CENTER FOR BIRD REHABILITATION AND PUBLIC EDUCATION IN THE UNION BAY NATURAL AREA

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ABSTRACT

Bird populations around the Puget Sound are increasingly threatened by habitat loss due to the urban development and growth of Seattle. Urban development not only destroys natural habitats, but also creates a new, lethal gauntlet that local and migratory birds have to traverse. Collisions with man-made structures (buildings, glass walls, power lines) and encounters with cats contribute significantly to bird mortality and are second only to habitat loss as the leading cause of population declines. To mitigate these threats, this thesis advocates a greater appreciation for birds as the first step in their protection. Increasing the public's and professionals' understanding of urban threats to birds and demonstrating interventions that can mitigate them offers the greatest hope in protecting bird populations. In addition, a proposed bird rescue center will care for birds that have been injured and attempt to rehabilitate and release them.

The Union Bay Natural Area is one of three major stopover spots on the Pacific Flyway for migratory birds within Seattle. It is also home to a large number of resident and summer-breeding bird species and attracts a large numbers of local birdwatchers. The thesis proposes a student-and-volunteer-run outreach center placed on the already-developed outskirts of the natural area, on University of Washington land. The center will provide public education and outreach opportunities, support environmental education to the youth, and guided birdwatching tours; additionally, it will attract volunteers to help with the rescue and rehabilitation of injured wild birds. With greater public understanding and support, the reduction and neutralization of hazards to birds, and improvements to urban avian habitats will result in healthier populations of local and migratory birds.

TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION

"In the end we will conserve only what we love;
we will love only what we understand and
we will understand only what we are taught"
Baba Dioum, 1968

Bird populations have experienced rapid decline over the past century due to habitat loss, mostly from agriculture and urban development. Urban development itself represents a threat to bird populations outside of habitat loss as it acts as a lethal gauntlet for local and migratory birds to traverse. Migratory birds depend on having critical stopover places along migration routes that are now dotted with metropolitan centers, which often overlap resident bird territory. Collisions with human-made structures (buildings, power lines) and encounters with cats contribute significantly to bird mortality and are second only to habitat loss as the leading cause of population declines. In the future, rapid human population growth mixed with an increased desire to live within cities will require greater land areas to be developed into urban centers. This transformation will result in even greater habitat loss and additional threats to existing bird populations.[1]

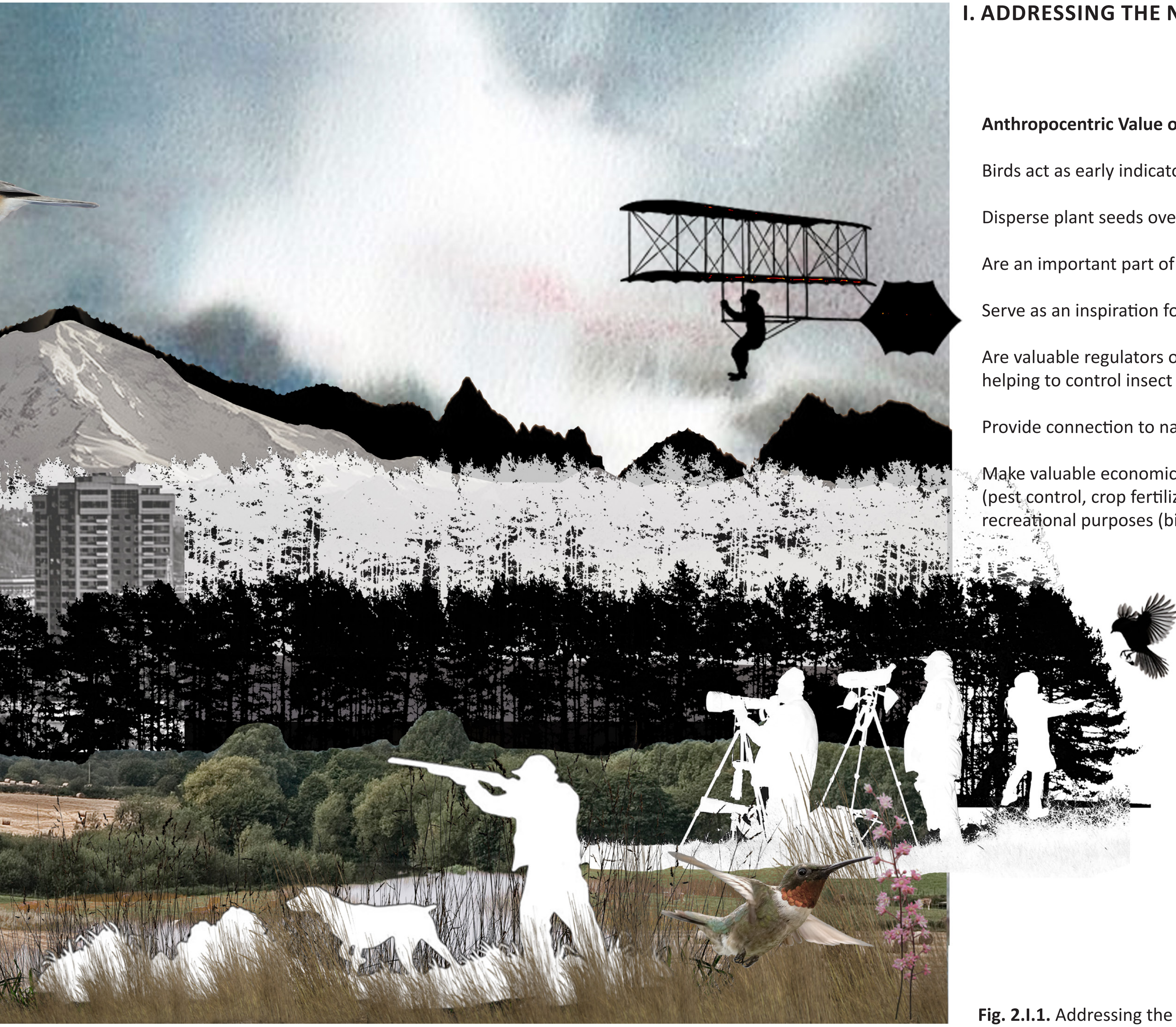
Despite these threats to many bird species, mutualism also exists between humans and birds. People benefit from birds' consumption and control of insect and rodent populations, their pollination of trees and crops, and their aesthetic presence. Some bird species benefit from the creation of human-made habitats and the increased availability of certain food sources. It is not unthinkable that humans could alter some aspects of urban environment to allow for the sustainable coexistence between the increasing number of humans and birds. Partial restoration of habitats within urban areas (use of local plants in city parks, thoughtful landscaping) together with hazard reduction measures, could mitigate some habitat loss while providing better urban sources of food and nesting sites for birds. The ability to sustain larger and healthier bird populations would be not only the moral thing to do but it would also provide people with other direct benefits, such as continued insect population control.[2] For the successful implementation of these changes, biologists and ornithologists need to induce a cultural change through the education of the general public, and designers need to create more thoughtful urban environments that do not pose as great a threat to birds.

The Bird Rescue Center proposed in this thesis proposes just such a cultural change. It will be a University of Washington facility consisting of an urban avian hospital and education center, concentrating on migratory birds. The primary goal is to enhance the coexistence of people and wildlife through mutual appreciation and understanding. Through thoughtful interventions and rehabilitation as well as public education and outreach, the thesis expects that a greater awareness of birds will develop and help foster a sense of moral and civic responsibility to mitigate population declines. The outreach focus will be on helping citizens understanding the lives of birds, involving them in projects that reduce or neutralize bird hazards, and protect and improve natural avian habitats in urban/suburban settings. The site proposed for the hospital is located in the Union Bay Natural Area, which is one of the most important "natural" areas in the city of Seattle due to its unique urban habitat for birds. It is located in close proximity to major streets and neighborhoods while still encompassing a variety of habitats that shelter over 200 species of birds. It is considered to be one of the best birdwatching sites in Seattle. The location of the site would make the proposed Bird Rescue Center was selected to meet the following criteria, namely that the facility for treating and rehabilitating sick and injured birds should be:

- In close proximity to where birds encounter a concentration of human activity and structures that cause the highest number of injuries.
- Near university facilities that relate to its mission (Veterinary, Environmental and Forest Sciences, Architecture and Landscape faculties) to facilitate access by students and faculty engaged in internships and hands-on experience in public education.
- Near public transit to facilitate access by visitors and volunteers, especially those who would be discouraged by a long trip.
- Serve as a demonstration of building techniques that minimize risks of injury or death to local bird populations as well as features that support them.

This thesis will illustrate why there is a need for measures that protect and support bird populations and biodiversity. Special attention will be paid to the two leading causes of population declines, habitat destruction and collisions with human-made structures. A framework of public and professional education will be outlined that will increase awareness of these threats as well as interventions that can be employed. A rehabilitation center located in the Union Bay Natural Area at the University of Washington, will help injured wild birds while raising public and professional awareness through outreach and educational programs. With its location on the University of Washington campus, the center will engage the general public while providing opportunities for university student in multiple disciplines to receive hands-on training. This thesis will use the rehabilitation center to demonstrate the types of interventions that prevent bird deaths and measures that integrate the building into the surrounding environment, creating habitat and supporting healthy urban bird populations.

I. ADDRESSING THE NEED FOR BIRD CONSERVATION



Anthropocentric Value of Birds

Birds act as early indicators of environmental hazards

Disperse plant seeds over a wider area

Are an important part of historical and contemporary culture.

Serve as an inspiration for technological inventions

Are valuable regulators of pest species,
helping to control insect and rodent populations.

Provide connection to nature in cities

Make valuable economic contributions, both in natural services (pest control, crop fertilization, pollination of plants) as well as recreational purposes (birdwatching, hunting).

Fig. 2.I.1. Addressing the need for bird conservation

CHAPTER 2: THEORETICAL FRAMEWORK

"There was once a town in the heart of America where all life seemed to live
in harmony with its surroundings… where, in spring, white clouds of bloom
drifted above the green fields. In autumn, oak and maple and birch
set up a blaze of color that flamed and flickered across a backdrop of pines…
The countryside was… famous for the abundance and variety of its bird life,
and when the flood of migrants was pouring through in spring and fall
people traveled from great distances to observe them… Then a strange blight
crept over the area and everything began to change… There was a strange
stillness… The few birds seen anywhere were moribund;
they trembled violently and could not fly. It was a spring without voices.
On the mornings that had once throbbed with the dawn chorus of
robins, catbirds, doves, jays, wrens, and scores of other bird voices
there was now no sound;
only silence lay over the fields and woods and marsh"
Rachel Carson, *Silent Spring* (1962)

I. ADDRESSING THE NEED FOR BIRD CONSERVATION

This chapter will underline the need for bird conservation by addressing national and statewide declines in many bird populations. Common local, summer-breeding and migratory birds that pass through the state and the natural history of their presence will be presented. The primary causes of populations declines and the greatest mortality threat to these birds, habitat loss and collisions with human-made structures, has been well studied. The biologic reason that glass in buildings is such a major threat to birds and the measures that reduce the likelihood of bird collisions are included. By addressing the need for conservation education to public and professional groups, these measures will begin to spread into society. Case studies of wildlife rehabilitation centers, birdwatching and visitor's centers that currently fulfill these goals in different parts of the world will also be presented.

As far back as written or drawn records go, birds have always captured the human imagination. Flight, until recently, was the domain of birds and only a few other animal species (outside of insects). The mastery of flight and the unshackled daily behavior of birds has long made them an example of freedom and power to humans. They appear in countless tales and legends across the world and are often assigned human emotions, ideas, and intelligence. People love birds for their bright plumage, cheerful songs, and almost limitless variety. They bring life to gardens and parks and are a fixture of natural habitats and neighborhoods worldwide. Birds are not only aesthetically valuable to people though, they also are an essential part of the world's environments and often act as an indicator of ecosystem health.[3]

Birds play many important roles in ecosystems, including acting as valuable natural controllers of insects and rodents that harbor diseases harmful to humans and other animals. Healthy bird populations have been shown to help prevent the spread of diseases such as West Nile virus, dengue fever, and malaria.[4] Birds are also essential agents in the maintenance and health of environmental flora, often through mutualism. The interactions between flora and native birds, where birds receive nectar, berries, and fruits from plants and trees, and the plants and trees become cross-pollinated and have their seeds dispersed over a wide area, are essential for both groups to thrive.[5] Some trees and plants are completely reliant on birds for these processes as some birds live only on nuts, fruits, and other plant matter.

Migrating birds play an important role in plant distribution -- research indicates that they are responsible for shaping many landscapes across the world. Darwin first speculated that the dispersal of certain species of plants from one continent to distant islands or shores could have been facilitated by water birds. He theorized that seeds could have traveled inside a bird's digestive tract, attached to the bird's feathers or in dirt on the bird's feet, and that over thousands to millions of years, their flight paths could have established some of the ecosystems that now exist.[6] Before Darwin's time, scientists were puzzled over the fact that some plants, fungi, and algae were only found in the arctic regions of North America and the southern tip of South America, but nowhere in between. Initial studies did not support the idea that this distribution was a result of gradual movement over hundreds or even millions of years, but rather was a result of quick leaps across the Americas. Researchers from the University of Connecticut took a closer look at the feathers of long-distance migratory birds and found fragments (spores, seeds) of 23 different plant and fungi species in the birds' plumage.[7] Some of trans-equatorial migratory birds such as American Golden Plover fly offshore from the Arctic Circle nonstop to the southern tip of South America, supporting the idea that birds are the most likely vector for these plants' distribution.[8]

Birds are also early indicators of environmental hazards. Birds are extremely sensitive to even small environmental changes or toxins. They have long been used as a sentinel species to protect human health, an animal species used to detect early changes or dangers to humans. This fact was recognized by Scottish physician John Scott Haldane in the late 1800s when he introduced domestic canaries in cages to coal mines to warn miners of increasing carbon monoxide or methane levels. Because their metabolisms were faster than the miners' and because of their smaller mass, the canaries would succumb to rising carbon monoxide levels earlier than the miners. Noticing a dead or dying canary would allow the miners to escape before they suffocated from the invisible gases.[9]

Birds have also acted as a sentinel species for environmental changes and as an indicator for an environment's health and diversity. Birds are often affected by ecosystem changes long before other, larger animals. Like canaries in a coal mine, changes in the health or population of birds can act as an early indication that there are environmental changes or issues occurring. The best known example of this was Rachel Carson's research during the 1950s on the damage of pesticides, especially DDT, on the environment. In her seminal book, *Silent Spring*, which is largely considered the start of the modern environmental movement, Carson contradicted the popular idea that DDT was harmless to animals including humans. She showed that nationwide, evidence had accumulated that bird populations in areas of DDT spraying were falling due to the negative effects of DDT on birds' reproductive system.[10] This led to closer scrutiny of the claimed benign effects in humans, which showed associations with several types of cancer, acute exposure toxicities, as well as human reproductive and developmental abnormalities. More recently, marine biologists have been using seabirds (especially penguins) as an indicator of marine ecosystem health and of the effects of climate change.[11]

BIRDWATCHING AS AN ECONOMIC RESOURCE

In addition to the many environmental assets birds offer, the estimated commercial value of wild birds in the United States' economy is staggeringly large. Birdwatching is currently one of the fast growing outdoor activities in the United States. Birdwatching was estimated to have generated $107 billion in economic output in 2011[12], and one in every four American adults was estimated to be a bird watcher."[13] According to a United States Fish and Wildlife Service report, there were 47 million birdwatchers (20 percent of the total population) in the United States in the year 2011. In Washington State, an estimated 24 percent of adults were estimated to be birdwatchers, making it 16th in the list of all states across the United States by participation rates.[14] With these numbers, it is incredible that more aspects of society do not reflect a love and concern for birds. While there is a slow-growing sense of responsibility in architecture to design with bird awareness, the value to clients (a number of whom, statistically, must be bird enthusiasts) in constructing bird-sensitive buildings is likely very large. The commercial value in architecture alone for designing and marketing buildings as bird friendly is a largely untapped area. This thesis hopes to heighten awareness of the value of birds and demonstrate some viable bird-friendly design elements that can be incorporated into new and already existing buildings.

BIRD HUNTING

In 2011, according to the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, there were more than 2.6 million migratory bird hunters in the United States. It is estimated that they spent $1.8 billion dollars on migratory bird-related trip and equipment expenditures, in the process of hunting birds such as waterfowl and doves.[15] According to data from the Washington Department of Fish and Wildlife "Game Harvest Report" in 2013, birds are the six most-popular game species in the state. Waterfowl (ducks) are the single most hunted animal in the state, with a total harvest in 2013 of 407,925 birds by 23,689 hunters. This is followed by quail, with 72,699 killed, Canada Geese with 61,504, and Mourning Doves with 50,358 killed. Other birds such as Grouse, Chukar, Wild Turkey, Gray Partridge and Snipe are also popular prey species and are pursued in great numbers each year. While some conservationists do not morally support hunting of wildlife, hunter's groups such as Ducks Unlimited (discussed further in section VII of this chapter) are some of the leading advocates of habitat protection and have helped draft important environmental protection laws.[16]

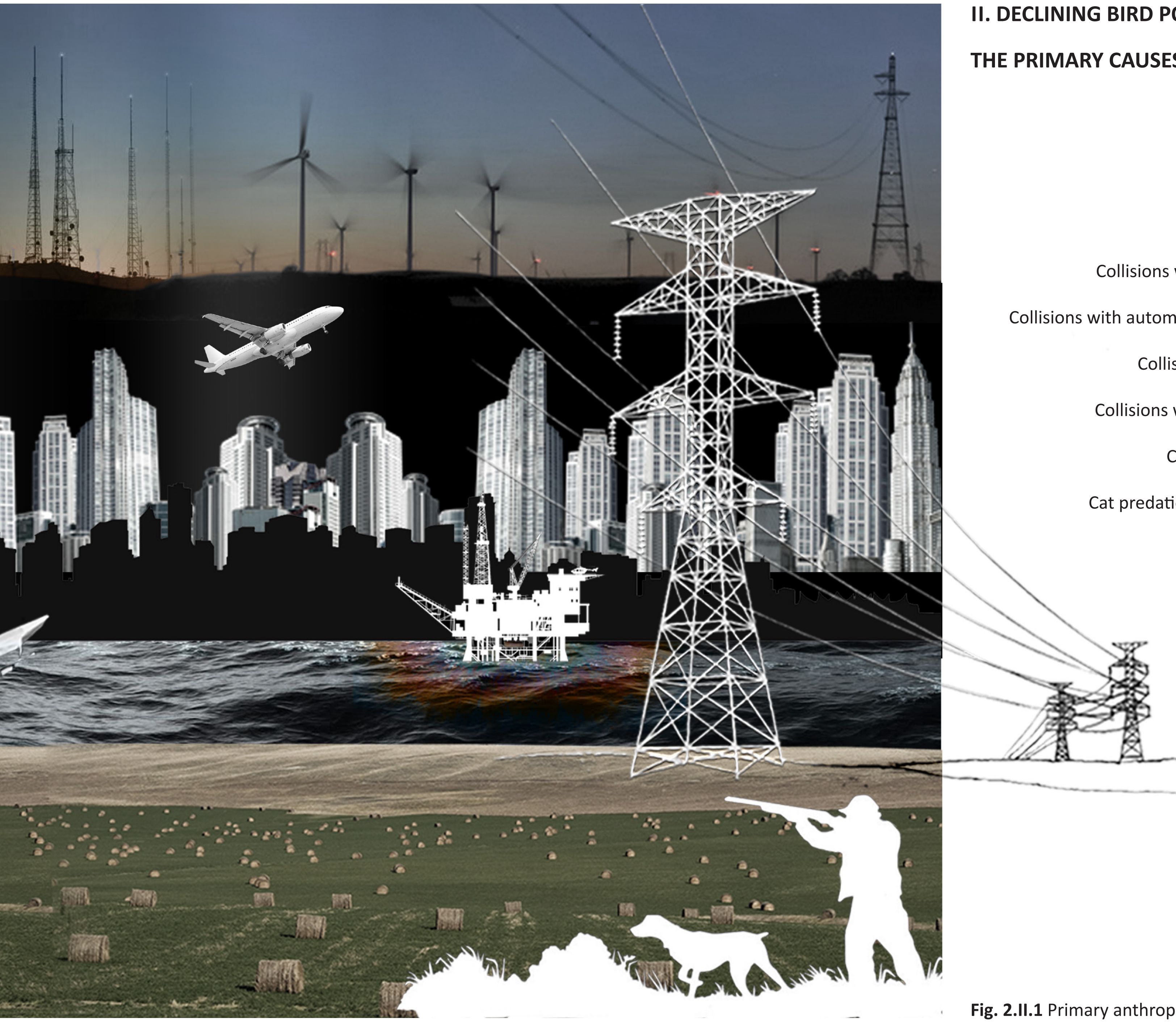
INSPIRATION

Birds have obviously both inspired and provided living instruction to humankind in its quest to fly and refine flight capabilities. It was the initial observation of birds that undoubtedly inspired the dream of human flight, but their inspiration did not end there. Engineering and design studios are increasingly utilizing the process of biomimicry, the observation and copying of evolution's answers to common physical problems, to implement into human design. Through evolution, birds have developed distinct flight characteristics which differ from one species to the other. By detecting, analyzing and applying these characteristics in engineering and technological fields, significant improvements to existing technologies have occurred.[17] Airbus, for example, has developed movable wings to adapt to small changes in wind gusts that provide greater stability and better fuel efficiency through the study of sea birds. The company has also developed winglets, the curved tip of a plane's wing that provides extra lift without extra wing length, by mimicking steppe eagles, and noise reduction systems have been inspired by the near silent flight of owls. Sometimes imitating nature is done for aesthetic reasons only, such as the Beijing National Stadium (aka the Bird's Nest) which was constructed for the 2008 Summer Olympic Games.

MORAL OBLIGATION

Outside of their aesthetic, environmental, economic, and research values, birds are sentient, evolved creatures. Their form and existence predates modern humans, their bipedal ancestors and even the primate mammalian order. The rise and spread of humans has generated many wonders but has also caused uncounted amounts of damage and destruction to the natural world, including the extinction of many distinct life forms. Now that humans are truly aware of their potential to interrupt and damage the natural world, and have the knowledge that other animals can think and experience emotions, they are morally obligated to preserve all species without differentiating between their functional values. Like the studies that Rachel Carson presented in *Silent Spring*, which made the detrimental effects of DDT on wild bird populations common knowledge, recent studies have shown that other human behaviors are similarly decimating some populations. In architecture, the extensive use of reflective materials such as mirrored glass has been shown to cause large number of bird deaths. This includes local bird populations as well as migratory birds, some of which are threatened or endangered species. By recognizing that buildings are causing such problems, architects become responsible to find solutions to protect and maintain healthy wild bird populations. The proposed center will help citizens and architects become aware of their moral obligation to Seattle's bird population.

II. DECLINING BIRD POPULATIONS AND THE PRIMARY CAUSES OF BIRD MORTALITY



Habitat destruction

Collisions with buildings and windows

Collisions with automobiles, trains, and airplanes

Collisions with high tension lines

Collisions with communication towers

Collisions with wind turbines

Cat predation (domestic and feral cats)

Pesticides

Oil spills

Fishing by-catch

Hunting / lead poisoning

Fig. 2.II.1 Primary anthropogenic causes of bird mortality.

II. DECLINING BIRD POPULATIONS AND THE PRIMARY CAUSES OF BIRD MORTALITY

Bird populations worldwide have experienced rapid declines over the past century mostly due to habitat loss from human agriculture and urban development. “Habitat loss” in this case does not necessarily refer to a physical loss, but rather to a transformation of the general characteristics of the habitat.[18] In many cases, the connection between a particular bird species and the environment in which it evolved is so close, that it has driven and dictated the evolution of its physical appearance. Most famously, Darwin’s Galápagos Finches developed different beak shapes and sizes across the island chain over time, due to natural selection and different environments. Significant changes or the loss of a species’ habitat, if it is too closely adapted, can lead to its decline and even extinction.[19]

The habitat transformation most closely associated with bird population declines is urbanization, which involves almost total habitat change and destruction. Urbanization tends to be permanent and has grown with human populations over time, explaining its outsized effect. Replacing the original ground cover with paved surfaces and native plant species with non-native landscaping, all play a role in declining bird populations and biodiversity. Transformation of wild lands into agricultural use is somewhat less destructive (except to forest-dwelling species) and is partially reversible, but can contaminate the land with pesticides and fertilizers.[20] No matter the setting, the elimination of vegetation, fragmentation of surviving habitats with roads and power lines, and obstruction of the landscape with built structures, all affect bird populations.

Rapid human population growth and an increased desire to live in cities will require more landscapes to be converted into urban centers in the near future. This transformation will result in the permanent loss of habitat and conversion of what remains into a more lethal environment for surviving wildlife. In a paper analyzing data from the North American Annual Breeding Bird Survey between 1966-2011, 36 percent of the 426 species surveyed experienced significant population declines.[21] Not all habitats are affected equally and there have been some positive signs in recent surveys. Arid land birds have experienced the most severe population declines, with a 46 percent decline since 1968. Eastern United States forest bird populations have experienced a 32 percent decline since 2009 while western United States birds have experienced a 20 percent decline. After decades of declining populations, grassland bird populations have remained stable (but down from earlier numbers) for the past 10+ years largely due to restoration of grasslands.[22] Wetland bird populations which have experienced a 40 percent gain since 1968 (Fig. 2.II.2.). These gains have been attributed to habitat protection through government initiatives such as the Clean Water Act as well as public and private conservation measures.

Worldwide, habitat loss due to urbanization and agricultural use is the largest contributor to bird population declines. The urban environment represents a threat to local and migratory birds in many different ways, causing deaths of up-to 1,000,000,000 (one billion) birds annually in the United States alone (due to anthropogenic sources): attacks by pets (especially feral and domestic cats) and collisions with moving vehicles and by built structures (power lines, communication towers, wind turbines, and especially glass facades and windows).[23] (Fig.2.II.1., Fig. 2.II.3.) In addition, chemical pesticides, fertilizers, cleaning agents and human hunters (using lead ammunition) further contribute to declines. Outside of restricting human population growth and land usage, understanding how and why birds are injured in urban environments offers the best option to mitigate our impact.

The growth of Seattle has mirrored national and global trends with declining populations of native bird species, increases in non-native species, declining diversity, and domination of the urban area by a few highly adaptable species (Pigeons, Crows, European Starlings, House Sparrows).[24] The concept of the urban forest amounts to the total number of tree and understory species (shrubs) located on public and private land within a city. This includes natural areas, public parks, as well as the trees along right-of-ways, streets and in yards.[25] The variety and amount of vegetation and the diversity of bird species in an urban environment is directly correlated, because "plants provide a number of distinct foraging and nesting resources, which allow competing bird species to coexist."[26] Most of the birds native to Puget Trough ecoregion evolved in the setting of conifer-dominant forest. Once this habitat was lost or replaced to expanding urbanization, those bird species that had not adapted, declined or left the area.[26] Citizens and professionals who come to the Bird Rescue Center will be educated on those local plants and tree species that are both aesthetically attractive and also provide needed habitat and food sources for wild birds.

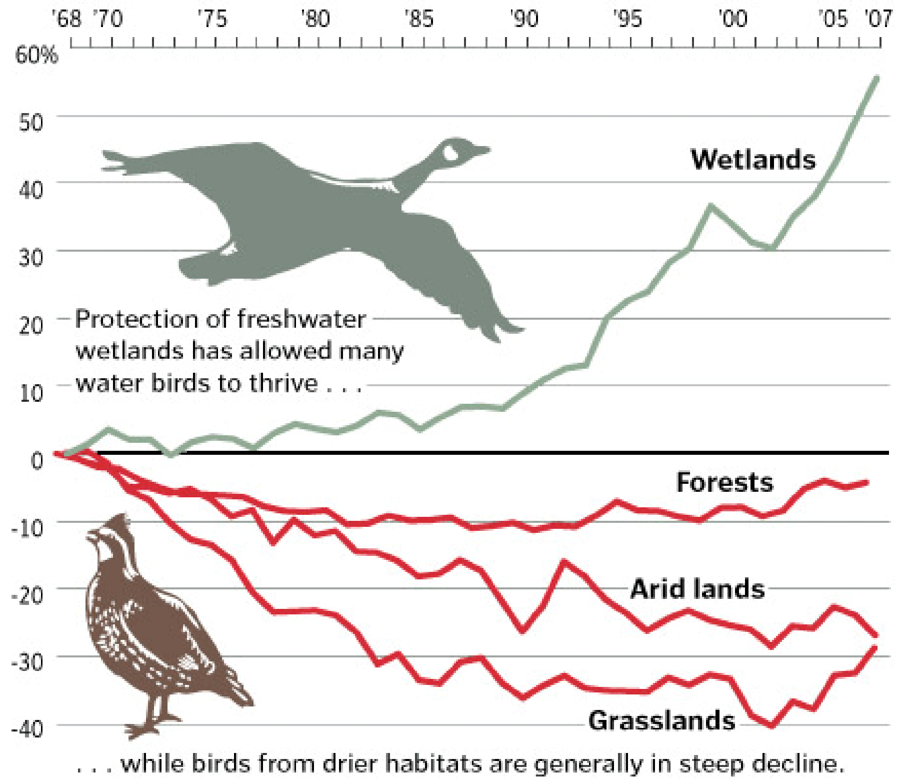


Fig. 2.II.2. Percent change in avian populations by habitat (since 1968)

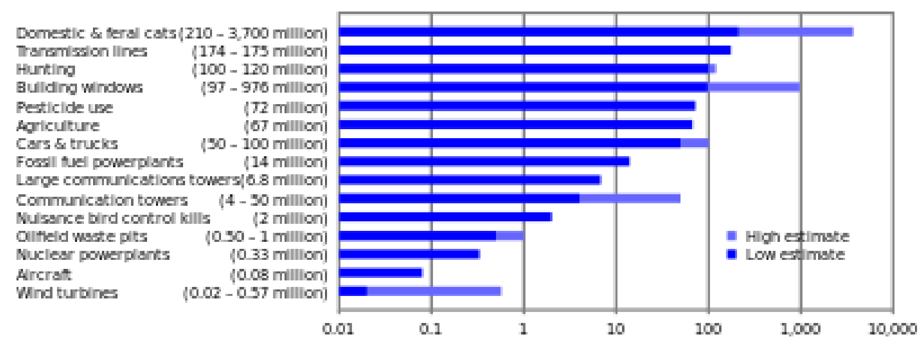


Fig. 2.II.3. Estimated annual avian mortality rates (in millions), 2013

III. BIRDS OF THE GREATER SEATTLE AREA

The bird population in the Seattle area is large and varies by the time of the year, consisting of one of three general groups. Resident bird species are those species that live in the Seattle area all year round, breeding and wintering in the same area. Migratory birds move through the area on a biannual basis, on the way to and from breeding grounds farther north. These species may use the city as a stopover place to forage and rest on the way but they do not summer in the Seattle area. The third group of birds are those that do breed in the Seattle area during the warmest months but migrate South in the winter. More than 500 bird species have been observed in Washington State and over 200 of these species breed in Washington State. [27] The Bird Rescue Center will accommodate all bird species, releasing rehabilitated migratory and summer-breeding birds at times more supportive to their survival.

