eric Abrahamson, IQM

Anthony Rylands, Conservation International

Bob Dugan, EDSA

Elisabeth (Ela) Koncza, ZSF

Nancy Wielert, ZSF

Eric Stephens, MMZ

William B. Tuttle, MMZ

Keith Larson, J&J

Tom Hartman, IQM

Mike Maunder, Fairchild Tropical Garden

Meeting Notes:

8:00 am: Presentation at the Zoo's amphitheater.

1. Keith presented the team's new members—Eric Abrahamson with IQ Magic and Anthony Rylands with Conservation International (CI)—and the concept development of the 4 approaches to the site design, image panels, and agenda for the next 3 days.

9:30 am: Fairchild Tropical Garden: the design team and Glenn Ekey visited the garden with Mike Maunder, Director of Horticulture, and Don Evans, Director of Grounds Management.

2. In managing the collection of plants, it is important to consider hurricanes and a brutal succession pattern. A full-time crew of six men, a curator, and volunteers maintain the Fairchild Tropical Garden.
3. A large grassy meadow at the Garden serves as parking lot for night events such as jazz concerts. The open waters surrounding this area really define the landscape. The lakes are fed by the water table with occasional salt-water inflows.
4. Another grassy area serves as a concert/performance area. It is framed on one side by a trellis and buildings. The area is between 1/3 and 1/2 acre.
5. Florida is part of the Caribbean region, and the Fairchild Tropical Garden will open a new Florida exhibit in 4-5 months.
6. There are wild ospreys, ducks, and macaws naturally nesting in the garden; this may be an issue at the Zoo.
7. The artificial stream in the Tropical Rainforest area lies on sand; it is lined with rubber matting on top of which rocks were placed in a naturalistic design. The canopy trees existed before the Rainforest exhibit and contributed to

the instant, attractive immersion effect. In the Rainforest, there are cool zones and breezes making it comfortable for visitors—a good incentive for having narrow paths and planting tall trees early at the Zoo.

8. Labeling plants like in the botanical garden would be a good interpretive opportunity for the Zoo.

Lunch

Review of Goals and Objectives

9. Ela summarized the goals for the Zoo and mentioned the importance of contact with the animals. The whole Zoo was originally planned with an isolated Children's Zoo. The new plan offers contact and interactive exhibits throughout the Zoo.
10. Glenn said that the existing Children's Zoo at MMZ is to go away. Opportunities for contact and other children's experience should be included in the new exhibits.
11. Mario added that a contact area at Tropical America should diverge from the traditional petting of domestic animals.
12. Mike said that CBSG (Conservation Breeding Specialists Group), as a part of the species survival commission, produced international guidelines for ex-situ conservation and delineated "quantifiable benefits" for countries needing training money. This can be read on the IUCN website. Paul suggested that the Zoo add it to this list of goals.
13. Glenn said that Jessica will collect comments on the Zoo's plan and goals from Teams A and B.
14. Mario reviewed the organization of Tropical America by regions. The 6 originally selected were too many, and he suggested creating

a meaningful experience with 4 contrasting habitats, illustrating Tropical America as more than a jungle (the regions take in consideration the words from Ginette Hemley's [WWF] speech at the February 12, 2003 workshop). The 4 regions would still be flexible and incorporate cultural and geographical layers.

15. Steve said that having the Jaguar in the Cloud Forest is technically accurate but in the present day it is not found there very much. Few of the species that are on the Zoo's list occur in the Cloud Forest, and Steve suggested the list be revisited.
16. Mike said that the ecology of the Cloud Forest is important but that it cannot be replicated accurately in Miami because of the soil difference. The Amazon will also be a challenge because of the lack of acid soils.
17. Mario restated that the Zoo will not duplicate the eco-regions nor bring those ecosystems in huge buildings, because that is not sustainable. There may be 40% of filler or "wallpaper" plants and 60% of accurate species.
18. Anthony said that the boundaries of the WWF eco-regions are somewhat arbitrary because they are an artificial construct for research purposes. The Zoo may want to think in terms of desert, mountains, forest (Atlantic Forest, Bamboo Forest, and Savanna Forest) and wetlands. He likes the Mangrove, Chaco, and the Savanna because a lot of the large vertebrates go through all of these regions. He also reminded the group that there is 75% left of the Amazon but that only 7% is left of the Atlantic Forest. He explained CI's approach of thinking in terms of major conservation corridors and hot spots and illustrating direct conservation measures.

