

Wildlife + Human Interaction:

Creating a Mindful Link between the Visitor + Pygmy Elephant Territories

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A Thesis submitted in partial fulfillment of the requirements for the degree of
Master of Architecture

University of Washington
2014

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Program Authorized to Offer Degree:
Architecture

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Abstract

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A growing number of animal species are becoming endangered due to the encroachment of built environments on natural habitats. On the island of Borneo in the Indian Ocean, aggressive clearing of native tropical rainforest for palm oil plantations has reduced a vital natural habitat of the endangered Pygmy elephant. Borneo is the only place on Earth where this species lives. Preventing further reduction of the Borneo rainforest habitat is crucial to the survival of this species. The focus of this thesis is to confront a paradox: how to provide a built environment for research and education within the natural territory of the Pygmy elephant in order to advance knowledge of the species and promote protection of their already-compromised habitat.

Acknowledgments

To my family for traveling to Borneo Island with me and understanding that grad school is hard.

To Clinton for his unwavering support, love and feeding me when I forgot to.

To my professors, Louisa, Rick, Ann Marie and Gundula for all their help and time.

To my classmates for all the impromptu desk crits and conversations we had during this process. I could not have done it without you guys.

Thank you.

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CHAPTER 1: INTRODUCTION

“The error of men is thinking nature is in our control, not the other way around”

~ Max Borenstein



image 1 (previous page) Palm oil plantation planting along the Kinabatangan Riverbank. This increases river erosion and rainwater run off into the water.

In the last decade, the Borneo Pygmy elephant is just one of many animals throughout the world that have become in danger of extinction. The leading cause of the imminent demise of this species is the loss and degradation of their habitat.¹ The most destructive force in this drastic habitat loss is a result of human activities, mainly in the form of built environments. Architecture has taken over animal territory and become an obstacle that animals have to overcome in order to continue to live in their native environment. Asian elephants, for example, are experiencing obstacles in their daily migration paths due to the appropriation of their habitat for built environments.

Borneo Pygmy elephants, located in Sabah, Malaysia are recognized as a subspecies of Asian elephants. It is estimated that only 1,500 Pygmy elephants remain in the wild, placing them on the World Wildlife Fund's (WWF) endangered species list². The animal's natural

1 Leitão, Andre Botequilha. *Biodiversity Planning and Design: An Issues Based Case Study*. Washington, DC: Island, 2006. Print.

2 "Overview." *WorldWildlife.org*. World Wildlife Fund, n.d. Web. 11 Sept. 2014. <<https://www.worldwildlife.org/species/borneo-pygmy-elephant>>.

habitat is the Borneo lowland rainforest, which is continuously decreasing in area because of logging and agriculture. As a result of these human activities, the habitat of these unique animals are disappearing and as a result their numbers are diminishing.

In response to this dire situation, some animal conservationists have sought to relocate endangered species to zoos. The purpose of the modern zoo is to protect and study wild animals in spaces that recreate their natural habitat while displaying them to the public. But these small artificial enclosures in urban settings cannot replicate the wild natural environment, resulting in abnormal behaviors in captive animals and threats to their well being. To combat the negative aspects of the outdated concept of the zoo, another approach to animal conservation has come in the form of the animal sanctuary. A sanctuary provides a larger more open area of land that seeks to act as a safe haven where the needs of the animals come before their exposure to humans. The sanctuary often contains some man-made elements, such as a heated barn

to care for animals on cold nights. However, even if these facilities are supposedly more “natural,” they are still artificial recreations of the animal’s original environment in the wild.

From the urban zoo to the rural sanctuary, these built structures confine animals within an enclosure. Whether large or small, these compounds are essentially cages, designed to confine animals. With zoos especially the animals are placed into an enclosure that also serves as an exhibit for human entertainment. This thesis proposes that architecture can go beyond its function as an obstacle or an enclosure and instead assist in cultivating a safe and humane way for animals and humans to interact. The design for a researcher outpost within the Pygmyelephant's territory provides a safe haven for the study and care of the elephants through a sustainable intervention in their innate setting, the Borneo rainforest.

CHAPTER 2: UNDERSTANDING WILD ANIMALS + HABITATS

“Just keeping animals healthy and well fed isn’t enough; we need to give animals enough social contact with other animals... to live an emotionally normal life.”

~ Temple Grandin



image 2 (previous page) A pronghorn crossing under a fence near Alberta, Canada. Photograph taken by Joel Sartore.

The wild belongs to those creatures that inhabit it. Human territory is largely the built environment that we live in: cities, buildings and enclosures that are dominated by order and structure. Animal territory consists of the natural world that is more organic, fluid and open. Responding to seasonal changes, animals migrate, traveling long distances within their territory as a means to stay alive. Unfortunately, human territory is a constant threat to the migration paths of animals and to their ultimate survival.

Movement of Animals

Migration is defined as a journey with a clear purpose from one area or region to another. Crucial to the survival of many species, migration enables animals to escape certain weather conditions or helps them to find food³. The animal is born with a mental map of the routes and places it needs to occupy in its search for a new habitat. Over time as habitats

3 Hoare, Ben. "How Migration Works." *Animal Migration: Remarkable Journeys in the Wild*. Berkeley: U of California, 2009. 8-41. Print.

are threatened and destroyed; animals often alter their path of travel. The most endangered species are migratory animals that are threatened because so many of the traditional paths they use have been disrupted by human constructions (image 2). Agriculture is another way in which people have taken over the land, reshaping it from its original wild state to be fit for human occupation. In these animal territories architecture can be an even more destructive force that causes the rapid loss of the migratory animal's habitats.

The destruction of habitats of many species took place at an especially rapid rate, between the years of 1945 to 1990. During this period seventeen percent of the world's vegetated area was destroyed.⁴ To protect what remains of this now fragmented habitat, scientists have come up with the solution of wildlife corridors. A wildlife corridor is a human built

4 Anderson, Anthony B., and Clinton N. Jenkins. *Applying nature's design: Corridors as a Strategy for Biodiversity Conservation*. New York: Columbia UP, 2006.



passageway or link between natural animal habitats through a landscape that is dominated by human architecture.⁵ (Figure 2) The idea is to allow animals to migrate from one area to another without being harmed or disturbed by humans. Therefore, instead of acting as an obstacle to animals, the human built environment can help and assist in the migration process. In the last few years the World Wildlife Fund has used this idea of wildlife corridors to help restore the habitat fragmentation occurring on Borneo Island.⁶

image 3 A wildlife corridor crossing over a highway.

⁵ Anderson, Anthony B., and Clinton N. Jenkins. *Applying nature's design: Corridors as a Strategy for Biodiversity Conservation*. New York: Columbia UP, 2006.

⁶ Majail, Julia, ed. "Kinabatangan Corridor of Life." *CORRIDOR Newsletter* 1 (2009): n. pag. Print.

image 4 Versailles
Menagerie.



BUILT ENVIRONMENTS FOR WILD ANIMALS

In the past another effort to protect these endangered animals, has taken the form of relocating them within human territory. The most familiar and popular environment built for wild animals is the zoo. However the appropriateness of the zoo as a form of animal conservation has been questioned in recent times. The most effective form of a built environment for a wild animal is a fully enclosed container that protects it from the outside world. However, this kind of enclosure cannot be justified as a safe and humane means of protection. While protected from the threats faced in the wild, animals face another set of threats in these restricted surroundings designed by humans. With no privacy they are put on display, forced to interact with humans. Rather than having the freedom to roam, they are confined to small, artificial enclosures.

Zoo

In the sixteenth century, people of wealth owned menageries, which were collections of wild animals kept solely for the purpose of personal entertainment. Owning a menagerie became a symbol of a person's wealth and power over nature.⁷ Rachel Couper states that the most well known of these built complexes was the Versailles Menagerie, owned by King Louis XIV (image 4). This building was part of the King's personal garden, designed by, Louis Le Vau. The menagerie was a radial building designed in a baroque style that displayed animals in cages.⁸ The strong geometry and hard surfaces marked a clearly artificial environment that was under human control,

7 Couper, Rachel. "Placing the Origins of the Zoo." *Proceedings of the Society of Architectural Historians*. University of Sydney. 235-46. 01 May 2014 <<http://www.griffith.edu.au/conference/sahanz-2013/>>.

8 Couper, Rachel. "Placing the Origins of the Zoo." *Proceedings of the Society of Architectural Historians*. University of Sydney. 235-46. 01 May 2014 <<http://www.griffith.edu.au/conference/sahanz-2013/>>.

image 5 (top) An example of zoo design landscape feature, such as a ha-has.

image 6 (bottom) Zurich Zoo. Zoos are a 19th century concept with the purpose of studying and protecting the animal, but the spaces that the zoo provides is artificial, small in comparison to the animal's natural habitat and becomes more of an exhibit.

with little connection to nature and regard for animal welfare.

During the French revolution, the royal menageries began to disappear, replaced by the idea of the zoological garden that was open to the public.⁹ The purpose of the zoological garden was to collect and exhibit wild animals for scientific and educational value. Despite this intended purpose the zoological garden, ended up as a large "natural landscape," with meandering paths for public recreation.¹⁰ The animals were placed on display in small cages as ornamental features alongside plants and trees within large garden settings. While the environment of the zoological garden was more "natural," the emphasis was on human entertainment, rather than animal conservation.

⁹ Couper, Rachel. "Placing the Origins of the Zoo." *Proceedings of the Society of Architectural Historians*. University of Sydney. 235-46. 01 May 2014 <<http://www.griffith.edu.au/conference/sahanz-2013/>>.

¹⁰ Iadarola, Lynne. *Architectural Design in the Zoo*. Thesis. University of Maryland, 1985. N.p.: U of Maryland, 1985. Print.

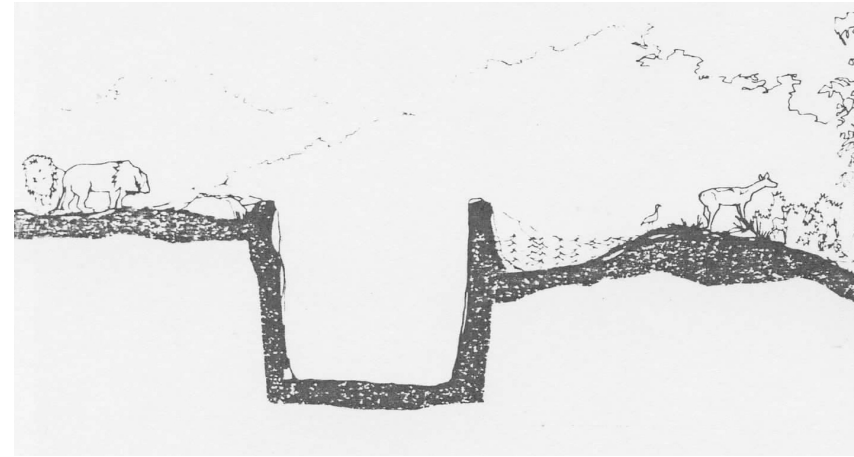




image 7 Stellingen Zoo

In 1910, the Stellingen Zoo (now known as the Hagenbeck Zoo) in Hamburg, Germany, became the first known modern zoo with redesigned animal exhibits that sought to “naturalize” the environment for animals and visitors. The goal was to create exhibits without any bars that would recreate the actual character of life in the “wild.” For example, lions could be seen as though they were in the same space as zebras, but in fact were physically separated by landscape features such as ha-has or sunken fences.¹¹ (image 5) This form of the zoo made a noble attempt to consider animal welfare, but still placed the animal in an artificial man-made cage. As Lynne Iadorola observes the benefit of creating the illusion that both lions and zebras were together was intended to benefit only the human visitors to the zoo.

Similar to zoological gardens, the modern zoo is a facility in which animals are confined within

¹¹ Iadorola, Lynne. *Architectural Design in the Zoo*. Thesis. University of Maryland, 1985. N.p.: U of Maryland, 1985. Print.

enclosures and displayed to the public for the primary purpose of entertainment and creating awareness. Nature conservation is usually a secondary aim. The design of the zoo is to accommodate the visitor as the main user, as well as the staff and the animals.¹² In most respects, the visitors are the most important concern for zoo designers because they provide the economic means to care for the animals.¹³ The design of a memorable and enjoyable experience depends in large part on the physical relationship between the animal and the visitor. The viewer desires not only to be able to see the animal within the exhibit but to watch it performing or behaving as in the wild.¹⁴ But in order to provide this most desired experience for humans at the zoo, the animal must suffer. Constantly placed on display, animals often have no spaces of seclusion as they would in the wild.

¹² “The Portico Group.” Personal interview. 23 May 2014.

¹³ Iadorola, Lynne. *Architectural Design in the Zoo*. Thesis. University of Maryland, 1985. N.p.: U of Maryland, 1985. Print.

¹⁴ Iadorola, Lynne. *Architectural Design in the Zoo*. Thesis. University of Maryland, 1985. N.p.: U of Maryland, 1985. Print.

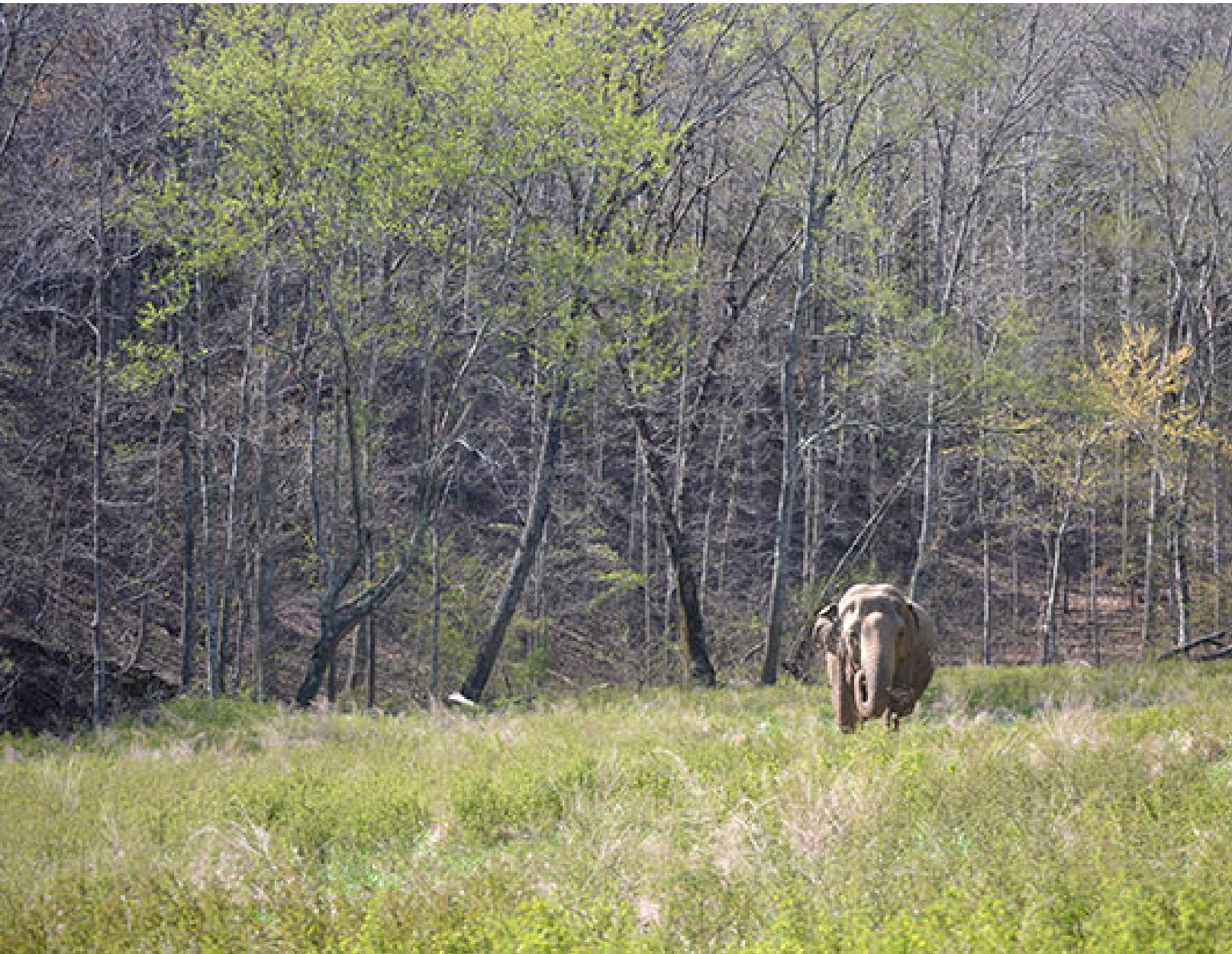


image 8 Elephant Sanctuary in Tennessee. A Sanctuary, although larger in area, is still not the animal's natural environment and still contains the animal within human territory.