A. RESIDENT AND BREEDING BIRDS

Seventy-two percent of Seattle's breeding bird populations are resident species (~75 species) and twenty-eight percent are migratory.[28] A study published by University of Washington researchers, found that an estimated $120 million dollars is spent by residents of Seattle annually on food, feeders and other measures that support bird populations.[29] Urban areas are considered young or immature natural environments, favoring the survival of adaptable species over local species which may have been found in greater numbers before human settlement. The Seattle Audubon Society has been monitoring birds in Seattle and the greater Puget Sound area for over eighty-five years, and has recorded increasing populations of the American Crow, Dark-eyed Junco, Song Sparrow and European Starling. In Seattle, additional resident species include the American Robin, Barn Swallow, Steller's Jay, Bushtit, Glaucous-winged Gull, Red-breasted Nuthatch, Spotted Towhee, European Starling, Song and Swamp Sparrows, Northern Flicker and others. Some birds, such as Anna's Hummingbird, have only established as a resident bird species over the past few decades. Other residents include water-centric species such as the Great Blue Heron, Mallard, Bald Eagle, American Coot, and the Double-crested Cormorant.

Summering or breeding birds are those species that reside and breed in the Seattle area during the warmest months but travel south for the winter. These include the Warbler, Flycatcher, and Vireo species, the Western Tanager, the Black-headed Grosbeak, and more.[30] Some of these species can be found in limited numbers during the winter but due to changes in the availability of their food sources, insects or seasonal fruits and nuts, the majority leave the area. With progressively warmer winters and changes in food availability, some of these summer populations may begin to stay through the winter, like Anna's Hummingbird.

B. MIGRATORY BIRDS OF THE PACIFIC FLYWAY

The city of Seattle is located on the Pacific Flyway (Fig.2.III.1), which runs from the Arctic Circle to the tip of South America. On this migratory path, "Two thousand species of birds, 20 percent of all known species, make regular seasonal movements."[31]. Many migratory birds travel hundreds and even thousands of miles twice a year. Some fly from one pole to the other between their breeding and wintering grounds. (Fig.2.III.2) Most follow the same routes that countless generations of their ancestors took. Each species follows its own route, based on the species' ecological and geographical boundaries. They all depend on having critical stopover places along their migratory path to rest and eat, though. Today, the number of potential stopover places has been reduced by development and may now include urban areas within their territory. In Seattle, three of these important stopover places are located in the center of the city's metropolitan area: Discovery Park, Green Lake, and the Union Bay Natural Area (Montlake Fill)[32] where the Bird Rescue Center will be located.

Despite an annual estimated one billion birds that migrate along the Pacific Flyway, this represents only a fraction of the number which took the flyway a century ago.[33] Biodiversity in the Puget Trough ecoregion has declined significantly over the past 100 years, both local species as well a migratory species.[34] Those that remain face not only habitat and food losses, but now also face a number of threats and dangers present in the urban environment (roads and cars, domestic animals, pollution and trash, etc.). Without proper rehabilitation and habitat protection, even migratory populations are likely to continue to shrink and may even disappear. The Bird Rescue Center hopes to stem the shrinkage of migratory populations.

Fig.2.III.1.
Pacific Flyway

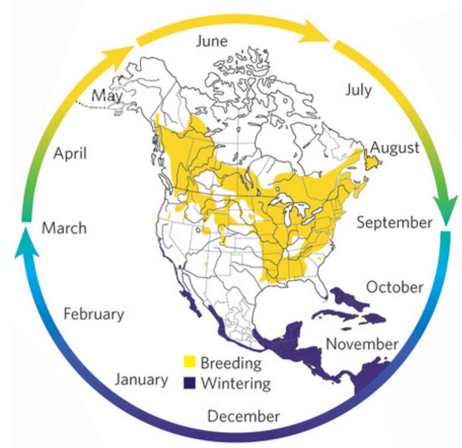


Fig.2.III.2.
Migratory Cycle

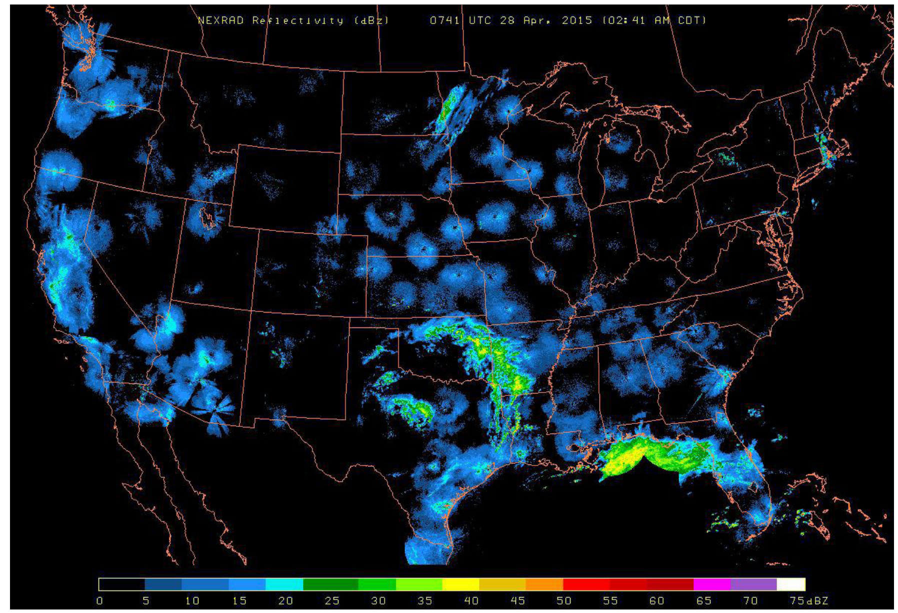


Fig.2.III.3. National Composite Radar, April 28, 2015;
Birds Migrating North at Night. (02:41 am)

Interpretation of the radar signal (Bird density):

<5 dBz	Minimal migration	<59 birds per cubic kilometer
5 - 10 dBz	Light Migration	59 - 71 birds per cubic kilometer
10 - 20 dBz	Moderate Migration	71 - 227 birds per cubic kilometer
20 - 30 dBz	Heavy Migration	227 - 1788 birds per cubic kilometer
>30 dBz	Extreme Migration (rare)	>1788 birds per cubic kilometer


Glaucous-winged Gull


Abandoned Building occupied by Pigeons


Cliff Swallow nests, IMA Building


Pigeon footprints in concrete, downtown Seattle


Rock Pigeon and a pair of American Robins bathing in fountain water

III. SEATTLE:

BIRDS IN A BUILT ENVIRONMENT


Bird House, Capitol Hill

Killdeer nest, Olympic Sculpture Park.


House Sparrows nesting in gaps of a building, 4th Ave.


Northern Flicker nest in a utility pole, Capitol Hill


Art Installation-Bird Houses, Caplitol Hill

Fig. 2.III.4

IV. BIODIVERSITY AS AN ARCHITECTURAL PROBLEM

"...The planet is ... covered with straight lines, squares, rectangles, circles... Their regularity, complexity, and distribution would be hard to explain except by life and intelligence, ... (with) simultaneous passion for territoriality and Euclidean geometry.... Many of the devegetated smudges are revealed to have an underlying checkerboard geometry. These are the planet's cities. Over much of the landscape, and not just in the cities, there is a profusion of straight lines, squares, rectangles, circles. The dark smudges of the cities are revealed to be highly geometrized, with only a few patches of vegetation—themselves with highly regular boundaries—left intact..."[35]

Carl Sagan.

The current worldwide human population for 2015, according to the United States Census Bureau, is an estimated 7.25 billion people.[36] The United Nations estimates that 54 percent of those people are currently living in urban areas but that may rise to 66 percent by 2050.[37] In the United States alone, an 2014 estimated population of 319 million people is expected to grow to 400 million by 2051.[38] More people living in cities will likely require greater expansion of urban centers as well as an increase in land employed for food production, leading to further habitat destruction that primarily favors humans. The adverse effects of buildings, such as air and water pollution and direct impacts on natural life (bird-window collisions, habitat fragmentation), further impacts surviving animal populations. Population growth will also lead to increased rates of resource consumption, compounding source constraints, habitat destruction, and environmental pollution. These combined effects negatively impact the biodiversity of the region and world.

Architects and urban planners that are willfully or inadvertently ignorant of these concerns, continue the cycle of negative environmental impacts that threaten the health of our world. Their individual impact is greater than the average person's due to multiplicative environmental effects of buildings and construction. This includes the sourcing and types of materials used, the lifecycle of the building's materials, the energy efficiency of the building, the contribution to local water and air pollution, and direct environmental impacts. In addition, effective design influences the behaviors of its users/occupants so poor design can compound these negative effects. The opposite is also true, however. Responsible design and construction can lead to reduced environmental impacts and even promote biodiversity. Educating architects on environmental concerns and effective countermeasures as well as instituting rules, laws and building practice guidelines that mandate the most effective interventions will further help this cause. The Bird Rescue Center will offer one possibility for such continuing education of architects.

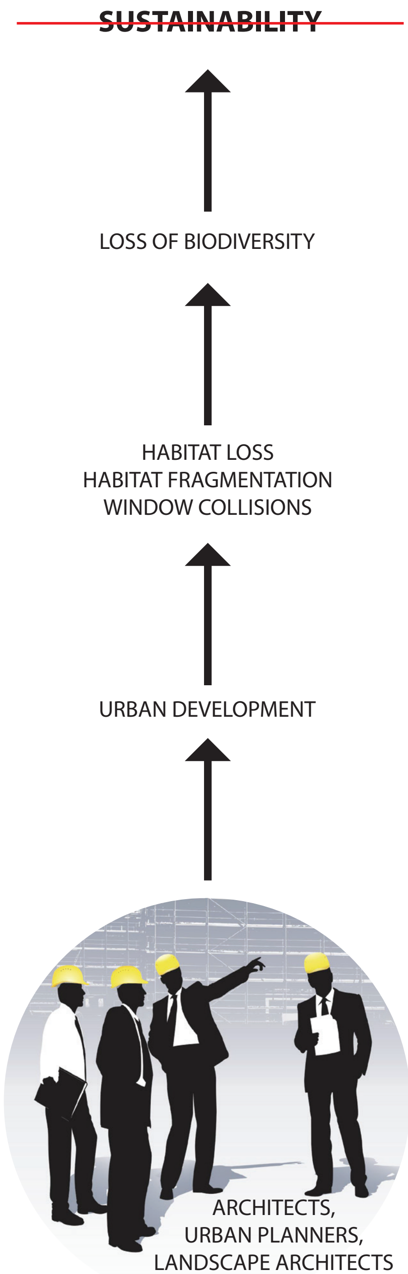


Fig. 2.IV.1 Changes from human related activities which cause threats to biodiversity


!
SAFECO FIELD

V. HABITAT LOSS IN WASHINGTON STATE

A few bird species (non-native and synanthropic) are more adapt to survival in urban environments, where vegetation is almost absent or replaced with exotic plants.

Native bird species are unable to adapt and forced to leave the area. Migratory also lose valuable stopover places along migratory routes.

Fig. 2.V.1

V. HABITAT LOSS IN WASHINGTON STATE

"To me, the top three threats to birds overall are habitat loss, habitat loss, and habitat loss ... We're losing the battle acre by acre."

Ken Rosenberg, Cornell Lab of Ornithology

The city of Seattle is located along the shoreline of the Puget Sound, on hills carved by glaciers and bordered by the volcanic Cascade Mountains to the east. Up until 150 years ago, a conifer-dominant forest with oak-savannah clusters covered the 53,000 acres of land now occupied by Seattle. In modern times, forest cover has been reduced to 3,200 acres, with only 200 acres of old-growth forest left. This number continues to decline. According to *a city forest management report*, thirty-five years ago tree canopy covered 40 percent of the city. By 2007, it had fallen to 18 percent,[39] half of the area recommended by the American Forests Association for cities the size of Seattle.[40] This reduction in forest cover has altered the natural habitat and decreased the survival of many wildlife species, and has contributed to a number of urban problems such as pollution.

The goal of this section is to analyze the effects of urbanization of Washington State on bird populations and avian biodiversity, which is vital to the thesis because of the important role the Puget Sound area habitat plays for diverse groups of local and migratory birds. The U.S. Environmental Protection Agency, among several other government agencies and scientific bodies, divides Washington State into 10 "ecoregions" or unique environmental habitats Fig.2.V.1. A habitat is the aggregate of the distinct features of a place that is a natural setting for certain features and/or organisms.[41] It includes a variety of physical elements such as vegetation, types of soil, temperature, and topography. The Seattle metropolitan area falls within a region defined as the "Puget Trough", in between the Pacific Northwest coast to the west and the north, and the west Cascades to the east (Fig.2.V.2.).

The Puget Trough, connected to the Georgia Basin to the north and the Willamette Valley to the south (Fig.2.V.4.), is part of a long corridor of valley lowlands, rainforest, and inland seas that covers 21,431 miles of the Pacific Coastal region.[42] The Puget Trough falls within a temperate climate zone with mild winters and summers and an average of about 40 inches of precipitation per year.[43] This zone has historically hosted a number of different habitats including (primarily) large coniferous forests, open prairies, wetlands, and varied rich marine environments. These habitats are integral components of the local environment, affecting rainfall and water retention, wetland maintenance and health, reinforcing the mild climate and hosting a wide variety of local and migratory wildlife.

A dominant, historical feature of the Puget Trough has been extensive coniferous and madrone forests which blanketed the region. These forests were composed primarily of Douglas firs, western hemlock, western red cedar, Pacific madrone, western white pine, Sitka spruce and big-leaf maple.[44] Before the incursion of early American settlers into the area, large old-growth forests, blanketed the lowland areas of the Puget

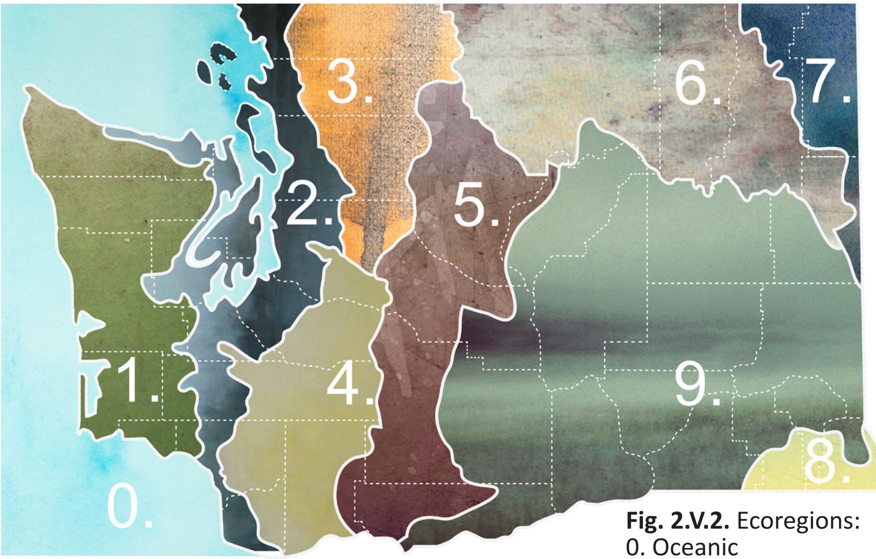


Fig. 2.V.2. Ecoregions:
0. Oceanic
1. Pacific
   Northwest Coast
2. Puget Trough
3. North Cascades
4. West Cascades
5. East Cascades
6. Okanogan
7. Canadian Rockies
8. Blue Mountains
9. Columbia Plateau

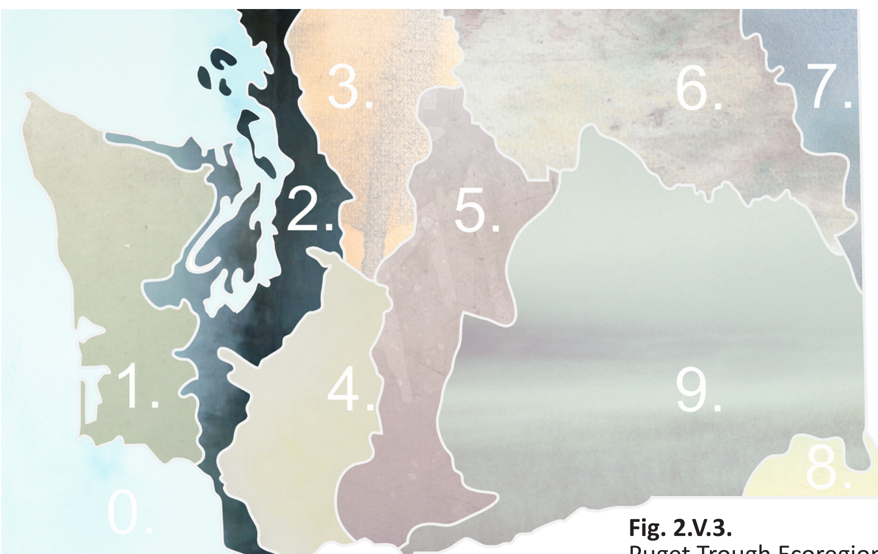


Fig. 2.V.3.
Puget Trough Ecoregion

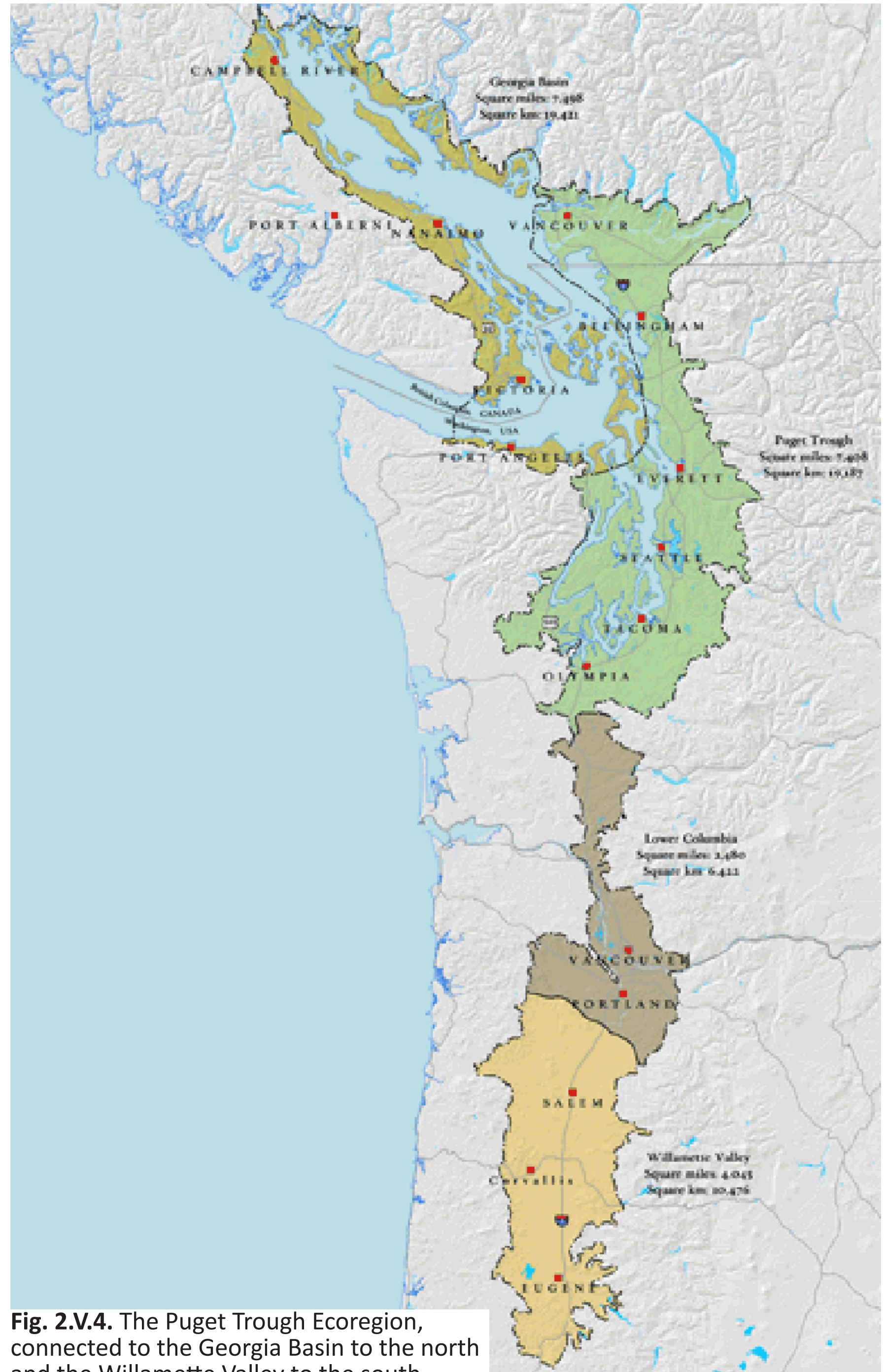


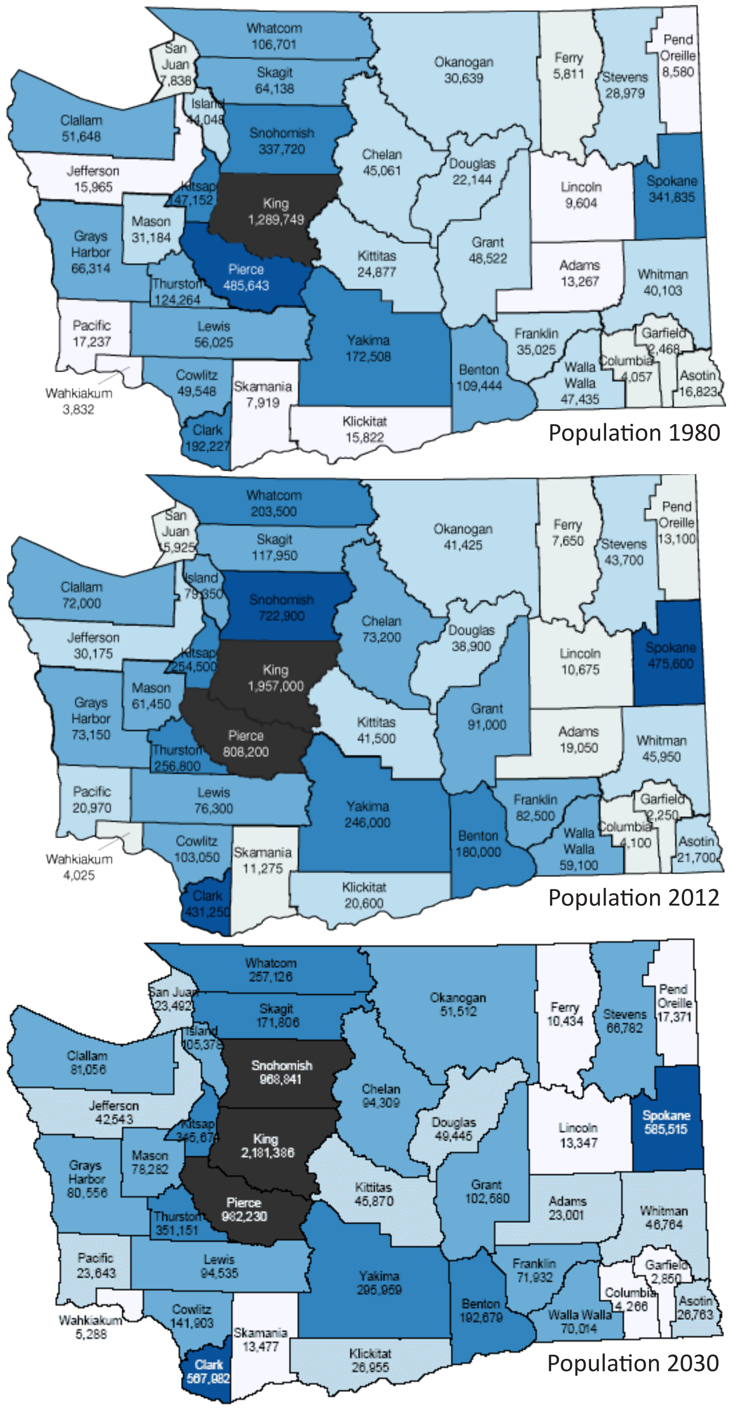
Fig. 2.V.4. The Puget Trough Ecoregion, connected to the Georgia Basin to the north and the Willamette Valley to the south.