Meeting Minutes

19. Anthony continued: the WWF eco-regions are useful in order to get a handle on the regions but are artificially constructed. For example, the freshwater ecosystem is not prioritized by WWF because their definition of it is not based on an analysis of threatened species but on the delineation of river basins. However, the freshwater ecosystems are the most trashed and endangered; the headwaters of these ecosystems have the greatest number of endemic species but are still not prioritized by the WWF for conservation. Anthony suggested using generic themes such as the great rivers (where the Guanaco and Spectacled bears are), tapuies, savannas, wetland, forest, wetlands, deserts, and mangroves. ...
 20. It is important to link the Zoo to conservationists and scientists from WWF and CI and from local and national efforts in the Tropics. Using "Pantanal" as a place name helps put the exhibit in a well-known place. Calling the exhibit wetland, for example, is general because there are wetlands everywhere. Having geographical anchors is important for the visitor's experience. The biome organization is not a suggestion to only organize the Zoo on scientific constructs but to refer to it when possible.
 21. Anthony suggested an overall theme: "Biodiversity in the Tropics" which allows us to chose significant habitat pieces such as the Amazon, Atlantic Forest, Flooded Savanna, and the Rivers. The conservation strategy based on corridors delineates a minimum area with a maximized biodiversity, sampling many species and including major flora and fauna. Here, corridors do not refer to a movement or migratory corridors. Using the concept of corridors to organize the exhibit would provide the Zoo with stories about tens of thousands of years of evolution and help protect ecosystems and promote long-term biodiversity. For example, the Amazon changes course over a century or more, and species shift and adapt.
 22. Glenn noticed that CI and WWF's regions overlap and that these overlapping areas seem to be important and reminded the group that it is important to approach this exhibit from a positive side to avoid "conservation fatigue."
 23. A regional, bio-geographical organization allows the Zoo to work with any conservation strategies and create partnerships, including working with CI, WWF, CBSG, etc....
 24. Glenn suggested the creation of a glossary of terms including for example: habitat, biome, and eco-region.
 25. Mario said that the goal is to make Tropical America mostly an outdoor experience with minimal climate-controlled areas. Providing refuge from extreme temperatures is important. Tropical America should be about 80% outdoor with weaving protected paths, water, vegetation, and built overhang and lots of shade. It will be important to determine the comfort levels of animals and people, and find out how long people can walk between cool zones and where they can comfortably sit.
 26. It will be a challenge to have outdoor living spaces for animals and offer visitors a comfortable experience. Since some species are nocturnal like the opossum and the ocelot, a night exhibit could be considered; making use of one of the nicest times of day here in southern Florida. A night experience could extend visitations. For example, the Singapore Zoo offers dinner and a visit through lighted exhibits.
 27. The monorail tracks are in place and the station can move anywhere up and down those tracks. Many decisions about the monorail stations and food have to be made in consideration with a long-term vision and the Master Plan for the Zoo. We do not know the reason why the monorail stops only at five wings of the Zoo instead of at all of them. The original thought was that the southern monorail station would be eliminated, avoiding the alteration of the overall master plan. However, it is thought now that the southern monorail station is less likely to go away because it is a handy shortcut back to the parking lot from the farthest reach of the Zoo. The monorail could disrupt the landscape immersion experience, the stations potentially being even more obtrusive than the track, although it is possible to move the station according to criteria we set especially for Tropical America.
 28. The preliminary plans and potential costs report by Keith attempt to illustrate the spatial exhibit layout and connections, create a framework and give building square footage with a suggested list of major trees.
- Break**
- Spatial Organization
29. Mario explained the four potential layout schemes:
 - a. Scheme A is a promenade on a central spine as the primary path going through all habitats, allowing a quick overview of the exhibit. Off that spine connect longer treks. The Coastal and Amazon zones are close to the water and there is no central village or outpost.
 - b. Scheme B has a long primary path going linearly through the whole exhibit with a series of short cuts. There is no central village or outpost.
 - c. Scheme C offers one central arrival space from which branch out many loops; the outpost is associated with the monorail station; the forest and the pathways would have a hierarchy.
 - d. In Scheme D, one arrives by foot at the river outpost and can choose from a hierarchy of loops.
 30. Comments were positive on Scheme D: people liked the outpost on the water (river boat link). A central point to come back to is practical for single parents with kids. Places to sit along the trek will be needed. It would be nice to combine C and A. An outpost at the river would be convenient for food and retail. Mario suggested that J&J review and assess the overall circulation scheme for the master plan to and from Tropical America.
 31. Glenn and Eric suggested that linking the exhibit with the other side of the lake will be important. One could access Tropical America by foot and by bridge that would act as a gateway, or by water taxi and shuttle. The cost, operations, and logistics of boats need to be considered. Boats are incompatible with bridges. A boat ride would be a nice supplemental experience and a revenue opportunity.
 32. The monorail can only go in one direction. Because of that, it is a supplemental experience. The monorail could be a very different experience or act more like a shuttle. Having a tram would be a problem because it needs to be away from pedestrians and necessitates 30' wide paths different from the proposed immersion paths.
 33. Primary transportation to and from Tropical America would be by foot, secondary access would be by monorail, and tertiary access would be by boat.
 34. Mario summarized the afternoon: the design team will try to combine A and C, and the outpost could include a restaurant and restrooms if desired.

End of Meeting Minutes for Day 1

Meeting Minutes

WORKSHOP #2, DAY 2—UNABRIDGED MINUTES

Location: Zoological Society of Florida, Miami, FL

Subject: Three Regions; Amphibians; Primates; Interpretation; Contact Opportunities

Attendees:

Carla Baker, ZSF

Jessica Swanson Carcerano, ZSF

Nora Robbins, ZSF

Carol Kruse, MMZ

Dave Jimenez, MMZ

Steve Conners, MMZ

Anne-Émilie Gravel, J&J

Mario Campos, J&J

Gregory George, Petraworks

Steven Wheeler, EDSA

Dan Licciardi, ZSF

Maria "Gucci" Sarno, ZSF

Paul Vrooman, ZSF

Eric Stephens, MMZ

Jo-Ann Jennier MMZ Children's Zoo

William B. Tuttle, MMZ

Caroline Kreiser, J&J

Eric Abrahamson, IQM

Anthony Rylands, Conservation International

Bob Dugan, EDSA

Elisabeth (Ela) Koncza, ZSF

Nancy Wielert, ZSF

Sandy Miot, ZSF

Jeff Sailer, MMZ

Kathleen Turner, MMZ

Bill Loftus, USGS

Keith Larson, J&J

Tom Hartman, IQM

Mike Maunder, Fairchild Tropical Garden

Meeting Notes:

Review of Regions

- Comments on the meeting minutes from Workshop 1 should be sent to Glenn, who will consolidate them. J&J will publish them as an addendum to the February minutes.
- The goal for the day was to review the Tropical regions, making them more global, creating the framework for science, including WWF ecoregion and CI's hot spots of highly threatened endemic species. Botanical and animal species would be discussed on the next day.
- Zone 1: Mezzo-America (Mesoamerica): Pacific Dry Forest and Cloud Forest.
- Zone 2: Rivers Amazon: The Tea, Black, and Blue Rivers, including the Brazilian and Guyana shields, wetlands, aquatic ecosystems, Andes foothills, and Amazon headwaters.
- Zone 3: Atlantic Forest and Pantanal, including a sample of the Chaco, the Savanna, the Atlantic Forest, and Pantanal grasses.