Even when zoo designers provide secluded places, the visitor and staff often still see and access them, because the aim is to have the animal be constantly visible.¹⁵

In recent years, the treatment of wild animals in zoos has become of greater interest to the public.¹⁶

As a result zoo designers have started to make the facilities used to care for an animal more visible, which in the past were behind the scenes. The San Diego Zoo for example, has an elephant care facility that seeks to educate visitors on how the animals are cared for, including grooming and maintenance.¹⁷ But these new facilities only emphasize the point that zoo designs are focused on the visitor experience. Similar to the zoos of the past, the modern zoo is intended to give visitors an exciting and memorable experience by viewing the animals up close in

enclosures, behaving as they would in the wild. The zoo does benefit animals by keeping the public interested in the welfare of endangered animals. By educating visitors, the zoo can help in a secondary way in animal conservation, however the animal suffers as a result.

Sanctuary

Some animal activists consider the sanctuary as a better alternative to the confinement of animals in the zoo. These larger, more open facilities provide a place for animals to live out the rest of their lives in a safe and more peaceful environment. There are several key differences between the function and form of zoos and sanctuaries. Generally zoos tend to trade and breed animals through unnatural medical procedures, in order to achieve animal conservation goals¹⁸. However, sanctuaries are seen more as a safe haven for animals, where they are largely left alone and only provided with daily health maintenance,

15 "The Portico Group." Personal interview. 23 May 2014.

16 "The Portico Group." Personal interview. 23 May 2014.

17 "Elephant." *San Diego Zoo Animals*. San Diego Zoo Global, 2014. Web. 09 June 2014. <<http://animals.sandiego-zoo.org/animals/elephant>>.

18 "The Elephant Sanctuary : Hohenwald Tennessee." *The Elephant Sanctuary : Hohenwald Tennessee*. 28 Feb. 2014 <<http://www.elephants.com/aboutSanctuary.php>>.

rather than more extreme medical intervention. According to the American Sanctuary Association this type of facility provides an opportunity for the animal "to behave naturally in a wonderfully loving environment."¹⁹

The Elephant Sanctuary in Tennessee for example, occupies more than 2,700 acres to provide a home for old, sick or needy elephants that have been retired from zoos and circuses (image 8). The private owners of this sanctuary are adamant about their mission of keeping the elephants themselves as their first priority. The sanctuary is divided up into three separate protected habitats, two for Asian elephants and one for African elephants. Each habitat has an elephant barn that is heated for the animals to use on cold nights. These structures are constructed of concrete floors and walls, making them solid and easy to clean. To protect the animals from the outside world, the sanctuary has placed a 222-acre

perimeter "people" fence.²⁰ The habitat within this sanctuary is described as having, "pastures, wooded areas, streams and ponds," which all are considered similar to the natural habitat of a wild elephant.²¹ While quite large in scale this complex is still restrictive by confining the animal to a specific territory. Also the climatic conditions in Tennessee are not the same as the natural environment of these animals in the wild.

Typically the architecture designed for wild animals is an enclosure to confine them, like a cage. While zoo design seeks to create an environment that enables the interaction of man and animal, it is too focused on accommodating the human visitors. A more interactive architecture is needed that is designed in a way that is more sensitive to the animal and its environment, putting the natural world before the human one.

20 "The Elephant Sanctuary : Hohenwald Tennessee." *The Elephant Sanctuary : Hohenwald Tennessee*. 28 Feb. 2014 <<http://www.elephants.com/aboutSanctuary.php>>.

21 "The Elephant Sanctuary : Hohenwald Tennessee." *The Elephant Sanctuary : Hohenwald Tennessee*. 28 Feb. 2014 <<http://www.elephants.com/aboutSanctuary.php>>.

19 "About American Sanctuary Association (ASA)." *American Sanctuary Association*. 30 Apr. 2014 <http://www.asaanimalsanctuaries.org/about_ASA.htm>

image 9 (top) Wildlife tourism



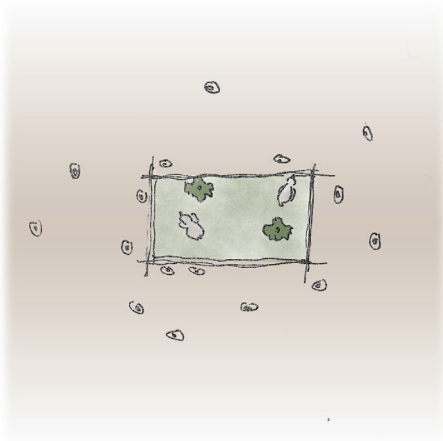
image 10 (bottom) Wildlife tourism while using other animals as a mode of transportation in India.



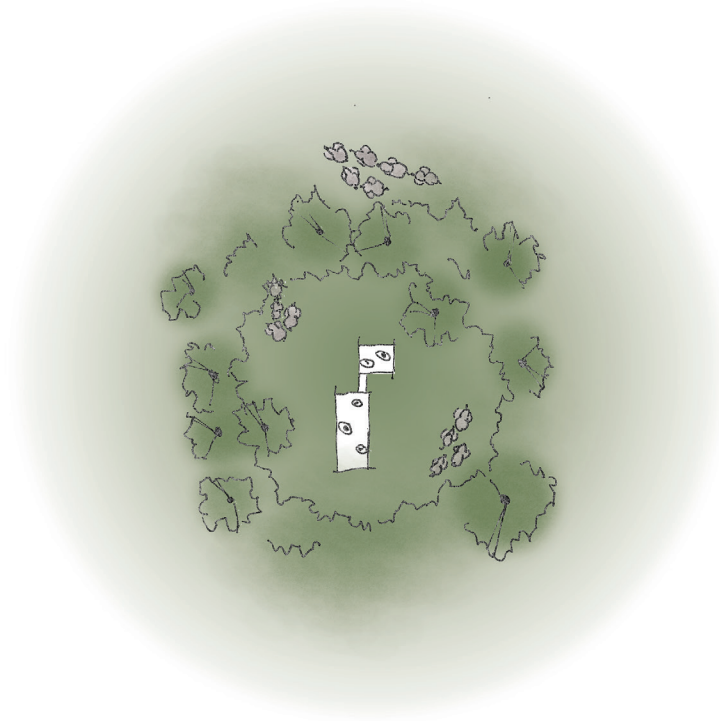
Wildlife Tourism

In recent years the idea of wildlife tourism has become popular. The idea is to enable tourists to see wild animals within their natural habitat. Often, wildlife tourism can consist of groups of people in vehicles roaming freely throughout the animal's habitat. This causes disturbance to the animal's feeding patterns, breeding and bonding behaviors.²² This random exposure to humans makes it more difficult for the animal to accept their presence within their territory. The intent of wildlife tourism is to bring humans to animal territory in order to experience the animals within their habitat. While this approach shows the way in which the visitors see the animals can be changed, the result is often the degradation of the animal and its territory.

22 Curtin, Susanna. "Managing the Wildlife Tourism Experience: The Importance of Tour Leaders." *Academia.edu*. International Journal of Tourism Research, 05 Aug. 2009. Web. 04 Dec. 2014. <https://www.academia.edu/364301/Managing_the_Wildlife_Tourism_Experience_The_Importance_of_Tour_Leaders>.



HUMAN TERRITORY
enclosure of animals



ANIMAL TERRITORY
enclosure for humans

figure 1 Project concept.
Containment for humans in animal
territory.

Therefore this thesis proposes to explore the role of architecture in interactions between humans and animals by reversing their typical roles (figure 1). The design for the researcher outpost seeks to create a space where humans are contained within the animal's home becoming guests to observe the animal for a short period of time. In this complex visitors will not be guaranteed of a close-up interaction with the animals but rather will have an opportunity to experience them in their habitats at many different levels.

ANIMAL TERRITORY

This thesis focuses on the endangered animal, the Borneo Pygmy elephant (image 11). This species of wildlife that is located on Borneo Island is most directly threatened by human encroachment in the form of palm oil plantations and logging camps. Due to the rapid encroachment of humans in their territory, the elephant's habitat has become fragmented, causing them to have larger and longer home range areas, which is the area an animal travels in search of food or a mate (figure 2).

Identifying the Landscape of Pygmy Elephants

The Borneo Pygmy elephant migrates daily to find food. In their travels, they occupy three distinct natural spaces on the island: the lowland rainforest, the swampland and the riverbank. Each space is occupied differently by these animals and plays a significant role in their migration path.

The lowland rainforest habitat (image 12) is very dense with trees and other low stunted vegetation. The forest ground is relatively flat and can have a layer of peat, a slightly decomposed plant material and deep marine alluvium.²³ The flat terrain is ideal for a Pygmy elephant because they cannot travel uphill or downhill easily. Compared to an African elephant, the Pygmyelephant is significantly smaller in stature. They grow to about six to nine feet tall and weigh about 2,000 to 5,000 kilograms. The animal's small build allows them to move in and out of the dense rainforest habitat easily and comfortably. Since the rainforest consists of large tall trees located close together, there is little room on the ground for animals to move and gather in groups. Therefore, the herds of Pygmy elephants are rather small, with

23 Alfred, Raymond, Abd H. Ahmad, Junaidi Payne, Christy Williams, Laurentius N. Ambu, Phua M. How, and Benoit Gossens. "Home Range and Ranging Behaviour of Bornean Elephant (*Elephas Maximus Borneensis*) Females." PLoS One E311400 7.2 (2012): 1-12. Open Access. Web. 28 Apr. 2014.

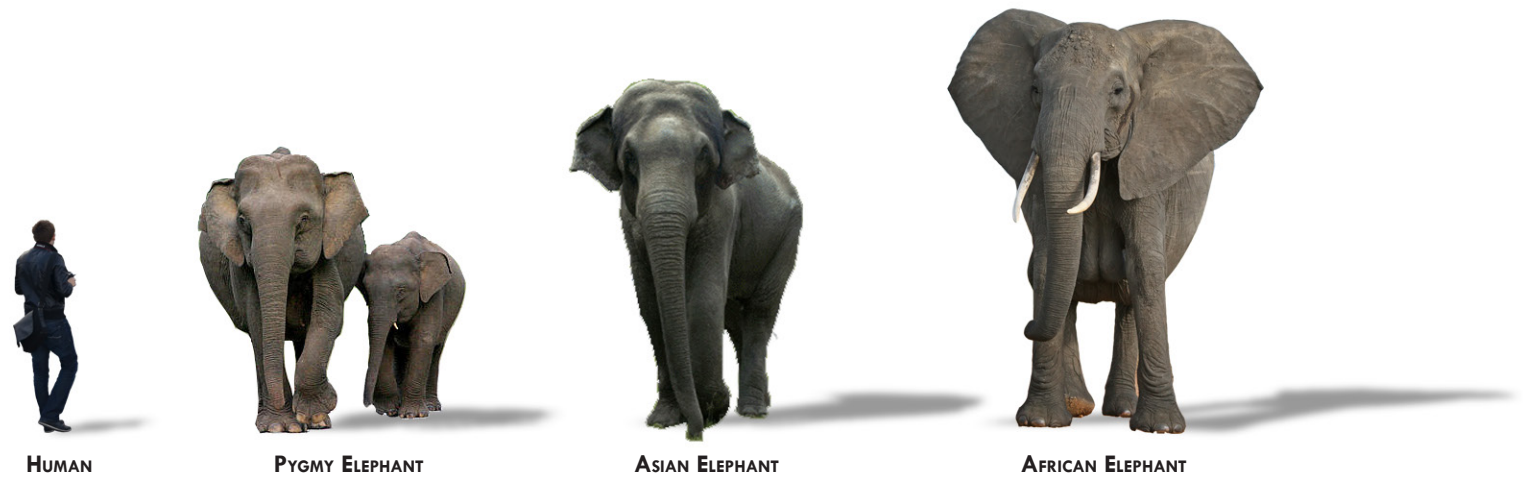
image 11 Pygmy elephant scale diagram.

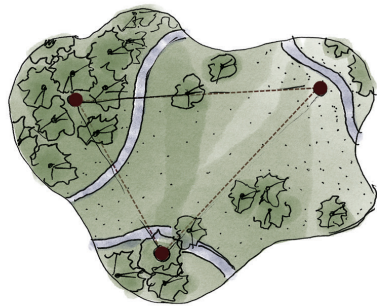
Height: 8-10 feet tall

Physical Features: Babyish faces, oversized ears, round bellies and long tails that sometimes drag on the ground.

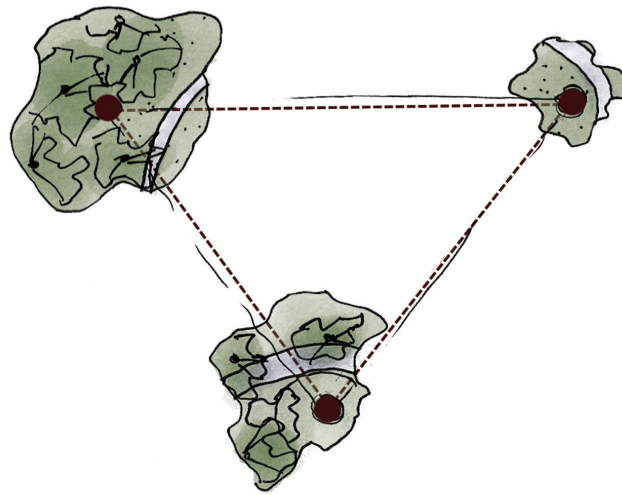
Habitat: Migratory animals that travel for food between several habitats of Lowland Rainforest, Swampland and Riverbank.

Personality: All female elephants are very social animals that thrive on physical touch and social settings. The pygmy elephant is recognized as having the least aggressive behavior. Pygmy elephants travel in a herd size of six to eight elephants, but are known to have large family reunions where multiple herds travel together for several days.





UNDISTURBED
250 - 400 km²



FRAGMENTED
600 km²

figure 2 Elephant home range distances. A home range is the area over which on animals or groups of animals regularly travels in search of food or a mate.

image 12 (top) Rainforest pygmy elephant habitat.



image 13 (bottom) Swampland pygmy elephant habitat.



eight to ten individuals in a herd.²⁴ The rainforest is a habitat mainly to find food, once the elephants have consumed enough they migrate to other habitats.

The swampland habitat (image 13) has fewer trees than in the rainforest, resulting in open tree canopy that allows light in. The Swampland is also poorly drained, which is beneficial to Pygmy elephants because it provides water to drink and a place to cool off and bathe. This environment is especially beneficial when a female Pygmy elephant gives birth. When first born the calf must learn how to walk, which prevents the herd from migration for several days. This habitat provides enough water and protection to the herd so that it can be immobile for a few days. Therefore, this habitat is a mixture of dense and wide-open spaces of landscape that provide areas of shelter and refuge for the animals.