Trough. Some tracts of trees were on average, greater than 1000 years old and stood hundreds of feet tall.[45] Despite the dominance of several large tree species, research has now shown that old-growth forests of the Puget Trough supported high levels of biodiversity for other vegetation, vertebrates and invertebrates as well as aquatic organisms.[46] Some of these species, both plants and animals, are highly adapted to and closely associated with these forests. Spotted owls, for example, require early old-growth tree forests (~200 years old) or mixed mature and young tree habitats for nesting, healthy mammalian prey populations, and particularly thrive in the temperate, damp microclimate of Puget Trough forests.[47]

Today, 70 percent of Washington State's population of almost 7 million people, (around 4.9 million people), lives within the Puget Trough region.[48] Washington State is the 18th largest state (by area) in the United States, covering 71,300 square miles. The area had only 1,201 American residents recorded in 1850 but over the following ten years, this number grew to 11,594 residents.[49] In 1910 the population exceeded one million and has continued its rapid growth since. According to The Office of Financial Management (June 30, 2014), between 2013-2014 the population increased by 85,800 people, which was the largest one-year gain since 2008.[50] Demographic forecasts predict that the state of Washington is expected to grow by an additional 2 million people by the year 2040.[51] (Fig.2.V.5) This rapid human population expansion has had a major effect on bird populations. The Puget Trough is the most affected ecoregion in Washington State. According to the Seattle Audubon Society:

> *Much of the original vegetation has been obliterated by land clearing, agriculture, logging, road-building, and settlement. Dikes, dams, dredging, draining, filling, and reinforcement of stream banks and shorelines have greatly altered the natural hydrology. Almost no old-growth conifer forest survives; the remnants are in tiny patches. Fire suppression, snag removal, clear-cutting, and other industrial forestry practices have altered the natural succession of the still-forested landscape, leading to a monoculture of even-aged tree stands with low avian diversity. Over 95 percent of the prairies of the South Sound have given way to farming and suburban sprawl. Fire suppression has encouraged native trees and exotic plants to colonize what remains of this distinctive landscape.*[52] (Fig.2.V.6)

The Puget Trough ecoregion is not the only one affected by the human activity in Washington State. All of the state's ecoregions have been affected by anthropogenic activities, creating multiple challenges for wildlife and threatening biodiversity. (Fig.2.V.7.-a.,b.: Ecoregions, Human Impact)



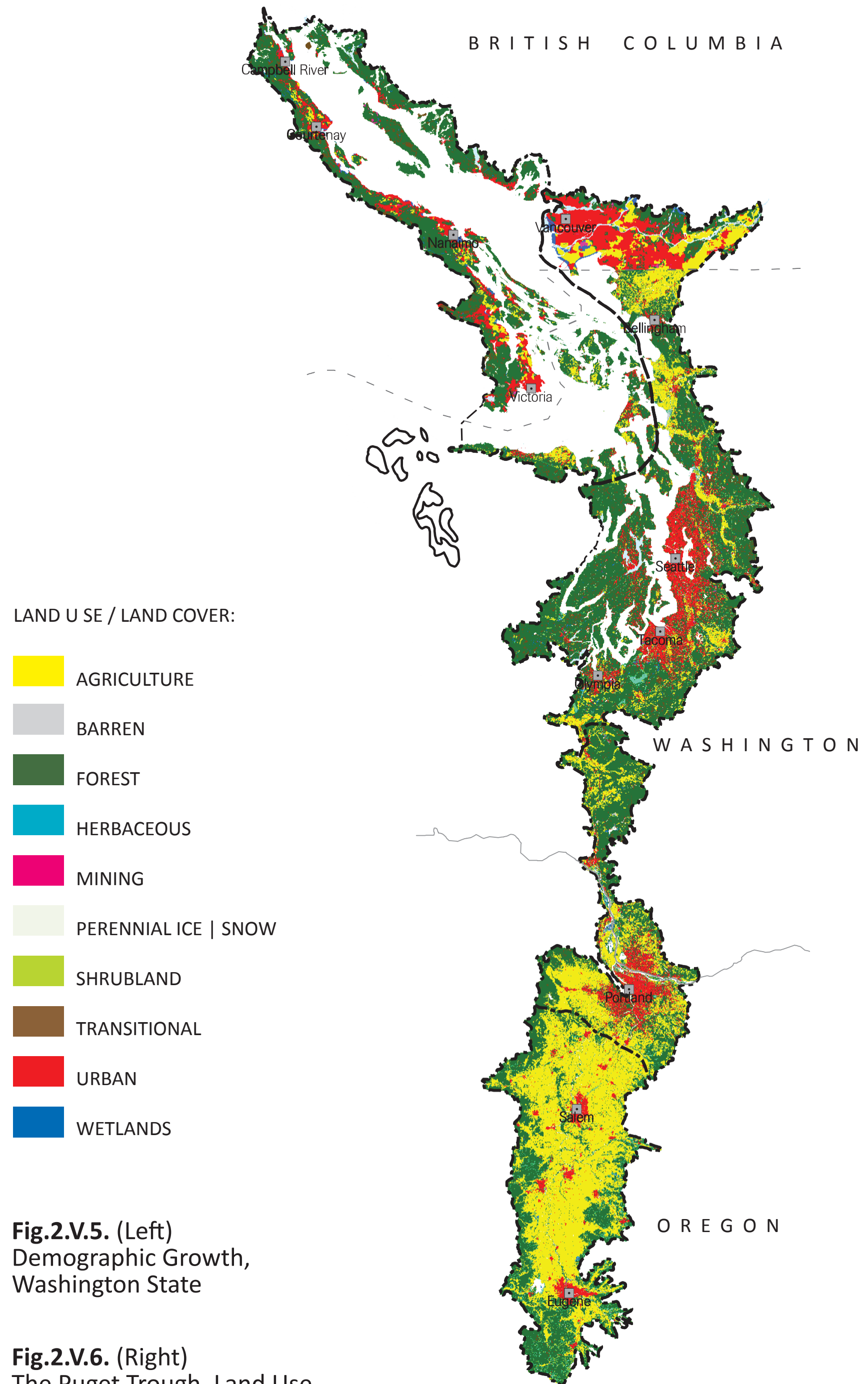
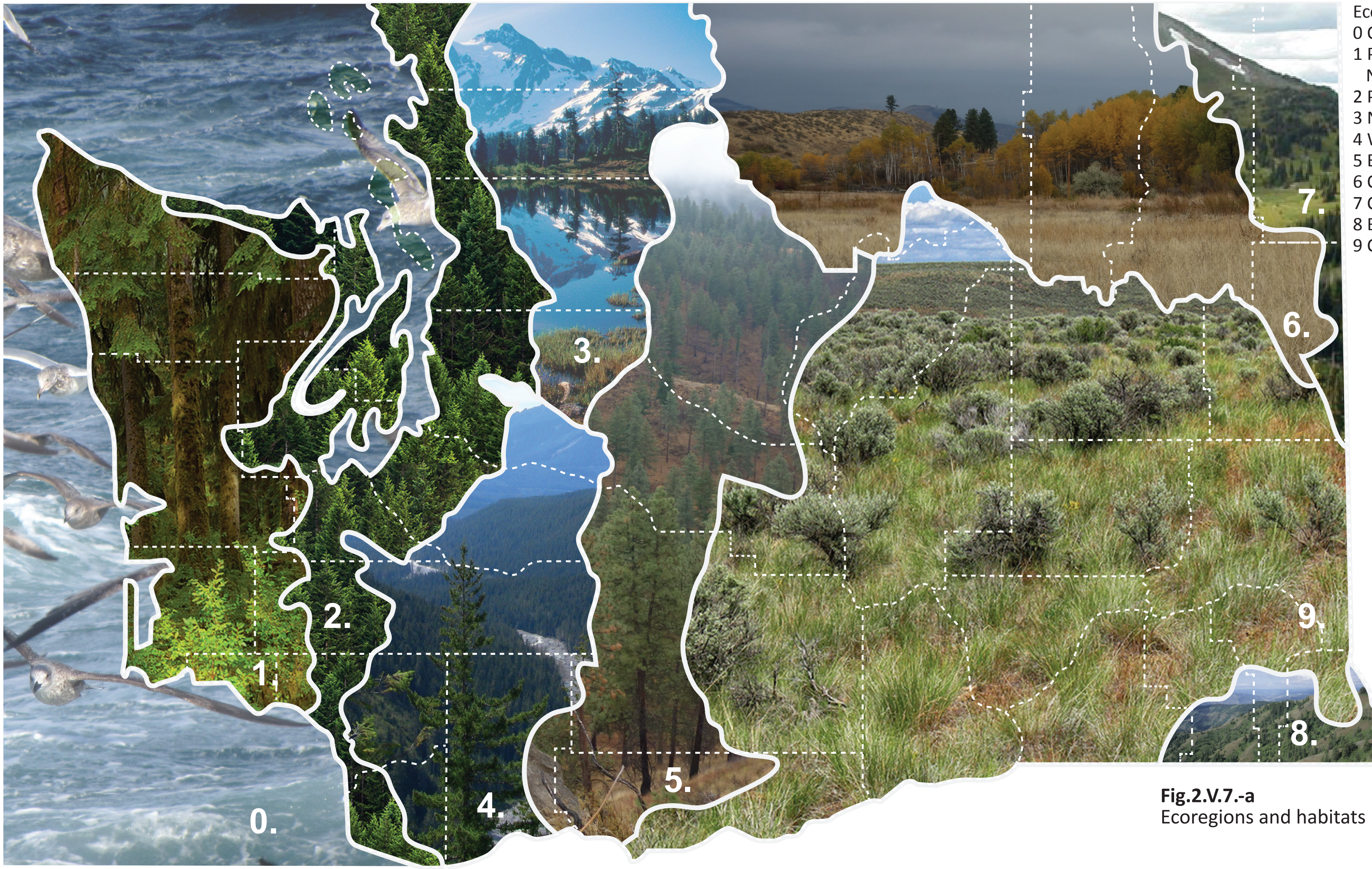


Fig.2.V.5. (Left)
Demographic Growth,
Washington State

Fig.2.V.6. (Right)
The Puget Trough, Land Use



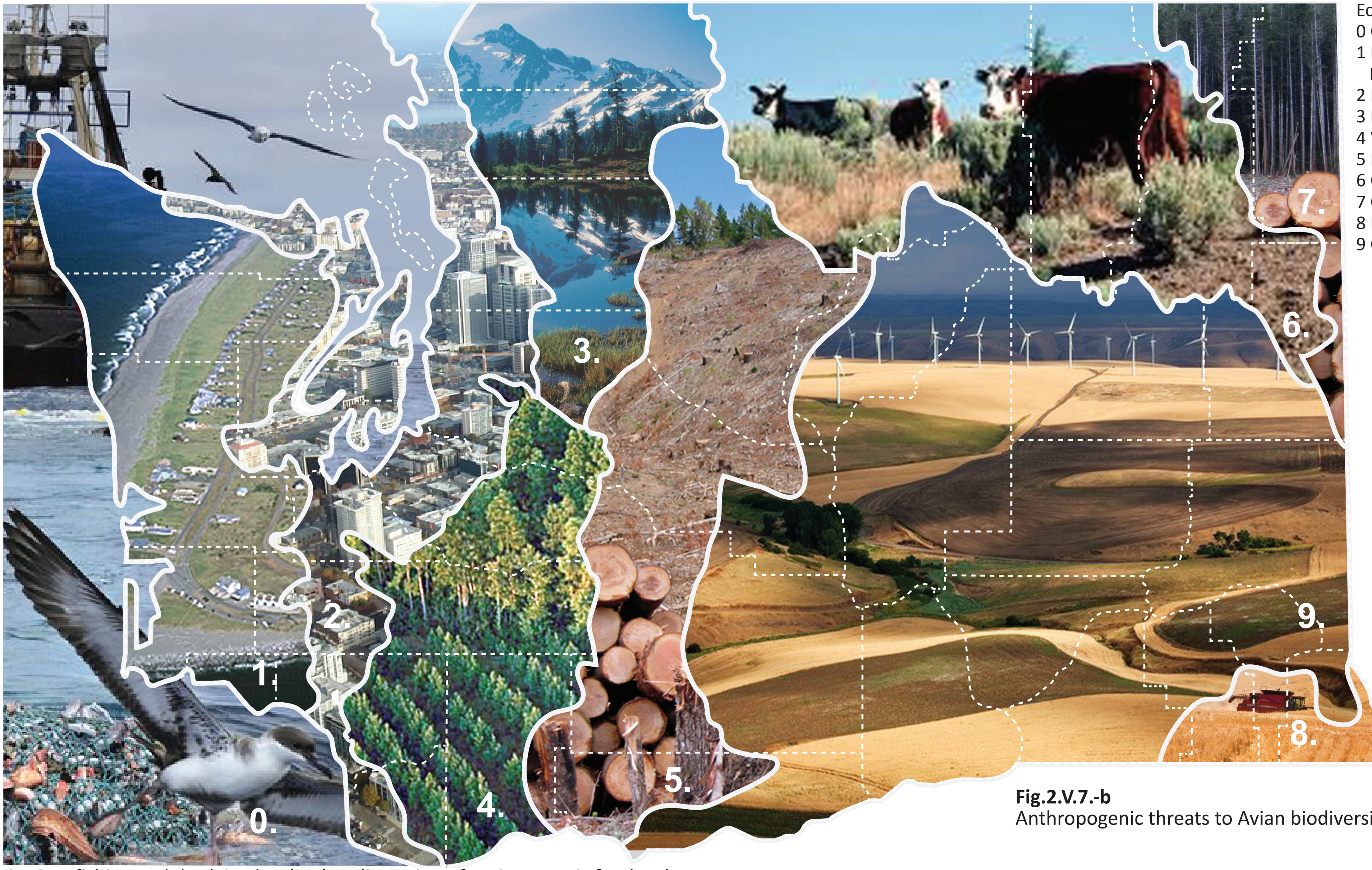
Ecoregions:
0 Oceanic
1 Pacific Northwest Coast
2 Puget Trough
3 North Cascades
4 West Cascades
5 East Cascades
6 Okanogan
7 Canadian Rockies
8 Blue Mountains
9 Columbia Plateau

Fig.2.V.7.-a
Ecoregions and habitats

0. - Aquatic and habitats traditionally rich in fish.
1. - Coniferous forests dominate the vegetation of the ecoregion with nation's greatest example of temperate rainforest at the western edge of the Northwest Coast.
2. -Rich and complex marine environment, including wide variety of deepwater and nearshore habitats.
3. - A mix of forested environments at lower, middle and higher elevations.
4. - Lowland areas (Mount Rainier National Park) covered in patches of old growth rainforest with up to a 1,000 years old trees. Subalpine areas are covered with wildflower meadows.
5. - The Ecoregion is mostly covered with Ponderosa pine forests. Low-elevations are occupied by dry forests, intersected by riparian corridors and a variety of aquatic habitats.

Fig.2.V.7.-a.,b.: Ecoregions, human impact; Changes in land Cover

6. - Alpine and subalpine meadows at higher elevations.
7. - Alpine meadows, dense coniferous forests, riparian woodlands, and rolling grasslands are all found here.
8. - Coniferous forests dominate much of the Ecoregion. At lower elevations, grasslands and patches of shrub-steppe are found.
9. - The Ecoregion is dominated by shrub-steppe, with shrubs such as sagebrush and bitterbrush. A living cryptobiotic crust of blue green algae, lichens, and mosses protects and enriches the soil, protecting them from erosion and fixes nitrogen. Herbaceous wetlands, marshes, and wet meadows, are found throughout.



Ecoregions:
0 Oceanic
1 Pacific
Northwest Coast
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3 North Cascades
4 West Cascades
5 East Cascades
6 Okanogan
7 Canadian Rockies
8 Blue Mountains
9 Columbia Plateau

Fig.2.V.7.-b
Anthropogenic threats to Avian biodiversity

0.- Overfishing and dredging has lead to disruption of entire aquatic food webs. Bycatch, debris and pollution further injure aquatic bird populations.
1.- Shoreline modifications and erosion has altered local habitats. Marine invasive species and agricultural runoff have damaged shoreline food webs.
2. - Changes in aquatic habitats reduce available food sources. Invasive species threaten shoreline habitats.
3. - The lowest human impact of any of the state's terrestrial ecoregions, with over 96% unsettled. Hydropower dams impede salmon migration and alter riparian and wetland functions.
4. - One of the most affected by human-related activities ecoregion. Extensive timber harvesting and road building has resulted in uniform aged young forests and fragmented habitats.
5. - Only 1% of the original range of ponderosa pine forests remain.
6. - Overharvesting of timber and fire suppression policies have devastated forested areas. Extensive grazing has damaged subalpine meadows.
7. - Large areas of clear-cutting, single species selection, and removal of dead trees have devastated traditional habitats.
8. - Fire suppression has lead to significant changes in the ponderosa pine and Douglas-fir forest composition. Many former grasslands have been converted for agricultural use.
9. - Agricultural conversion has resulted in losses of over 50% of shrub-steppe and 70% of previous grasslands. The area has been further impacted by hydropower dams and waterways affected by agricultural pollution and runoff.

EFFECTS OF FUTURE URBAN DEVELOPMENT ON AVIAN POPULATION

Research conducted by University of Washington professors Marina Alberti and John Marzluff predict population growth in four Washington State counties (King, Kitsap, Pierce, and Snohomish) with major metropolitan centers (Seattle, Tacoma, Everett, and Bellevue) (Fig.2.V.8.). Their research estimates the impact on the avian population and diversity over a 28-year period from 1999 to 2027, based on historic data. It factors in the decrease in mature forests, both deciduous and coniferous, from an earlier 45 percent land coverage (1999) to 27–30 percent (2027), as well as other factors of urban development known to affect bird populations.[53] (Fig.2.V.10.) The prediction is that continued declines in the biodiversity of native bird species will result in the possible loss of 24 species from Washington State (Fig.2.V.11). At the same time, diversity of synanthropic species i.e., species that are highly adaptable to and thrive in urban environments (American Crow, House Sparrow, European Starling, Rock Pigeon), are predicted to increase. (Fig 2.V.9.)

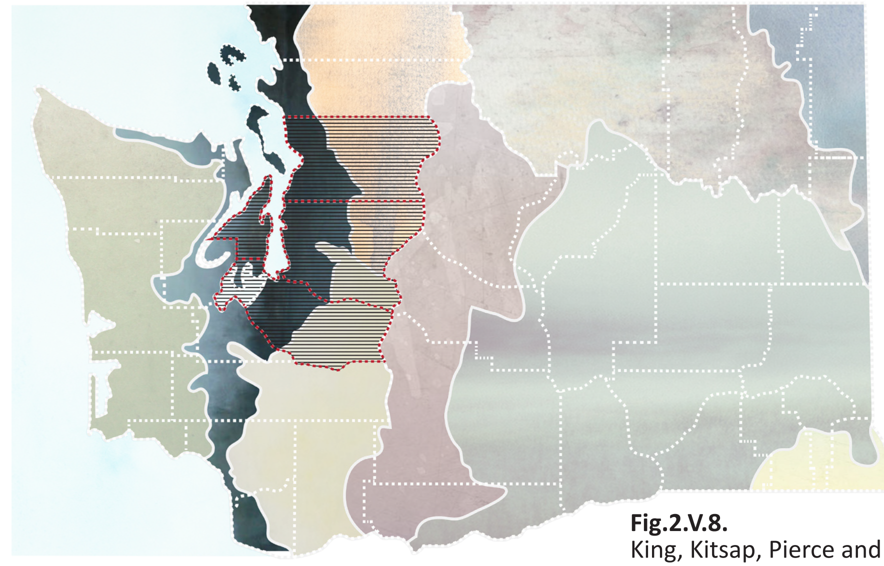


Fig.2.V.8.
King, Kitsap, Pierce and Snohomish Counties

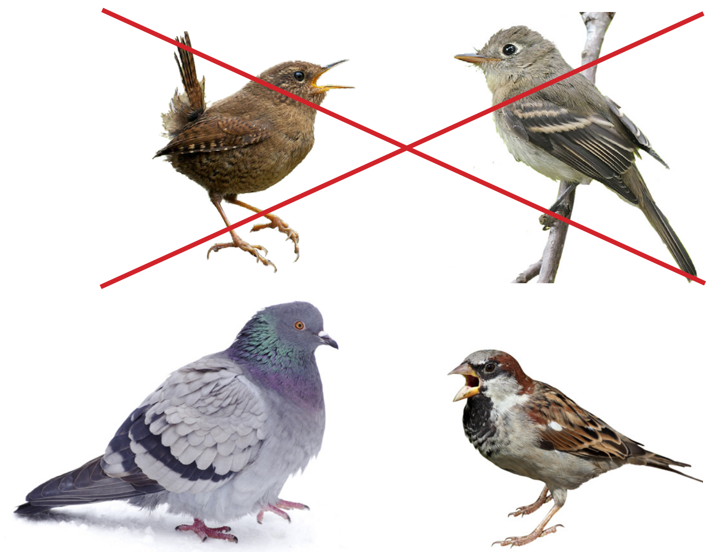


Fig.2.V.9.
Loss of native avian species (Pacific Wren, Pacific-slope Flycatcher);
Gain of Synanthropic (American Crow, Rock Pigeon) and
exotic/non-native (House Sparrow, European Starling) avian species

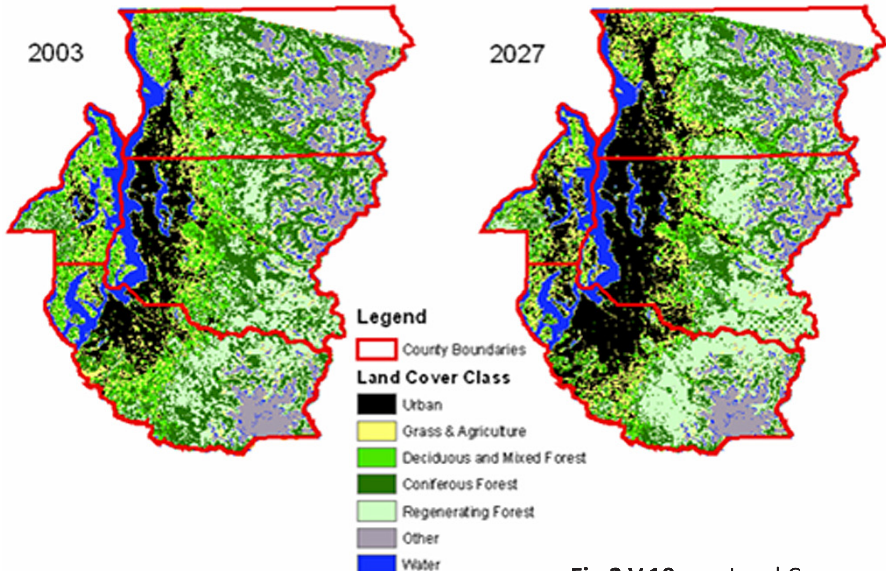


Fig.2.V.10. a. - Land Cover

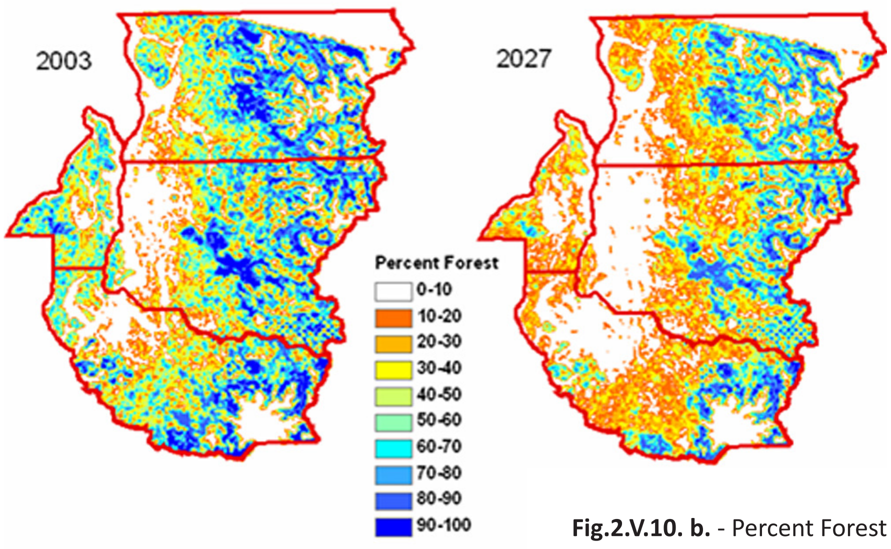


Fig.2.V.10. b. - Percent Forest

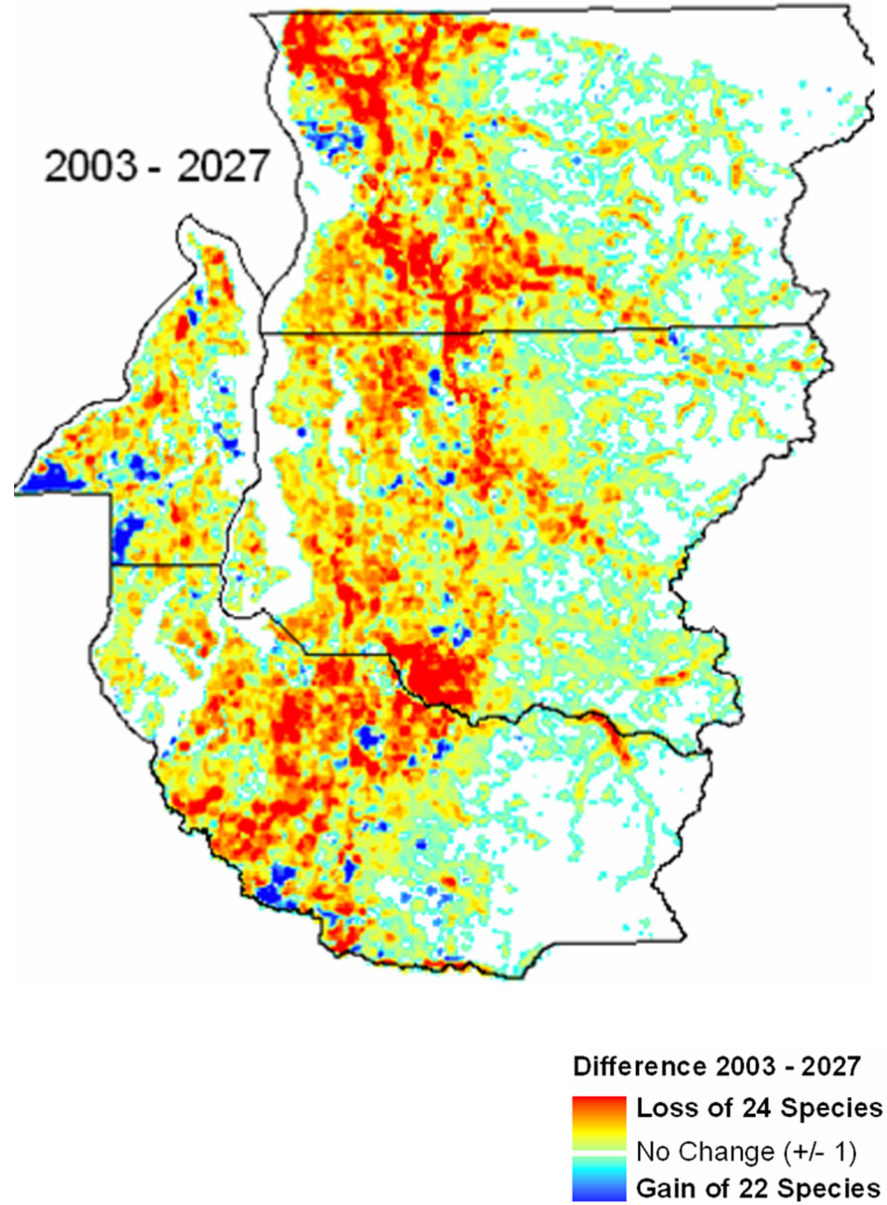


Fig.2.V.10. a,b.
Predicted changes in land cover, 2003-2027
(King, Kitsap, Pierce and Snohomish Counties.)

Fig.2.V.11.
Effect of land cover changes on native avian biodiversity, predicted loss of 24 species.

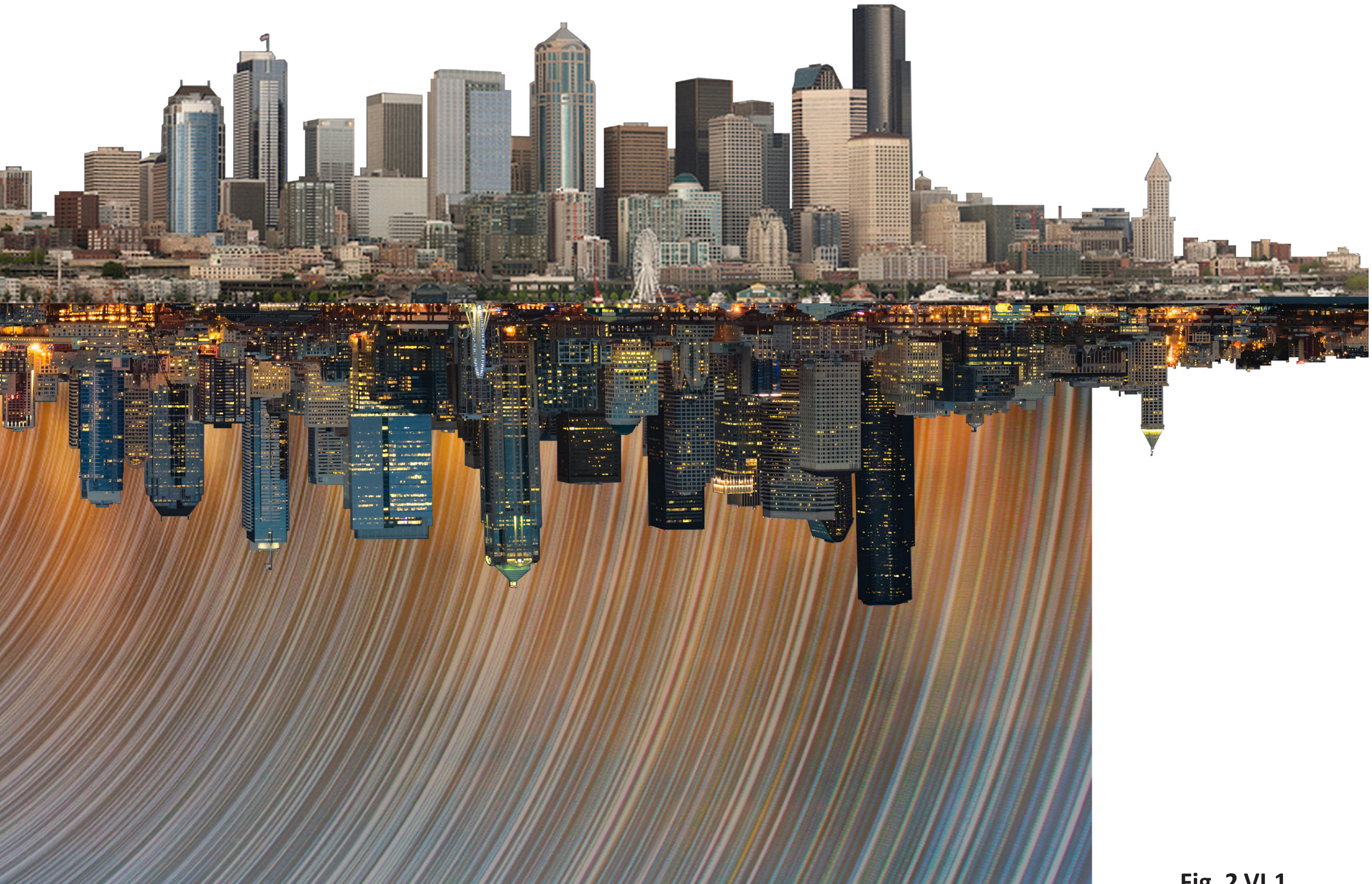


Fig. 2.VI.1

VI. BIRD-WINDOW COLLISIONS

Urban development represents a threat to local and migratory bird populations outside of habitat loss, by forming an extremely dangerous environment that they must traverse. According to Daniel Klem (one of the leading experts on the subject of bird-window collisions), buildings are the largest factor responsible for bird mortalities and population declines after habitat loss.[54] Two major factors affecting bird collisions with built structures are the presence of glass, which is invisible to birds, and the presence of artificial light sources (interior and exterior) at night.[55] In this section Why glass is so deadly to birds and how artificial lights sources lead to bird deaths will be addressed. In addition, the architectural and landscape features that further exacerbate this problem will be analyzed. Being aware of these issues is important to architects and this thesis as windows collisions are the greatest threat to bird populations within an urban setting. It is also the primary reason birds will be brought to the rehabilitation center and why the design of the center needs to stand as an example of the simple interventions that reduce this risk.