The Amazon:

- The *Rivers Amazon* book is a great resource for stories. Reference: Alex Showmatoff, *The Rivers Amazon* (San Francisco: Sierra Club Books, 1978).
- The flooded forest is a major dynamic habitat with fish and vegetation. Fishes are linked to seed dispersion of trees. The exhibit could show processes of the forest occurring only in the Amazon. For example, in the relationship between the catfish and dead trees, the fish act as termite and process the forest litter. Monkey fish leap one meter out of the water to eat insects off trees. When the flooded forest is dry,

it is bug infested, there is mulch on the ground. Insects migrate up to the trees and canopies to avoid the flood. Temperature changes are not dramatic; they are the same as in any tropical forest. Creating dynamic exhibits is hard because there is a lot of stress on the acrylic with cleaning. An alternate approach is to have one flooded display and another dry. There is a flooded forest exhibit at the Tennessee aquarium.

- Another interactive exhibit could be the electric eels. They emit electrical impulses for communication about food and predators that could be demonstrated outside of the tank. People should experience an extra layer of fun with light and sound signals. Fish would be talking and the visitor would understand their types of communication. Where the eels live, the water is murky so they need these devices to survive. Exhibitory could include fish in murky water and in clear water.
- Other stories to include: the dynamic of wide sand banks where turtles wait for low water to nest.
- Sting rays are linked to the origin of the South American continent.
- Interactive exhibits: introduce food above the water to make Monkey fish leap. Tambaki or Paku are round dark fish used for food by native peoples. At the exhibit, the public could press buttons linked to a feeder and watch fish come out of the water. This is also a cultural story: people over-fished them using fruits on cables and hooks.

- The State of Florida is against having Piranhas; although it is a legendary fish, it can't be imported.
- Demonstrate the seasonal changes.
- There are completely different forest species and ecologies in the Amazon:
 - "Varzea": white water forest. The trees have big leaves and are deciduous, the soil is rich in nutrient. This is quite an endangered type of vegetation in the Amazon. There are dramatic images of logged forest, industry and international trade. Waters are not stable and change their course all the time. When rivers change course, and animal populations change sides of the river. A great graphic would be to incorporate photos of all the oxbow lakes.
 - "Igapo": the black water forest with wonderful beaches. The Amazon River slows the Rio Negro down, backing up the waters, creating lake deposition of sediments and fresh water archipelago. The Rio Negro is stable and acts as a barrier for endemic species.
 - Clear water and black water: change of chemistry, stunned fish and many dolphins. For 20 miles, the two waters of the Amazon and the Rio Negro remain separate and travel together.
- When the forest is cut down, foods for the fish are destroyed. The *piaba* (native name for small fish) is part of the tropical fish trade. There are also stories about dynamite fishing.

Meeting Minutes

16. Logging, agriculture, and mining by big international industries are good stories to tell. A recent threat consists of paving roads, inviting monocultures of soybean in the central Amazon. There are 3 to 4 species that create habitat conversion problems: cattle, soybean, coffee, and sugar. This is true in some parts of Mexico as well.
17. Selective logging induces microclimate changes, and with El Nino years, the dry forest is under an incredible danger of fire. Small forest fires kill the under story. There are good night images of the Amazon with specks of light caused by forest fires.
18. Importers such as the Japanese government JICA (Japanese International Corporation Agency) fund road construction to take the timber out of Central America. The British are major users of tropical wood.
19. The Amazon was devastated for natural gas by big multinationals.
20. There are wonderful trees dispersed in the Amazonian forest. Many timber ventures have failed because there is not enough quality timber. They used to cut down the trees during the dry season and let them float out of the forest during the wet season.
21. There are monocultures of trees for pulp paper industry in Jari in Gmelina arborea and Fordlandia for the rubber trees.
22. In Mamiraua State there is the Sustainable Development Reserve encompassing about 1,200,000 hectares of flooded forest and lakes. Local fishing communities protect and manage their own resources with the aid of scientists. This is a successful protection project.
23. Tom Lovejoy has studied the effect of the fragmentation of the forest since 1978 at the National Institute for Amazon Research (INPA) in Manaus with the Smithsonian Institution. This study is now called Biological Dynamics of Forest Fragments Project.
24. The Zoo can initiate advocacy in the teenage population without naming specific multinationals or corporations. The Zoo can tell the story of Americans' consumerism and throwaway society and talk about companies that do good while initiating local stewardship. Home Depot may be a local partner because of their certified sustainable timber. The Zoo should anchor people in their personal stories and empower visitors to take action.

Break

Amphibians:

25. Amphibians are indicators of the quality of the environment; they are the first to decline in population with pollution. They can be distributed in the three regions. Caecilians use underground habitats.
26. They will be a challenge because they are mostly nocturnal. They will need to be fitted in the exhibit environment according to location, size and what they contribute to the story.
27. Amphibians are important because they will focus the eye on the smaller scale also giving an opportunity to focus on small aquatic plants and the small-scale landscape. Ferns and mosses will survive with the amphibians. Frogs can live with Bromeliads.
28. Bromeliads in the Cloud Forest and the Dry Forest: they have the biggest diversity in Southeast Atlantic Forest Mountains, the Mezzo-American (Mesoamerican) Dry Forest, and the Dry Forest of Brazil. In the Tepui Range, some bromeliads are passive carnivores and feed on insects. They are easy to buy commercially. There are hummingbird pollination stories.
29. Steve said that crocodilians present many conservation concerns and that their population is very reduced. *Crocodylus intermedius*, the Black caiman, looks like the American alligator. In the Pantanal: *Caiman crocodylus yacare*, Dwarf caiman, is fairly common and need not be bred in the Zoo. Having a Yacaré could offer a more dramatic exhibit at which there could be 15–20 animals together. There could be combined over- and underwater viewing of crocodilians.
30. In the Pantanal, when marshes flood, the lack of oxygen has forced animals to develop interesting breathing devices. There are all sizes of fish. There could be Yacaré and fish together.
31. Mike mentioned that the population of wading birds in the marshes could be a huge part of this exhibit. Screamer is a good bird to be exhibited in the Pantanal. The large grassy areas where they live can create restful, distant vistas in the Zoo.
32. The giant Amazon sideneck turtle is huge and interesting and can link MMZ with the Belize Zoo. There are also central American conservation projects for turtles. Their eggs are harvested around Easter for a typical dish: "Hicatilla." The Mata Mata turtles live in shallow Amazonian waters; they are spectacular to view from the side but boring from the top.
33. The Black Waters are interesting but poorly represented in American zoos.