Unlike the dense lowland rainforest, the riverbank (image 14) is a wide-open space. Running through

²⁴ Redmond, Ian. *Eyewitness: Elephants*. London: Dorling Kindersley, 1993



the dense rainforest, the river creates a narrow open habitat that borders the water banks. Unlike the other habitats that provided small crevasses for hiding, the open nature of this habitat leaves the elephants fully exposed. Once a year, Pygmy elephant herds gather at the riverbank for a family reunion. An entire family can consist of about fifty Pygmy elephants, who often greet each other with a touch of the trunk.²⁵ Only in this habitat can a family reunion occur, which makes the space even more diverse. The open river allows enough space for the entire elephant herd to enter the water to play, bathe and cool off. The river serves as a source of water and the trees that border the river provide food. Even though the riverbank provides for all the needs of the elephants, once the food is consumed the herd continues to migrate to other parts of the rainforest.

image 14 (top) Riverbank pygmy elephant habitat.

image 15 (bottom) Palm oil plantation, human territory encroaching on animal territory.



²⁵ *Pygmy Elephants: Documentary on the Jungle Pygmy Elephants of Borneo.* Youtube. World Wildlife Fund. WorldWildlife.org. World Wildlife Fund, 8 Oct. 2013. Web. 18 Jan. 2014.

Since the beginning of the twentieth century, this landscape that Pygmy elephants occupy has begun to disappear. Current natural habitats have dwindled to the point that they cannot continue to sustain the entire elephant population. The human occupation of the Borneo forest region has reshaped the environment and must be understood as part of the current habitat, now both natural and man-made is occupied by the Pygmy elephants.

Human Impact on Pygmy Elephant Habitats

Human cultivation of the land, such as in logging camps and palm oil plantations are encroaching on what remains of the viable elephant habitat. Logging camps have turned once dense vibrant forests into large open spaces of bare dry ground (image 16). This man made habitat also contains many built forms and foreign objects that have been located along Pygmy elephant migration paths. Elephants can accidentally enter the spacious environment, curious and hungry. The animals do not see the poisonous

containers as harmful threats; rather they are seen as objects that could possibly contain food. In 2008, near Kampung Sukau in Kinabatangan, Sabah, two elephants were found trapped in a muddy pool of water in a logging camp and were not rescued until a day and a half later.²⁶ The animals are not able to differentiate between these contaminated muddy pools in logging camps and natural swamp pools. Thus, logging camps become dangerous playgrounds for Pygmy elephants to occupy.

Though very common, logging camps, have not encroached on animal environments as much as palm oil plantations, which are the major causes of rapid habitat loss. The impact on natural habitat is so great that Pygmy elephants spend a good portion of their migration path in palm oil plantations because those have replaced enormous areas of the original lowland rainforest. Pygmy elephants pass

²⁶ WWF. *Green Heart*. Brochure. Sabah, Malaysia: Author. *Save Our Gentle Giants in Borneo*. Mar. 2013. WWF-Malaysia. 08 Jan. 2014 <wwf.org.my>.



image 16 Logging camps are destroying pygmy elephant territory.

through this man-made habitat when migrating, but then stay to eat the palm trees. To deter elephants from consuming their crops, plantation owners leave poisonous fruit for them to eat. As a result, numerous Pygmy elephants, sometimes entire herds have been found dead in these areas.

These plantation complexes threaten the welfare of Pygmy elephants and act as a hindrance to their natural migration path. The animals are often seen as the problem, a threat to profits and human lives. With the constant built encroachment on animal territory, people and elephants are at higher risk of contact. The World Wildlife Fund's proposed solution to reduce this conflict is to build wildlife corridors to reconnect fragmented habitats to maintain separation between animal and human territory.²⁷

This thesis proposes that architecture can play a positive role in creating a safe human and elephant

relationship, if it is designed to not disturb the animal in their territory. The animals ideally would be left alone, however human development has already permanently disrupted and negatively impacted their environment. The design of a researcher outpost will provide a place for humans to occupy the elephant's territory and to be educated about the animal. In its siting and massing the architecture will serve the needs of researchers, veterinarians and visitors studying and caring for these animals, but not disrupt their natural habitat.

²⁷ Majail, Julia, ed. "Kinabatangan Corridor of Life." *CORRIDOR Newsletter* 1 (2009): n. pag. Print.

CASE STUDIES

The case studies analyze several built projects whose primary purpose is to provide different levels of interaction between man and animals. The Apenheul Primate Park is based on the idea of allowing zoo primates to roam free around the park, while visitors walk a designated path. The elk viewing stations deal more with humans being outside observers of the animal's migration process. The Sepilok Orangutan Rehabilitation Center balances the interaction between wild animals and human visitors for the purpose of education.

Apenheul Primate Park

The Apenheul Primate Park opened in the Netherlands in 1971. The park is well known for its strategy of housing “free-ranging” primate species in a built environment that is semi-natural. The man-made habitat is designed to allow the animals to decide how to interact with visitors. Ropes and rope ladders



image 17 (top) Apenheul Primate Park in Netherlands, where the animals decide whether to interact with humans or not.



image 18 (bottom) Dean Elk Viewing area. Architecture is sited out of the animal's path and allows humans to be contained while viewing the elk's in their natural habitat.

image 19 (top) Sepilok Orangutan Rehabilitation Center visitor viewing platform.



image 20 (bottom) Sepilok Orangutan Rehabilitation Center eating platform.



are placed over the visitor's designated path, so the animals can observe humans from a distance or up close without making physical contact (image 17). The founder of the park, Wim Mager, argues that this approach is beneficial to the animal's well being and health. He states that allowing the animals to roam free within the park also creates a less controlled and more stimulating experience for visitors.²⁸ To maintain and allow visitors to continue this direct interaction with "free-ranging" primates, much security and control is needed. More staff is needed to supervise the animals and humans of the rules within the park. Close attention and study of animal behavior is required in order to allow these groups of primates to roam freely within park boundaries.

The primates are divided up into what are called "social groups" according to species and gender. Throughout the day these different groups are

²⁸ Jens, W., C. A. X. Mager-Melicharek, and F. E. Rietkerk. "Free-ranging New World Primates in Zoos: Cebids at Apenheul." *International Zoo Yearbook* 46 (2012): 137. Wiley Online Library. Web. 23 Apr. 2014.

rotated between smaller confined areas and the larger "free-ranging" zone. The determination of which social groups are allowed to roam freely within the park boundaries has taken park facilitators much time and effort. This zoo has placed the animal's needs, before those of the visitors, understanding the primary role of the park as the primate's habitat rather than an entertainment activity for humans.

Dean Elk Viewing Area

The Dean Elk Viewing area in Oregon is a year round residence for a herd of 100 Roosevelt Elk. The protected lands for these animals stretch three miles along the Oregon Highway 38. The project demonstrates a balanced interaction between the natural and built environments. Along the highway are several "observation pull-outs", or outdoor interpretive centers.²⁹ (image 18) These viewing

29 Coos Bay District. *Dean Creek Elk Viewing Area*. N.p.: Coos Bay District, n.d. BLM. Bureau of Land Management, 2006. Web. 23 Apr. 2014. <<http://www.blm.gov/or/resources/recreation/files/brochures/Dean%20Creek%20Elk%20Viewing%20Area.pdf>>.

areas allow visitors to see and study these wild animals in their natural habitat. The simple architectural form that server as the observation area provides a simple shelter, all that is needed to observe wildlife. The architecture is positioned according to the movements of the natural realm and its inhabitants, rather than that of humans. Architecture as a result becomes a container for humans voluntarily entering to see the wild animal. These elk viewing stations allow humans to experience and observe elk in their natural habitat.

Sepilok Orangutan Rehabilitation Center

The Sepilok Orangutan Rehabilitation Center located in Sabah, Malaysia along the edge of Kabili Sepilok Forest Reserve also provides humans possibilities to see wild orangutans within their natural habitat.³⁰ The center viewing station is placed across from a

30 "Sepilok Orangutan Appeal UK." *Sepilok Rehabilitation Center-Sabah-Borneo-Orangutan Appeal UK*. Orangutan Appeal UK, n.d. Web. 11 Sept. 2014. <<http://www.orangutan-appeal.org.uk/about-us/sepilok-rehabilitation-centre>>.

feeding platform, where the wild orangutans come to eat (image 19 + 20). The structure of the buildings is a simple post and beam construction, but rather than enclosing the wild animals, it is the humans who are wrapped in a wooden and steel fence enclosure for protection. The viewing station provides several levels, which allows large groups to capture a clear glimpse of the wild animals. A boardwalk that leads up to the viewing station meanders through the forest reserve, which allows visitors to experience and be encased within the rainforest of Borneo. The architecture of this project, although simple, is effective in providing visitors an opportunity to learn about the wild animals in their natural habitat.



image 21 Sepilok Orangutan Rehabilitation Center, Orangutan eating platform.

CHAPTER 3: SITE ANALYSIS + DESIGN METHODOLOGIES

“By caging an animal, one deprives it of the possibility of making organized journeys.”

~ Gerald Durrell



image 22 (previous page) The researcher outpost site along the Kinabatangan River.

The architecture of zoos and sanctuaries typically confines wild animals within enclosures that take the form of geometrical shapes that are rigid and clearly man-made. Rather than protecting their habitat, humans have often seen fit to relocate the wild animal into built environments to preserve the species. However, animal behaviors are clearly negatively impacted by their removal from their natural habitat. This thesis proposes to make use of architecture to protect Borneo Pygmy elephants by designing a nature reserve in their own natural habitat.

Borneo Island

Located in the Indian Ocean, Borneo Island is the third largest island in the world, divided into three countries, to the south is Indonesia, north is Malaysia and northwest is Brunei (image 23). The island has a land area of over 740,000 square kilometers, 80 percent of which is covered in vegetation. This Southeast Asian Island contains one of the oldest

rainforest in the world, housing a diverse range of endangered species of wildlife and flora.³¹ Borneo Island has an equatorial climate, with minimal temperature and humidity differences throughout the year. There are only two distinguishable seasons in the northeastern region of Borneo, rainy and dry. The rainy season is between the months of October and February, with the rest of the year considered as the dry season.³² With an annual rainfall of 3,000mm (118 in), flooding has been constant over the years along the longest river in Borneo, the Kinabatangan River. However flooding has worsened with deforestation and plantation construction. The rapid increases in palm oil plantations have contributed to habitat loss for the Borneo Pygmy elephant.

31 Butler, Rhett A. "Why Is Palm Oil Replacing Tropical Rainforests?" *Mongabay. Tropical Conservation Science*, 25 Apr. 2006. Web. 23 May 2014. <http://news.mongabay.com/2006/0425-oil_palm.html>.

32 "WeatherSpark Beta." *Average Weather For Kota Kinabalu, Malaysia*. N.p., n.d. Web. 5 Feb. 2014. <<https://weatherspark.com/averages/34017/Kota-Kinabalu-Sabah-Malaysia>>.



image 23 Borneo Island is divided up into three countries. Indonesia is in the south, Malaysia is overlaid red and Brunei is in the northwest of the island.

image 24 Sabah Malaysia has four designated elephant habitats. This thesis focuses on the Lower Kinabatangan Habitat.



Pygmy elephants occupy the northeastern portion of Borneo Island called Sabah, Malaysia. Within that region there are four distinct elephant habitat sites identified by the Sabah Wildlife Department: Lower Kinabatangan (400km²), North Kinabatangan (1,400 km²), Tabin (1,200 km²), and Central Sabah (7,900 km²)³³ (image 24). This thesis will focus on the Lower Kinabatangan elephant habitat because it is the smallest habitat, most fragmented and adversely affected by agriculture. It is also the only habitat that is in close proximity to the Kinabatangan River that both man and animal depend on. Environmentalists estimate the Lower Kinabatangan habitat is too small and dispersed to sustain its current elephant population.³⁴ There are "limited dispersal options"

for elephants, meaning that elephants are trapped within human made barriers and have only limited areas of natural habitat that cannot sustain their dietary needs³⁵. These animals have inadvertently been placed in confinement. With the overgrowth of human activity, barriers have been erected that block and restrict elephants from their natural migration paths (figure 3). Forced to enter the surrounding agriculture territory to find food, elephants come into frequent conflict with humans along the Kinabatangan River.

Site Area

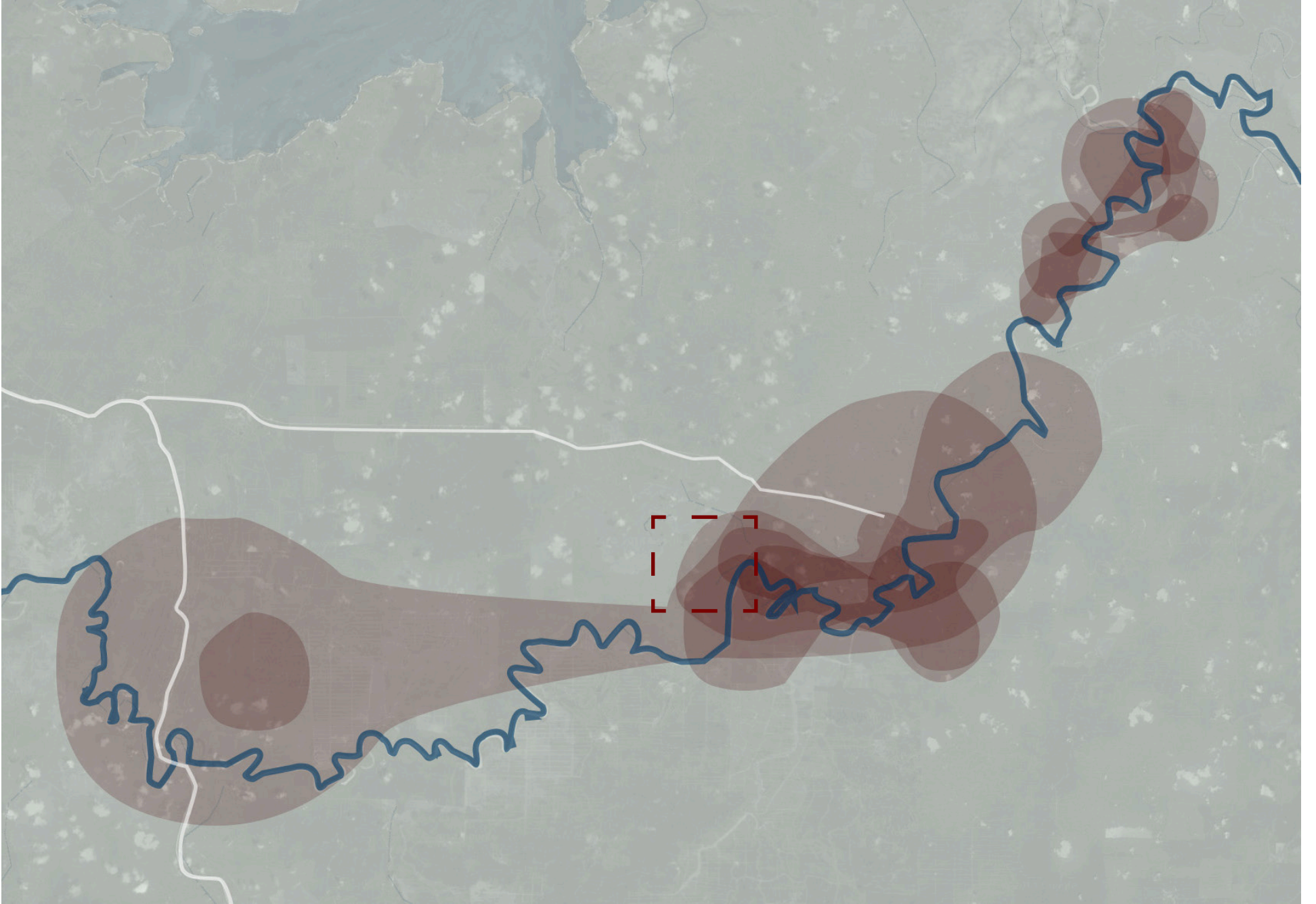
From the series of elephant migration maps (figure 3), the site area was located based on elephant

33 Estes, Jason G., Nurzhafarina Othman, Sulaiman Ismail, Marc Ancrenaz, Benoit Goossens, Laurentius N. Ambu, Anna B. Estes, and Peter A. Palmiotto. "Quantity and Configuration of Available Elephant Habitat and Related Conservation Concerns in the Lower Kinabatangan Floodplain of Sabah, Malaysia." Ed. Andrew Hector. PLoS ONE E44601 7.10 (2012): 1-10. No Records. Web. 28 Apr. 2014.