Bird collisions with glass facades or windows have been reported worldwide and throughout time regardless of the building type or location, from single-family residences in the suburbs to multistory commercial facilities in urban centers.[56] Strikes happen in various weather conditions and at different times of the day, with majority of collisions occurring during the daylight or twilight hours.[57] No correlation between the birds' age, sex, or health have been found with bird strikes. Unlike predators, who are most likely to prey on weaker individuals, collisions with glass facades or windows kill even the strongest and fittest individuals.[58] Window strikes occur with clear, reflected, or even tinted and colored panes of glass of varying height, size, and building orientation. According to Klem's research, "birds are more vulnerable to large (> 2 m^2) windows near ground level and at heights of 3 meters in suburban and rural areas."[54] 264 North American bird species have been documented in window collisions, which is 28 percent of the 947 species currently known in the United States and Canada.[54] Particularly concerning is that a number of the species which have had documented collisions in the United States include a large number of threatened species that appear on the National Audubon Society's 2007 Watch List: 6 of the 67 (9 percent) species on the Red List, and 24 of the 94 (26 percent) on its Yellow List.[59]

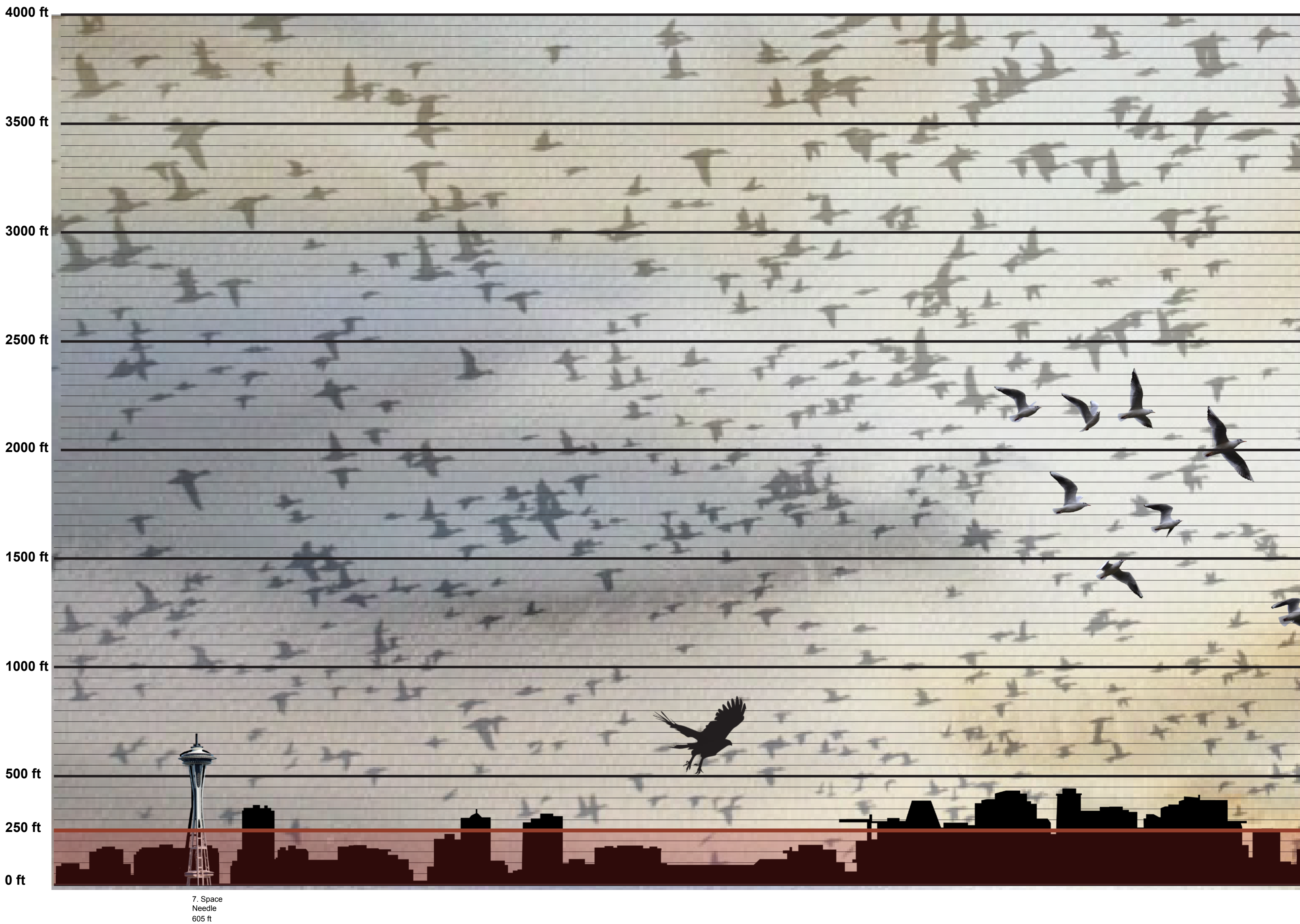
MAGNITUDE OF THE PROBLEM

The current statistics for annual bird mortality in the United States caused by glass collisions have been estimated to fluctuate between 100 million to 1 billion birds. Klem calculated this number based on the conservative assumption that 1 to 10 birds are killed per year, per every building in the United States as a result of a collision. Using the 1986 United States Bureau of Census data, he "estimated the number of U.S. buildings by assuming each housing unit (93,519,000), commercial building (3,948,000), and school (96,626) equated to 1 building each." The outcome of this calculation gave the number of 97.6 to 975.6 million window-killed birds per year in the United States[60] There is no direct evidence supporting this range but based on multiple monitoring studies conducted over the past few decades, the estimation given by Klem is generous but likely within range or maybe even conservative. Klem himself came to the conclusion that “at least 33 deaths/year resulted from window strikes at a single dwelling, and 1 out of 2 strikes resulted in a fatality.” Monitoring studies have revealed that window strikes are equally lethal for small and large species.[61] Klem compares glass-related bird mortality with the Exxon Valdez oil spill in 1989, which resulted in an estimated death of 100,000 to 300,000 marine bird deaths in Alaska. He argues that the number of deaths resulting from bird collisions is equivalent to 333 Exxon Valdez oil spills annually, even at the lowest range of estimated bird deaths. The Deepwater Horizon/BP oil spill of 2010 in the Gulf of Mexico, the largest oil spill in the history of the United States, is often cited as a “world-class environmental disaster.” That accident was responsible for the immediate death of an estimated 600,000 to 800,000 birds, which is a much smaller environmental disaster to bird species as a whole when compared to the number of window-killed birds each year, which is equal to about 130 Gulf of Mexico oil spills per year.[62]

BIRD VISION AND COLLISIONS

A “bird’s eye view” and “eagle-eye vision” are phrases often used to describe a large field or sharpness of vision. Birds heavily rely on their visual sense to survive and some species have developed unique capabilities.[63] Birds’ vision is generally sharper and less obstructed than human’s due to differences in their eye structure. First, birds have relatively large eyes in comparison to their bodies, and proportionally larger than humans. Larger eyes allow for more light to pass through which creates a larger image to be projected onto the retina. A European starling’s eyes, for example, are approximately 15 percent of its head mass, while human eyes are only about 1 percent. Many bird species also have a wider field of view: songbirds have eyes located on the sides of their heads, which provides a 360-degree field of view. Others, such as raptors, have eyes located on the front of their face in a way that the two visual fields overlap, producing binocular vision. This overlap produces a sharper field of vision while providing a 180-degree field of view, compared to human’s 120 degrees.[64]

Similar to a human eye, birds have two light receptors – rods (responsible for black and white vision in low light conditions / night vision) and cones. Unlike humans, who have three color cones (R, G, B = Trichromatic color vision), most birds have four cones (tetrachromatic color vision), which allows them to see a wider spectrum of colors, including ultraviolet. Birds also have a greater cone density which allows for greater resolution of details. The human eye has 10,000 cones per millimeter versus a songbird’s 120,000 cones per millimeter. The fovea, the area at the back of the eye with the greatest concentration of photoreceptors, contributes to the ability to focus on an object and for the resolution of the eye. The human eye can focus only on one point at a time. Many birds are “bifoveal” which means that they have two foveae in each eye, which allows them to


4000 ft
3500 ft
3000 ft
2500 ft
2000 ft
1500 ft
1000 ft
500 ft
250 ft
0 ft
7. Space
Needle
605 ft

MIGRATION ALTITUDES OF SOME BIRD SPECIES COMPARED TO THE TEN TALLEST BUILDINGS IN SEATTLE

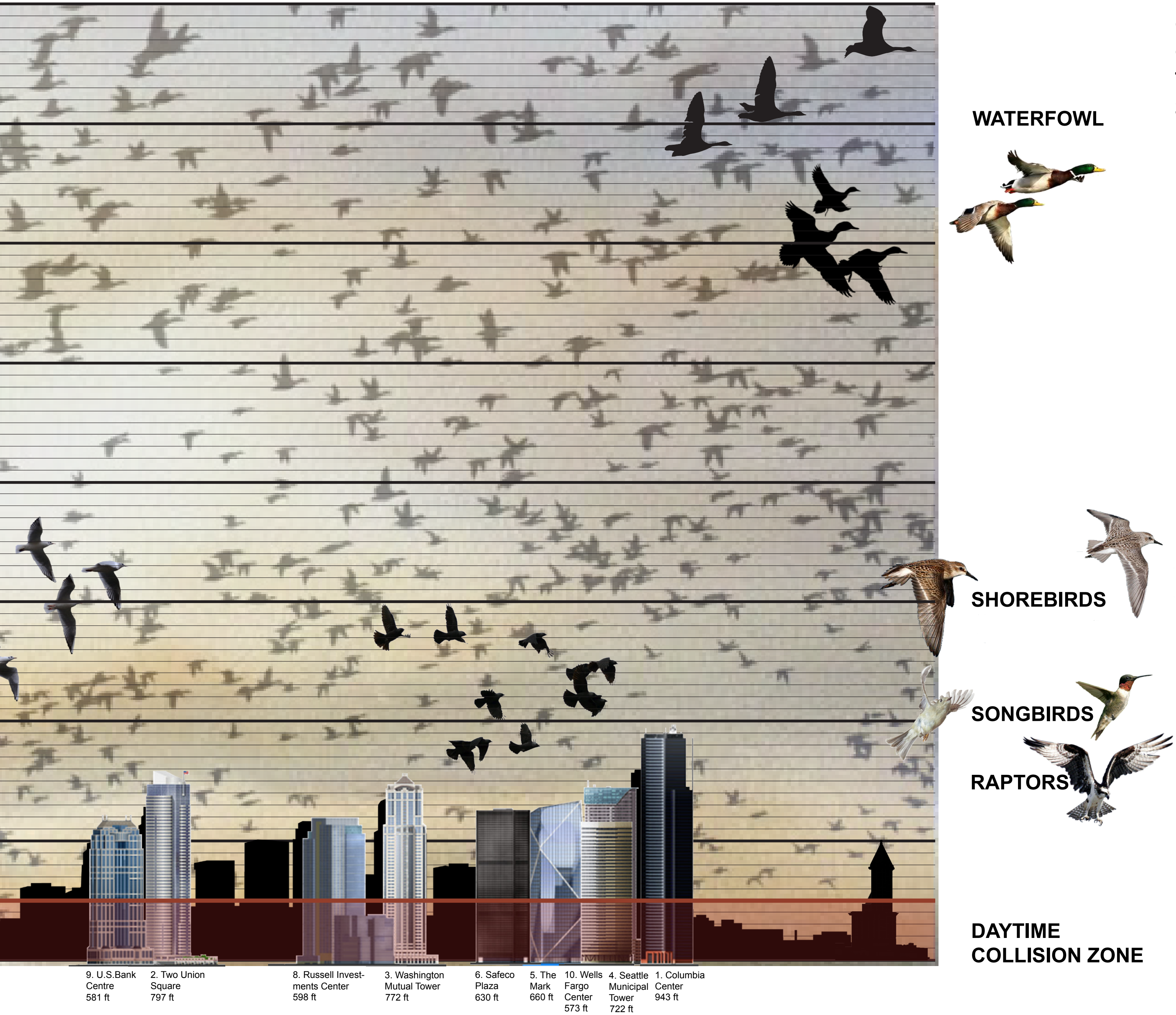


Fig. 2.VI.2

focus on two points per eye at one time, for example the horizon and prey in front of them. Some birds such as terns and swallows, even have a third fovea. The last adaptation is the pecten oculi, a distinct adaptation of birds which allows them better resolution while still maintaining the necessary, vital support functions of the eye. This places the blood vessels that provide nutrition to the retina outside of the retina instead of overlaid on top like humans, which reduces photoreception.

Despite superior to human vision, birds are unable to see or understand clear and reflective glass, especially when flying at high speeds.[65] The question is why birds, despite having much better sight than humans, collide with windows and glass facades while people do not? People also often do not notice glass well. Human collisions with architectural glass facades have a long history, with the first recorded fatality occurring more than 100 years ago.[66] The number of estimated human injuries as a result of architectural glass-related accidents in 1975, was 73,000 accidents treated in hospital emergency rooms and 2,400 people who required hospitalization. The total number of estimated injuries in the United States at that time was 190,000.[67] These estimations and public awareness led to federal legislation that enforced the use of "safety glass" in 1977, which resulted in significant reductions in serious injuries from architectural glass.[68] An additional study by the National Glazing Association in 1966, found that an average of 320,000 injuries per year resulted from people impacts with glass in doors and windows, often as a result of walking through a pane of glass in a door or facade.[69] This demonstrates that people often do not see the glass in facades, windows or doors, but instead rely on "reading" architectural clues, such as door and window frames, door handles, mullions. Birds do not recognize and understand these clues and as a result, along with their higher speeds of movement, collide with glass. A study by Stephen Hager et al. said it well:

> The problem of windows has been inferred from the human perspective rather than bird vision and flight behavior. Specifically, a flying bird understands the world via acute lateralized vision, optic flow fields, and head movements, whereas a human perceives the external environment with highly acute binocular vision in the frontal space.[70]

Awareness of this problem will help guide the design and construction of the Bird Rescue Center.

CAUSES OF COLLISIONS, ARCHITECTURAL AND LANDSCAPE FACTORS

Analysis of bird-glass collision sites has revealed some several major factors that have contributed to the high collision rates. One aspect examined is the percentage of glazed glass area compared to the overall facade. It has been found that windows with less areas of glazing compared to the area of the primary facade material, increases bird-window collision rates.[71] It has also been found that plain, unpatterned glass is invisible to birds. Any presence of vegetation or decorative plants on the interior of a building which is visible from outside, can be viewed by a bird as an extension of its habitat and promote collisions. The transparency of smaller architectural structures (glass walkways, pavilions, greenhouses, or even building corners) where natural bird habitat is present on either side of the structure and is visible through the clear glass creates a "fly-through effect." Birds do not see that there is an obstruction and continue to fly at normal speeds into the glass. Even reflective glass can present a hazard to birds. Birds seem unable to distinguish between real habitat and the reflection of a habitat in a glass facade or a window, leading to collision. In either case, the bird collides with the glazing.[72]

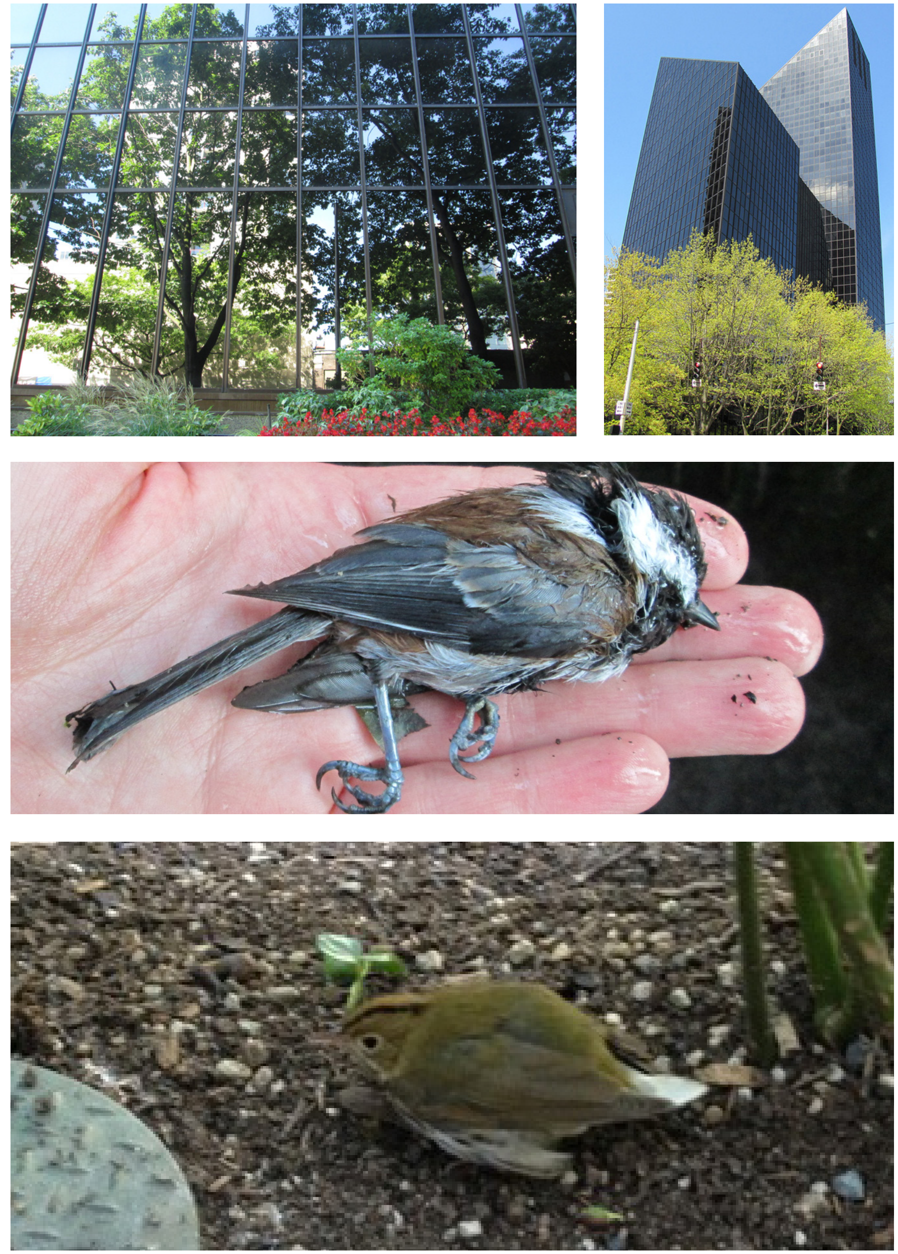
A study of the two Morgan Mail facilities in the Chelsea neighborhood of New York City, New York has also revealed the effect of buildings that sit adjacent to wooded or heavily-vegetated bird habitats. The buildings' primary facades face the un-vegetated western and southern edges of Chelsea Park, which has a non-uniform distribution of vegetation (more trees on the eastern side of the park and less on the western side, more vegetation near the southern end of the park). Twenty-eight bird collisions were recorded over a three-day period with collision rates significantly higher on those facades that reflected vegetation; one collision was recorded at the western facade while twenty-seven collisions were counted on the southern facade. Further analysis of the southern facade demonstrated relationships between reflections of highly-vegetated regions to lower-vegetated regions, with a documented collision ratio of 5:2.[73] Klem calculated the correlation between vegetation height and its reflection on adjacent building windows to the number of bird collisions. His results estimated that for every 10 percent increase in ground cover or tree height, the amount of recorded collisions increased by 13 percent and 30 percent respectively.[13]

Brightly-lit urban centers, including interior lights left on at night and upward-directed street light fixtures, any other sources of artificial lighting (especially red – constant or blinking) have been known to attract and disorient birds, making them vulnerable to collisions. The majority of songbird species migrate during the night and many of these large groups of birds have been known to fly at lower elevations.[74] A majority of their natural north-south migratory routes lie over what are now brightly-lit human cities and towns. A correlation between levels of light emission by a particular building and the number of bird collisions has been supported by several studies showing that artificial light from buildings at night has a significant impact on bird mortality.[75] The highest levels of collisions occurring in North America are naturally found during spring and fall migration periods.[76] Peak migration periods for North America occur between March and May in the spring, and between August and October in the fall, and peak bird deaths as a result of bird collisions also occur during this period of time.[77]

HAZARD 1: REFLECTION OF VEGETATION

One Union Square Building, Seattle; reflective glazing with multiple bird imprints.

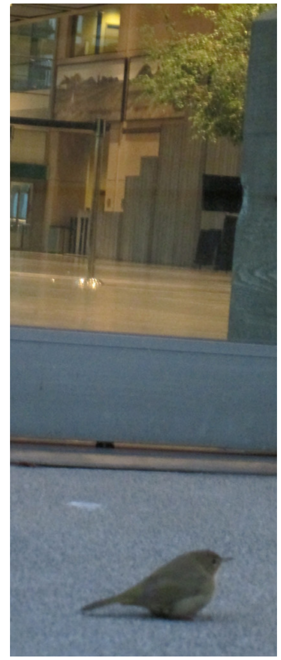
09.18.14, 08.05 a.m. 8th Ave. and Stewart st., Seattle
Dark-eyed Junco, Problem: reflective glazing.



Blanchard st.&4th Ave.;
Problem: Reflective curtain wall façade and reflection of vegetation.
09.15.2014, 07.20 a.m. - Chestnut-backed Chickadee
09.29.2014, 12.00 p.m. - Ovenbird

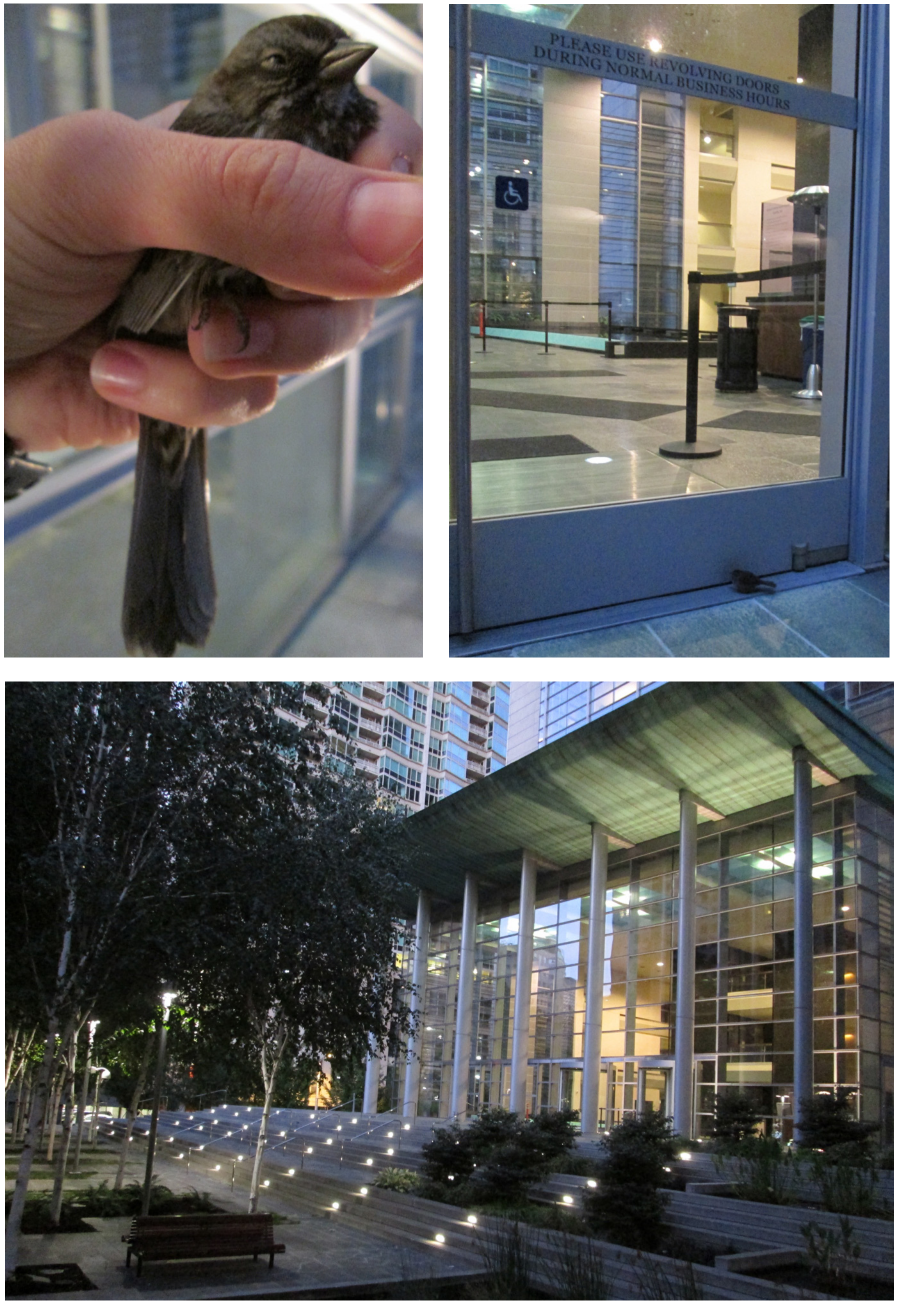
Fig. 2.VI.3

HAZARD 2: VEGETATION BEHIND TRANSPARENT GLASS.



09.21.2014, 06.50 A.M. Stewart st. and 8th Ave., Convention Center
Common Yellowthroat (stunned) **Fig. 2.VI.4**

HAZARD 3: LIGHTING



09.20.2014, 06.30 a.m. Stewart St.and 8th Ave.
Courthouse Building.Song Sparrow (stunned)

12.13.2014, 08.00 a.m. International District, Office Building
Black-capped Chickadee

Fig. 2.VI.5

HAZARD 4: FLY-THROUGH EFFECT

09.28.2014, 08.20 A.M. Seattle Art Museum.
Northern Flickr

09.18.2014, 08.05 A.M. Western and Columbia St.
Chipping Sparrow

Fig. 2.VI.6

HAZARD 5: WEATHER CONDITIONS, FOG

09.21.2014, 06.50 a.m.; Lenora st.and 6th Ave.;
Fox Sparrow; Problem: Highly-Reflective Façade, heavy fog

10.05.2014, 08.50 a.m.; 5th Ave. and Cherry st.; Columbia Center
Common Nighthawk; Problem: Reflective Façade, fog

Fig. 2.VI.7

Fig. 2.VI.8.
Dead migratory birds collected in Toronto's Downtown Financial District by the Fatal Light Awareness Program (FLAP) during one migration season.

CONCLUSION

Rapid human population growth, increasing urbanization of the land with an accelerated rate of development, along with the current architectural trends of extensive use of glass, will likely continue the trend of high bird mortality in the near future due to window collisions. Though a wide knowledge of the causes of bird-window collisions exists and while the solution in some cases may be fairly easy to achieve, many problems are inherent factors of bird evolution and development combined with the extensive use of glass, reflective surfaces, and artificial lighting by humans. It is unlikely that every problem facade or artificial light can be changed worldwide but some changes, such as reducing artificial light pollution at night, especially on street lamps and with large buildings, is achievable. Continued research on those things that make glass or human-made structures more visible to birds or encourage them to avoid them, will further mitigate unnecessary bird deaths and help to stabilize declining bird populations. Visitors to the Bird Rescue Center will be exposed to this research on bird collisions through both exhibits that explain and demonstrate the problem to the general public and professionals, as well as solutions implemented in the center's design.

THE STATE OF URBAN THREATS IN SEATTLE

In Seattle there are no bird-friendly design guidelines, no monitoring systems to evaluate bird collision deaths, and no lights out program during migratory seasons. Osprey platforms and bird proofing of wires are the only interventions that have been implemented.

"Architects and their clients can use all the recycled material they want, they can save all the energy they want, but if their building is still killing birds, it's not green to me."