34. The strength in those exhibits lies in a blend of species of fish and crocodilians, illustrating a cross-section of the community.
35. The Flooded Forest area would provide an interface between the forest and the water.
36. The Green iguana is an invasive pest in Florida. Stories about invasion can be told with iguanas, marine toads, and feral parrots. This is also an opportunity to educate people about not releasing their pets into the wild even if they are big and live for 25 years. Illustration of pests in the area could go as far as having a typical Miami house and pool that hosts all invasive species and shows the biological invasion. In all cases great resources should not be spent on these species, but maybe just a graphic panel in the retail outpost can be enough.
37. The Jamaican iguana is from the Caribbean but has ties in the Dry Forest, and the Zoo has previously committed to have it. It is not possible to keep 2 together because they will kill each other, but 50 together is fine. The 3 species: the Rock or Jamaican iguana, the Grand Cayman iguana, and the Anegada iguana are the rarest lizards in the world, well-understood animals.
38. The costal zones were once forests, with species that are now surviving in shredded remains.
39. Snakes and their broad spectrum of different adaptations and forms will be addressed in a future discussion. They can be put anywhere in the exhibit.

Primates (Anthony to summarize his talk in a separate paper)

40. Primates are mainly in the Amazon:
 - a. The Zoo already has Squirrel monkeys that can be mixed with Brown capuchin, forming a mixed species group typical of Flooded Forest. There are introduced groups of monkeys in Florida (for example Squirrel monkeys).
 - b. Spider monkeys.
 - c. Ideally the Zoo could get the Pied tamarin, a dramatic animal. Andrew Baker bred them in Europe. It is a good conservation story. The Emperor tamarin (in current collection at MMZ) and Saddle-back tamarins can form mixed species group.
 - d. There are good stories associated with the Goeldi's monkey pertaining to their teeth and genetic linkages. It is rare and lives in the Bamboo Forest; there is quite a lot of information about them in Bolivia.
 - e. Titi monkeys: breeding in Europe.
 - f. White face Saki.

Meeting Minutes

- g. Red-bellied Tamarin and Saddle-back tamarins can form mixed species group.
 - h. A group specialized in Amazon primates is the Stewart Muir Shaldon Wildlife Trust in England.
41. Atlantic Dry Forest:
- a. Capuchins monkeys, Cotton-top tamarin in the dry forest of Columbia, and endangered species are already in captivity in many labs and zoos (see Ann Savage at Disney Corporation).
 - b. Geoffroy's spider monkey in Central America.
 - c. The call of the Howler monkey and the singing of the Musician wren are sounds that could be part of the exhibit.
42. Atlantic forest:
- a. The Gold-headed tamarin.
 - b. Capuchin monkeys have conservation stories associated with them.
 - c. Out from other zoos: Woolly spider monkey are not easy to find. They are very important seed dispersers. They are better known as the Muriqui and there are only 20 in captivity.
 - d. Lion tamarins.
 - e. Owl monkeys are the only nocturnal mammals in the Amazon, Chaco, and Dry Forest. They may be exhibited in the same exhibit with other monkeys that are active during the day.
43. Careful selection of plants as food for primates.
44. In the Pantanal:
- a. Not a lot of primates.
 - b. Black-tailed marmoset.
 - c. Black howler that the Zoo already has.
45. Holding rare primates is an issue. The Zoo should pair with another Zoo or conservation program to make breeding more viable. The Zoo should reach out to in-situ scientific efforts and put animals back in wild. The Zoo needs to discuss these issues.
46. Getting a rare monkey species may not be affordable since MMZ does not have the jaguar nor the Giant otter yet.

Lunch

Interpretation: Engaging the visitor in conservation with TH and EA

47. From the group's conversation, the key issues seem to be:
- a. How does the Zoo engage its visitors?
 - b. What about advocacy?
 - c. How does the Zoo tell conservation stories without communicating despair?
 - d. How will the Zoo establish itself as a comfortable destination experience?
48. Through "story telling," the interpretive approach will tend to resolve three problems together and look for ways for visitors to emotionally connect with conservation issues, without diminishing the scientific context and content of the exhibit.
49. To do that the story can be driven by:
- a. A character that could be an animal, a person in interaction with the animal, bringing the public into intimacy and wanting to care for them. Heroes and villains in order to understand the tension.
 - b. An event with stories that progress.
 - c. A Journey or Discovery narrative.
 - d. Stories of decline and recovery.
50. The things that make story compelling are: the character, a strong sense of place, and a structure.
51. Glenn said that measuring the way interpretive stories change behavior would be interesting to find out.
52. It should be possible for any individual to identify with the main exhibit message. But how will a general message appeal to everybody? What are the stories that the Zoo want to tell and who is the audience? The message should foster ageless involvement in loving nature and personal action.
53. The main message is that Tropical America is not just a generic jungle but a mix of distinct habitats. The design team suggested J&J conceptualize the whole Tropical America (as well as temperate America and the Patagonia region) to update the master plan and provide the appropriate framework for the initial phases of Tropical America.
54. Immersion will be part of the exhibit, which will become a botanical garden.
55. Ela reminded that group that this exhibit has to be fun. How will we select the areas? Will it be scientifically based? The hook of the exhibit is science for the young and the old who will discover facts in many ways. There should be

interactive exhibits and some theatrical elements for groups of children.