34 The current estimated Pygmy elephant population in Lower Kinabatangan habitat is 300 elephants. Alfred, Raymond, Abd H. Ahmad, Junaidi Payne, Christy Williams, Laurentius N. Ambu, Phua M. How, and Benoit Gossens.

"Home Range and Ranging Behaviour of Bornean Elephant (*Elephas Maximus Borneensis*) Females." PLoS One E311400 7.2 (2012): 1-12. Open Access. Web. 28 Apr. 2014.

35 Estes, Jason G., Nurzhafarina Othman, Sulaiman Ismail, Marc Ancrenaz, Benoit Goossens, Laurentius N. Ambu, Anna B. Estes, and Peter A. Palmiotto. "Quantity and Configuration of Available Elephant Habitat and Related Conservation Concerns in the Lower Kinabatangan Floodplain of Sabah, Malaysia." Ed. Andrew Hector. PLoS ONE E44601 7.10 (2012): 1-10. No Records. Web. 28 Apr. 2014.



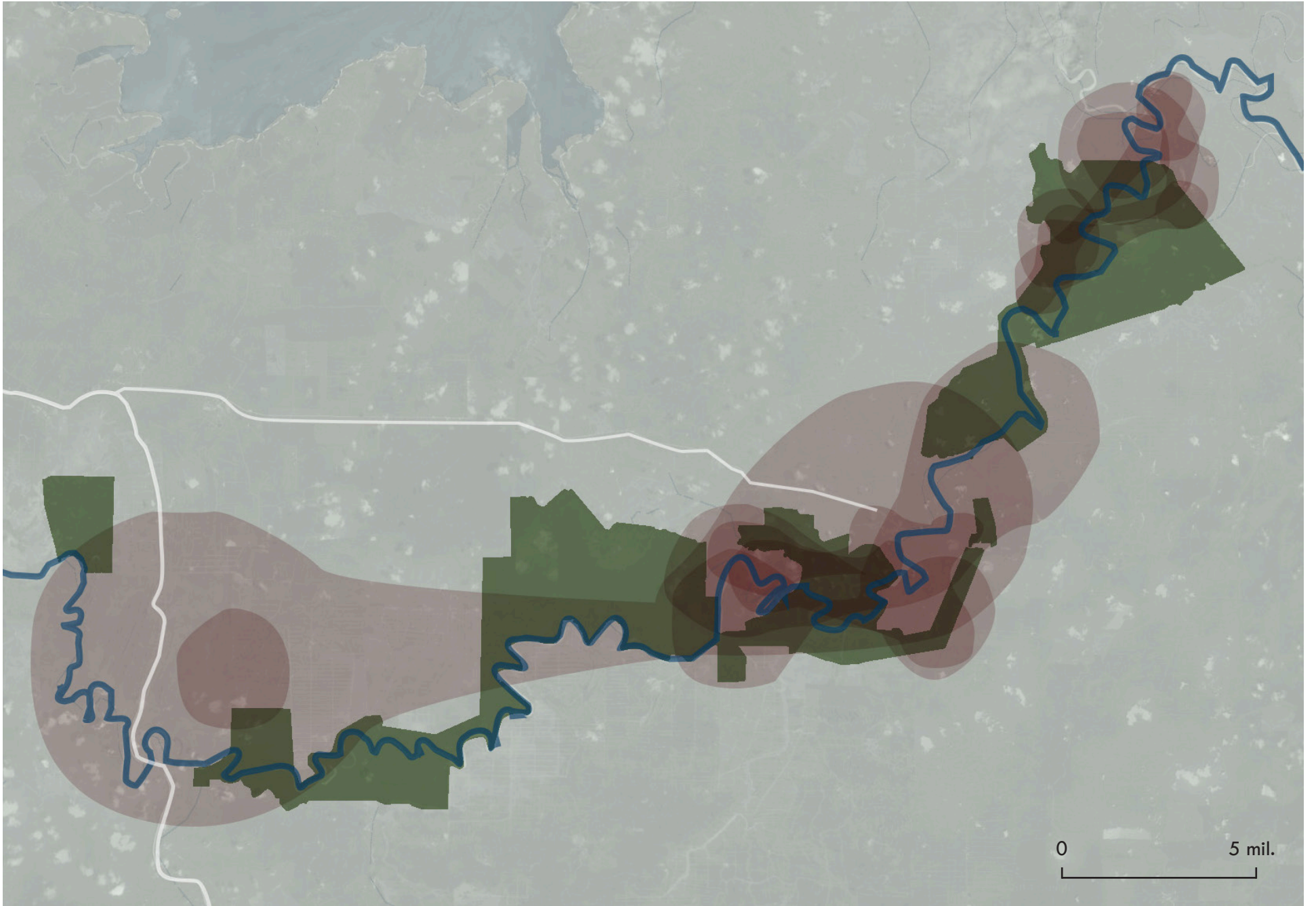


figure 3 (previous page left) The spaces that the Pygmy elephants occupy per month in the Lower Kinabatangan habitat. From the series of migration maps the thesis site area was located based on elephant occupied land occurrence during the year and accessibility.

figure 4 (previous page right) The spaces that the pygmy elephants occupy per month in the Lower Kinabatangan habitat and the land actually “protected” by the Lower Kinabatangan Wildlife Sanctuary. Everything outside of the green is human territory that has taken over once animal territory.

occupied land occurrence during the year and accessibility. The site area of the project is located along the Kinabatangan River. The river is 560 kilometers long, covering 23 percent of the total land area of Sabah, Malaysia.³⁶ The Sabah government has declared the habitat areas along the river to be a sanctuary for wildlife (figure 4). However, only about half of Lower Kinabatangan Wildlife Sanctuary (LKWS) has been officially designated as a protected forest.³⁷ Although the government claims that the Pygmy elephants are on protected land, the reality is, that human territory can continue to encroach on the land designated for the sanctuary without any repercussions or penalties.

36 Indran, Datuk R. “Malaysia: Managing the Kinabatangan Floodplains in Sabah (#256).” *GWP: Tool Box*. Global Water Partnership, 2012. Web. 23 May 2014. <<http://www.gwp.org/en/ToolBox/CASE-STUDIES/Asia/Malaysia-Managing-the-Kinabatangan-floodplains-in-Sabah-256/>>.

37 Out of the 218 kilometers squared for LKWS only about 89 kilometers squared is considered a protect forest. Estes, Jason G., Nurzhafarina Othman, Sulaiman Ismail, Marc Ancrenaz, Benoit Goossens, Laurentius N. Ambu, Anna B. Estes, and Peter A. Palmiotto. “Quantity and Configuration of Available Elephant Habitat and Related Conservation Concerns in the Lower Kinabatangan Floodplain of Sabah, Malaysia.” Ed. Andrew Hector. *PLoS ONE* E44601 7.10 (2012): 1-10. No Records. Web. 28 Apr. 2014.

The site area contains a major road to Bilit village and is in close proximity to palm oil plantations. The project location contains the three major natural habitat types occupied by Pygmy elephants, lowland rainforest, swampland and riverbank as well as the man-made habitat of palm oil plantations. Satellite tracking research performed by World Wildlife Fund, shows the area around Bilit is occupied by Pygmy elephants throughout most of the year (figure 3).³⁸ Therefore, the area provides opportunities to see the animals in the wild, without disturbing them, and to keep an eye on their physical health and safety in their natural habitat.

Users

The river is a life source to the villages and is a huge asset to the traditional occupations of farming and

38 Estes, Jason G., Nurzhafarina Othman, Sulaiman Ismail, Marc Ancrenaz, Benoit Goossens, Laurentius N. Ambu, Anna B. Estes, and Peter A. Palmiotto. “Quantity and Configuration of Available Elephant Habitat and Related Conservation Concerns in the Lower Kinabatangan Floodplain of Sabah, Malaysia.” Ed. Andrew Hector. *PLoS ONE* E44601 7.10 (2012): 1-10. No Records. Web. 28 Apr. 2014.



image 25 Plantations defying the government regulations by planting along the riverbank.

fishing. The Orang Sungei people have always been considerate of the Pygmy elephants and have lived in peace with them.³⁹ However, with the current increase of palm oil plantations, the villages are gradually losing their land and their traditional way of survival. Between the constant intrusion of elephants into their crops and palm oil plantations polluting the river, these people have gradually lost their economic income. As a solution, the Orang Sungei has tapped into a new source of income, tourism. Villagers are serving as tour guides for foreign visitors wanting to explore the Borneo rainforest. With visitors interested in sleeping in the wilderness, local villages like Bilit have built cabins for overnight stays (image 28). Ironically tourism is possible due to the road systems that were originally constructed for logging camps and plantation developments.

The man-made farms of palm oil plantations are the main cause of the fragmentation of the Lower

³⁹ "Orang Sungai." *New Sabah Times* 2012, Culture sec.: 9. Print.

Kinabatangan habitat. Although some areas along the Kinabatangan River are considered protected, plantation owners have openly defied local regulations, by planting along the riverbank.⁴⁰ (image 25) These protected zones, were intended to act as forest corridors, for tree growth and reduced water pollution run off, or wildlife corridors for animal migration. With the lack of boundaries plantations have the potential to contaminate the surrounding wilderness with the pesticides and herbicides used on palm trees. With no wildlife corridors the habitat is fragmented even further forcing elephants to migrate through plantations. While some plantation owners have openly defied the regulations, others are actually trying to be more sustainable and educated about the needs of the wildlife.⁴¹ The Malaysian Palm

⁴⁰ "Palm Oil Industry Threatens to Pollute Kinabatangan River." *Rainforest and Wildlife Conservation in Action with the World Land Trust*. World Land Trust, 22 Oct. 2013. Web. 29 Apr. 2014. <<http://www.worldlandtrust.org/news/2013/10/palm-oil-industry-threatens-pollute-kinabatangan-river>>.

⁴¹ MTN, Dzaenis. "Borneo Elephant Sanctuary Launch at Kinabatangan, Sabah - Malaysia Travel News." *Malaysia Travel News RSS*. N.p., 22 Sept. 2013. Web. 23 Apr. 2014. <<http://malaysiatravelnews.com/borneo-elephant-sanctu->

Palm oil plantations
poison the elephants
to protect their crops.

logging: clearing of
the pygmy
elephant's natural
habitat

hunters set snare
traps for boars,
which elephants get
caught in & the trap
can become
embedded in
elephant's skin

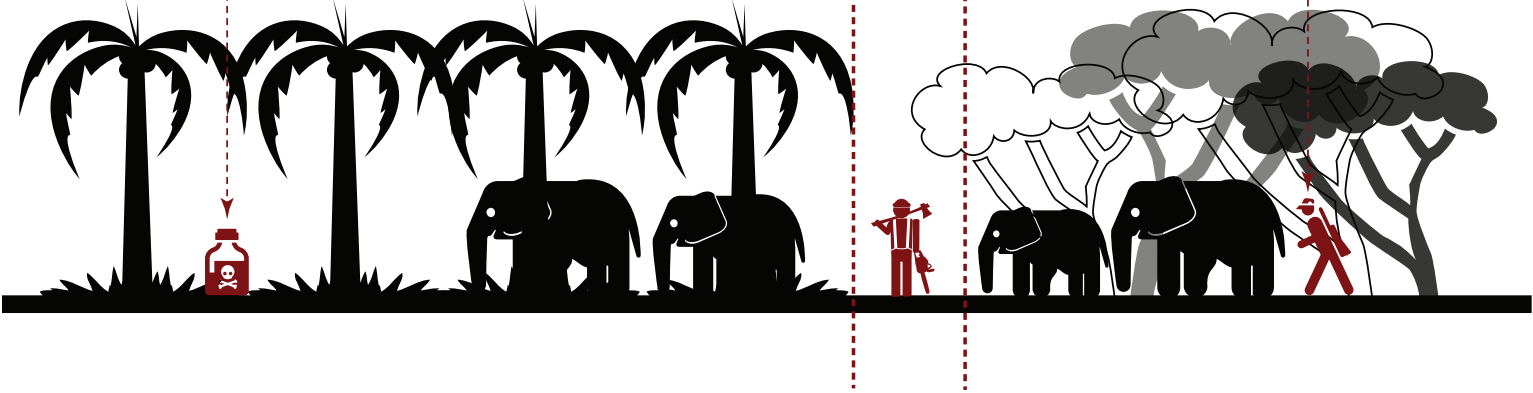


image 26 The results of humans entering into animal territory.

Oil Council (MPOC) is a main sponsor and contributor to the Borneo elephant sanctuary established in the far west section of LKWS. The organization aims to “create a more harmonious environment whereby precious wildlife co-exists along with plantation landscapes”.⁴² Because palm oil plantations do not need vast amounts of land to be profitable there is no need to continually expand the plantation and destroy animal territory for profit⁴³. The human encroachment that causes the loss of natural habitat is what is driving the animals to extinction. In order to save these animals and their habitat from disappearing, humans must study them in the wild within their own territory. Therefore, research to gain knowledge and education is the key to saving these animals.

ary-launch-at-kinabatangan-sabah/>.

42 MTN, Dzaenis. “Borneo Elephant Sanctuary Launch at Kinabatangan, Sabah - Malaysia Travel News.” *Malaysia Travel News RSS*. N.p., 22 Sept. 2013. Web. 23 Apr. 2014. <<http://malaysiatravelnews.com/borneo-elephant-sanctuary-launch-at-kinabatangan-sabah/>>.

43 Basiron, Yusof. “Palm Oil Production through Sustainable Plantations.” *European Journal of Lipid Science and Technology* 109.4 (2007): 289-95. *Palm Oil Production through Sustainable Plantations*. European Journal of Lipid Science and Technology, 12 Apr. 2007. Web. 07 Dec. 2014. <<http://onlinelibrary.wiley.com/doi/10.1002/ejlt.200600223/abstract;jsessionid=43967DB93668C541881B5E84242940DF.f02t03>>.



image 27 Pygmy elephants on a logging camp road.

image 28 (next page) Bilit Rainforest Lodge, vernacular architecture.

CHAPTER 4: DESIGN APPROACH

“We live in a world we did not create and cannot control.”

~ Timothy C Weiskel





BILIT VILLAGE

elephant locations
researcher outpost
outlooks



BILIT VILLAGE

● researcher/visitor outpost
● outlooks

image 29 (previous page left) The site area of the project consists of four permanent sites located along the Kinabatangan River.

image 30 (previous page right) Kinabatangan River catchment can be in three to four feet deep water.

The site research indicates that Borneo Island was once entirely covered by a rare natural rainforest. However, today the devastation is beyond control and many animals endemic to the island are under threat of extinction because of the rapid clearing of the rainforest. This thesis project focuses on changing the way the built environment is designed for animals in animal territory. To do this, we as humans must change the way we interact and approach wildlife territory. Currently, the built environments and human territory have become barriers that animals must overcome, especially migratory animals. Animals are becoming more endangered because of the human encroachment on their land.

The once popular solution of the zoo was a way to combat animal extinction. However, in reality, an animal is changed when translocated to a zoo and is no longer considered the same animal as if it were in the wild.⁴⁴ Therefore, research of the animals in its

44 Baratay, Eric, and Elisabeth Hardouin-Fugier. "The Illusion of Liberty." *Zoo: A History of Zoological Gardens in the West*. London: Reaktion, 2002. 262-63. Print.

natural state and in their own territory is needed for their long-term survival.

This thesis project consists of design interventions on four permanent sites located along the Kinabatangan River (image 29). This allows for consistency and established areas where humans can occupy. The largest site is a researcher outpost where visitors can visit. This was placed away from the elephants and their migration path, because it is a significantly larger building than the other three. The other three sites consist of an individual outlook located within the elephant's territory. Transportation between each site will be done on the river by boat.