Dr. Daniel Klem,
Muhlenberg College,
Audubon, Nov-Dec 2008

ACTIONS TAKEN BY OTHER STATES:

1. - Guidelines for Bird-Friendly Building Design

2. - LEED Pilot Credit PC-55: Bird Collision

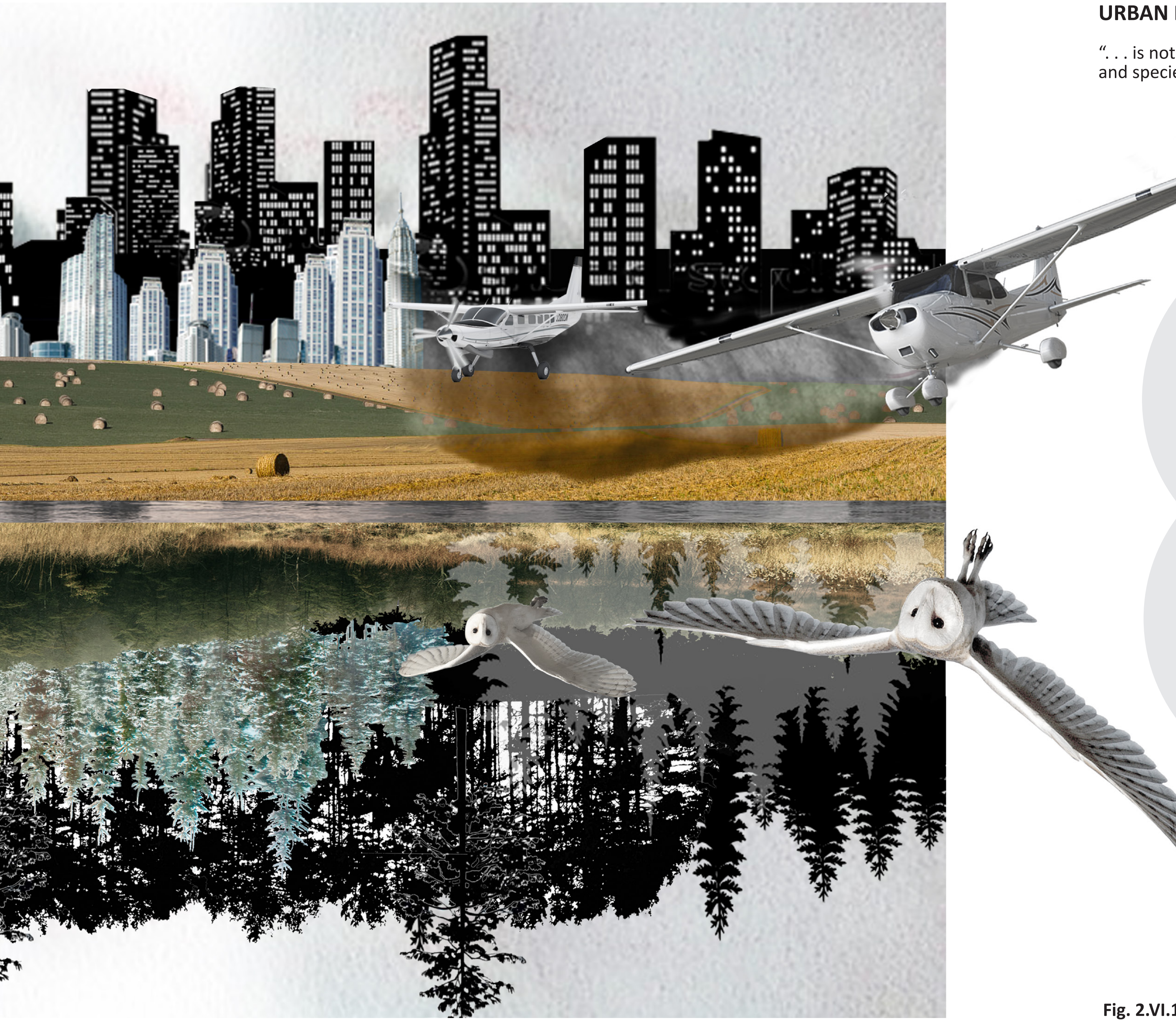
3. - "Lights out" program during migration season

Fig. 2.VI.9.

URBAN NATURE CONSERVATION

“. . . is not so much about saving natural habitats and species as about living with wildlife.”

Nature Conservation, London



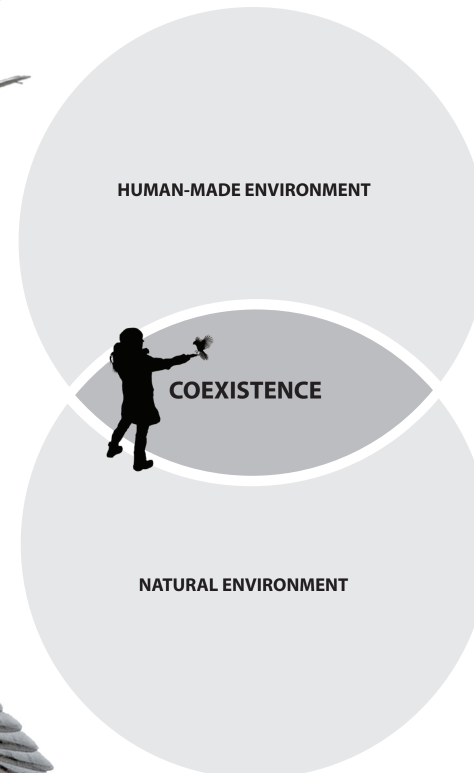


Fig. 2.VI.10.

VII. BIRD RESCUE AND REHABILITATION CENTERS

The Bird Rescue Center will serve many important roles on the local, state and even national level in addressing the issue of human-made habitat destruction and unnecessary wildlife deaths in urban environments. Educating the general public as well as professionals about these issues will be accomplished through public outreach to include lectures, exhibitions, interactions with professional groups (AIA, engineering associations, etc.) as well as engagement with public schools and universities. Through participation of the rehabilitation of injured birds and public demonstration of the local scale of unnecessary bird deaths due to collisions, the Center will make the issue more real than an advocacy group alone could do. This public engagement will hopefully result in both grass-root changes in building practices but also foster the creation of building and professional practice guidelines and even state and federal laws, that will implement design strategies that support biodiversity.

As indicated earlier in this thesis, collisions with human-made structures (particularly glass) is the second leading cause of bird deaths, killing up to 1 billion birds a year.[78] Glass is particularly deadly to birds as it is abundant in human developments but birds have not, until recently, had any evolutionary pressure to adapt to its presence. The greater the bird population or amount of habitat nearby a group of buildings, the greater the mortality threat. Birds collide with glass due to several problems related to qualities of glass which are only contextually understood by humans. The reflections cast by most glass are a copy of the surrounding environment, so birds mistake the surface of the glass as a continuation of the surroundings. Shadowed patterns in glass are sometimes mistaken for small holes or gaps in leaves that birds can fly through, also resulting in collisions. Transparent glass walls or windows (such as sky-bridges) can reveal unopposed views of areas on the opposing side, leading birds to try flying through the area due to its perceived openness. Lastly, light from buildings at night has also been noted to attract birds, particularly migratory birds, enticing them into collisions.

The mechanism and types of injuries that birds suffer from collisions is easily understood. Birds flying at relatively high velocities collide with a solid object (glass), with the momentum of the bird being converted into deforming forces across its body. In windows strikes, the head is normally the first thing impacted but despite common assumptions, death is not normally caused by a “broken neck.” In fact, research has shown that only 10 percent of birds that die due to window collisions had any fracture whatsoever.[79] Instead, most birds die a few hours after a collision due to bleeding around the brain, leading to swelling and destruction of brain architecture. Larger birds are at greater risk of bleeds deeper within the brain and spinal canal but are no more or less likely to die. Unlike many natural survival pressures, window collisions equally kill young and old, strong and weak, as well as male and female birds. If stunned but not initially killed, some birds with brain swelling and bleeding can be saved if the intervention occurs early enough.

In areas that have bird rehabilitation centers or veterinary schools, wild birds that have sustained injuries due to human activity have a better chance to be saved and rehabilitated. The general goal of bird rescue centers is to treat and restore health to injured or orphaned birds in order to release them back into the wild. In order for this to be effective, an intake process identifies birds with injuries that may be survivable, provides appropriate medical care, then places the birds in a safe environment to allow healing. Most centers strive to keep birds with the same or similar species and avoid over-exposure to humans to increase their chance of a successful release. If a bird progresses, it is often placed in a more open cage or aviary to increase activity. With further improvements, birds are prepped for release. A certain number that don't improve are kept for educational purposes, either for science and veterinarian medicine students or the general public. Facilities that publish statistics on the successful rehabilitation and release of birds, such as the Raptor Center at the University of Minnesota, show a success rate of around 40 percent of all birds admitted.[80] While these facilities provide a helpful service to injured birds, it does not even begin to mitigate human caused injury and death, which is why an educational component is also needed.

Bird rehabilitation centers not only help to protect and rehabilitate local bird populations, but they also serve as centers for learning and the promotion of wildlife conservation. Facilities close to veterinarian schools give students the opportunity to work with university staff on real cases while gaining exposure to non-domesticated species. This training not only serves a practical purpose (gaining experience), but also encourages future veterinarians to become more active in wildlife protection. Veterinarian tech and other science students gain the same benefits from the presence of rehabilitation centers. In addition, local volunteers who want to learn more about birds or participate in conservation efforts, gain a focus to apply their desire and energy. Most centers have a standardized teaching curriculum that promotes an avian-centric philosophy of doing no harm, while helping birds for their own sake. They provide basic training in bird biology and behavior, nutritional and other needs, and the basics of bird care. Some centers additionally train long-term volunteers to be outreach speakers and educators. These volunteers help teach a philosophy of bird awareness and conservation in surrounding communities, often with injured bird ambassadors that are otherwise too injured to be released.

Educating the general public about birds, urban threats and means of conservation are some of the primary benefits that rehabilitation centers provide. Most individuals see birds at a distance or only note them as a feature of the surrounding scenery. Interacting with them closely and understanding more about them provides greater insight into their lives and helps the general public recognize their value. Through greater understanding, conservation becomes more important. It is likely that most of the public is not aware that window collisions are the single greatest risk for birds in an urban environment. Without greater understanding or a personal connection to birds, even if they do know, altering urban environments or creating laws that promote protection is not a priority for the public. Research has shown that simple changes, such as patterned or opaque glass or the addition of simple flourishes to windows, can greatly reduce the risk of bird collisions.[81] By creating a connection between the general public and architects with birds and educating them about these threats, protecting birds would likely become a greater priority.

Increased awareness and valuation of bird species also inevitably leads to greater personal support of environmental protection and involvement. One example of this is process in action is a group called Ducks Unlimited. An international non-profit formed in 1937 of primarily waterfowl hunters, the groups' mission is to protect and conserve waterfowl habitat in order to maintain healthy bird populations. The group was formed in response to the devastation of waterfowl populations in North America as a result of early twentieth century development, habitat destruction, and over-hunting. Today, the group has over 600,000 members and has helped place over 13 million acres of land into an environmental conservation status.[82] While the group promotes hunting, they do so only in the setting of healthy and sustainable populations of waterfowl. Other public initiatives, such as the Audubon Society's annual Christmas Bird Count, encourages public participation in large-scale science projects which further increase awareness. Over the 2013-2014 Christmas season (the 114th annual count), over 70,000 United States citizens participated in a national bird survey, resulting in data that is vital to many scientific studies and to tracking and promoting conservation efforts.[83] These efforts also help urban citizens to connect and foster appreciation of nature, furthering the cause of general wildlife conservation. In a study published in 2015 titled, "Are wildlife recreationists conservationists? Linking hunting, birdwatching, and pro-environmental behavior," Caren Cooper et al. concluded: [84]

> *We found wildlife recreationists—both hunters and birdwatchers—were 4–5 times more likely than nonrecreationalists to engage in conservation behaviors, which included a suite of activities such as donating to support local conservation efforts, enhancing wildlife habitat on public lands, advocating for wildlife recreation, and participating in local environmental groups. Moreover, effects were additive; hunter–birdwatchers had the greatest likelihood of engaging in all types of conservation behaviors.*

VIII. CASE STUDIES AND DESIGN PRECEDENTS

This section of thesis provides examples of buildings and programs that have provide medical services to injured birds, have implemented building features that reduce the risk of bird collisions, or blend into their environment more seamlessly. These include bird rehabilitation centers as well as bird advocacy and birdwatching centers. The major lessons learned from these precedents influences the design choices of the University of Washington's Bird Rescue Center. There are also examples of design features which provide nesting sites or some other support to local bird populations while also having aesthetically appealing design.

Minnesota Raptor Center
Location: Minneapolis, MN

Wildlife rescue and rehabilitation centers are generally considered to be places that provide medical treatment for orphaned, sick, and injured wildlife. Another core component they provide however, is an educational role that is mutually beneficial for the center and the public. The Minnesota Raptor Center is located on the main campus of the University of Minnesota and was founded as a student group by veterinary medicine students and interns at the College of Veterinary Medicine. The center did not initially include a public education role in its mission, instead focusing on raptor care and practical experience for university students. Its first outreach programs were presented for adult groups and were created out of a need for donations to maintain the rehabilitation program and sustain research.[85] A second wildlife rehabilitation center that admits a variety of animal species, is now located in Roseville, MN and is an extension of the program of the Raptor Center. Today the centers provide internship opportunities for almost 50 veterinarian or biology students every year.

The Wildlife Rehabilitation Center of Roseville, handles an average of more than 7,300 animals each year while the Raptor Center admits about 650 birds of prey annually, accounting for nearly 70 percent of all animals. The wildlife center treats around 200 different animal species annually, one-third of which are small mammals such as cottontail rabbits, raccoons and squirrels. The remaining two-thirds are mostly small birds. About 50 percent of all animals received are ultimately released back to the wild, 25 percent die, 12 percent are euthanized, and the remainder are transferred to other rehabilitation facilities.[86] An estimated 80 percent of the animals admitted to either center are due to injuries directly or indirectly caused by human activity. This includes domestic animal attacks (about 10 percent of animals treated), window or structural collisions, car accidents, habitat destruction and poisoning.[87]

Fig. 2.VIII.1

Grange Insurance Audubon Center
Architects: DesignGroup, 2009
Location: Columbus, Ohio, USA

The Audubon Center is located right next to downtown Columbus, Ohio. There were several reasons behind this unusual, urban location. The first was the hope that the location within the city would make the facility more central, to encourage urban residents to visit. The other hope was that at least one of out of every four children in the metropolitan area would be able to visit the center, thereby building a connection with nature and birds at an earlier age. The program for the Center includes multiple classrooms, a flexible multi-purpose room, administrative offices, a gift shop, an exhibition space in the large lobby and areas for bird watching. The Audubon Center is located on land formerly used for warehouses as well as asphalt and concrete production. Through ecological restoration and site improvements, it is now designated as an "important bird area," a place officially recognized and protected as essential for the survival of bird species. It is nestled against the edge of a forest on its south and west sides, creating intimate spaces which draw visitors outside to connect them with nature. A custom ceramic frit pattern covers glass windows on the building, which was developed through studies of bird-friendly building guidelines to prevent bird strikes.

Fig. 2.VIII.2.

Tåkern Visitor Centre
Architects: Wingårdhs Architects, 2008
Location: Sweden

Visitor centers are designed with the goal of educating visitors about a specific place or subject. The design of a visitor center related to geology or the natural sciences usually emphasizes the strong connection between the building and the surrounding site or subject matter. The architecture is not the dominant feature of the site, but should be harmonious with the surrounding environment and enhance visitors' experience. The Tåkern Visitor Centre complex consists of a visitor's center, a service building and a birdwatching tower. The tower is located alongside the waterline of Lake Tåkern, which is a protected bird sanctuary providing nesting grounds and habitat for more than a hundred species of birds. The building takes an organic form whose roof and walls are thatched with golden reeds. These additions provide temporary hides for bird-watchers while providing nesting materials and hiding places for small birds. The large, public lobby of the center provides scenic views and also functions as a bird hide. Through a series of strategically selected, framed views overlooking Lake Tåkern, the center provides a birdwatching experience from a cozy and warm interior space while also encouraging interaction with other birdwatchers. This modern building does not dominate the site, drawing-away all the visitors' attention, but rather stands in harmony with the surrounding landscape, framing and enhancing natural elements.

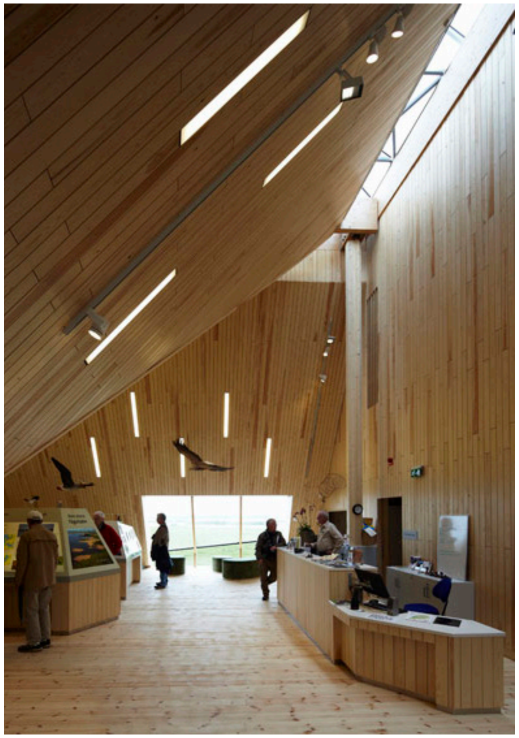


Fig. 2.VIII.3

Urban Ecology Center, Riverside
Architects: The Kubala Washatko Architects, Inc. (TKWA), 2004
Location: Milwaukee, Wisconsin

The Urban Ecology Center is a non-profit organization in Milwaukee, Wisconsin dedicated to educating the community about urban ecology and environmental stewardship. In 2004, the Riverside Park branch of the organization opened their new Urban Ecology Center “Green” building, incorporating the latest sustainable and green design techniques on a lot nestled into the forested park. On site is Wisconsin’s largest solar array and a visitor’s and educational center which include auditoriums, exhibit areas, a live animal center, a 40-foot climbing wall and green roof gardens. Despite many innovations in the design of the center, the most successful aspect of the new facility is its connection to the outdoors. The design dissolves boundaries between outdoor and indoor spaces and encourages the exploration of different spaces, both inside and out. The complex seems integrated into the site as a functional part and is itself a section of the local ecology.

Fig. 2.VIII.4

Bird park (Parc Des Oiseaux)
Architects: Tectoniques, 1998/2005
Location: Villars-les-Dombes, Ain, France

Birds from four of the world's continents can be found at the Parc Des Oiseaux (Bird Park), in Villars-les-Dombes, France. This bird park is home to more than 3000 individual birds from around the world, on display on 35 hectares over park space. The park but has 3 major functions: as a tourist destination to observe birds from across the world; as a recreational facility with organized activities based around environmental or bird themes; species conservation and preservation, through the public education as well as the breeding of endangered bird species. The birds of the facility are surrounded by elements of their original habitat, including native plant and tree species from their countries of origin. In order for the public to be able to view the birds while still allowing the birds to live in semi-freedom, the Tectoniques' architects created a series of walk-in aviaries, where birds can fly freely. In addition, large reflecting pools for water-loving birds were constructed in front of the visitor's center, enabling visitors to observe the birds from a close distance.

Fig. 2.VIII.5

Brike – piKs Design

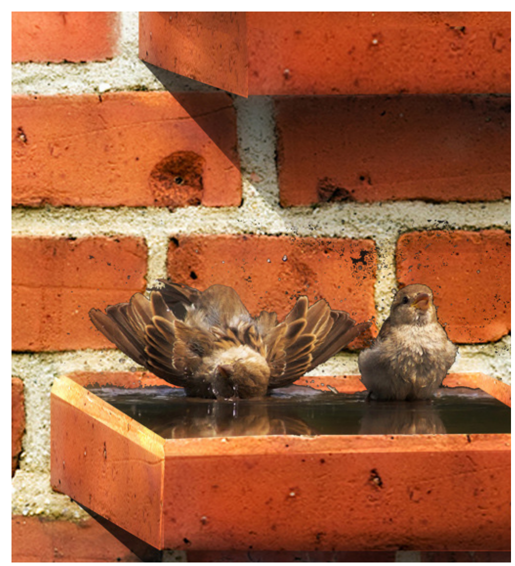
This line of modular bricks for birds, insects and plants called “Brike,” was designed by French architects Pierrick Taillard and Christine Cordelette (piKs Design). Integrated into the facade, the brick design elements provide shelter, food, and safety for urban birds and insects, transforming barren walls into an urban micro-ecosystem. Made from natural materials (clay, sand and water) the bricks are safe for people and birds. The Brike system has a number of options, leading to numerous nest systems for different bird species. In addition, it allows for customizable facades that can create unique aesthetic values in different settings. Birds, favorable insects (bees) and plants brought together can sustain a natural cycle of pollination and pest control in an urban environment, enhancing biodiversity.[88] This modular unit goes beyond fashionable trends in sustainable architecture and truly accounts for a natural ecosystem.

Creature Code - Ulf Mejergren Architects (proposal)

“A series of smaller projects to make life easier for urban critters”

- Tokyo, Japan, 2012

This proposal includes a modular system of wall additions which provide shelter, places for nesting and water baths for urban avian populations. Much of the water in downtown areas is chlorinated for sanitation reasons, which makes it largely unusable for birds. This system provides small pools that collect rainwater for drinking and bathing by urban bird populations. In addition, other elements create shaded perches and nesting platforms.



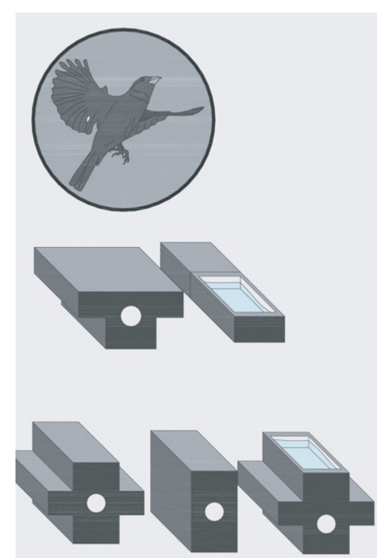
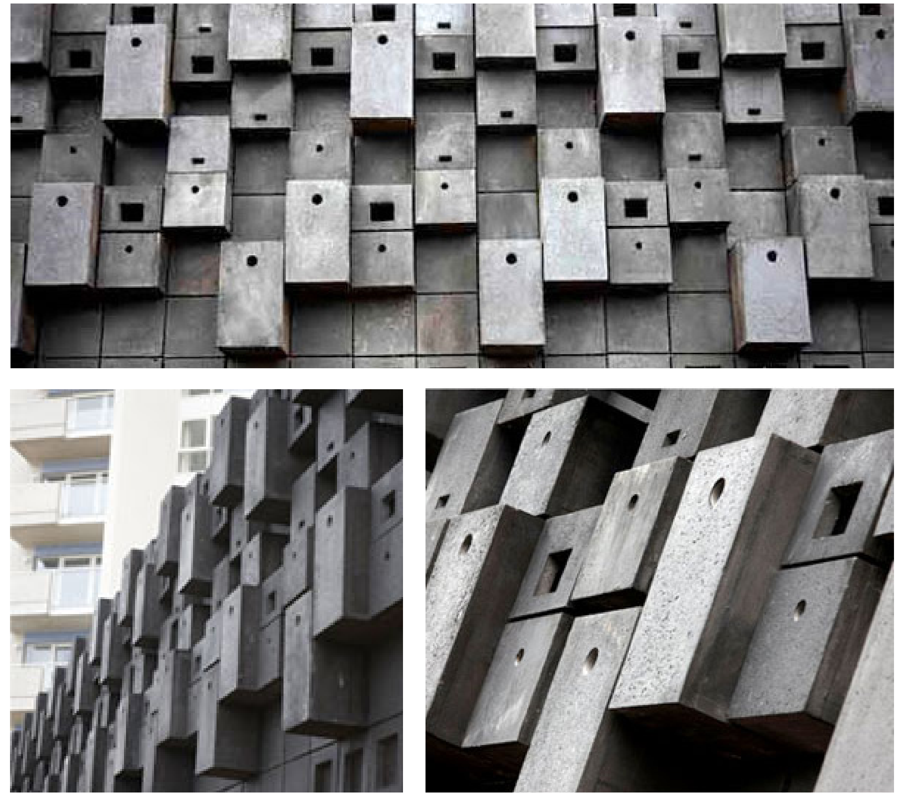


Fig. 2.VIII.5, 6

Animal Wall - Gitta Gschwendtner

A housing development in Cardiff Bay, Wales expanded with 1000 new apartment units and new facilities for residents in 2009. To help mitigate the destruction of the natural habitat in the area, a 50-meter-long wall with 1000 bird and bat nesting boxes was installed next to the residential development. The wall is assembled from four different types of nesting boxes and carries an aesthetic value as an art installation in addition to providing homes to local birds and bats.



Bird Apartment - Nendo

Located in a forest in Komoro City, Japan, this installation is a treehouse designed for the Ando Momofuku Center. The center's is devoted to increasing access to, and promoting interactions with, nature. The treehouse is divided into two sections. The first contains 78 individual bird nesting spaces, grouped together onto one side. The other section is a small room reached by ladder, with enough room for one space. From this room, 78 small peep holes allow an individual to look into each cell to observe birds that are nesting there.

Fig. 2.VIII.7, 8

LESSONS LEARNED FROM THE PRECEDENTS

These case studies suggest that the Bird Rescue Center should be: near a population center for easy accessibility and greater public interactions; the building's design should be an example of bird-safe measures; the mission of the center will be more impactful if the building and area are an example of design that blends into the environment and is as beneficial to local bird populations as it is to humans; should actively recruit and involve volunteers and professional interns in the care and rehabilitation of birds to develop a strong and supportive local movement. There are also many simple features that can be added onto a façade or integrated into the Center's physical structure, that support and nurture local bird populations while providing aesthetically pleasing accents.

COEXISTENCE

THESIS QUESTION:

How can you support bird populations in a city while reducing potential harms, while providing a facility to treat ones already injured?

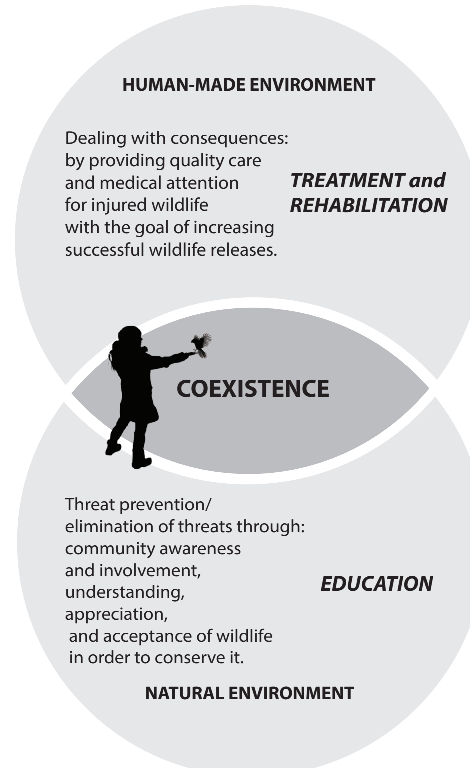


Fig. 3.1

CHAPTER 3: METHODS

"In the end we will conserve only what we love;
we will love only what we understand and
we will understand only what we are taught"
Baba Dioum, 1968

The goal of this thesis is to propose the founding of a student-and-volunteer-run bird rescue center inside the Union Bay Natural Area. The center will provide public education and outreach opportunities, support environmental education to the youth, and guided birdwatching tours; additionally, it will attract volunteers to help with the rescue and rehabilitation of injured wild birds. Through greater public understanding and support, the reduction of hazards to birds and improvements to urban habitats will result in healthier populations of local and migratory birds.

I. THE SITE: THE UNION BAY NATURAL AREA (MONTLAKE FILL)

The Union Bay Natural Area is located on the northern shore of Lake Washington, just east of the University of Washington Campus. (Fig. 3.I.1,2) The natural area occupies a total of 74 acres, including 4 miles of coastline along Lake Washington. The Union Bay Natural Area is one of the most important and unique urban ecosystems in the city of Seattle. While it is located in close proximity to several major streets and neighborhoods, it still harbors a wide variety of wildlife: beavers and a beaver dam, raccoons, turtles, eagles, owls, ducks, herons, and many other animal species. The site is considered to be one of the best birdwatching locations in Seattle, with over 200 species of identified birds seen in the natural area. The site has a varied history and in recent memory was not a natural area teeming with wildlife.

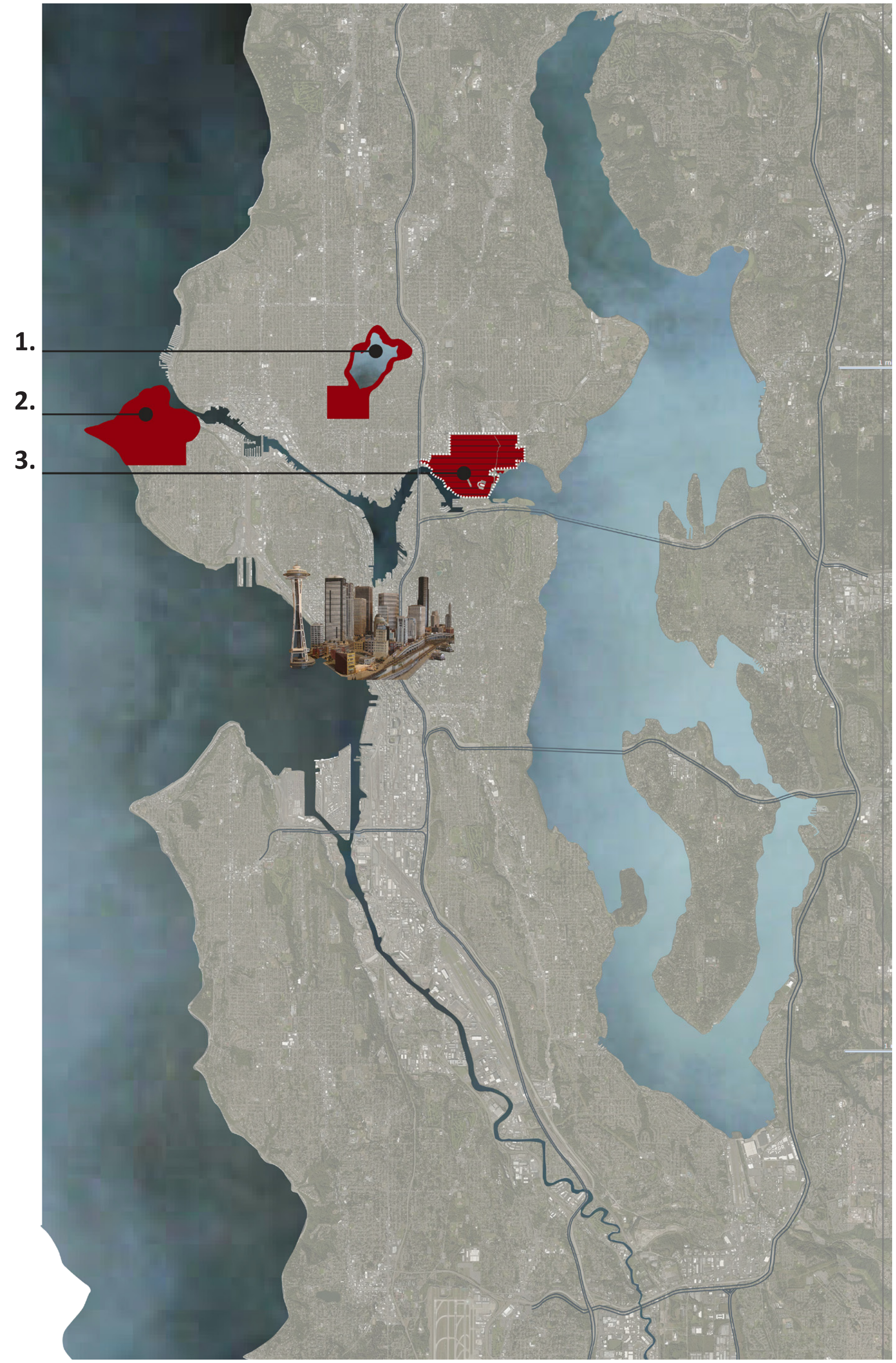


Fig. 3.I.1.
Union Bay Natural Area with
the view to the Mount Rainier.