56. The drama is part of the science. Theater works well because it hides science in the story and engages the public as part of the theater. Stories could include humor, theater, and creatively abstract animals. There could be performances in the Zoo. Traditional Hawaiian people transmit oral history to the kids, making them want to preserve the volcanoes.
57. Within the local community, the term science evokes the Miami Museum of Science.
58. The character in the story could be the common person, a fifth-grader should recognize him or herself and go back home, act responsibly even if they will never become a biologist. The exhibit should create sympathy and a bond with the issue; people should feel sorry and bad but at the same time feel hopeful. The Zoo should create personal connections with rivers and the habitats through stories and elevate that connection to the system and bigger picture. It is the idea of making people see wonderful things the way they did not see them before.
59. The monorail should be its own experience. A boat ride could also be a very specific experience.
60. By walking, taking the boat, and the monorail, the visitor would get a total experience. We should start thinking about the monorail interpretatively. From the moment visitors get out of the monorail, they should be immersed; the monorail should be part of the theme and the exhibit and could give a preview and introduction to the exhibit.
61. If we want the public to come back, the parking lot and the entry of the Zoo need to be rich and more than a drive-through experience. The idea of one huge grassy area as a parking lot would work to bring people in close to events and attractions. In addition, it would be good to give visitors a clear perception of the whole Zoo layout.
62. Stories can include acculturation and how cultures relate to the animals. Docents can tell stories with more details and are not tied to a script.
63. Paul suggested a discussion of stories about coca leaves and other ethnic herbal medicines and remedies and how these crops have affected the environment here in North America and there in Tropical America.

Break

Meeting Minutes

Contact opportunities (toddler and young children's learning opportunities):

64. The Zoo needs more opportunities for interactions; not necessarily a petting zoo, but a place where parents and children should learn how to be gentle with the animals. It could include for example: llamas, muscovy duck, reptiles, when docents are present, as well as water features. The tamarins are very little and are a common pet (stories possibility about domestication of animals), they are touchable, friendly and like to be around people. There is learning between people who interact. Guinea pigs and rabbits are not intimidating animals. Sloth can be petted but careful handling is necessary.
65. Other possibilities include built-in elements such as real fur, tree bark, leaves, and textures showing different types of trees as well as other props. In some ways, it is more educative, even though it does not offer access to the wild animals, it does encourage contact with live wild animals. However, petting is not just an educational experience, it is also exciting and creates a personal connection with the animals.
66. The idea is to bring animals out from their exhibit area without having them walk through an open area. Close encounters with invertebrates is very staff-demanding and requires spaces for the animals to get away from the visitors if they want to. There are issues of curatorial, horticultural, and maintenance staff and cost. There should be enough animals to rotate those through...6,000 people a day touching a sea star is a lot of stress. Not every kid needs to touch. Some Zoos have had people sit in a room and let monkeys come in and touch visitors. This is high-maintenance and high-risk.
67. Tasting chocolate and bugs can be interesting. People can bring some food home. They can learn about the diet of animals and see where the food comes from. These foods can create tangible links to stories of plants and animals that were traditionally available in people's gardens. The Cubiuba tree has sap that can be refined to gasoline.
68. There needs to be 1 or 2 main consistent message(s), kept through all the process of workshops, design and construction:
 - a. Tropics are diverse, fun, amazing. There is an incredible species diversity, fauna and flora.
 - b. There are natural science stories and cultural stories.
 - c. There is the reality of the finite resources leading to conservation efforts for preservation.
69. Eric Abrahamson said that the message does not have to be rigid; not every story has to tie back to the main message. The interpretation texts should not use "is" as a verb. For example: "biodiversity contributes to . . ." The Zoo should risk making statements.
70. The exhibit and stories are about empowerment; anybody can participate in conservation.

End of Meeting Minutes for Day 2

Meeting Minutes

WORKSHOP #2, DAY 3—UNABRIDGED MINUTES

Location: Zoological Society of Florida, Miami, FL

Subject: Expectation of Probable Construction Cost; Animals; Horticulture

Attendees:

Adam Stern, ZSF

Carol Kruse, MMZ

Steve Conners, MMZ

William B. Tuttle, MMZ

Keith Larson, J&J

Anthony Rylands, Conservation International

Bob Dugan, EDSA

Elisabeth Koncza, ZSF

Eric Stephens, MMZ

Terry Webb, MMZ

Anne-Émilie Gravel, J&J

Mario Campos, J&J

Mike Maunder, Fairchild Tropical Garden

Penny Honychurch Billingham, EDSA

Jessica Swanson Carcerano, ZSF

Jeff Sailer, MMZ

Tom Trump, MMZ Maintenance

Caroline Kreiser, J&J

Gregory George, Petraworks

Chris Rollins, Fruit and Spice Park

Steven Wheeler, EDSA

Meeting Notes:

LEED Presentation by Caroline

- With sustainable techniques and green measures, the Zoo can collect points to get LEED certification. The minimum points to get a certified building is 26. There are no certified buildings in Florida at this time, but 12 may become certified, none of those in Miami. A building cannot be certified until the project is operational.
- Green strategies include the use of recycled materials, daylighting, and energy efficient HVAC equipment. Utilities savings is one immediate benefit. 2" mulch in garden can significantly reduce irrigation (almost to zero). There is a premium associated with solar power equipment but savings go up too. A payback matrix can be explored further in the project.
- LEED or green environments are more conducive to an effective educational experience.
- It is also important to select a contractor who understands LEED or at least green design.
- There can be related green stories treated as exhibits such as hyacinths for water filtration systems, ground water recycling facility, and animal recycling stories. There could be an exhibit suggesting the involvement of visitors, testing the water for chemicals.
- It may be part of the conservation message to have a green building, obviously different from other conventional buildings.

Expectation of probable construction costs

- Is the nature of J&J's work and firm and to look at the big picture to make sure that we do not preclude the Zoo from opportunities of logical sequential growth. An "expectation of probable construction costs" is almost never done this

early in the design. It is normal that what we want to put on the site is more than we can afford for now.