Program (figure 7)

Any built space designed with the idea of interacting with animals will always be an artificial environment for the animal. In a zoo the primary focus of the architectural design is to provide the human visitor with the best possible view of the animal. The architectural interventions within this thesis project

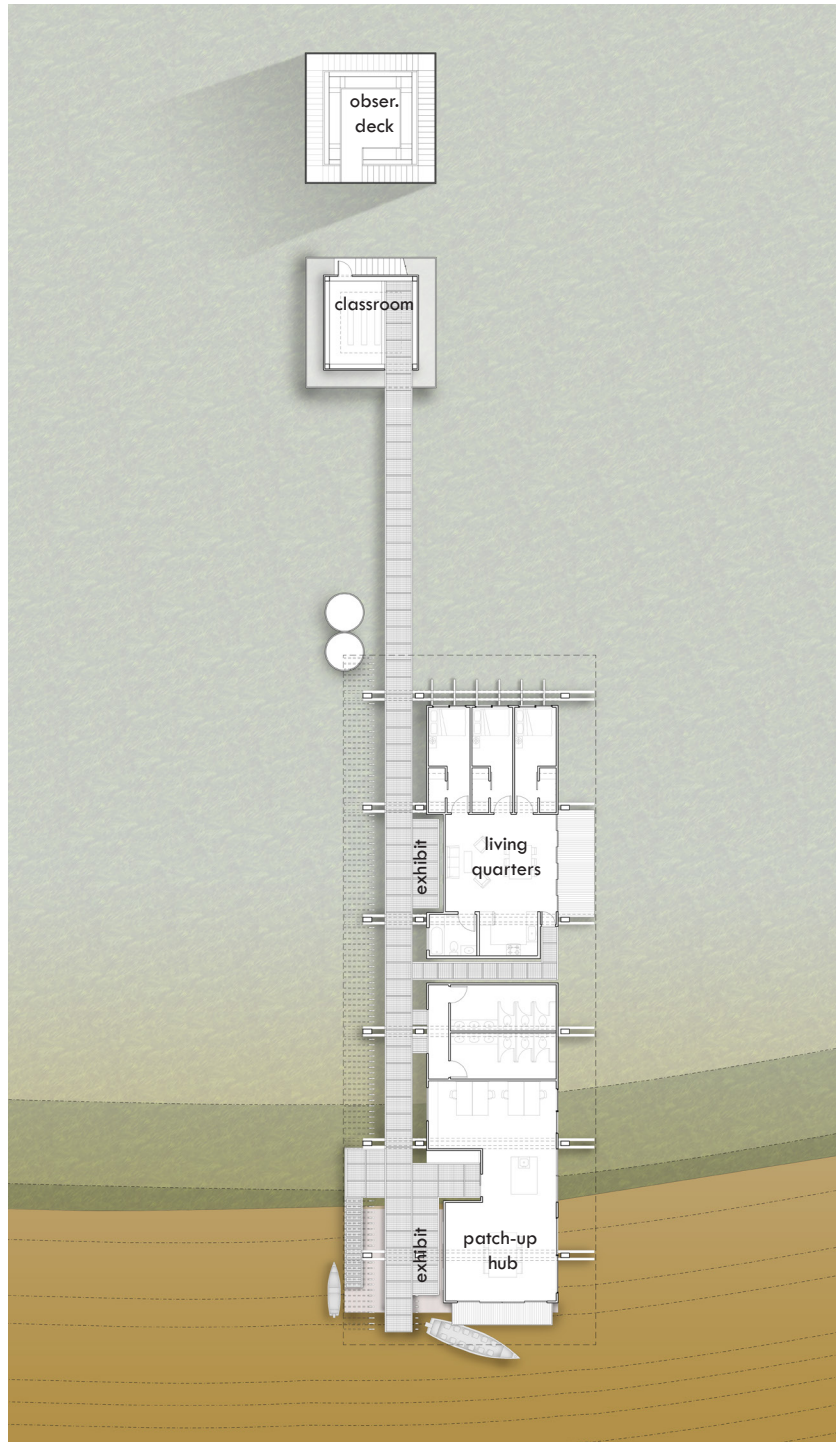
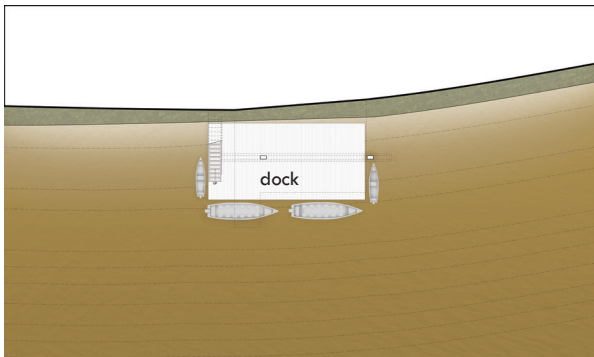


figure 5 (right) Researcher outpost plan level 1.

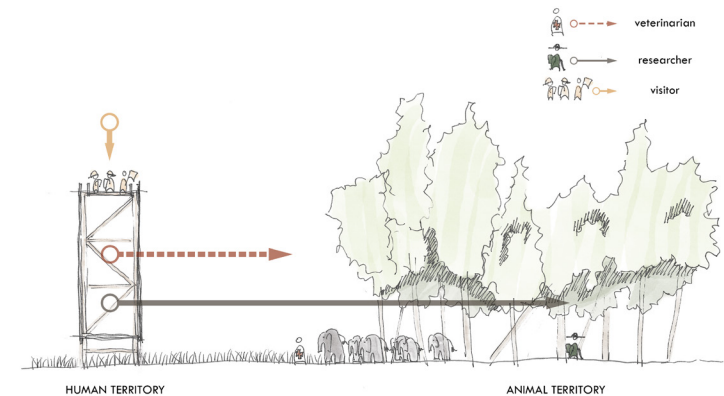
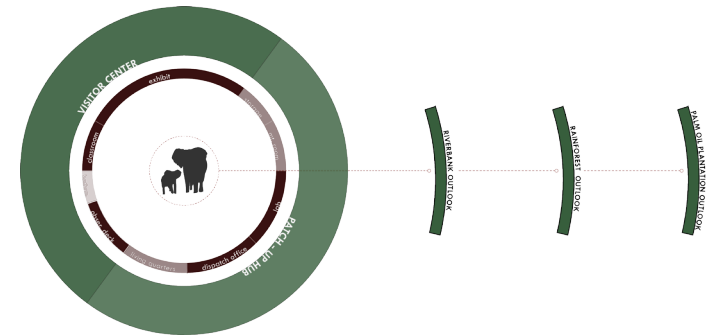
figure 6 (left) Dock level.

figure 7 (top) Program. The researcher outpost consists of a patch-up hub with living quarters for three researchers that can be at the outpost for six to twelve months, a research lab and dispatch office for two veterinarians that help the elephants in an emergency. Also a visitor center element with an exhibit, classroom and observation deck/outlooks.

figure 8 (bottom) Three users diagram. The researcher, veterinarian and the visitor. The visitor is a guest to the researcher, while the researcher is a guest to the animals in their territory.

aims to provide a congruent environment where wildlife and humans can interact safely. The intention for these sites is to create a space to contain the visitors within the animal's territory. The building will not only control the human's interaction with the elephant, but also educate and focus their attention on certain elements within the landscape, thus educating them about the land and the inhabitants.

The researcher outpost consists of a patch-up hub that has living quarters for three researchers. These researchers are either World Wildlife Fund workers or scientists who are interested in studying Borneo rainforest. The patch-up hub also consists of a lab for the researchers where they can leave all of their work supplies and research. The lab space is shared with the dispatch-office, which houses two veterinarians who track the elephants and will respond on site if an elephant is in danger or needs emergency surgery. The last component of the outpost is the visitor center element, which includes an exhibit, classroom and observation deck.



The project also contains, three outlooks that are placed within the animal's habitat. These structures are placed at the riverbank, in the rainforest and in the palm oil plantation. The outlooks on the riverbank and in the rainforest will provide the visitors a view of the elephants within their natural habitat. The last outlook is placed on the distinct line where the rainforest and palm oil plantation meet. The view from building allows the visitor to see firsthand the devastating impact humans are having on animal territory.

USERS' EXPERIENCE

A Visitor's Experience

The researcher outpost accommodates three types of users, the researcher, the veterinarian and the visitor (figure 8). If the visitor is considered as a guest of the researcher, then both the visitor and the researcher are guests of the animals in their home. Of all the three users, the visitor must be the most contained and guided through the animal's territory. After exiting the boat the guests take the entry stairs up and are immediately contained by a wooden ribbed structure of the outpost (image 31). This structure is intended to remove the occupant from the surrounding landscape, so they can focus more on gaining knowledge from the exhibit and from the researchers. Before entering the patch-up hub, the visitor will take off their shoes and receive sandals, a Malaysian custom, then are guided through the lab and dispatch office (image 32). Then they proceed down the veranda on a steel grate path that is

image 31 (far right) Entry way into patch-up hub. Visitors will take off their shoes and given sandals to explore the building within animal territory.

lined with an exhibit describing and explaining the devastations of the land and the resulting impact on the elephants (image 34). At the end of the exhibit, the wooden structure ends and the guest is greeted with a five-foot wide bridge with no handrails. The experience of crossing the bridge is meant to feel extremely exposed and a bit uncomfortable. However, it is also a moment where one can reflect and appreciate the animal territory they currently occupy (image 37). Before the end of the path a corten steel tower encroaches onto the path, cutting the visitor off from the outside landscape. The corten steel tower is intended to represent the unnatural presence of palm oil plantations encroaching on animal territory. The spaces inside the tower, is a tall and slender. This vertical hollowness is to express the millions of Borneo Ironwood trees cut down in the rainforest for plantations (image 40). On the first level of the box is the classroom, where visitors will learn by video or through a lecture by a researcher

about the animal territory and its inhabitants. From the classroom, the path continues up and around the exterior of the corten steel tower, but the visitor still remains enclosed by a perforated metal skin that wraps the tower. This allows them to once again reflect upon the knowledge they have gained without the distractions of the view. Once on the observation deck, the space opens up and the visitor can fully appreciate the privilege of seeing the full extend of the rainforest and animals that are currently under threat of extinction (image 39).

From the observation deck the group of tourist are again guided back down the tower toward the boat dock. On the way back to the boat they will again pass the exhibit, living quarters, and patch-up hub. At the patch-up hub they will collect their shoes and then continue down the stairs to the boat dock. The visitors will board a boat that takes them to the three outlook sites.

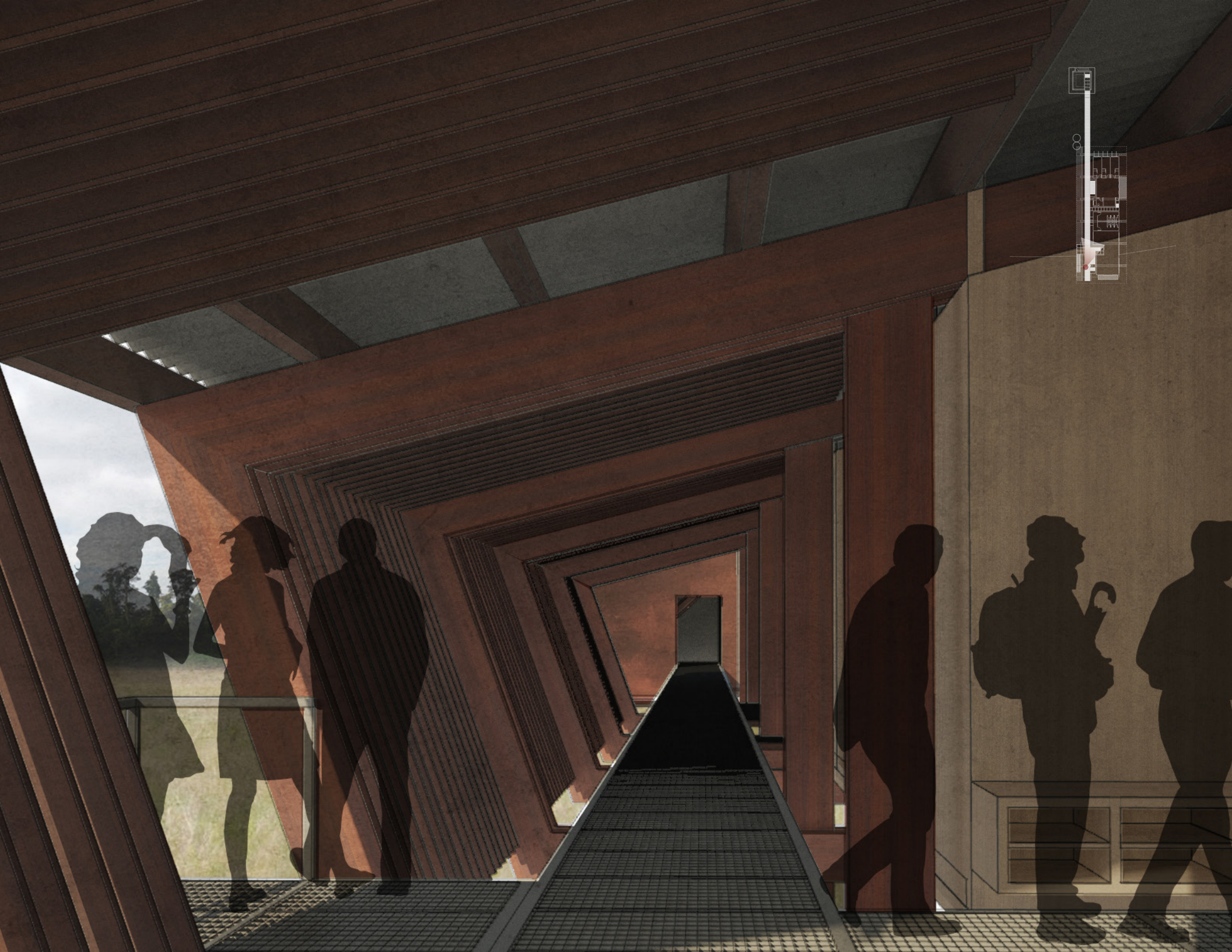


image 32 (top) Patch-up hub; lab and dispatch office.

image 33 (bottom) Section of lab and dispatch office, looking north.

image 34 (far right) Exhibit lining the steel grate path.

First they will arrive at the riverbank outlook (image 43 - 45). This structure is about eight feet off the ground in order to allow for views over the elephant grass. The second outlook is in the rainforest, where the structure is closer to the ground because of the density of the vegetation. Lastly, the third outlook is located at the edge of a palm oil plantation. The structure is forty feet off the ground in order to get above the palm oil trees that grow to about thirty feet tall. This last outlook is a crucial component in educating the visitors about the human encroachment on animal territory. The ability to see the ongoing devastation of the animal's habitat is ultimately what really educates the visitor and will linger in their memories long after they return to their own homes.