Fig. 3.I.2. (Right)
The Union Bay Natural Area is one of three
major stopover spots on the Pacific Flyway
for migratory birds, found within Seattle:
1. - Discovery Park,
2. - Green Lake,
3. - Union Bay Natural Area (Montlake Fill).

II. SITE SELECTION RATIONALE

Site selection for the center weighs considerations such as accessibility by the general public, proximity to prospective volunteers and students, and the natural surrounding. Wildlife rehabilitation centers are nonprofit organizations receiving no government funding, so access to a sufficient pool of potential volunteers is crucial. Located on the University of Washington Seattle campus and designed as another outreach center like the Center for Urban Horticulture, the Bird Rescue Center will provide and encourage opportunities volunteer and for-credit internships and research projects for students of biology, veterinary medicine, and environmental sciences departments. (Fig. 3.II.1.) Close proximity to the city's veterinarians and the veterinarian school, will also reduce difficulties in finding those willing to volunteer and teach at the proposed center.

The Union Bay Natural Area already acts as an attraction for residents and the rehabilitation will further act as a figurative bridge between urban and natural environments. The site is considered to be one of the best year-round birdwatching location in Seattle, with over 200 species of both resident and migratory birds identified in the natural area. The site is also home to the Center for Urban Horticulture, which opened in 1984 and is now part of the University of Washington Botanic Gardens. The Bird Rescue Center proposes to link with and expand this very successful model of education and community outreach. The site is an example of wildlife restoration from an area of earlier urban development and carries an environmental message and lesson on its own. It provides hope that past mistakes of human development can be mitigated and that coexistence of people and other species can be fostered, even near dense urban centers.

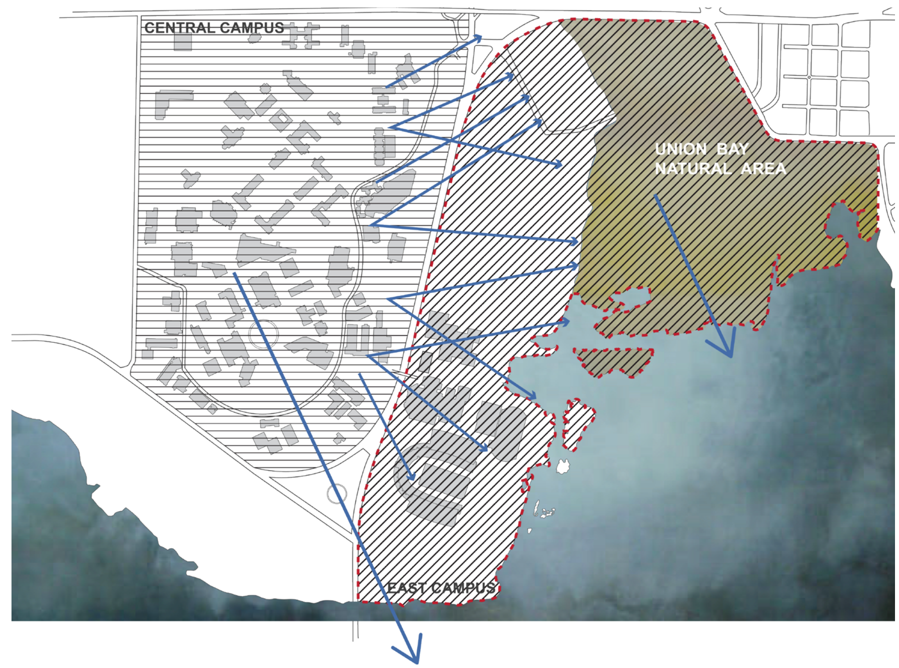


Fig. 3.II.1.
Union Bay Natural Area is a part of
East Campus of the University of Washington.

Fig. 3.II.2. (Right) Accessibility


UNIVERSITY VILLAGE
UW CAMPUS
RESIDENTIAL NEIGHBORHOOD

III. HISTORY OF THE SITE

The history of the area now known as the Union Bay Natural Area is one of many changes, first natural and more recently, anthropogenic. Seventeen thousand years ago what is now the Union Bay Natural Area was completely covered by glacial ice, entombing the land below. Approximately 15,000 years ago the glaciers began to slowly retreat and 4,000 years later, the area was free of ice, leaving behind Lake Washington, Lake Union, and the Puget Sound. Soon after the area became habitable, evidence shows that people soon inhabited the area. By the time of first European contact, the Native American tribal groups who occupied the area, referred to themselves as the Duwamish tribe.

At the time of the first white settlers in the mid-1850s, Union Bay was no more than 17 feet deep. On its northern shore lay a marshy land surrounded by thick forests growing in centuries of accumulated peat deposits. In 1888, on the north shore of Union Bay in what is now Yesler Swamp, Henry Yesler built a sawmill to harvest and process the rich forests. Before the mill began its operations, the area was a heavily forested with 150-foot tall fir and cedar trees, thick underbrush and few deciduous trees. Once logging began and the area's forests had been converted into lumber, the cleared area quickly became inhabited and was eventually transformed into a small town, later into an urban neighborhood.

Until the late 1800s, Lake Washington and Lake Union were two separated lakes without a connection between the bodies of water. One of the earliest settlers of Seattle, Thomas Mercer (1813-1898), was the first to propose a canal to connect the two lakes. The first attempt to join the lakes was made by Harvey Pike, who on his own attempted to dig a ditch between the lakes, but eventually gave up the project. In 1883, a 16-foot wide but shallow canal was completed and was called simply, Portage Canal. Its primary function was to allow the floating logs of the sawmills on the north shore of the Lake Union to be transported to facilities on Lake Washington.[89] In 1911, construction began on the Lake Washington Ship Canal to allow ships to move from Lake Washington, through Lake Union to Salmon Bay, then out to the Puget Sound. In 1916, the project was completed as well as a complex of dams and locks on the west end of Salmon Bay.

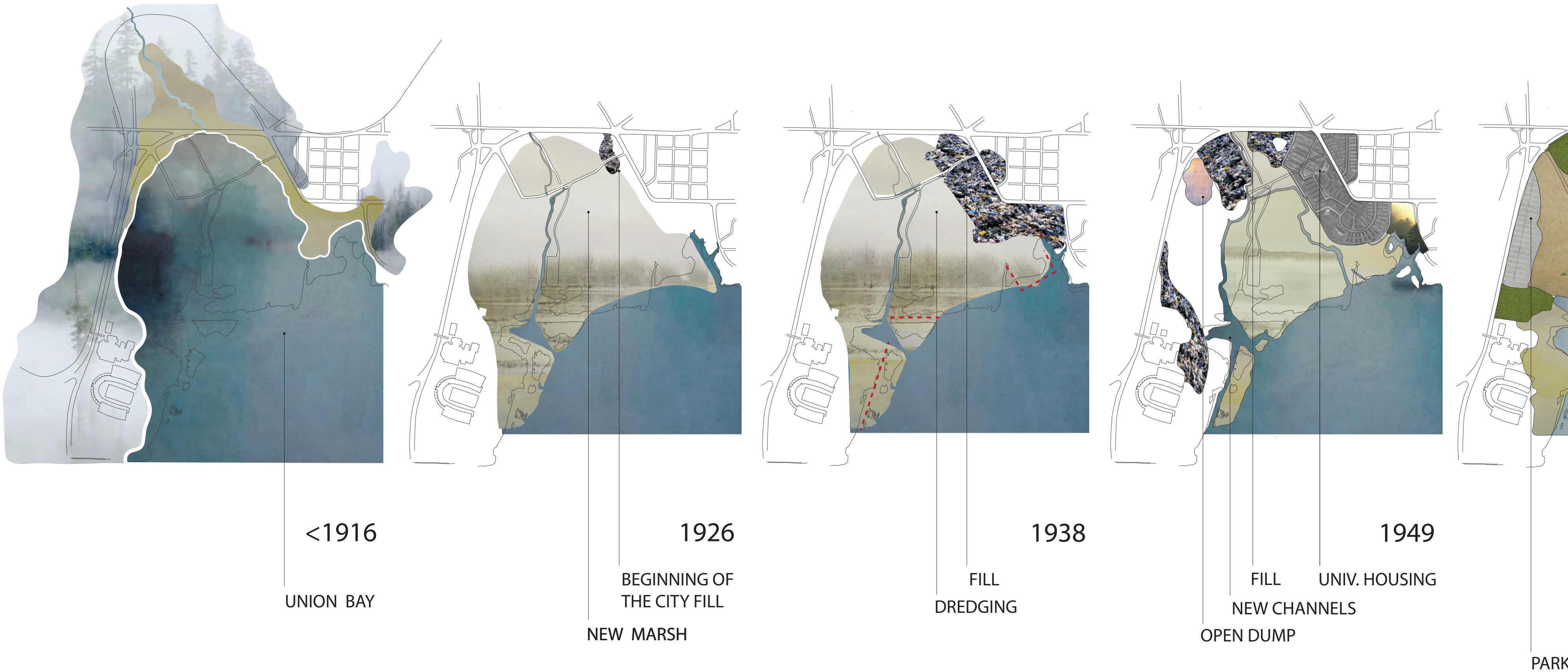
After opening the canal, the water levels in the three connected bodies of water were leveled at the historical average height of Lake Union's water level, or 22 feet above sea level. Seasonal fluctuations were from then on controlled by the Salmon Bay's Locks, resulting in Lake Washington's water level dropping by 8.8 feet. With the fall in the lake's water levels, formerly submerged areas of land became exposed on the northern end of Union Bay. Although this change put an end to seasonal flooding, benefiting the property owners around the lake, the newly exposed land was considered to be of little use or value. Unlike the surrounding former shoreline, the newly exposed land formed a large, unstable pit inappropriate for building. For approximately 10 years, the land remained unused.

In 1917, two large dump sites operated on the south and north ends of what is today Washington Park Arboretum. The working lifetime of these dumps was known to be limited and in 1926, the Montlake Dump (also known as the Ravenna Dump, University Dump, or the Union Bay Dump) was opened in the newly exposed land off the north shore of Union Bay. Due to Seattle's fast-growing population and the large volume of waste and garbage it generated, the Montlake marshland quickly began to fill with garbage. The garbage initially was concentrated in the northern corner of the Union Bay area (now the intersection of NE 45th Street and Mary Gates Memorial Drive) but soon after, another section of the dump officially opened for public dumping. [89] During the first twenty years of operation, city garbage haulers dumped up to 100 loads a day. With larger amounts of trash accumulating, in 1949 the west edge of the pit (now Montlake Boulevard) started to function as a burning dump. The burning was stopped in 1955 due to complaints from nearby neighborhoods and thereafter, the site was known as the Montlake Landfill.

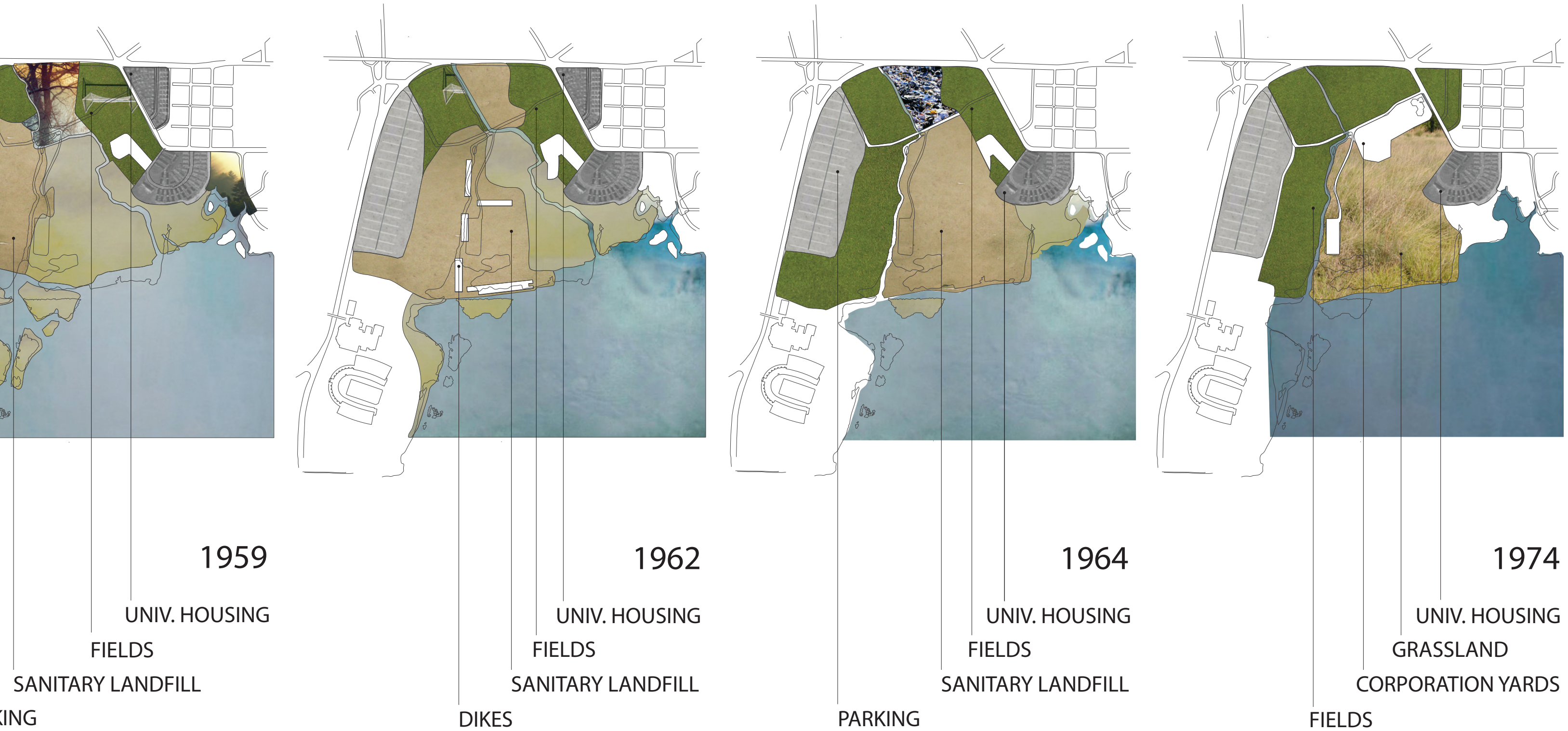
During the early 1950s, the city recognized that the dump was displacing increasingly large amounts of peat from subsurface layers into Union Bay, threatening its aquatic habitat. The dump was constructed over land that naturally contained up-to 50 feet of clay overlaid by 20 feet of peat. On top of this was dumped 15 feet of wood infill and another 20 feet of city waste.[90] The garbage was dumped from the pit's shoreline border towards the center as initial sections were filled. The increasing weight and pressure of compressed garbage began to squeeze the soft layer of peat into the area of least resistance, the waters of Union Bay. The peat seeping into its waters began to muddy Union Bay despite temporizing measures such as reinforcing the outer dump walls with timber. New sanitary landfill techniques adopted at the Montlake Landfill in 1956, which required new infill to be covered with dirt, only exacerbated the problem of peat displacement. Eventually, a dike system was built around the landfill, with compacted earth walls 15 to 40 feet wide and up to 200 feet in length. This helped stabilize the site and roads, which resulted in even more rapid accumulation of infill.

By 1962, the amount of waste transferred daily to the Montlake Landfill had increased due to a closure of a nearby dump. The increased rate of dumping and the infill required to cover the waste, quickly consumed what free space remained. In 1964, the Montlake Landfill was closed for public dumping and by 1966, all dumping was prohibited and the landfill closed. During its almost 40 years in operation, the Montlake Landfill received 40 to 66 percent of the garbage produced by the city of Seattle which included biodegradable, non-biodegradable, and toxic wastes. It also had accrued 11 million cubic yards of infill, which included two million cubic yards of free dirt and rubble.[91] In some places the debris and garbage reached 40 feet deep.[92] During the 1960s, underground water drains and methane gas collectors (methane is produced by the bacterial decomposition of the layers of peat, vegetation and trash) were installed at the landfill and out to the outer swamp, where runoff water was drained and gas burners consumed the vented gas.[92]

Between 1969 and 1971, the dump was closed, the ground was capped with two feet of topsoil, seeded with grass and left to grow.[92]



Over time local plants began to establish themselves and birds began to occupy the grassland, bringing further seeds to the natural area. The site was left unmanaged until 1998, at which time almost half of the 76 acres was overrun by Himalayan Blackberry.[93] A proposal had originally been made to the city in 1966 by Walter Dunn, a general engineering professor at the University of Washington, to reclaim the former landfill for sports fields, parking lots, and other uses which didn't require solid foundations to be built. In 1974, the dean of UW's College of Forestry, James Bethel, proposed instead that unoccupied areas be transformed into an arboretum and natural area. The next year, a proposal was submitted for the "Union Bay Teaching and Research Arboretum" dedicated to environmental research, teaching, stewardship and public outreach. The Center for Urban



Horticulture at the University of Washington was founded in 1980 and took over the management of the 54 restored acres east of University Slough, now known as the Union Bay Natural Area.

Over the previous few years, the State Route 520 Bridge which borders the natural area has undergone major renovations. State and federal laws mandate that with publicly funded infrastructure projects, a percentage of funds be spent on ecologic restoration to mitigate the construction's impact on local ecology. For this purpose, two million dollars were designated to restore and improve the habitats at the UNION BAY NATURAL AREA.

Fig. 3.III.1. History of the site.

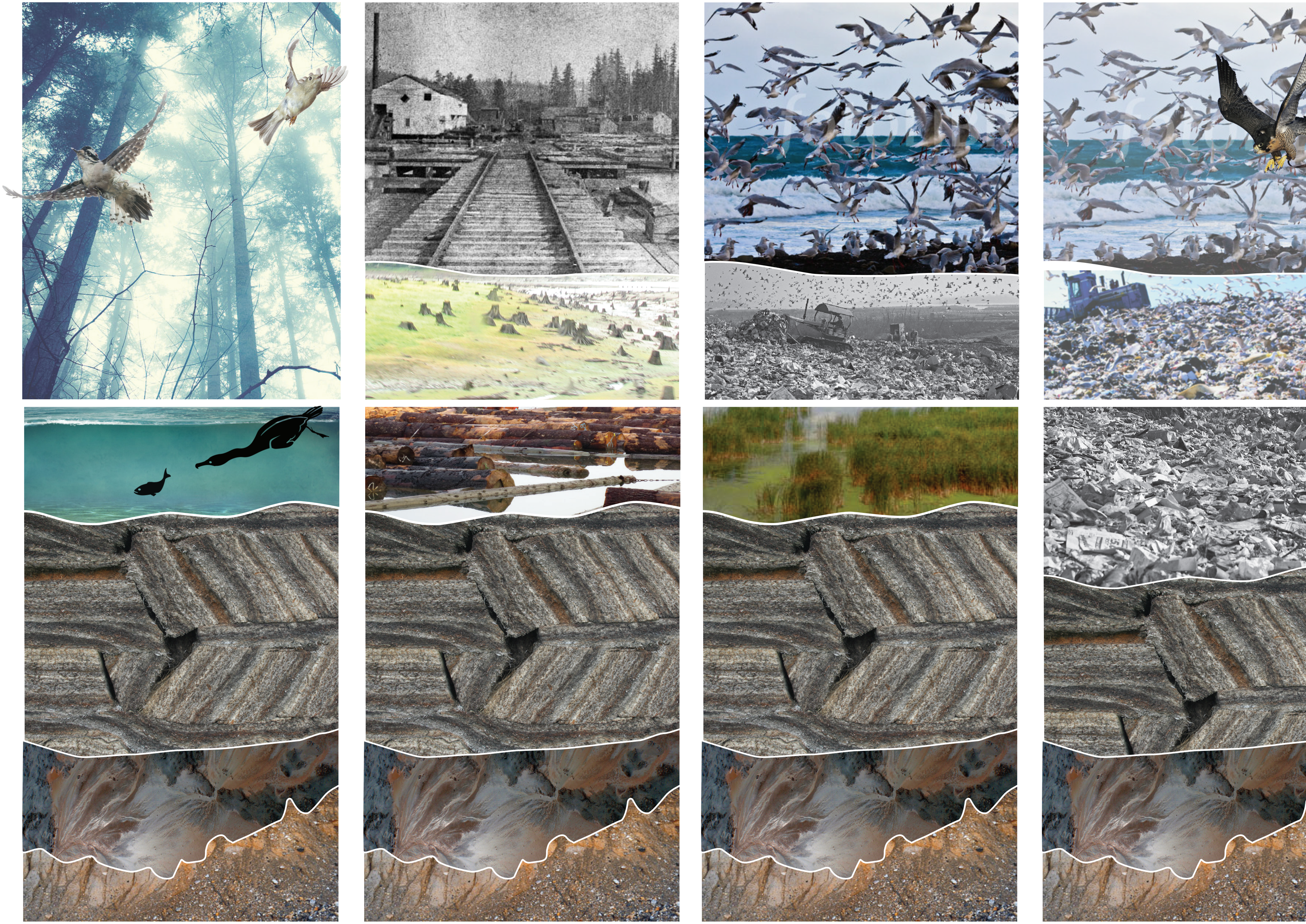


Fig. 3.III.2. History of the site, a bird's eye view: Metamorphosis

IV. SITE ANALYSIS

This section looks at the current makeup and use of the Union Bay Natural Area. This includes the geology of the site itself, common flora and fauna, tree species, birds and current human uses. The proposed location of the Bird Rescue Center is also discussed, including the criteria that makes it the most favorable location to fulfill the Center's goals while minimizing environmental impacts.

A. HUMAN USE OF THE SITE

The Union Bay Natural Area is located on the northern shore of Lake Washington, just east of the University of Washington Campus and is owned and managed by the University of Washington. The natural area occupies a total of 74 acres, including 4 miles of coastline along Lake Washington. The Union Bay Natural Area is surrounded by athletic fields and large parking lots on it's North and West edges respectively, and a residential neighborhood and Yesler Swamp in the East. Most visitors enter the site from the northeast (Mary Gates Memorial Dr. NE/ NE 41st St.) and arrive directly to the Center for Urban Horticulture by car or by foot. Other visitors arrive from the western side from the University of Washington campus.

Wahkiakum Ln. trail connects the two main "gates" to the site and connects to a second waterfront trail, which creates a loop at the central portion of the natural area around the site's four ponds and follows along the shoreline. Although the site has no programmed recreational activities, it attracts a large number of people with areas for walking, biking, jogging and birdwatching; it is also frequently used by elementary, high school and university students for field trips.

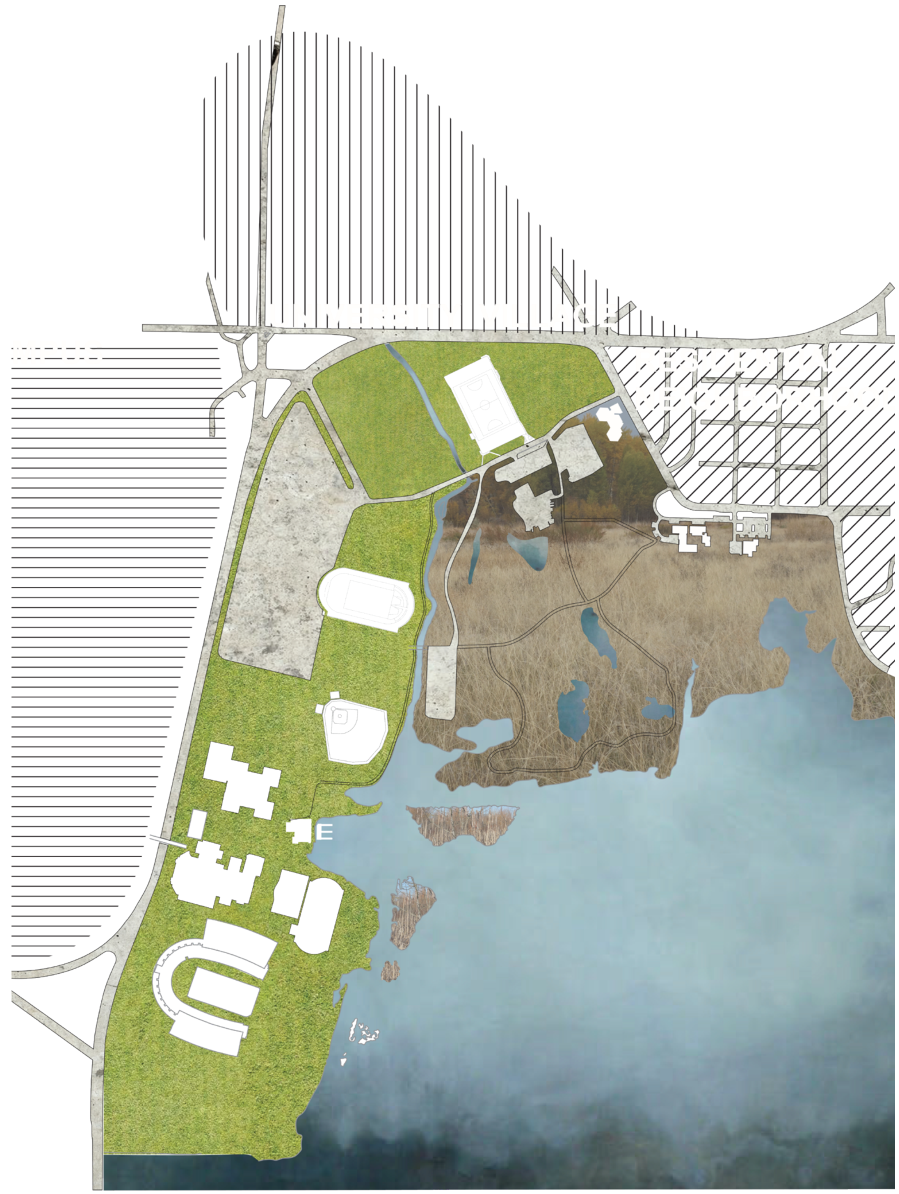


Fig. 3.IV.1. The site is surrounded by University of Washingtons sport facilities, athletic fields and parking lots.

Fig. 3.IV.2. Current site use by people.

B. BIRDS

The Union Bay Natural Area is one of the most important and unique urban ecosystems in the city of Seattle, harboring a wide variety of wildlife: beavers, raccoons, turtles, eagles, owls, ducks, herons, and many other animal species. It is a natural refuge within a largely metropolitan area, with a wide variety of habitats: woodlands, scrublands, grasslands, freshwater wetland, ponds (both permanent and seasonal), lake shore with marsh and islands that attract a wide variety of bird species. Over the past years more than 200 bird species have been recorded at the former landfill site.[94] It is an important stopover spot on the Pacific Flyway for migratory birds as well resident bird species, and is an active breeding site in the summer and feeding ground in the winter.

C. FLORA

The various habitats of the Union Bay Natural Area include grasslands, shorelines, marshes, and small forested areas. There are over 140 species of flowering plants found on the site that are not native to the area. Some of those flowering plants are considered invasive species, such as Purple Loosestrife, Himalayan Blackberry, Reed Canary grass and Scotch Broom.[95] In addition, a variety of tree species and grasses are also found throughout the site.

Fig. 3.IV.3.
Future Site improvements

Fig. 3.IV.4.
Current site use by local and migratory birds.

D. GEOLOGY

A cross-section of the earth underlying the Union Bay Natural Area is composed of a number of different strata.[96] The surface layer consists of a minimum of 2 to 12 feet of topsoil. This encapsulates a thick layer of refuse which reaches a depth of 40 feet in some places. Underlying the refuse is 2 to 60 feet of highly compressible peat, which is followed by a 100-foot layer of soft clay and glacial till, with sand underneath. This unstable foundation means that depending on the depth of various strata at different site locations, all but the lightest buildings constructed will require deep concrete piles to reach a stable foundation. At the site of the future Bird Rescue Centers, piles sunk into the ground will likely reach depths of 35 feet or more.