- The Miami Dade County requires: 10% fee for construction contingency + 1.5% of the design fees for Art in Public Place (AIPP) + 0.25% of construction costs for Inspection General (IG) + 0.75% of the construction costs for Independent Private Sector Inspector General (IPSIG). Art pieces can be part of the interpretive features and contact opportunities for children. The Art and Public Commission Committee will chose a project-specific piece for the Zoo. The Zoo can give its input but cannot vote.
- For hot snakes: 6-foot aisle way would be sufficient plus 2 layers of glass. There are no advantages of separating and dispersing the hot snakes and the back of house areas. The displays of snakes can face different directions.
- Amphibians and bromeliads can be together. Water filtration by reverse osmosis should be used for amphibians. It will be worthwhile to test the quality of water at the Zoo before investing in water systems.
- Mario asked which regions should be built first? We want the visitor to think that they are moving according to a geographic logic. J&J can leave the Zoo with a concept for a whole Tropical America that can be built in phases. This will ease the decisions we are making now of circulation and zonal design. We may have to phase the regions because watering down the regions and experience is not an option.
 - In the next phase: Could be either exhibits for Atlantic Forest or Mezzo-America (Mesoamerica).
 - In this phase: the Amazon region will be the primary exhibit area.

12. The regions are:

- Mezzo-America (Mesoamerica), Pacific Dry Forest, and Cloud Forest.
- Rivers Amazon (includes Guyana and Brazilian shield, the Amazon rivers, and parts of the Andes foothills).
- The Atlantic Forest and the Pantanal, the Savanna as part of the Atlantic Forest, and a sample of the Chaco.

Animals

- If the Zoo has animals that are from Tropical America, these should be moved to the Tropical America exhibit and be replaced by other animals as appropriate. If it is not possible to accommodate the animals in the right thematic place, then the animal should go to another zoo.
- The Chilean Flamingo and the Andean Condor belong in Patagonia and the Andes.
- Humans and monkeys should not get too close to each other. Since we have more land and less money than we need, it makes sense to avoid buildings or glass separators. Primates may be on an island exhibit with many other species but there should be enough animals to be seen by the public.
- The team should consider holding requirements for each species and some space for separating individuals too.
- Anthony said that tamarins need more space than what they presently have in the ZSF building. Having the tamarins in a building is needless considering Miami's climate. Anthony added that they need more habitat immersion and can be grouped in a community with different species. Minimum tamarin area should be 200sf for 4–5 animals. In the wild, they move about 2–3 km everyday. Ideally, it should be a tall skinny area, for them to travel and run and

Meeting Minutes

have varied places where they can hang out. They can be conditioned to come in a room and spend their evenings inside.

18. Spider monkeys like tall forests and like to get high up to look down. 20 feet high is the minimum for the monkeys and is the maximum for public visibility. People could go to the canopy, in monorail or elevated platform. The monkeys are very active: they swing about, make faces, and are always shaking leaves.
19. There is nothing wrong with teaching people what to look for in an exhibit. Docents could stage the discovery for visitors, making people believe that they are on an adventure trek.
20. ADA (American Disability Act) is an important cost element. There could be boardwalks gradually ascending into the canopy. An elevated perspective is rarely afforded to people.
21. Spider and Capuchin monkeys can be together. They are active, intelligent, and destructive: they bang nuts and forage the forest floor.
22. Howler monkeys are not active and need a smaller exhibit of about 20x15 feet. The Zoo already has 12 Howler and 5 Squirrel monkeys living together.
23. The family structure of primates is important to show in an exhibit. The Zoo should not think about having only a pair of each primate species.
24. Muriquis or Woolly spider monkeys are large primates with great background research. They could be flagship species for the Zoo, mixed with the Golden lion tamarin, the agouti, and the marmoset.
25. Terry said that Capuchin, Spider monkeys, and Howler monkeys can all be in the same exhibit during the day with separate holding areas for nighttime, giving them a rest from olfactory, tactile, and visual contact. Each species should have its own door; with time they will know which door is theirs. The exhibit design should include strata and levels, branches and trees. We should allow Capuchins a lot of time on the ground and reserve them that territory. Capuchins and marmosets will kill birds.
26. There are no known health concerns with mixing aquatic species and primates other than risks of salmonella.
27. Sloth were potential species with the Armadillo and Agouti. They are not dynamic but require very low maintenance and low planting to the ground, otherwise they will not be seen.

Sloth can be a contact animal if it has been acclimated. The Radipus would be good for contact as well.

28. Howler monkeys are Pantanal animals and need lots of space. If there are 2 mating animals, they will not accept other members in their group. They can be bred to increase their own family size, or the Zoo could find a bigger group to effectively tell the story of grouping in the wild.
29. Capuchin, Howler, Titi, and Spider monkeys (and more) have the potential to become the most spectacular exhibit at the Zoo. Terry prefers a small exhibit for easier disease and breeding management.
30. Mixed exhibits offer interpretation about interdependence between species. If monkeys are the priority, then we can choose other complementary species such as birds. If birds living in the mixed species exhibit do not ever breed, it will be okay. It is possible to have birds and primates from the same region; these birds would not need holding areas.

Lunch break

Horticulture breakout session 12:20-2:30pm

Glenn, Eric Stephens, Tom, Anne-Émilie, Mario, Mike, Steven, Bob, Penny and Chris were present at this breakout session.

31. In efforts to simulate habitat, we are in reality creating a botanical garden. We need to plant big trees. Twenty significant trees should be put in the ground by July 2003 at the end of the schematic design phase. More trees can be taken into the Zoo in oversized boxes. We can create instant canopy and shade that will grow over time and may need to be replaced later. The Zoo will have to manage the plant collection the same way the animal collection is managed. We are in the perfect place and have the right people to make a great statement.
32. There will be animal and human impact on the plants. Some animals (for example, monkeys) are more destructive than others. We will need a strategy and plant trees that can take some abuse, or strategies for replacement. The tapir will kill the trees from the trunk (potential for hot wire?). In addition, compaction is the underestimated cause of mortality. The capybara and tapir make plants hard to keep because of compression and trampling. Other risks include frost and hurricanes.
33. This exhibit will not be a 100% taxonomic ecological habitat replication. With the Central-American woodland habitat, we can be accurate.