A Researcher's Experience

A researcher uses the outpost in a distinctly different way from the visitors. For these longer-term occupants the building is used as a temporary home and office space. Depending on their research these scientists can take residence in the building for a few months



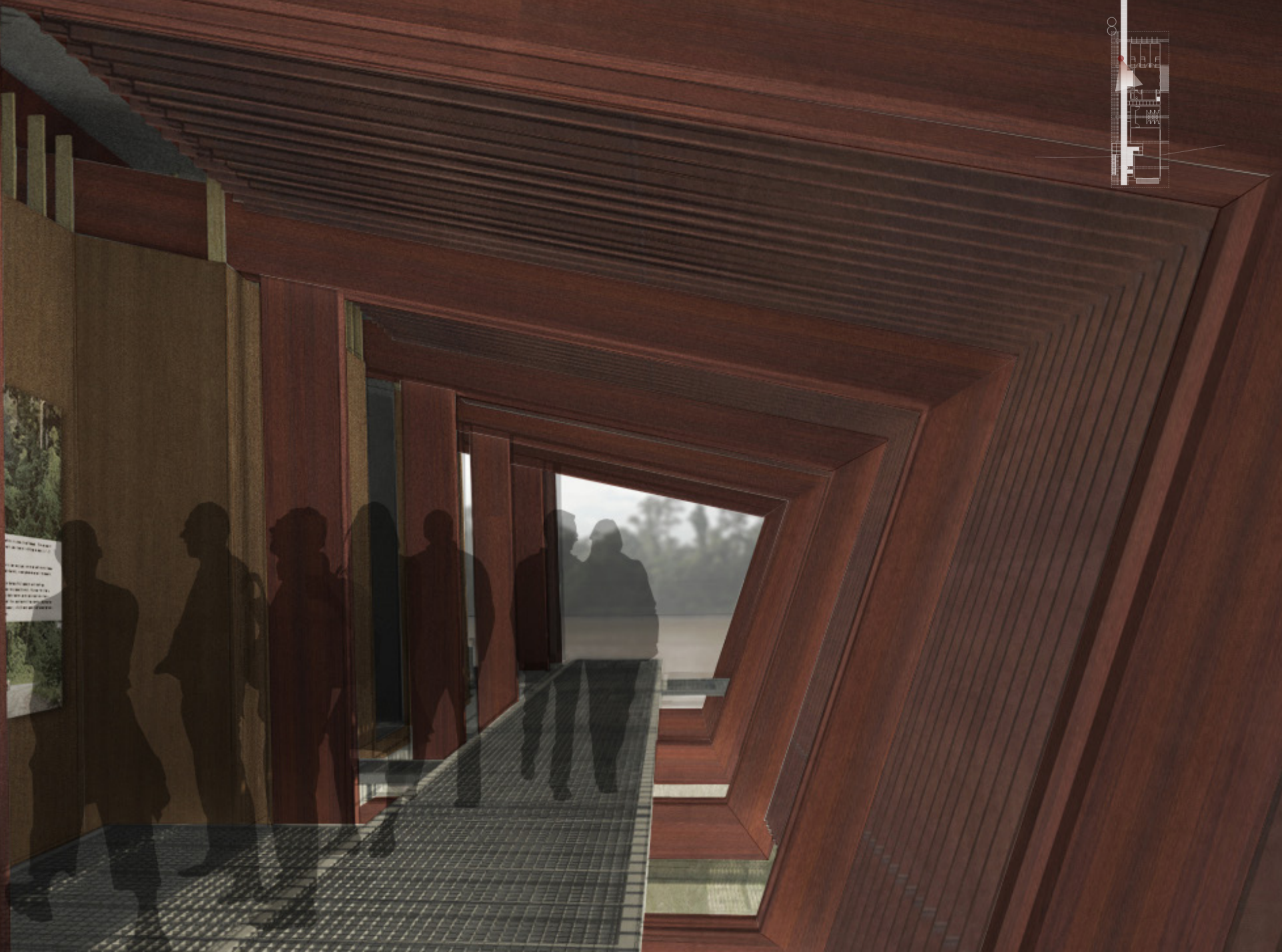
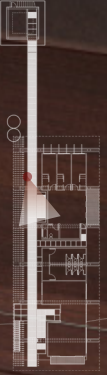


image 35 (top) Section of researcher living quarters looking north.

image 36 (bottom) Section of tower looking north.

image 37 (far right) The end of exhibit, with the path continuing on a five-foot wide bridge with no handrails.

to a couple of years. Unlike the visitor, the researcher spends most of their time within the rainforest, collecting samples or data. Therefore it is envisioned that almost everyday the researcher will wake up and take a boat to a research site and spend most of their day there, unless they are the one to guide the visitors through the outpost that day. As they return back to their temporary home, the visitors and veterinarians will have left for the day, leaving them alone in the outpost.

A Veterinarian Experience

Like the researchers, veterinarians are able to enter the rainforest without a designated path or need for containment. However, the veterinarian's enter the habitat to directly help an elephant in need of medical attention. The veterinarians use the outpost as an office space that they arrive to everyday. When not out in the field mending an elephant, the veterinarians are either helping the researchers with their projects, pursuing their own research or educating and helping guide visitors through the animal territory.



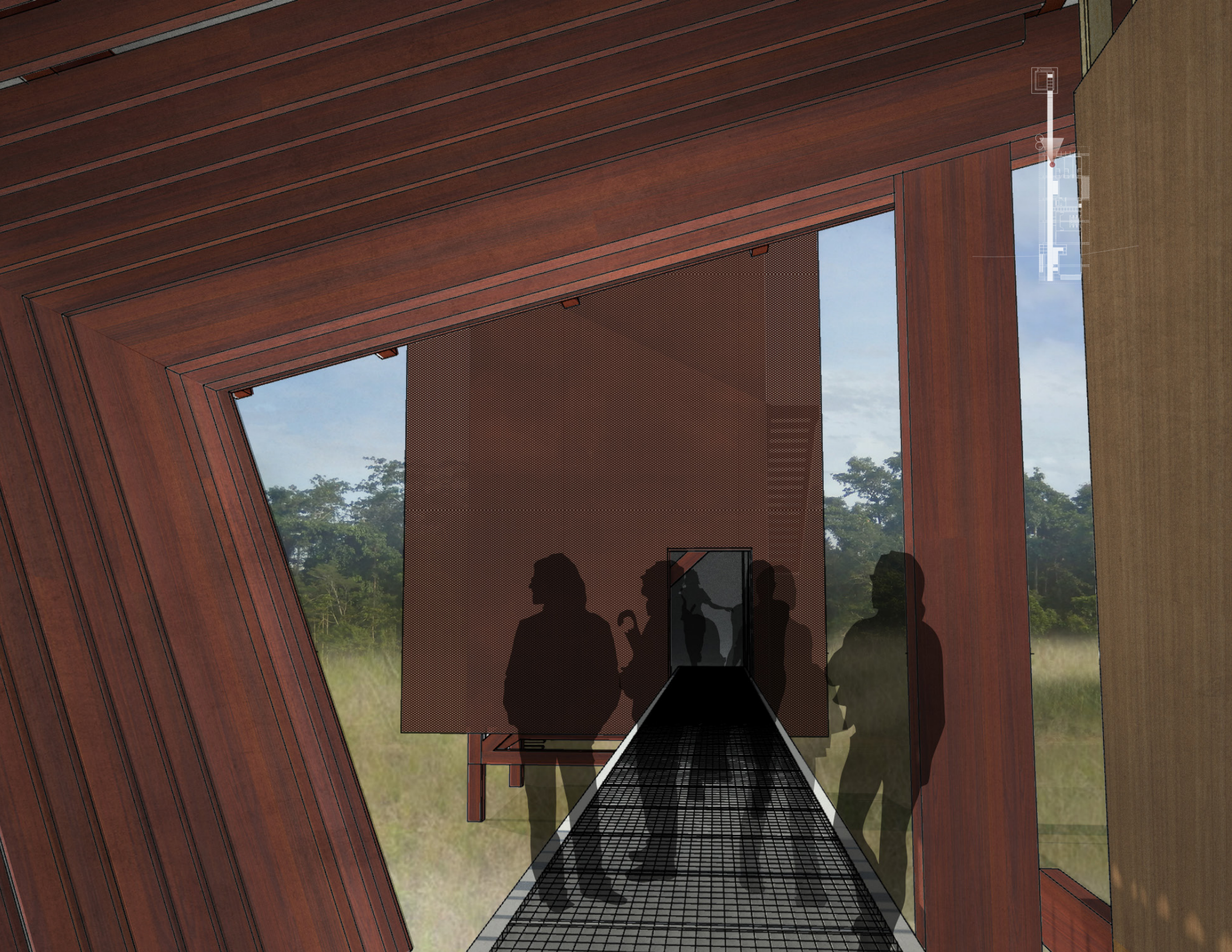


image 38 (right) Tower first level.

image 39 (bottom) Observation deck.

image 40 (far right) Tower looking up.

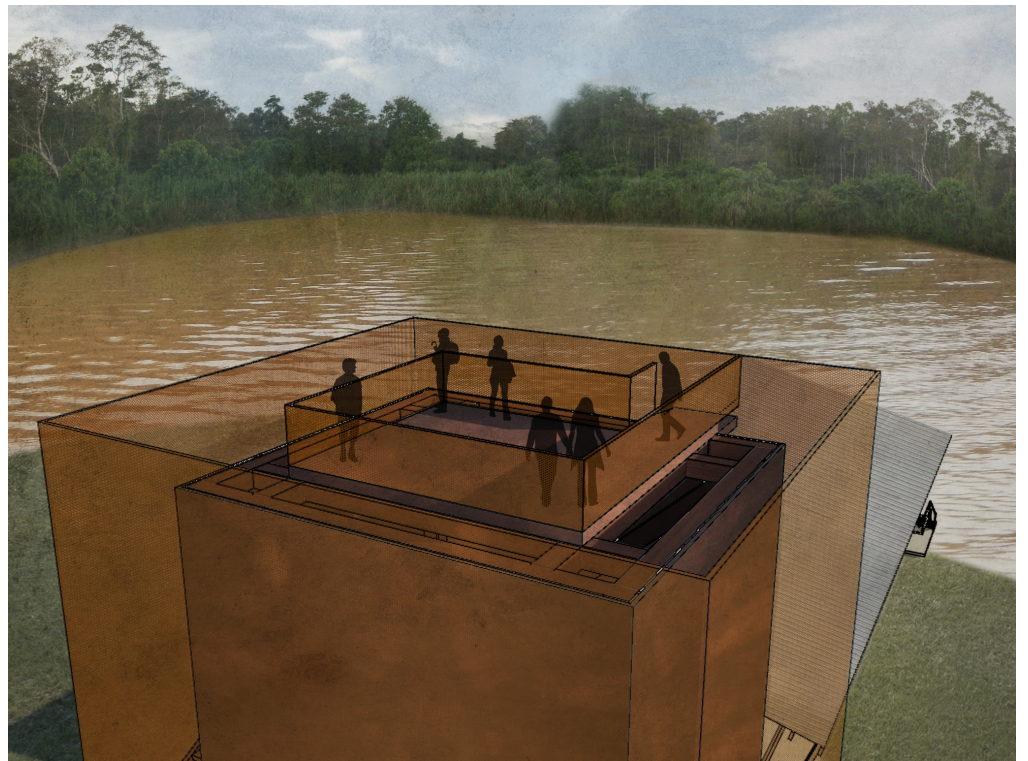




image 41 Researcher outpost west elevation.

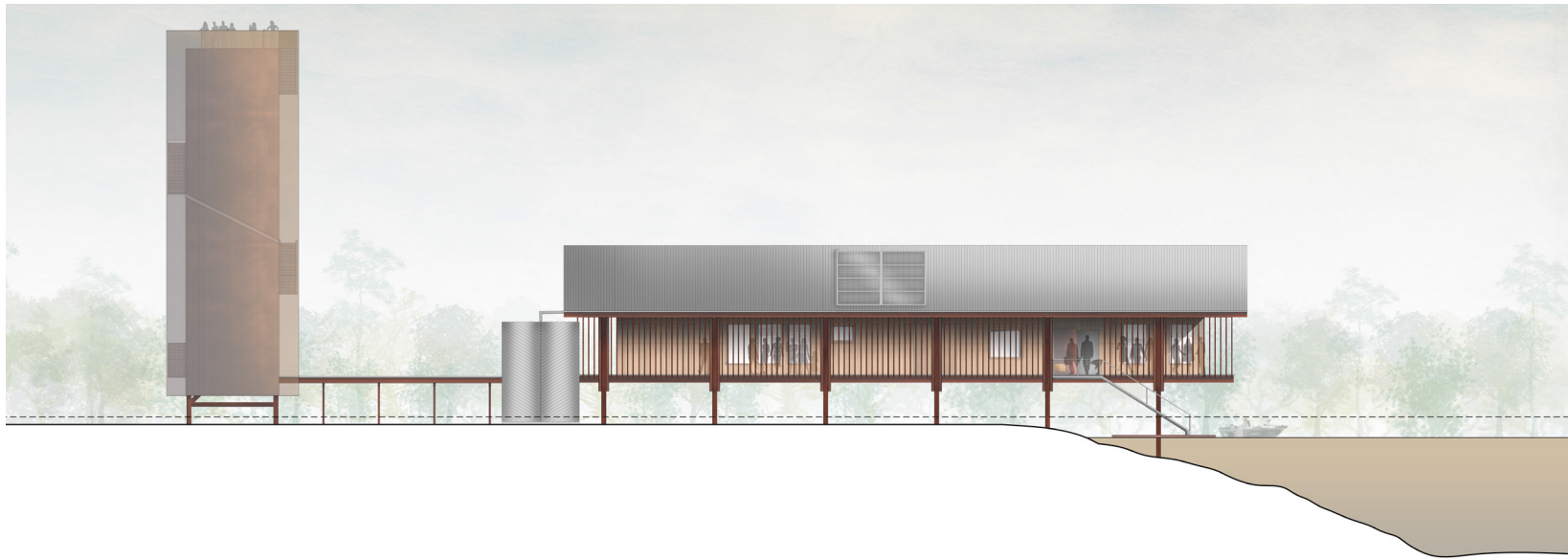




image 42 Researcher outpost
longitudinal section looking east.

image 43 (top right) Riverbank outlook plan.

image 44 (top left) Riverbank outlook section.

image 45 (bottom) Riverbank outlook perspective.



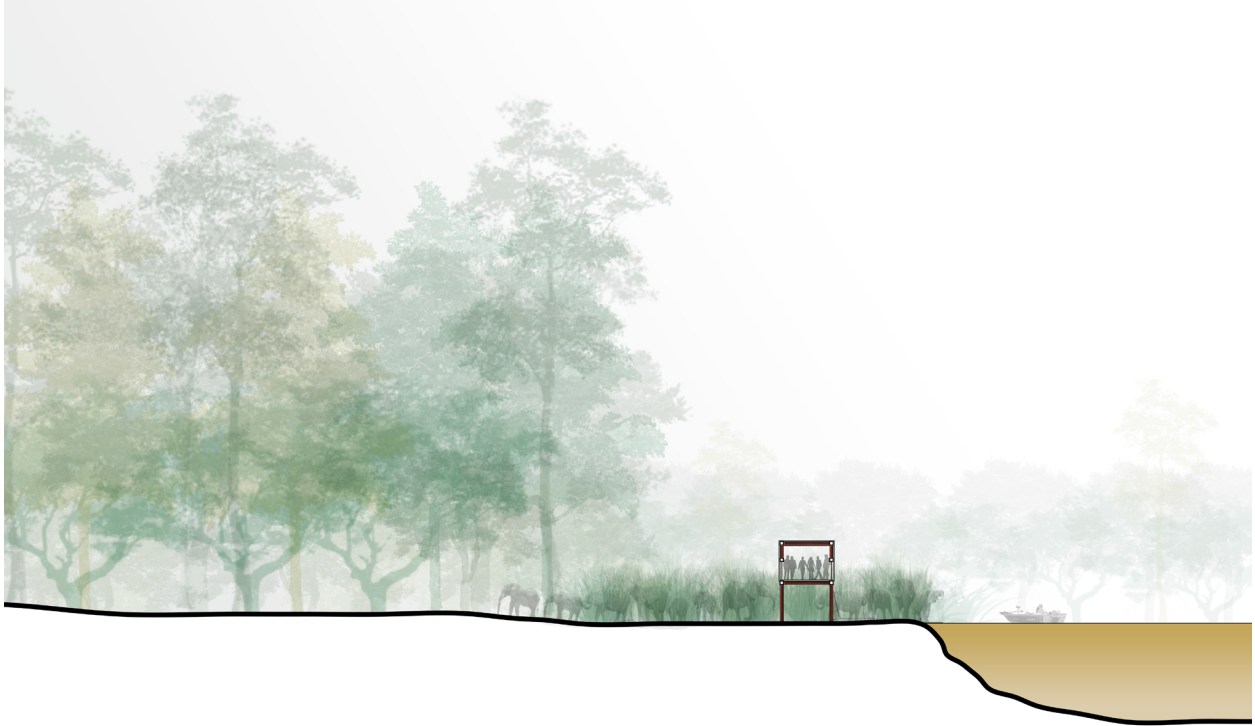


image 46 (top) Rainforest outlook plan.

image 47 (bottom) Rainforest outlook section.

image 48 (far right) Rainforest outlook perspective.