E. LOCATION FOR THE PROPOSED CENTER

A large section of land located in the northwest corner of Union Bay Natural Area is under-utilized by people. It contains only two equipment storage yards, providing parking spaces for UW service trucks, as well as a small security shed. By relocating the equipment at the two storage yards to a different site, an abundance of space will be freed for other uses. In 1985, the master plan for the Center for Urban Horticulture indicated that the two yards and a parking lot would eventually be phased-out, freeing additional space.[97] These areas were identified as a "known stable ground" by Jones and Jones Architects, in a Union Bay Arboretum progress report. With the transfer of the yards and equipment, this stable site would be the ideal location for the bird rehabilitation and education center. The site would provide easy access to roads, the University of Washington campus and to greater Seattle. Its location would place it within the natural area without the need to destroy or alter pre-existing habitats.

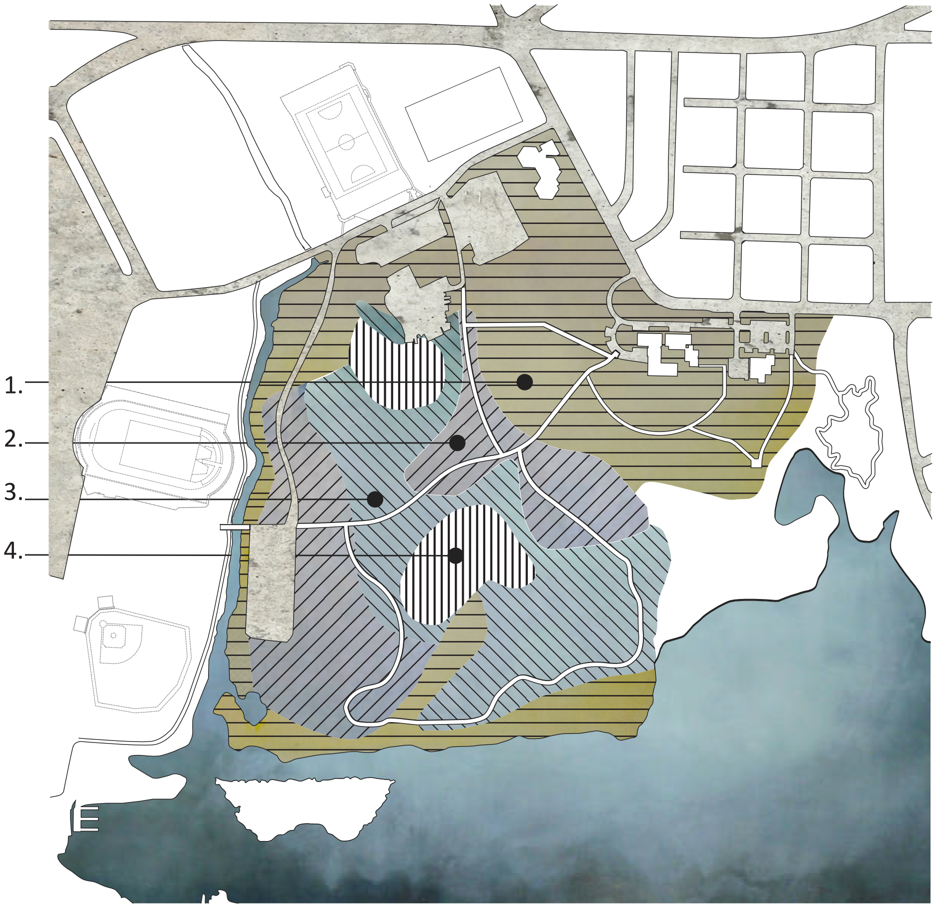


Fig. 3.IV.5.
Potential subsidence in future:
1. - LOW
2. - MODERATE
3. - HIGH
4. - VERY HIGH

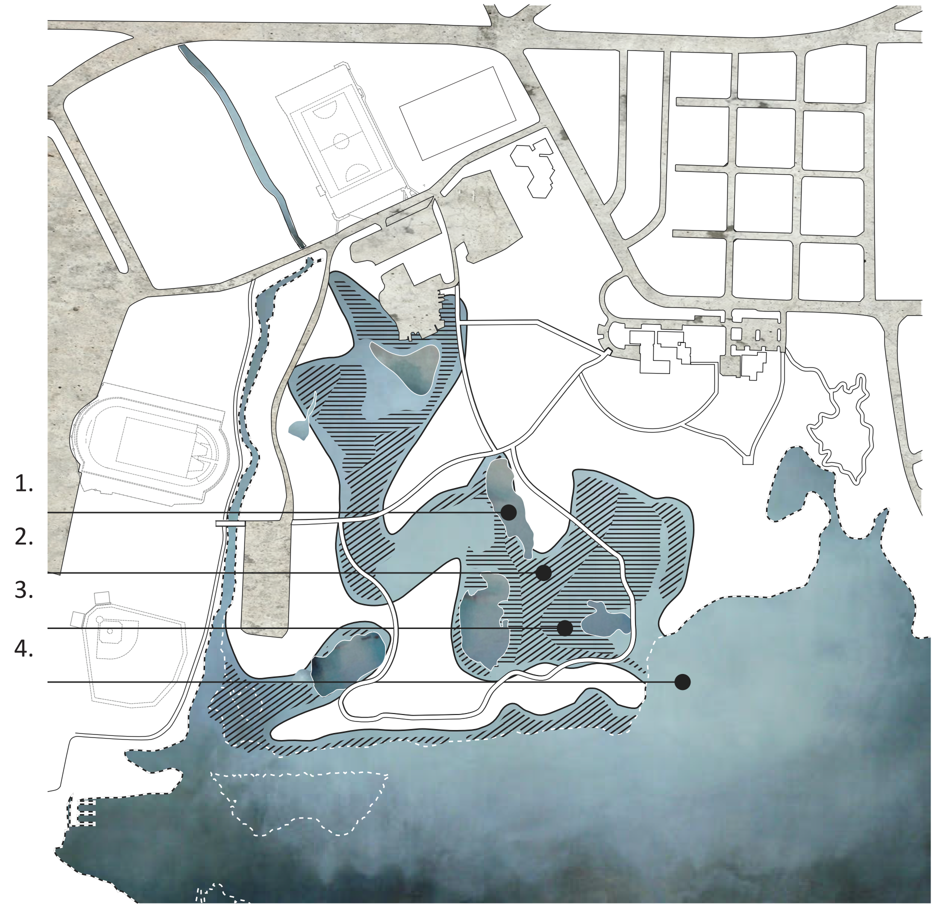


Fig. 3.IV.6.
2025 Shoreline advance, predicted
1. - EXISTING POND
2. - SHALLOW
3. - 5 FEET DEEP
4. - 10 FEET DEEP

Fig. 3.V.1

SITE USE:

Local and migratory birds

Students

General public

V. DESIGN GUIDELINES

"The same way that crossing a footbridge seems to prompt people to stop and look down and a bench
invites us to pause and rest, a viewing blind can be a cue to look carefully.
Viewing facilities are like those highway signs that say "scenic overlook,"
all of us stop to see what's there – we don't want to miss the opportunity!"
Karen Hardesty

BIRD WATCHING TOWERS AND HIDES

Birdwatching is one of the most popular hobbies in the United States. In 2011, 47 million people (16 years and older) were considered birdwatchers, which is 20 percent of the United States population.[98] The same source estimates that 24 percent of Washington State residents participated in birdwatching at some point. Birdwatching has also become the fastest growing outdoor recreational activity.[99] Birdwatching hides provide an opportunity to observe wild birds in their natural habitats and at close distances, without disturbing the birds.[100] These structures allow a greater number of viewers to observe undisturbed wildlife in a setting that has some protection from the natural elements such as standing water, wind, and weather.[99] Professionals, amateur bird watchers, wildlife photographers and scientists all use birdwatching hides for their enhanced viewing experience. When designed correctly, these facilities not only allow for a unique experience with nature but also help protect local ecosystems and can increase property values.[101]

To protect habitats from disturbance, birdwatching hides should have minimum impact on the site they are being built on, both during the construction and utilization phases. Minimizing environmental impacts such as the removal of plants, alteration of waterways or building during the prime migratory season, ensures a healthier and more natural habitat. These measures also help maintain healthy and diverse bird populations, the primary purpose for constructing birdwatching hides. The location of a bird hide or viewing platform must allow for the improved detection and observation of birds in their natural habitat. The unique perspective and enhanced access to a habitat are the primary advantages of these facilities. The birdwatching structure is more efficient when positioned in a way that overlooks a variety of habitats on at the site, allowing for the observation of multiple bird species.[102] For the proposed Bird Rescue Center, a birdwatching tower will be located in the southwest corner of the site, far enough away from the main complex to allow for undisturbed viewing opportunities. This location also has the greatest widest-angle of views overlooking the natural area.

To help minimize the impact of birdwatching hides and towers on the surrounding habitat, natural materials and colors are used help blend in with their surroundings. The outside of the proposed tower will be covered almost entirely in wood, with tones that match the surrounding area. These neutral or muted designs have been shown to be accepted and ignored by birds, more quickly.[103] The entrance to a hide is preferably located opposite the direction from the targeted viewing area, protecting the birds from the flow of traffic and sight of people. The interior should be dark, decreasing the likelihood of the viewer's silhouette being noticed by the birds. The entrance to the hide is best offset and not in a direct line to the viewing area to further reduce visual disturbances. For the best viewing experience, the direction of the viewing slots or windows should be oriented so that the sun is behind the viewer during prime birdwatching season. The positioning and size of the viewing slots should take into account the different viewers' height (children, people in a wheelchair, and adults of differing heights).

The height of the bird watching structure should also be taken into consideration. For photography, it is preferable that the person taking pictures be at the same level as the birds. Birdwatching towers and observation decks provide visitors with a view of a habitat from a "birds-eye" perspective. Greater height allows for a more distant viewing, as in the proposed site, and also allows for viewing birds in the tree canopy in forested areas.[99] A bird hide can be open to the elements but it is generally preferable that they are able to be closed-up after use (doors, window shutters). If left open, birds or other animals may begin nesting inside the structure and rain and wind will lead to quicker deterioration and leading to a need for more frequent maintenance. Viewing platforms or structures should, if possible, be accessible for people in wheelchairs to maximize the viewing experience for everyone. Boardwalks are useful means to increase access to sites such as wetlands and can provide additional viewing opportunities outside of the bird hide or viewing platform. An additional benefit of boardwalks is the minimization of land directly impacted by people which helps in reducing erosion and habitat disruption.

B. WILDLIFE RESCUE CENTER AND REHABILITATION SPACES

As wild birds and other animals attempt to adapt and survive in Seattle's increasingly human-dominated environment, the risk of injuries from human-related activities are numerous. Research has suggested that encounters with human activity or structures is the largest cause of wildlife injuries.[104] According to the Minnesota Wildlife Rescue center: "About 80 percent of the animals are admitted for trauma directly or indirectly caused by humans, including domestic pet attacks, car accidents, habitat destruction and poisoning."[105] Some bird rescue centers focus on rescue, rehabilitation, and release of wild birds, as well as euthanizing birds that cannot be released back into the wild. Other centers keep non-releasable birds and provide educational outreach programs. The center proposed in this thesis will do just that.

The spaces dedicated to for treatment and rehabilitation have restricted public access and are limited to staff and trained volunteers only. Once an injured or orphaned bird is brought to the rescue and rehabilitation center, it is admitted through an intake area and placed in a quiet holding area to await further examination. A veterinarian or vet technician performs a thorough examination of the bird to determine its health and likely chance of survival. Depending on the outcome of the evaluation, the bird either immediately undergoes necessary treatments, which may include surgery, or it may be euthanized. Special quarantine rooms are required for birds with contagious diseases such as avian pox, which require a separate airflow system.[106]

After undergoing evaluation and initial treatments, birds are transferred to the rehabilitation area, which is warm and provides partitioned, quiet spaces. Separate rooms are generally dedicated for different kinds of birds in order to keep songbirds, birds of prey, and waterfowl and water birds separated. At this stage, smaller sized cages are purposefully used to restrict the bird's movements, which prevents further injury and allows for easy handling by the staff.[107] Orphaned, young birds are placed in an avian nursery (which is also a part of rehabilitation area), with incubators for nestlings (featherless baby birds) or small cages for fledglings. These birds are generally fed manually by volunteers every 15-20 minutes during the daytime.

The last section of the rehabilitation facility is the pre-release rehabilitation area. The healthier birds and those young birds that have begun to self-feed (juveniles), are placed in large, outdoor flight cages which enable the birds to exercise and build-up flight muscles. These cages are intentionally unconditioned and exposed to weather, allowing birds to become accustomed to the outside temperatures. Some basic, multi-leveled perches may be present but little else occupies the space. These cages should provide protection from natural predators such as small mammals and domestic pets (cats or dogs). The size of each flight cage differs by the number and types of birds that are housed, separating songbirds, raptors, water birds and waterfowl (refer to Appendix for flight cage specifications).

C. EDUCATION AND COMMUNITY OUTREACH PROGRAMS

Non-releasable birds with permanent injuries will be kept for educational purposes at the proposed center, which requires a valid permit issued by the U.S. Fish and Wildlife Service. The Migratory Bird Special Purpose Possession - Education Permit for Live Birds, allows an organization to keep non-releasable wild birds for the purpose of educating the public on bird biology, conservation, and ecology.[108] Some of the Bird Rescue Center's permanent collection of birds will be used for outreach visits to schools and other organizations, to increase understanding and appreciation. Others will be used in open flight demonstrations, live semi-unrestricted lives on site (waterfowl that are free during the day to go into the pond), or be on display in multi-story aviaries at the Center.

Outside of the state and federal guidelines for the cages of protected birds (weather migratory, song birds or raptors), the center will comply with additional guidelines for exhibiting birds. State and federal wild bird permits are only issued to individuals or groups to hold otherwise unreleasable birds (those too injured to survive independently in the wild) for scientific or educational purposes. If a wild bird is used for public exhibition, whether in a publicly accessible facility or in travel exhibitions, a licensed handler or caretaker must handle and protect the bird. The facilities and cages must meet federal standards and appropriate feed must be given. Each bird must be exhibited at least 12 times per year and at no time can anyone from the public handle or touch a live bird. In addition, the bird must be fed a species appropriate diet and not be placed in a stressful situation for prolonged periods of time. Meticulous records of care, handling and public exhibitions must be recorded and records submitted to the government, yearly.

CHAPTER 4: DESIGN APPROACH

I. PROGRAM OF SPACES:

Construction of a wild bird rehabilitation center, placing it an urban setting, and providing educational programs for the surrounding community will foster awareness about birds and the impact of urban communities on wildlife. The University of Washington's Bird Rescue Center will accept wild birds injured as a result of encounters with human activity in the Seattle metropolitan area. It will provide medical treatment as well as space for further rehabilitation with a goal of releasing healed birds back into the wild. Wildlife rescue centers are often located on the outskirts of a city due to the cost of large parcels of land. This makes it difficult for the public to appreciate the impact modern cities have on birds and missing an educational opportunity to learn about local species. The Montlake Fill offers an ideal natural habitat for the birds and as well as easy access for the public, on land located inside the city but not suitable for a number of other activities. Located on university property, the center will be run by students and volunteers and serve three primary purposes: 1. conservation and rehabilitation of wild birds; 2. public and professional education; 3. internships and hands-on experiences for University of Washington students.

1. The rehabilitation center is a bird hospital, providing quality care for injuries and illnesses that result from encounters with human activity or occur within the metropolitan area. It will accept all injured, sick, and orphaned wild birds and will offer medical treatment and rehabilitative care to all species of wild birds. The primary goal of the center will be the release of all birds back into the wild. Those that are too injured to be released but could have a relatively high quality of life in captivity will be retained for educational purposes whenever possible.

2. A large portion of the center will be dedicated to public and continuing professional education and will house a permanent exhibition of birds that have permanent injury and cannot be released back into the wild but that are healthy otherwise. The center will provide an opportunity to educate the public through involvement with the center as well as participate in different educational and research activities. This will include on-site wild bird observation, lectures, and learning programs for primary school classes, research projects, and involvement with care. An auditorium will be available for volunteer training and for lectures and films on ornithological and nature-related topics.

A large bird habitat located within an urban setting is a great place to begin birdwatching. Improvements to the existing site, including birdwatching towers and boardwalks, will increase access for a greater number of people while restricting the environmental impact. Birdwatching will support the center's educational goals and philosophy, providing new experiences to the public while enhancing their appreciation of nature through first-hand experience.

3. The center will offer internships for veterinary students, providing an opportunity for practical experience in avian medicine. Their

contribution will not only benefit their education but will also supply a reliable and constant flow of volunteers for the rehabilitation center. In the same way that the Center for Urban Horticulture educates people and students about restoration ecology and ecological habitats, the proposed center will provide education about birds and their needs. (Fig. 4.I.1.)

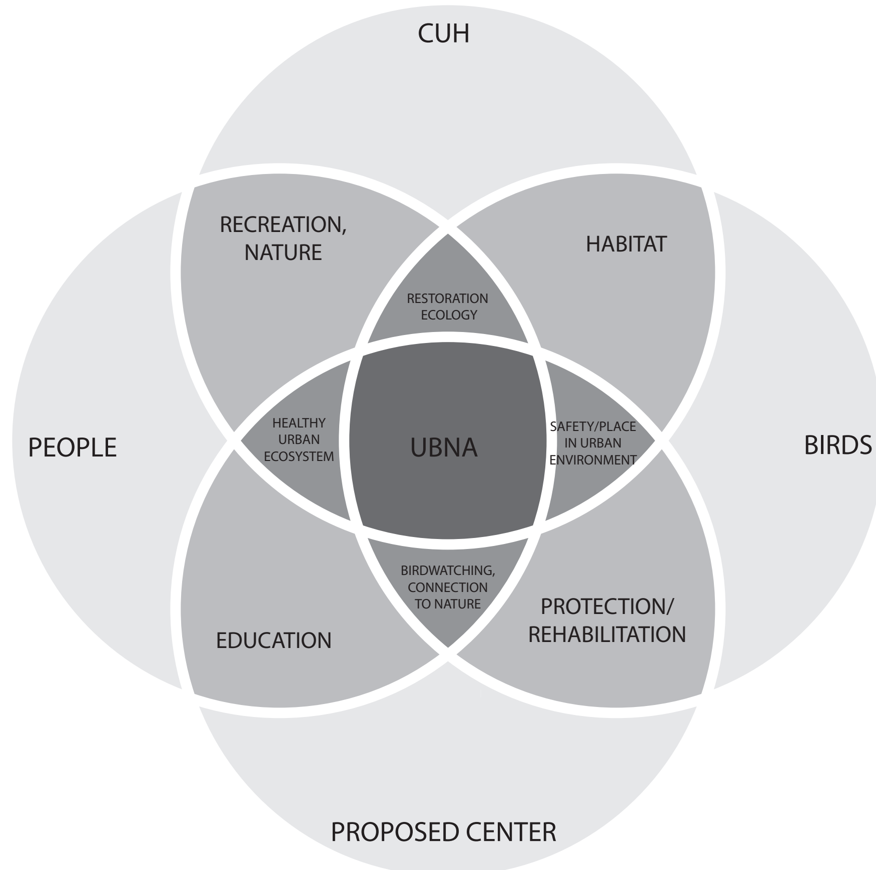


Fig. 4.I.1.
The new center will bring birds and people together through education.

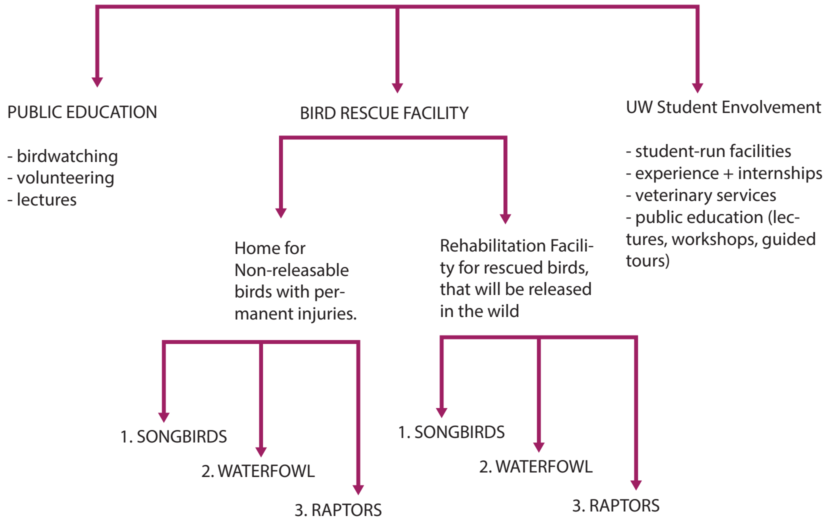
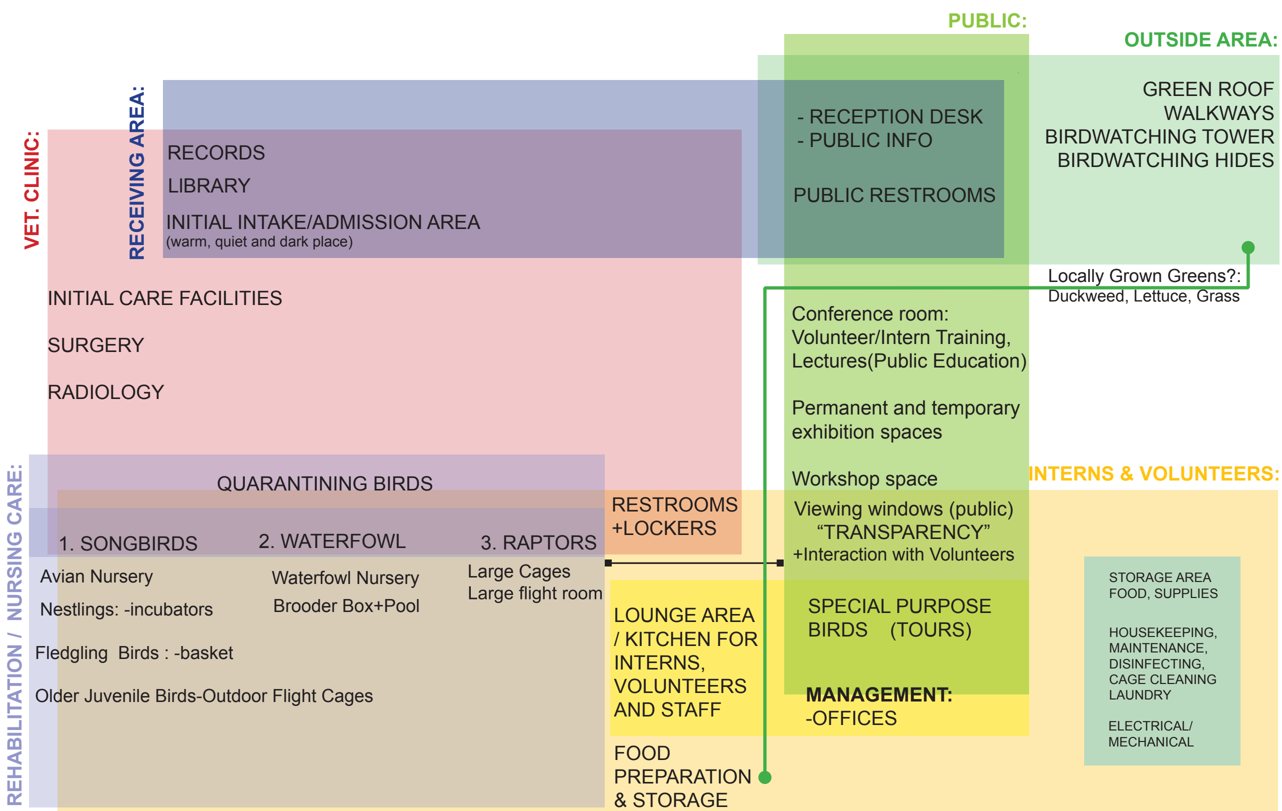
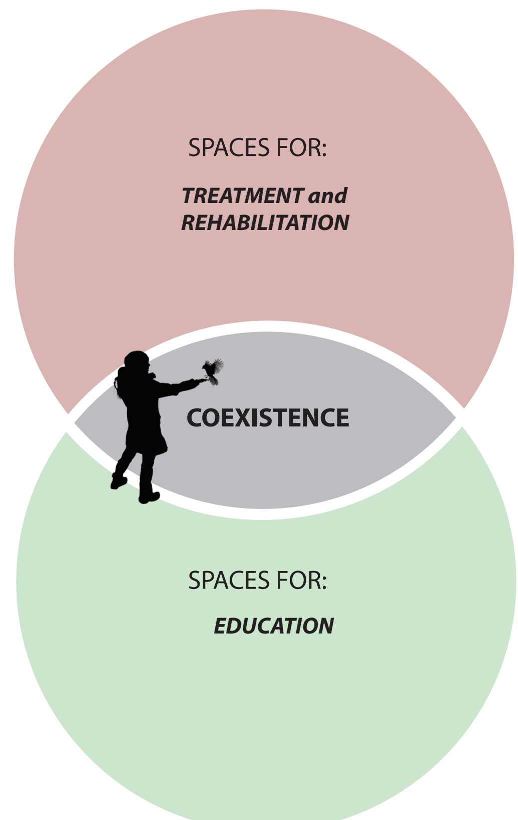


Fig. 4.I.2. Programatic relationships.

Fig. 4.I.3. Program of spaces.





TREATMENT and REHABILITATION

VETERINARY CLINIC:

I. Intake Area

Reception desk (Recording the information

from the person who brought the bird)

Waiting area for people

Hold area for accepted birds (usually dark and quiet space)

II. Veterinarian clinic:

Health condition evaluation area

Treatment room (for newly accepted birds and daily check-up area)

Surgery

Radiology (dark room, x-ray and ultrasound machines)

ICU - close daily observation and treatment

Quarantine area- Prevention of disease transmission/rooms with separate airflow

Reference/info area (computer and books) & access to the patient's history

Cage preparation area

III. Rehabilitation Area:

Food preparation area, food storage area

Avian nursery (songbirds)

Songbirds rehabilitation area

Waterfowl/waterbird rehabilitation area and nursery

Raptor rehabilitation area

IV. Pre-release exercise area:

Song bird aviary

Raptor flight cages

Waterfowl/waterbird pans with pools

PUBLIC EDUCATION:

V. Public education:

Reception

Public lounge with views

Shop, cafe (profit generation)

Small woodworking shop (bird-feeder and nest box building), art classes

Auditorium for volunteer training and public lectures on ornithological topics

Bird exhibition area (covered) / permanently injured, non-releasable birds.

Public restrooms

VI. Administration:

Offices

Lockers for volunteers and students

Kitchen/Lounge area

VII. Extra spaces:

Storage spaces for food, cages and supply donations

Laundry room

Cage cleaning and disinfecting area

Mudroom

Mechanical room

Electrical closets

VIII. Exterior/Site:

Parking area: cars and bicycles

Pond/flooded habitat

Boardwalk

Birdwatching tower/hide

II. LOCATION ON THE SITE

During the site analysis, it became obvious that the northwestern portion of the Union Bay Natural Area is hardly used by people and does not contain prime natural habitat. The site is currently overgrown with brush and contains a small, inaccessible pond that can only be accessed by small songbirds. In addition, it contains several shipping containers that serve as storage for the surrounding athletic facilities as well as a parking area for service vehicles. Placing the center at this location will minimize destruction of highly developed and productive ecological habitats. By opening up the pond for greater use by local wildlife and developing additional habitats together with the rehabilitation center, the density of productive habitat should actually be increased. Another advantage of this location is the proximity of roads and preexisting transportation networks which lie on the border of the Union Bay Natural Area, making the center both accessible and connected to the surrounding community. There will be very few barriers to accessing the center and this will encourage a greater portion of the city's population to visit.

Fig. 4.II.1. a,b,c.
Existing Conditions. Pond with the facility storage yard in the background.

Fig. 4.II.2.
Proposed Location on the UBNA site for the new center.

III. BUILDING-DESIGN CONCEPT

The rehabilitation center is actually a series of compact, interconnected buildings joined together by a series of aviaries and platforms. The buildings are designed to minimize the square footage constructed in order to reduce operational and maintenance costs. Each building is flexible and creates a unit in a greater complex of buildings that serve either the avian medical care or the educational mission. All these components (buildings) in the complex are connected by walkways and platforms around the outer edges of the center. This allows large groups of people, such as visiting school children, to view the entire center in an orderly and complete manner. It also solidifies the concept of the center as a multipurpose space joined together for a greater cause.

Each building is designed as a multi-use space to help reduce the overall size of the center and impact on the surrounding environment, without limiting its program. An example are the avian nurseries, which will provide care for nestlings and juvenile birds but will only be operational in the spring and summer months. During the fall and winter, these spaces can be used as a plant nursery, placing young plants in a conditioned environment during the colder months. The buildings' facades are also multi-purpose, some serving as small exhibition spaces showing local flora and fauna, including invasive species, while also serving as protective habitat for songbirds. Temporary exhibit space can be created inside several of the buildings in addition to those exhibits integrated into the buildings' facades. Habitat for wild birds is formed through a number of specially designed building components created during construction, creating nesting and watering areas on the outside of the building.