However, it will be hard to simulate the Cloud Forest from Ecuador without architectural analogs that will give the feel of the forest but will not be the horticulturally accurate specimens. Central American species will be easier than Amazon species.

34. Proximate to the path, we want to be as faithful as possible, but far away in the backdrop, we want balanced hurricane- and drought-resistant species. There are horizontal layers of landscape:
 - a. The external scene-setting landscape, the stage, creating the immersion experience.
 - b. The animal-affected areas with some sacrificial plantings.
35. Live oaks could be used for background and character planting. The live oak is sensitive to transplanting, but most of the tropical trees will be vigorous. At the Fairchild Tropical Garden rainforest, the live oaks were complemented by many epiphytes.
36. Actual Central American trees that we can use are the Ceiba tree (*Ceiba pentandra*), Guanacaste (*Enterolobium clocaprum*), and the Guyanna Chestnut (*Pachira aquatica*) (in the Amazon along the Orinoco). They grow fast here and promote the integrity of a tropical American botany.
37. Most Amazonian trees would not resist the hazardous weather of Florida.
38. Certain trees on site could be replaced for smaller ones and be included in the Tropical America. We will need to survey the site for species.
39. Mangoes need maintenance and should not go over walkways but can be good background tree, filling blank areas. Fruit trees such as the banana tree also grow very fast, but not native from Tropical America.
40. It may be possible to get some plants from private collectors.
41. Mike's key rules:
 - a. Do not use any species that are potentially invasive and limit the ecological impact on the local environment.
 - b. Promote as much local wildlife as possible: butterflies are important.
 - c. Use green "wallpaper."
 - d. Use species native from South Florida that are also native in Central America.
 - e. Everything 2 feet from the path has to be very robust. We can find tough species to give the look that we are after.

Meeting Minutes

42. Cacao needs some protection from the cold and a low level radiating heat source. Cacao has some cultural and historical interpretive values ("Chocolatl," the traditional Aztec and Mayan beverage and crop). The USDA is researching the sequencing of the chocolate genome and the world center for chocolate is located in Miami.
 43. The Sugar Cane is Asian but is a great grass screen and "wallpaper" plant. However, a lot of habitat is destroyed in Tropical America because of it. This is a possible interpretive story. One side of the path could show a diverse plant community and the other side could show a wall of sugar cane. The story could also explain the environmental cost of having these monocultures and what happens to the land when the crops are abandoned.
 44. It is possible to grow coffee. The Madre de Cacao is a canopy tree shading coffee plants. It grows fast up to 20 feet.
 45. Potentially discuss the impact of soybean on the environment.
 46. People are also interested in medicinal indigenous plants, medicinal gardens and spices. Foods and spices mean something to local and South American peoples: the avocado and chocolate are from Central America.
 47. The time really needed for plants to establish themselves is about 18 months before the exhibit opens. Some areas can be fenced off while construction goes on. At least 6 months would still be adequate.
 48. We could use vine pergolas or trellises for shade, creating nice aromas and cool zones, using species such as the *aristolochia* and *passiflora* and bamboo trellis. Cultural elements could be interesting and appear to be in their natural setting. Tall bamboo and trees and a narrow path with misters can create shade and create immersion. The narrower the path the better for shade and immersion.
 49. Trees with buttressed roots, aerial roots like the ficus and fig trees work for a rainforest look. Artificial trees can be built with an exhibit inside. In real forest you never see the top of the tree anyway.
 50. It is possible to move trees with large wide root ball without compromising the canopy. Right now is the ideal time to root prune. The Zoo would be able to root prune.
 51. Temporary irrigation in black pipe is a possibility.
 52. Bill Tuttle asked for pictures of plants and trees, in a photographic reference document.
 53. The Flowering Tree Society is a resource for anything of any size, they know plant collectors and can help the Zoo access private yards.
 54. Palms are used for buildings and food.
 55. The typical South American Bamboo, "Guadawa," can be boxed nicely. It is considered aggressive because it has thorns but it is non-running. If watered and fertilized, could be really robust. Stories about bamboo never end.
 56. The coconut is a coastal staple but not native, it comes from Southeast Asia. It is not incorrect to use coconut but it may be better if we showed more diversity.
 57. The Central American Dry Forest is the habitat that we have the most to choose from, for example: Trumpet tree (*Tabebuia* sp.), Senna or Shower tree (*Cassia* sp.), Coral tree (*Erythrina* sp.).
 58. The Cloud Forest is a challenge: the epiphytes and stunted little trees define its character.
 59. The understory: for the Chaco and Pantanal we could use native Florida grasses; otherwise it would be impossible to maintain them, and it is illegal to import non-native grasses. In the grassy event parking area, we could play with vistas to the area of wild grassland. Burning Florida grasses a couple times a year is the natural control method. *Chamaedorea* is an understory palm and likes shade.
 60. Water plant: the classic *Victoria Amazonica* or water lily is the iconic South American plant. It can be bought but needs tight protection; we can grow it as an annual or a perennial. It likes acid water and requires full sun. Unless it is netted and protected, it will not survive disturbances from turtles but can survive small fish and frogs. It will need its own pond and is more of a beautiful landscape feature. It could be visible from a boardwalk. Since it is popular, this would provide photo opportunity. We can acquire it and other cultivars from Longwood Gardens in Pennsylvania.
 61. All Bromeliads are Tropical American (about 2,000 species), except for one. We can use them for screening; they are hardy. The Pineapple is a bromeliad, and the wild pineapple of Central America can be used as a razor fence. They are specific homes for spiders and frogs.
 62. Orchids on the tree are a big thrill for tourists. Orchids and bromeliads are part of the Cloud Forest.
 63. Ferns: Tree ferns are viable in the Cloud Forest; they tolerate shade, love mist, and are native to Tropical America.
 64. The Pitaya or Dragon fruit has a big, visually compelling fruit that is exported to the Japanese. The best-known flowering plant is called night-blooming cereus (*Hylocereus undatus*).
 65. For night events: night flowering and scented plants, such as Moon vines at the walkways and Angel's-trumpet.
 66. We do not want toxic plants: oleander is highly toxic. People should stand clear of the Tecoma or Yellow elder.
 67. Seasonal blooming: The Zoo's busy season is from Christmas to Memorial Day so we need winter flowering plants, and Fall flowering plants to extend the season.
 68. It will be important to have a cohesive master plan in order to guide people from horticultural societies who want to volunteer at the Zoo.
 69. Banana: wild bananas are robust plants but are not native from Tropical America and need maintenance. They could be used to feed monkeys (fruit) and elephants (roots).
 70. There are many Heliconia that are native and could give summer color.
 71. Palm thickets (*Pavotris*) in the Amazonian grassland: are nice if possible to recreate that landscape.
 72. Chris Rollins will soon submit his own list of suggestions.
- Mammals breakout session 12:20-2:30pm (ZSF notes):
- Keith, Ela, Jeff, Adam, Terry, Greg, Anthony, Caroline, and Jessica were present at this breakout session.
73. Herps are flexible and should be worked into exhibits whenever possible.
 74. Identify key factors that could incorporate a mix of species; Zoo to identify which animals are wanted for exhibits, research, and conservation.
 75. A wish for primates would be an exhibit like the aviary with walkways for the public and islands separating the monkey species; we could do research if only on a few.
 76. Jeff would like raptors in this exhibit with other birds as filler, Anthony likes capuchins.