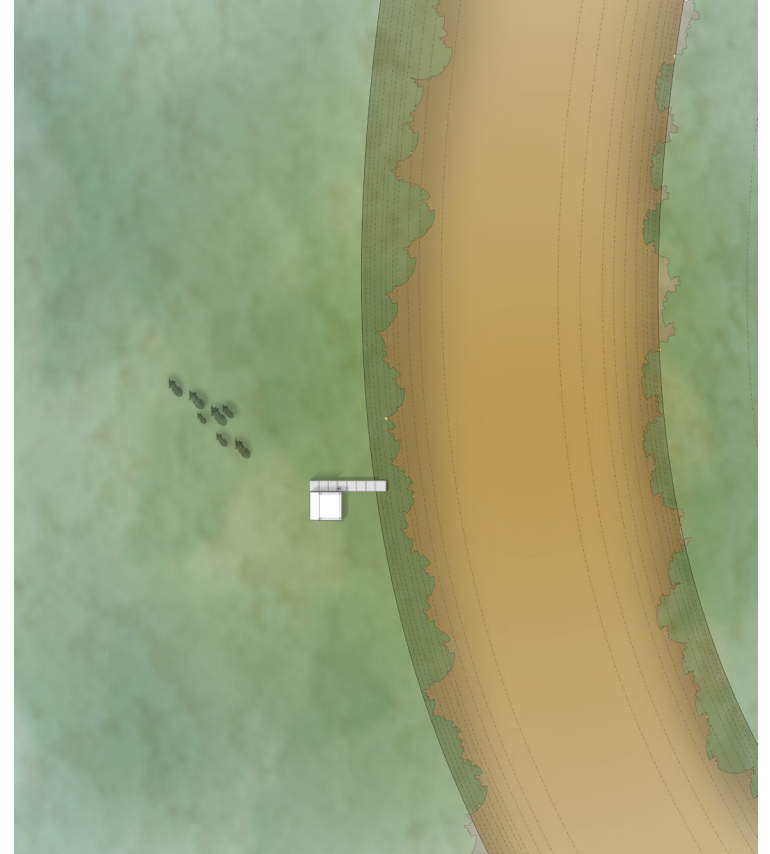
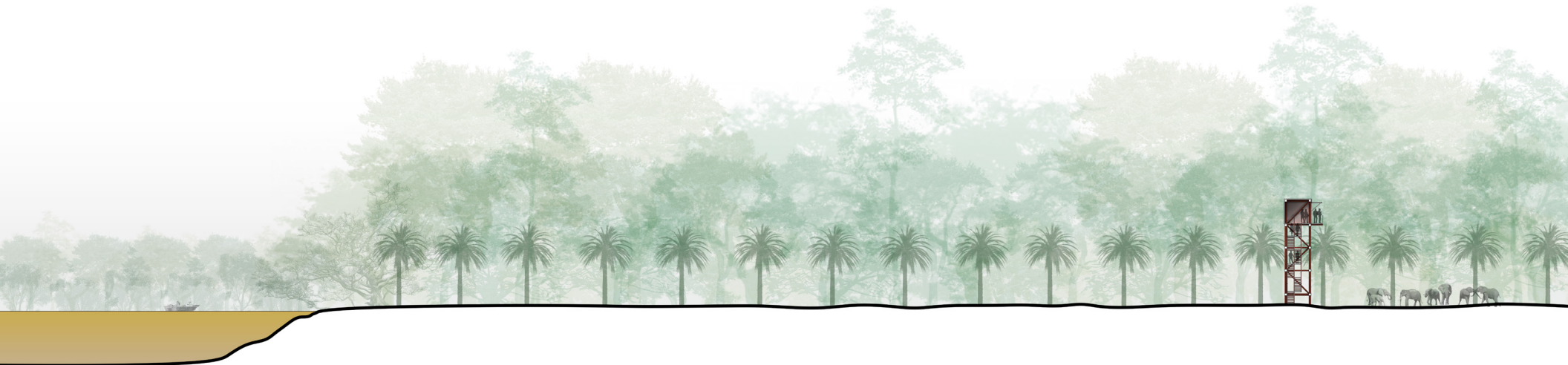




image 49 (top) Palm oil plantation outlook plan.

image 50 (bottom) Palm oil plantation outlook section.

image 51 (far right) Palm oil plantation outlook perspective. The outlook borders the rainforest and palm oil plantation. This placement allows the visitor to see firsthand the devastating impact humans are having on animal territory.





TECTONICS

The idea behind the tectonics of the building is to use already logged trees from the surrounding logging camps, therefore, reducing the amount of materials shipped to Borneo Island. All buildings touch the ground lightly by having structures raised on columns, which also helps with natural ventilation and reduced humidity. Since the building is located in an equatorial climate, traditional wall construction is not needed and the line between the interior and exterior can be blurred. The “interior spaces” such as the patch-up hub have large sliding doors that allow for lock up at night, but during the day can be fully opened to allow for natural ventilation.

The use of nontraditional vernacular construction materials within the tower allows the building to stand out and have a strong presence within this vast landscape. The tower is intended to look “unnatural” and out of place, which emphasizes

the distinction between the two territories of human and animal. The corten steel surfaces of the tower represents the area humans can occupy and roam within. Therefore, the three smaller outlooks carry the same tectonic and material language of the tower in the researcher outpost. The outlooks are to be distinguished within the landscape; so that both humans and animals understand the spaces that humans can occupy.

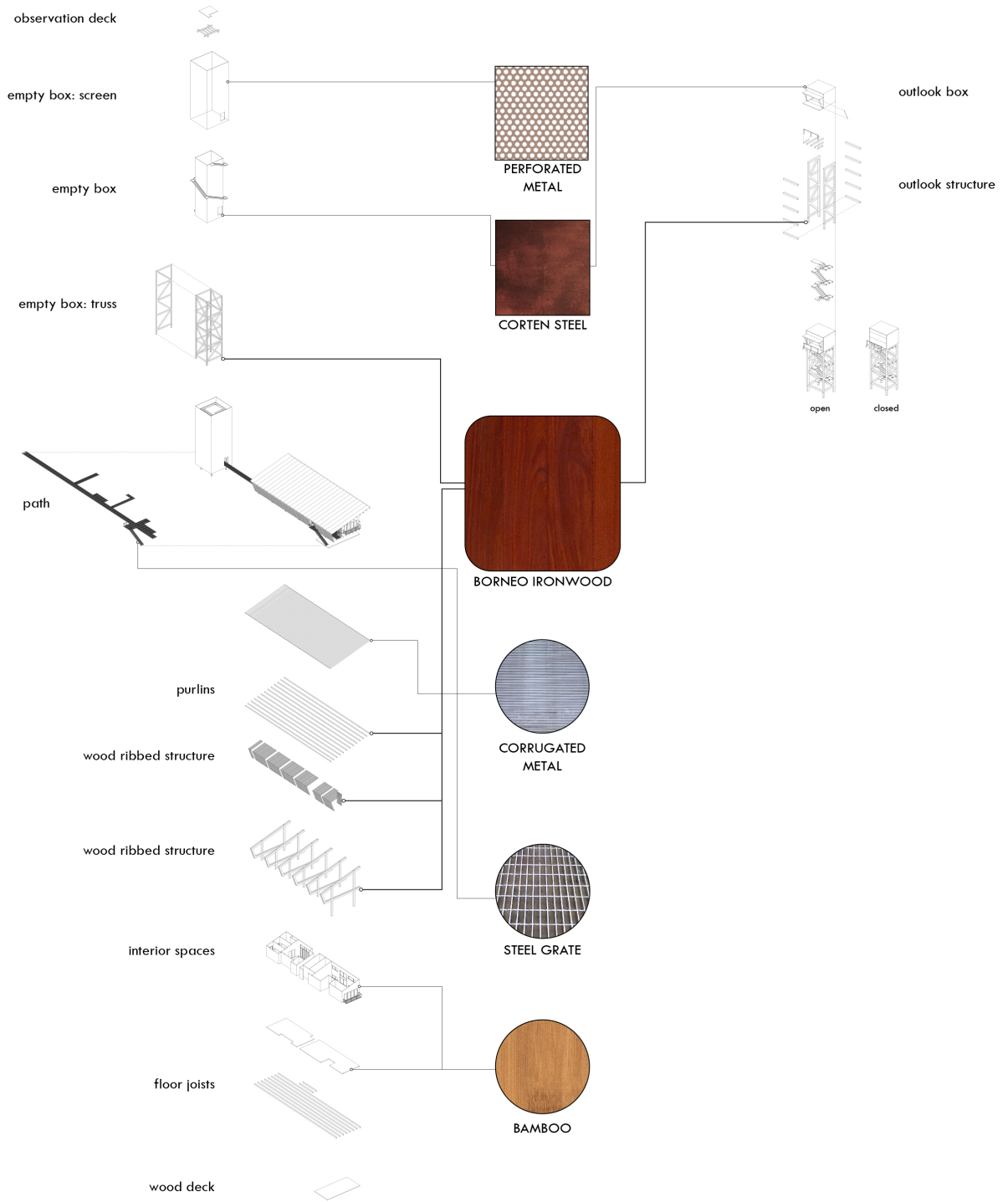


figure 9 Tectonic diagram. Palm oil plantation outlook (right). Researcher outpost (left).

CHAPTER 5: CONCLUSION

“Nature’s great masterpiece, an elephant; the only harmless great thing.”

~ John Donne



image 52 (previous page) Borneo
Pygmy elephant in elephant grass.

In this thesis, the focus was only on the endangered Pygmy elephants and the problems that they face. However, in order to save many species of endangered animals and their habitat from extinction practice of relocating them to a built environment for human enjoyment needs to stop. This can no longer be a solution to solve animal extinction because of the negative impact on the animal and the environment. The way humans view and study animals needs to change from the containment of animals in human territory to humans being contained and respectful to the animals and their territory.

The problem of habitat loss that the Pygmy elephants face is not an uncommon issue facing all endangered species. This thesis uses architecture to contain the humans within animal's territory, but also to direct human's attention away from their own needs but to the needs of the animal. The architecture frames views and creates an experience of the landscape that educates the visitor not only about the animal but also about its natural habitat.

Humans have continued to take over animal territory without considering the repercussions. However animal territory is not our land to take; now it needs to be protected. As Gandhi said, "the more hopeless a creature the more entitled it is to protection by man from the cruelty of man".⁴⁵

45 "Can the Greatness of a Nation." *PETA Can the Greatness of a Nation Comments*. PETA, n.d. Web. 01 Dec. 2014. <<http://www.peta.org/features/gandhi/>>.

APPENDIX A: LOWER KINABATANGAN WILDLIFE SANCTUARY TRIP

“You can judge a man’s true character by the way he treats his fellow animals.”

~ Paul McCartney



image 53 (previous page) Borneo Rainforest.

image 54 (top) City of Sandakan.

image 55 (bottom) Palm oil plantations line the road to the Bilit Rainforest Lodge.

The following images were taken on the author's trip to Borneo Island. These images are to give the reader a feeling and understanding of Sabah Malaysia and the environment the project is located in.

The author traveled to Borneo Island on September 2014 for four days and three nights. The first night was spent in the city of Sandakan, Sabah. The second day was spent traveling to the Borneo rainforest in the Lower Kinabatangan Habitat. Two nights were spent sleeping in the rainforest at the Bilit Rainforest Lodge. Several trips were taken along the river, which allowed the author to gain a vision for the thesis project and find the project sites.

There was also an hour walk in the rainforest to an ox-bow lake. This allowed the author to experience what it was like to be in the dense rainforest.

Lastly, many different wildlife was seen throughout the entire trip.





image 56 Palm oil plantations are continuously breaking the rules and planting right up to the riverbank, not leaving a wildlife corridor for all animals.

image 57 (left) Borneo Ironwood Tree, during a jungle trek.

image 58 (right) The rainforest.

image 59 (far right) The riverbank with elephant grass.





image 60 (left) Proboscis Monkey, also known as the "long lost monkey".

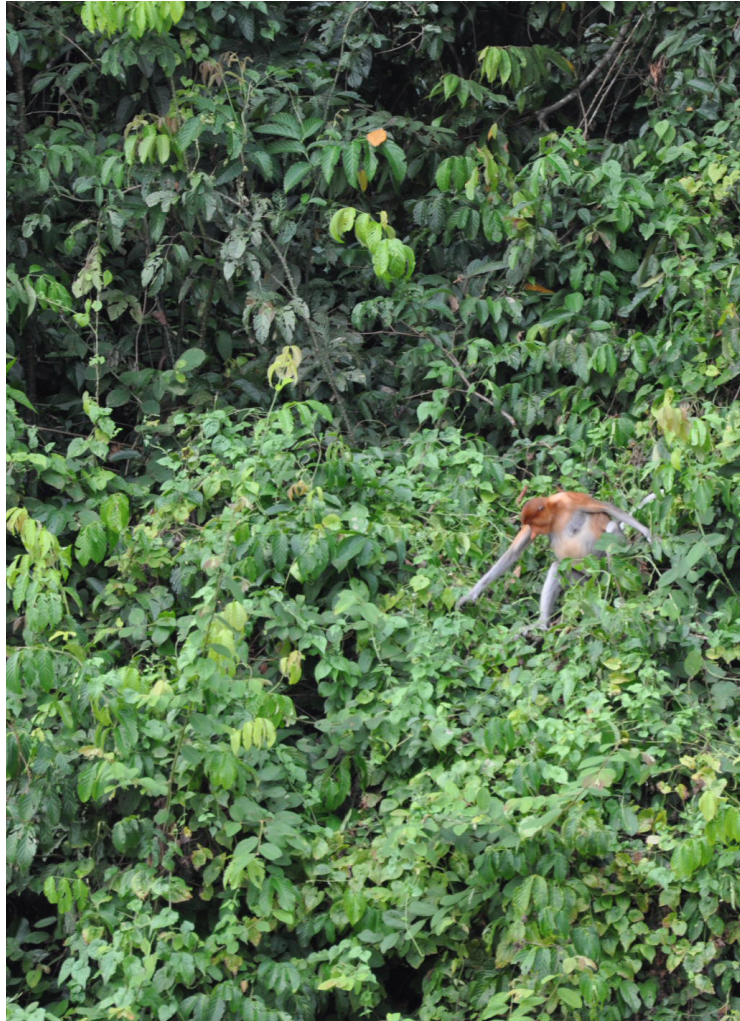


image 61 (right) Rhinoceros hornbill.

image 62 (far right) A view from the Kinabatangan River .





APPENDIX B: MODELS

“The elephant can survive only if forests survive.”