Meeting Minutes

77. MMZ has a lot of great apes and monkey deficient at the present time, we could have a first-time-ever mixed-species exhibit and write a paper on it. Primates must be divided to include disease parameters.
78. We need to build for species we want but have back ups in case we don't get them. Design for the most preferred species and if we don't get them put in an alternate.
79. The Zoo needs to decide now what we want and start the paperwork as soon as possible.
80. Amazon-mixed tamarins and marmosets—capuchins would eat Squirrel monkeys, so they need to be separate.
81. We need behind-the-scenes experiences also—opossum would be one candidate.
82. Coati—why was it removed? Everyone agrees that it is a good contact animal... diurnal, can live in big groups, very charismatic.
83. Behind-the-scenes public experience needs to be separate from real keeper areas—people can see, but it doesn't impact keeper staff. But the feel needs to be that it is very unusual to see this.
84. No Spectacled bear: it would cost \$2.5 million to construct a good climate for the Spectacled bears, would necessitate air-conditioning, and the Zoo already has 3 other bears. Money could be better spent elsewhere.
85. No ocelots: would cost half a million dollars, they smell very bad, marking their cages, and are nocturnal.
86. Giant river otters—capybara could use exhibit if we don't get them, the water filtration is different though it is easier to change the filtration than the whole exhibit. Glenn said that we will get these.
87. Yes to jaguars.
88. The otter and tapirs could go together or the otter and capybara, but not tapir and capybara with the otter. Birds can be with tapirs. The filtration system would have to be heavy duty.
89. Quarantine space needs to be made for fish. We could do behind the scenes views with quarantined fish.
90. Oscillated turkey—spectacular, will be running throughout the exhibits and public areas.
91. Ela and Anthony want the *Kapok* sp.
92. Cock of the Rock—This bird has an interesting mating ritual and can lead to a fun interpretation activity similar to bronze footsteps inserts illustrating human dance steps on Broadway in Seattle. We could do those bronze inserts showing a bird dance or mating ritual for kids to imitate. If we want to get this bird, we must make the commitment now!
93. We need institutional commitment on some of these animals.
94. We have insufficient quarantine facilities here for these new animals and fish. We would have to build holding places first. Where will they go after quarantine if exhibit is not built yet? We cannot do the same thing as was done for the aviary. Tennessee aquarium built all of their holding facilities first. We can build outdoor temporary quarantine space for some. (Behlen Cages, cyclone-resistant, and Butler-type buildings.)
95. Staff: the Zoo projects that we will need 8 keepers and 17–20 new staff for this exhibit, not including contact staff. We don't have the supervisor hired yet, we need that before the design phase is done.
96. Finances—how much for obtaining birds? The most expensive is \$1,500 per bird, \$32 for vaccines, \$1.25 per day to house. If one bird tests positive for disease, they kill the whole flock. The USDA/FDA quarantine is minimum wage staff, not Zoo Keepers, although the Zoo is training a FDA staff member. Birds in SSP are often given on breeding loans, and we must give some offspring back to SSP.
97. Rhea is probably off the list because it is from the Chaco and we may not be able to do justice in representing this biome.
98. Galapagos tortoise is off list because we are not doing that region.
99. Dwarf caiman—have on exhibit, we may include it or not.
100. Maned wolf is now off list because it is from Patagonia.
101. Coati is back on the list.
102. Insects are needed throughout exhibits.
103. Tetras and dwarf cichlids in jaguar and fish wherever possible.
104. Jaguar: can it roam through exhibit, winding around the path, climb above the public, go through a Plexiglas log. Very food driven, can be coaxed to go anywhere.
105. Giant otters: can we have a viewable den? We could have a log on exhibit. Exhibit should be 75% water or not less than 50/50 (land and water).
106. Staff who can help on project:
 - Dave Jimenez: invertebrates, herps, and amphibians
 - Carl Burch: birds
 - Chad Davis: hoofstock
 - Kurt M.: primates
 - George Smith: elephant
107. Kitchen staff and budget need to be addressed; food budget is going to be substantial.

End of Meeting Minutes for Day 3

Meeting Minutes



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iq—IQ Magic

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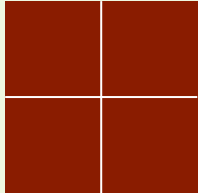
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