~ Mark Shand

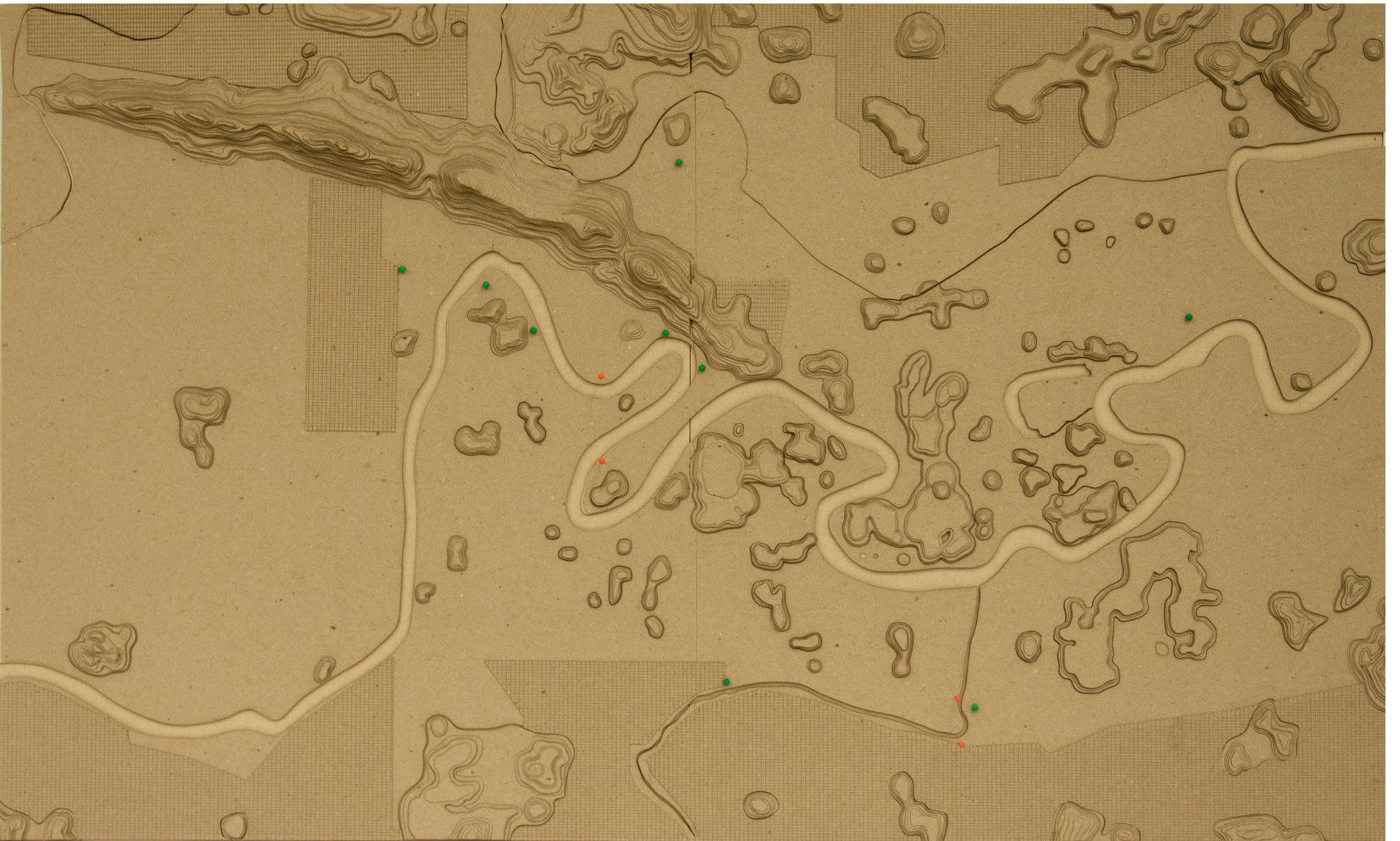


image 63 (previous page) Site area topography map.

image 64 (right) Section model of reseracher outpost.





image 65 (top) West elevation.

image 66 (bottom) East elevation.



REFERENCES

- "About American Sanctuary Association (ASA)." *American Sanctuary Association*. N.p., n.d. Web. 30 Apr. 2014. <http://www.asaanimalsanctuaries.org/about_ASA.htm>.
- Alfred, Raymond, Abd H. Ahmad, and Junaidi Payne. Rep. N.p.: n.p., n.d. Print.
- Ambu, L. N., Andua. P. M., Nathan, S., Tuuga, A., Jensen, S. M. Cox, R., Alfred, R., Payne, J. (2002). *Asian Elephant Action Plan Sabah (Malaysia)*. Sabah Wildlife Department
- Anderson, Anthony B., and Clinton N. Jenkins. *Applying Nature's Design: Corridors as a Strategy for Biodiversity Conservation*. New York: Columbia UP, 2006. Print.
- Basiron, Yusof. "Palm Oil Production through Sustainable Plantations." *European Journal of Lipid Science and Technology* 109.4 (2007): 289-95. *Palm Oil Production through Sustainable Plantations*. *European Journal of Lipid Science and Technology*, 12 Apr. 2007. Web. 07 Dec. 2014. <<http://onlinelibrary.wiley.com/doi/10.1002/ejlt.200600223/abstract;jsessionid=43967DB93668C541881B5E84242940DF.f02t03>>.
- Baratay, Eric, and Elisabeth Hardouin-Fugier. "The Illusion of Liberty." *Zoo: A History of Zoological Gardens in the West*. London: Reaktion, 2002. 262-63. Print.
- "Borneo Pygmy Elephant." *WorldWildlife.org*. World Wildlife Fund, 2014. Web. 8 Jan. 2014.
- Buss, Irvn O. *Elephant Life: Fifteen Years of High Population Density*. Ames: Iowa State UP, 1990. Print.
- Butler, Rhett A. "Why Is Palm Oil Replacing Tropical Rainforests?" *Mongabay. Tropical Conservation Science*, 25 Apr. 2006. Web. 23 May 2014. <http://news.mongabay.com/2006/0425-oil_palm.html>.
- "Can the Greatness of a Nation." PETA Can the Greatness of a Nation Comments. PETA, n.d. Web. 01 Dec. 2014. <<http://www.peta.org/features/gandhi/>>.

- Coos Bay District. *Dean Creek Elk Viewing Area*. N.p.: Coos Bay District, n.d. BLM. Bureau of Land Management, 2006. Web. 23 Apr. 2014. <<http://www.blm.gov/or/resources/recreation/files/brochures/Dean%20Creek%20Elk%20Viewing%20Area.pdf>>.
- Couper, Rachel. "Placing the Origins of the Zoo." *Proceedings of the Society of Architectural Historians*. University of Sydney. 235-46. 01 May 2014 <<http://www.griffith.edu.au/conference/sahanz-2013/>>.
- Curtin, Susanna. "Managing the Wildlife Tourism Experience: The Importance of Tour Leaders." *Academia.edu*. International Journal of Tourism Research, 05 Aug. 2009. Web. 04 Dec. 2014. <https://www.academia.edu/364301/Managing_the_Wildlife_Tourism_Experience_The_Importance_of_Tour_Leaders>.
- "Elephant." *Elephant*. N.p., n.d. Web. 07 Dec. 2014. <<http://animals.sandiegozoo.org/animals/elephant>>.
- "Elephant." *San Diego Zoo Animals*. San Diego Zoo Global, n.d. Web. 09 June 2014. <<http://animals.sandiegozoo.org/animals/elephant>>.
- "The Elephant Sanctuary : Hohenwald Tennessee." *The Elephant Sanctuary : Hohenwald Tennessee*. The Elephant Sanctuary : Hohenwald Tennessee, n.d. Web. 24 Feb. 2014. <<http://www.elephants.com/aboutSanctuary.php>>.
- Eltringham, S. K. *Elephants*. Poole, Dorset: Blandford, 1982. Print.
- Estes, Jason G., Nurzhafarina Othman, Sulaiman Ismail, Marc Ancrenaz, Benoit Goossens, Laurentius N. Ambu, Anna B. Estes, and Peter A. Palmiotto. "Quantity and Configuration of Available Elephant Habitat and Related Conservation Concerns in the Lower Kinabatangan Floodplain of Sabah, Malaysia." Ed. Andrew Hector. *PLoS ONE* E44601 7.10 (2012): 1-10. No Records. Web. 28 Apr. 2014.
- Gaalema, Diann E., Bonnie M. Perdue, and Angela S. Kelling. "Food Preference, Keeper Ratings, and Reinforcer Effectiveness in Exotic Animals: The Value of Systematic Testing." *Journal of Applied Animal Welfare Science* 14.1 (2011): 33-41. WorldCat. Web. 8 Jan. 2014.

- Hoare, Ben. *Animal Migration: Remarkable Journeys in the Wild*. Berkeley: U of California, 2009. Print.
- Iadarola, Lynne. *Architectural Design in the Zoo*. Thesis. University of Maryland, 1985. N.p.: U of Maryland, 1985. Print.
- Indran, Datuk R. "Malaysia: Managing the Kinabatangan Floodplains in Sabah (#256)." *GWP: Tool Box*. Global Water Partnership, 2012. Web. 23 May 2014. <<http://www.gwp.org/en/ToolBox/CASE-STUDIES/Asia/Malaysia-Managing-the-Kinabatangan-floodplains-in-Sabah-256/>>.
- Jens, W., C. A. X. Mager-Melicharek, and F. E. Rietkerk. "Free-ranging New World Primates in Zoos: Cebids at Apenheul." *International Zoo Yearbook* 46 (2012): 137. Wiley Online Library. Web. 23 Apr. 2014.
- Laurentius, Ambu N., and Andua M. Patrick. "ASIAN ELEPHANT ACTION PLAN SABAH (MALAYSIA)." *Sabah Wildlife Department* (n.d.): 1-20. Print.
- Leitão, Andre Botequilha. *Biodiversity Planning and Design: An Issues Based Case Study*. Washington, DC: Island, 2006. Print.
- Majail, Julia. "Kinabatangan Corridor of Life." *CORRIDOR Newsletter* 1 (2009): n. pag. Print.
- Meijaard, Erik. "Mammals of South-east Asian Islands and Their Late Pleistocene Environments." *Journal of Biogeography* 30.8 (2003): 1245-257. *WorldCat*. Web. 22 Jan. 2014.
- MTN, Dzaenis. "Borneo Elephant Sanctuary Launch at Kinabatangan, Sabah - Malaysia Travel News." *Malaysia Travel News RSS*. N.p., 22 Sept. 2013. Web. 23 Apr. 2014.
- "Orang Sungai." *New Sabah Times* 2012, Culture sec.: 9. Print.
- "Overview." *WorldWildlife.org*. World Wildlife Fund, n.d. Web. 11 Sept. 2014. <<https://www.worldwildlife.org/species/borneo-pygmy-elephant>>.
- "Palm Oil Industry Threatens to Pollute Kinabatangan River." *Rainforest and Wildlife Conservation in Action with the World Land Trust*. World Land Trust, 22 Oct. 2013. Web. 29 Apr. 2014. <<http://www.worldlandtrust.org/news/2013/10/palm-oil-industry-threatens-pollute-kinabatangan-river>>.

"The Portico Group." Personal interview. 23 May 2014.

Pygmy Elephants: Documentary on the Jungle Pygmy Elephants of Borneo. Perf. World Wildlife Fund. *WorldWildlife.org*. World Wildlife Fund, 8 Oct. 2013. Web. 18 Jan. 2014.

Pygmy Elephants: Documentary on the Jungle Pygmy Elephants of Borneo. Youtube. World Wildlife Fund, 08 Oct. 2013. Web. 18 Jan. 2014.

Redmond, Ian. *Eyewitness: Elephants*. London: Dorling Kindersley, 1993. Print.

Redmond, Ian, and Dave King. *Elephant*. New York: Knopf, 1993. Print.

"Sepilok Orangutan Appeal UK." *Sepilok Rehabilitation Center-Sabah-Borneo-Orangutan Appeal UK*. *Orangutan Appeal UK*, n.d. Web. 11 Sept. 2014. <<http://www.orangutan-appeal.org.uk/about-us/sepilok-rehabilitation-centre>>.

Varadharajan, Vanitha, and Thiyagesan Krishnamoorthy. "Social Life of Captive Asian Elephants (*Elephas Maximus*) in Southern India: Implications for Elephant Welfare." *Journal of Applied Animal Welfare Science* 14 (2011): 42-58. Print.

Veasey, J. "Concepts in the Care and Welfare of Captive Elephants." *International Zoo Yearbook* 40.1 (2006): 63-79. *WorldCat*. Web. 8 Jan. 2014.

"WeatherSpark Beta." *Average Weather For Kota Kinabalu, Malaysia*. N.p., n.d. Web. 5 Feb. 2014. <<https://weatherspark.com/averages/34017/Kota-Kinabalu-Sabah-Malaysia>>.

WWF. *Green Heart*. Brochure. Sabah, Malaysia: Author. *Save Our Gentle Giants in Borneo*. Mar. 2013. WWF-Malaysia. 08 Jan. 2014 <wwf.org.my>.

IMAGE REFERENCES

If image is not referenced, it is the authors original work.

"1664: The Royal Menagerie Built by Le Vau." Over the Centuries. Versailles 3D, n.d. Web. 13 Mar. 2014.

<<http://www.versailles3d.com/en/over-the-centuries/xvii/1664.html>>.

"Adventuresinbeeland's Blog." Adventuresinbeelands Blog. The Twenty Eleven Theme, 05 June 2014. Web. 11 Nov.

2014. <<http://adventuresinbeeland.com/tag/borneo/>>.

"Apenheul Primate Park, Holland." Vets into the Wild. Blog at WorldPress, 04 Feb. 2009. Web. 11 Dec. 2014.

<<http://outdoorvets.com/2009/02/04/79/>>.

"Award Winners - Joel Sartore." Joel Sartore. Joel Sartore Photography Inc., n.d. Web. 14 Aug. 2014.

<<http://www.joelsartore.com/galleries/award-winners/23/>>.

Baratay, Eric, and Elisabeth Hardouin-Fugier. "The Illusion of Liberty." Zoo: A History of Zoological Gardens in the West.

London: Reaktion, 2002. 262-63. Print.

Chiew, Hilary. "Split by Oil Palm." Archives. The Start Online, 27 Oct. 2009. Web. 07 Apr. 2014.

<<http://www.thestar.com>.

[my%2Fstory%2F%3Ffile%3D%252F2009%252F10%252F27%252Flifefocus%252F4847900%26sec%3Dlifefocus](http://www.thestar.com/my%2Fstory%2F%3Ffile%3D%252F2009%252F10%252F27%252Flifefocus%252F4847900%26sec%3Dlifefocus)>.

"Dean Creek Elk Viewing Area, Reedsport." Dean Creek Elk Viewing Area. Trip Advisor, n.d. Web. 11 Aug.

2014. <http://www.tripadvisor.com/Attraction_Review-g52034-d2106046-Reviews-Dean_Creek_Elk_Viewing_Area-Reedsport_Oregon.html>.

"Issue of the Week: Wildlife Corridors." First For Wildlife. Safari Club International Foundation, 16 Sept. 2014. Web. 30 Oct.

2014. <<https://firstforwildlife.wordpress.com/2014/09/16/issue-of-the-week-wildlife-corridors/>>.

"NEW ELEPHANT HOUSE AT ZURICH ZOO: SIKA MAKES A KEY CONTRIBUTION FROM THE FOUNDATIONS TO THE ROOF." New Elephant House at Zurich Zoo. Sika Group, 06 Apr. 2014. Web. 27 Nov. 2014. <<http://www.sika.com/en/group/Media/SikaNews/new-elephant-house-at-zurich-zoo.html>>.

Steel, Megan. "Preserving Nature - Wildlife Tourism." Fantastic Cleaners. N.p., 17 Aug. 2013. Web. 30 Nov. 2014. <<http://fantasticcleanersmelbourne.com.au/preserving-nature-wildlife-tourism-1712/>>.

"Swamp Thing: Euphoric, Relaxing, Long-Lasting Kratom Blend." Kratom Eye. Kratom, n.d. Web. 10 Nov. 2014. <<http://buykratomflorida.com/kratom-shop/house-blends-mixes-strains-mitragyna-speciosa/swamp-thing/>>.

Tipp, Andrew. "Volunteering with Animals in Malaysia." Gapyear.com. Flight Centre (UK) Limited - Company, n.d. Web. 10 Nov. 2014. <<http://www.gapyear.com/articles/149886/volunteering-with-animals-in-malaysia>>.

"What Is Deforestation?" Mongabay.com. N.p., n.d. Web. 10 Apr. 2014. <http://kids.mongabay.com/lesson_plans/lisa_algee/deforestation.html>.

"Wildlife Tour." Support Tourism. Techno Developers Group, n.d. Web. 30 Nov. 2014. <http://www.supporttourism.in/package_wildlife_bird_watching.html>.

Yooniq Images. Yooniq Co. Ltd, n.d. Web. 10 Nov. 2014. <https://yooniqimages.blob.core.windows.net/yooniqimages-data-storage-resizedimagefilerepository/List/10029/1d2c86b7-99a9-40dd-84aa-40f7fc23287e/YooniqImages_100294362.jpg>.