The energy and water usage of the center have been mitigated as much as possible through several active and passive strategies. The buildings themselves are oriented on an east-west axis to allow for more efficient solar control and natural light capture. Large exterior windows (all with blinds, shadings, or opaquely-glazed glass to reduce the risk of bird collisions) and high ceilings will help to maximize the amount of natural light penetrating the building, reducing energy inputs and connecting occupants with the surrounding site. Energy use from the electrical grid will be minimized through a combination of geothermal and solar heating as well as a general design that encourages passive cooling in the summer. In general, rehabilitation facilities use significant amounts of water to clean cages and dishes as well as for drinking and swimming. This facility includes systems to reuse waste and grey water whenever possible, as well as the collection and storage of rainwater, to minimize demand and reduce wastewater generation.

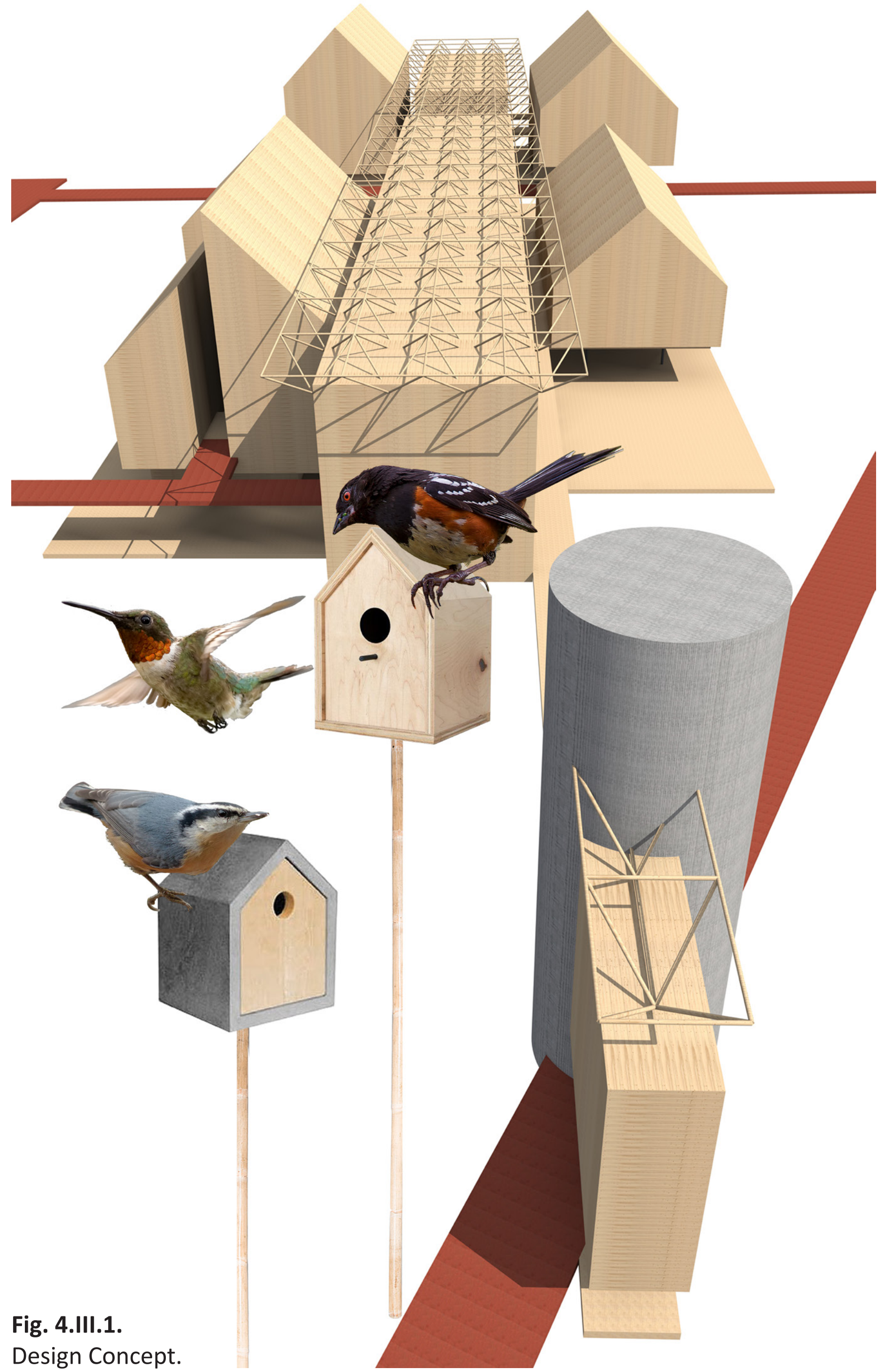
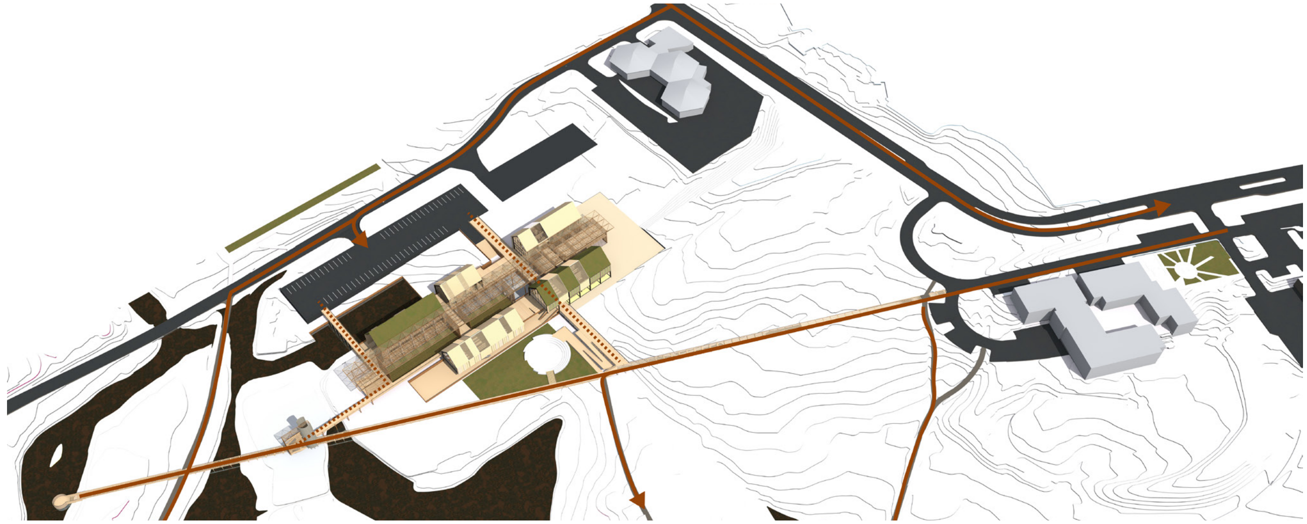


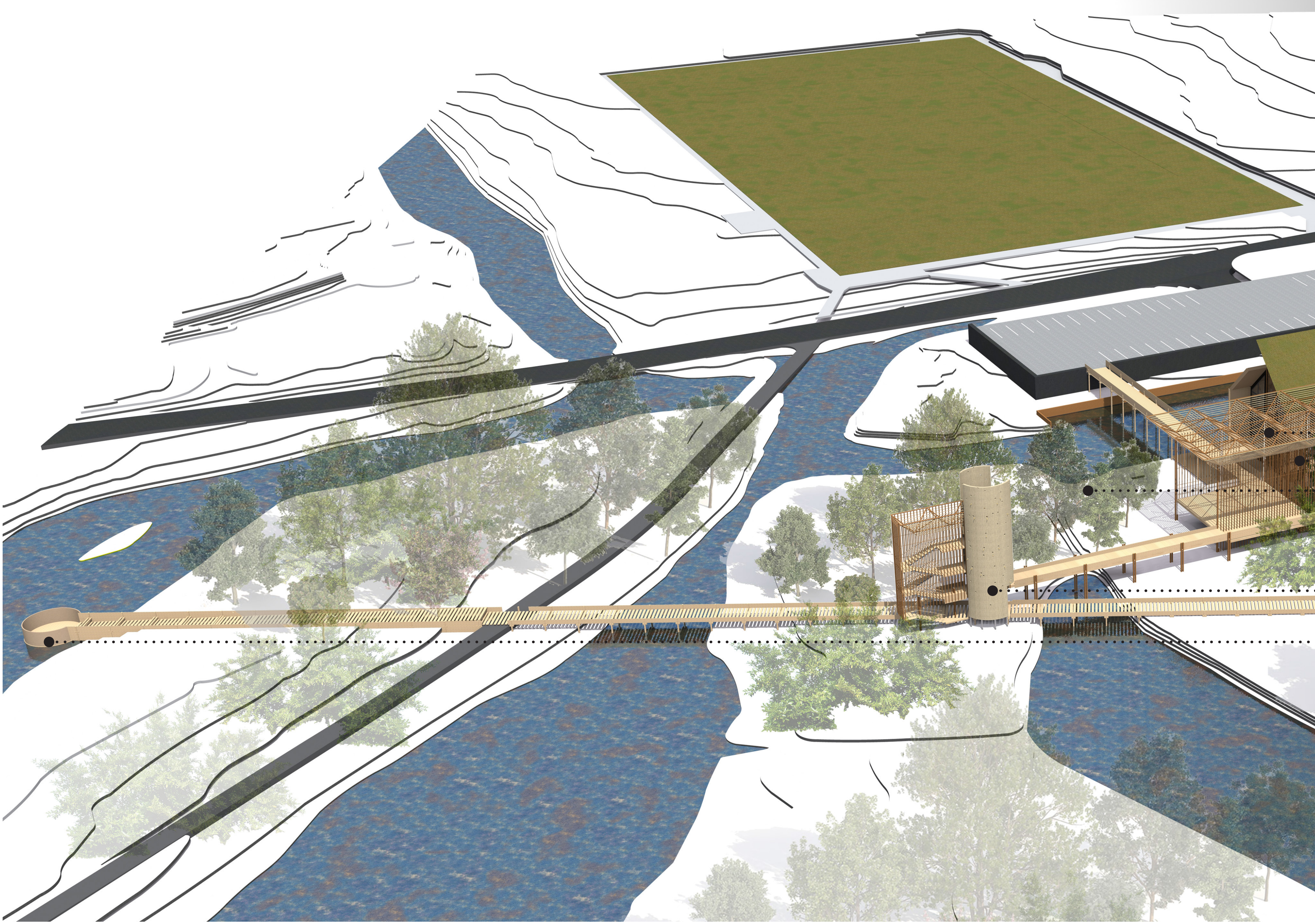
Fig. 4.III.1.
Design Concept.

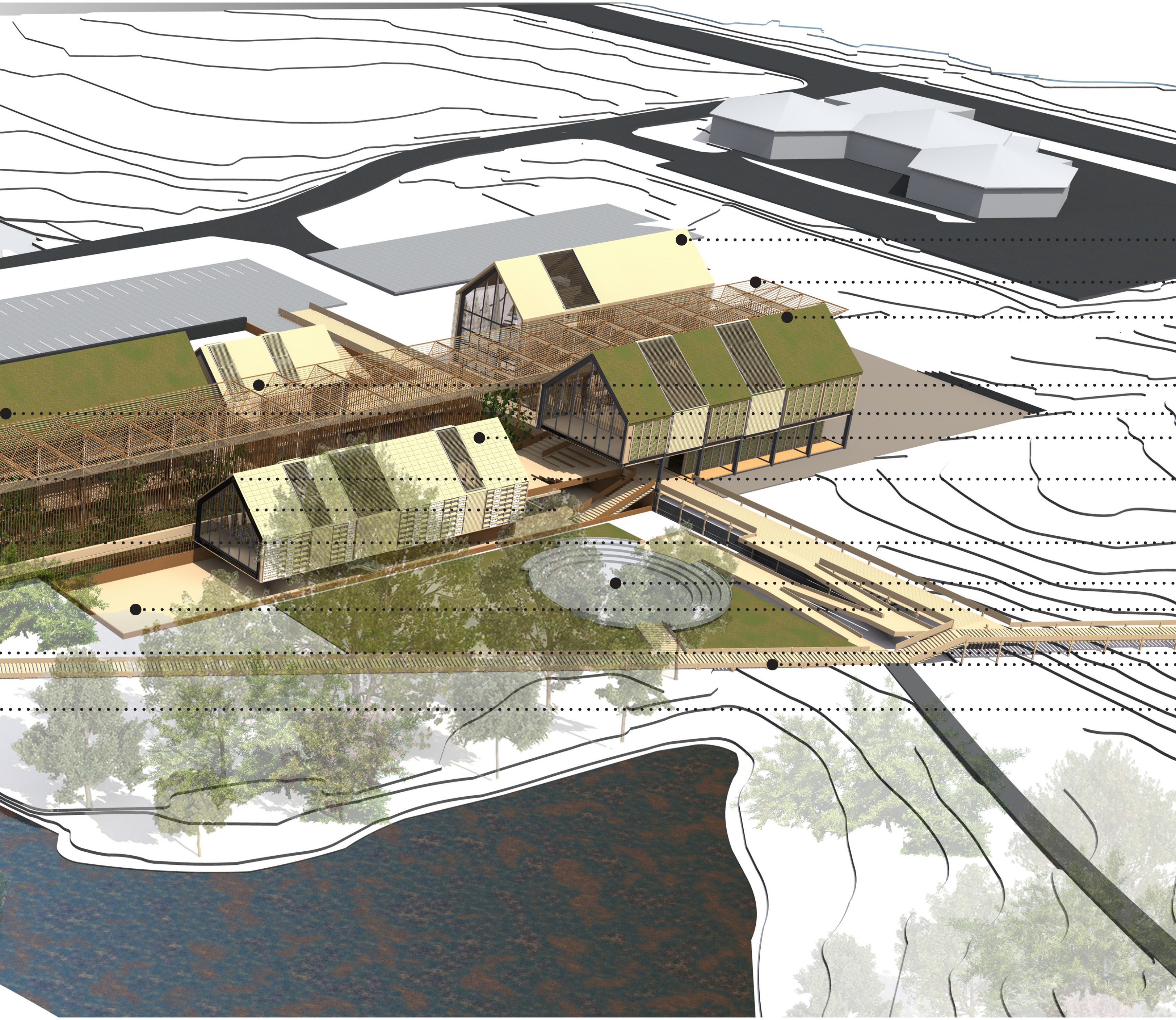
ARRIVAL

Two boardwalks lead visitors from a university parking lot towards the rehabilitation center, encouraging all the guests of the Union Bay Natural Area to visit. Some of these visitors will arrive for a planned trip to the center for leisure or educational purposes, to bring in an injured bird, or for volunteering. Others perhaps have not planned on visiting the center or did not even know it existed, but are directed towards it from the parking lot. A reception area and bird intake borders the northwest corner of the facilities. When the center is closed, the visitors have to walk around the center on the newly created walkways in place of the old road leading to the reclaimed “dime” parking lot. These walkways provide access to the rest of the natural area.

Fig. 4.III.2. View of the Center from the parking lot.
Fig, 4.III.3. Existing pathways to the Center, and connection to the UBNA site.







PROGRAM:

TREATMENT:

1. VET. CLINIC
2. PRE-RELEASE FLIGHT CAGES (AVIARY)
3. AVIAN REHABILITATION AND NURSERY.

PUBLIC / EDUCATION:

4. PUBLIC REST ROOMS
5. CAFE, GIFTSHOP AND LIBRARY
6. VISITOR CENTER
7. SPECIAL PURPOSE BIRDS (WALK-IN AVIARY)

SITE:

8. REFLECTING | HABITAT POOL (for waterfowl and shorebirds)
9. SPACE FOR OUTDOOR FREE FLIGHT SHOWS
10. FLOATING PLATFORM WITH BIRDFEEDERS
11. OBSERVATION TOWER
12. BOARDWALK
13. FLOATING BIRD HIDE (Ravena Creek)

Fig. 4.III.4

Fig. 4.III.5 - LOWER LEVEL

Fig. 4.III.6 - MAIN LEVEL

Fig. 4.III.7 - UPPER LEVEL

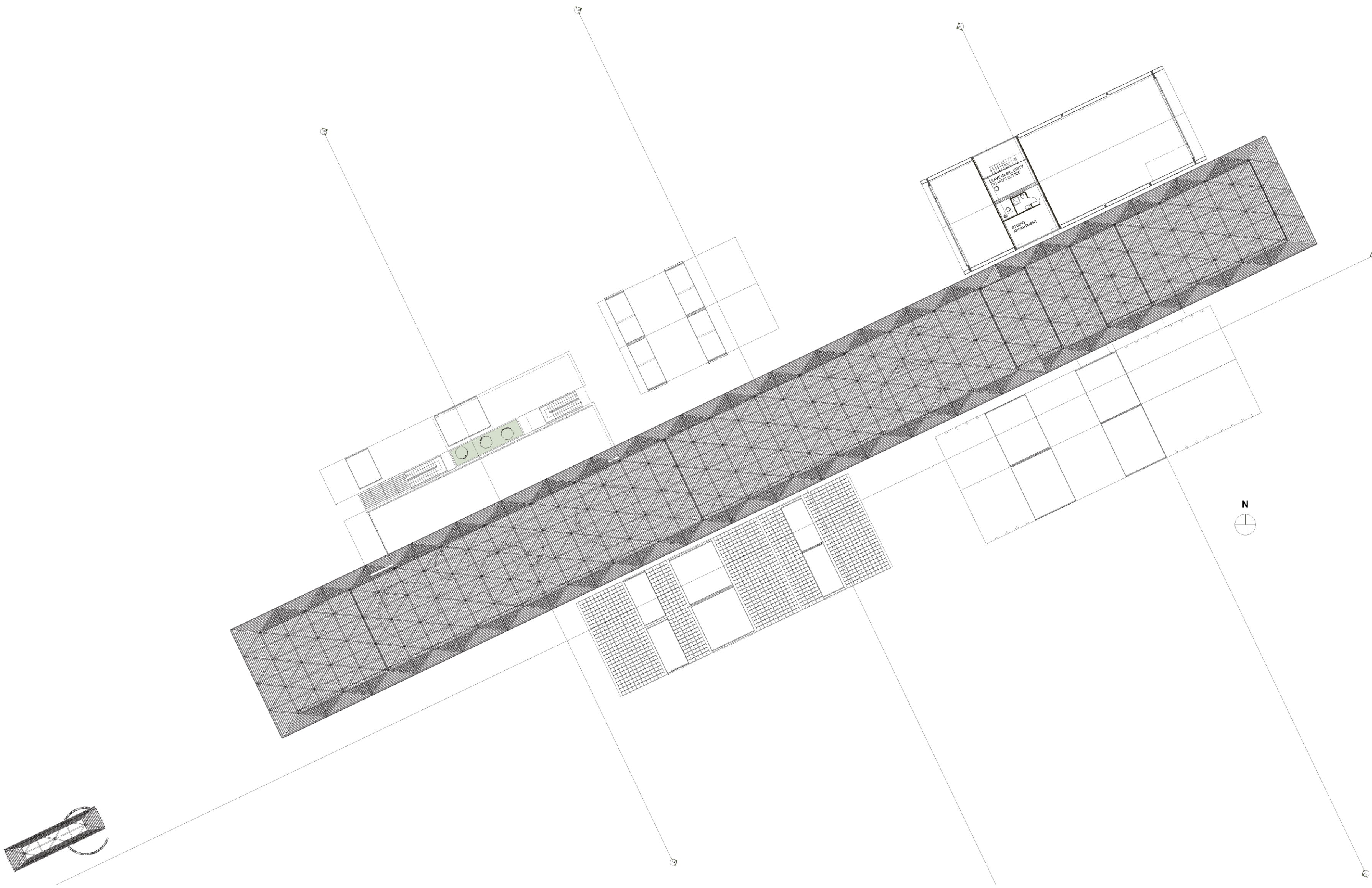
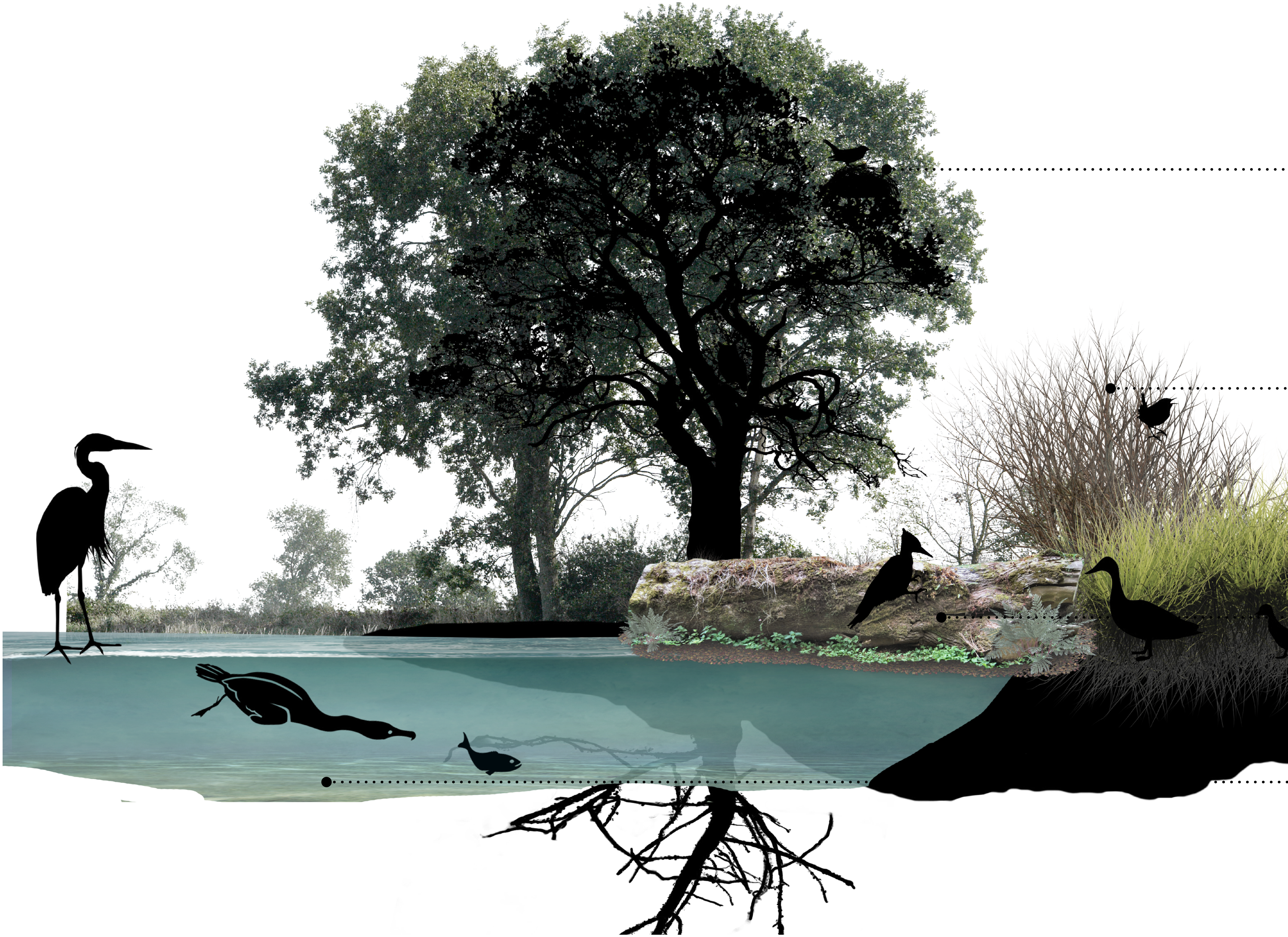
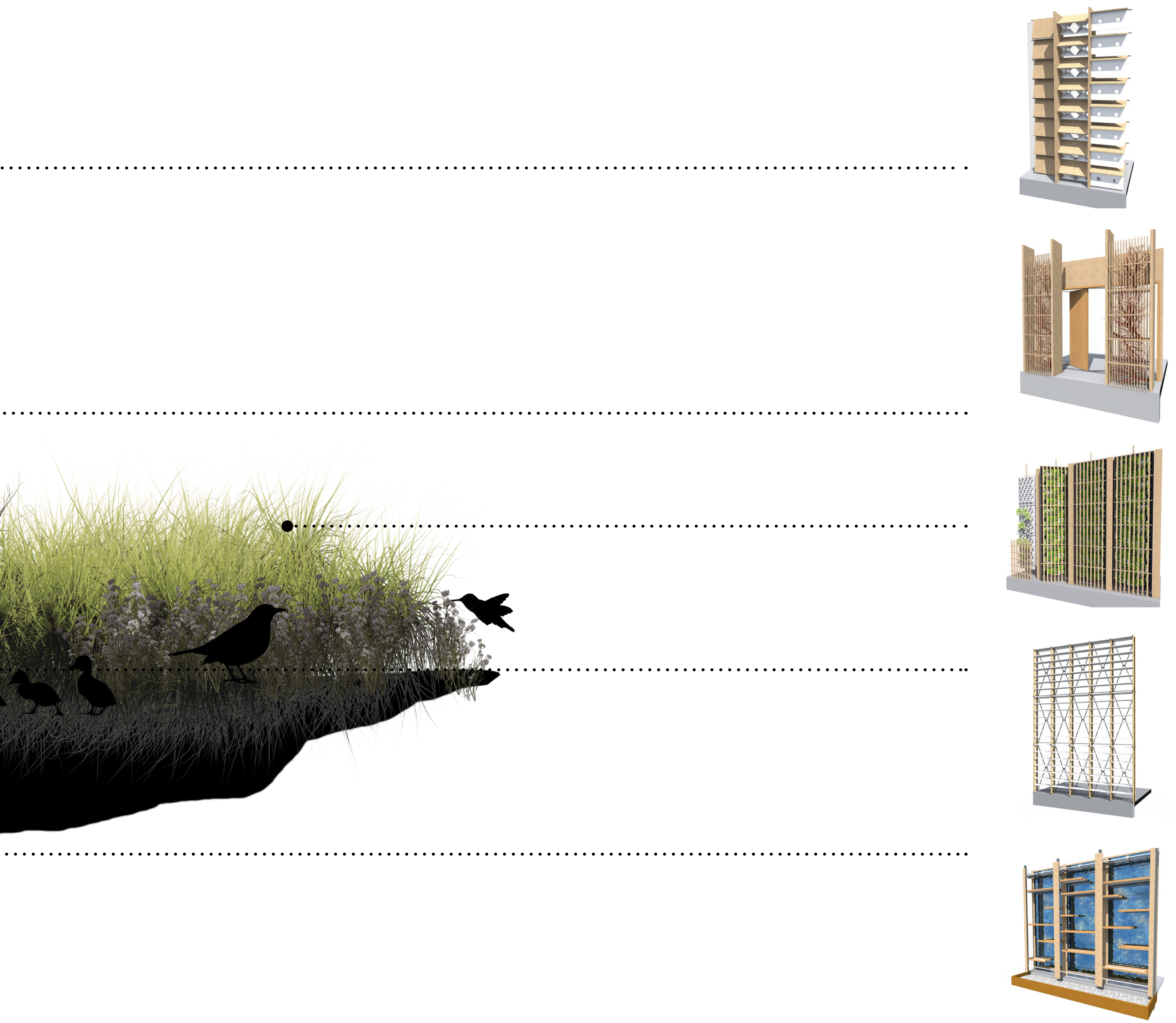


Fig. 4.III.8 - ROOF





FACADES THAT REFLECT THE SURROUNDING HABITAT

KINETIC FACADE WITH NESTING BOXES

FACADE MADE OF INVASIVE PLANT SPECIES; PROVIDES SHELTER FOR BIRDS AS WELL AS AN EDUCATIONAL OPPORTUNITY

PIVOTING PANELS FOR GROWING NATIVE PLANTS; PROVIDE FOOD (SEEDS) AND PLACES FOR NESTING

CRICKET AND MEALWORM VERTICAL FARM

RAINWATER COLLECTING FACADE WITH WATER FEATURES FOR BIRDS

Fig. 4.III.9

TREATMENTW

The avian rehabilitation is divided into separate areas for the three primary stages of treatment: veterinarian clinic and hospital, rehabilitation and nursery area, and pre-release flight cages. The clinic and hospital is run primarily by professional or trainee veterinarian medicine specialists, with minimal reliance on general volunteers and is not a regular visitor destination. The rehabilitation and nursery area is run primarily by specially-trained volunteers who interface with the medical professionals but provide the day-to-day care for releasable birds. The pre-release flight area contains larger cages for birds preparing to be released that require minimal attention and interaction from volunteers.

1. VETERINARIAN CLINIC AND HOSPITAL

The clinic and hospital areas are the initial destination of any new birds presenting to the rehabilitation center. An intake area is located off the northwest corner of the building, with an elevator and stairs that access the second-floor clinic and hospital. The manager’s office is located behind the intake area. After passing through intake, the birds are examined to determine what injuries or deficits they may have. If deemed likely or possibly able to live with treatment, a bird’s immediate medical needs are addressed. Facilities are available for both simple and more complex surgeries and include post-surgical holding areas for recently operated-on birds. The façade of the clinic is constructed from wooden panels with branches of invasive plant species (the Himalayan Blackberry) held between wooden screens. These educate visitors about the problem with non-native and invasive plants and their impacts. This façade additionally provides shelter for small birds (hiding places from predators) and shading to prevent collisions with the glass facade.

Fig. 4.III.10

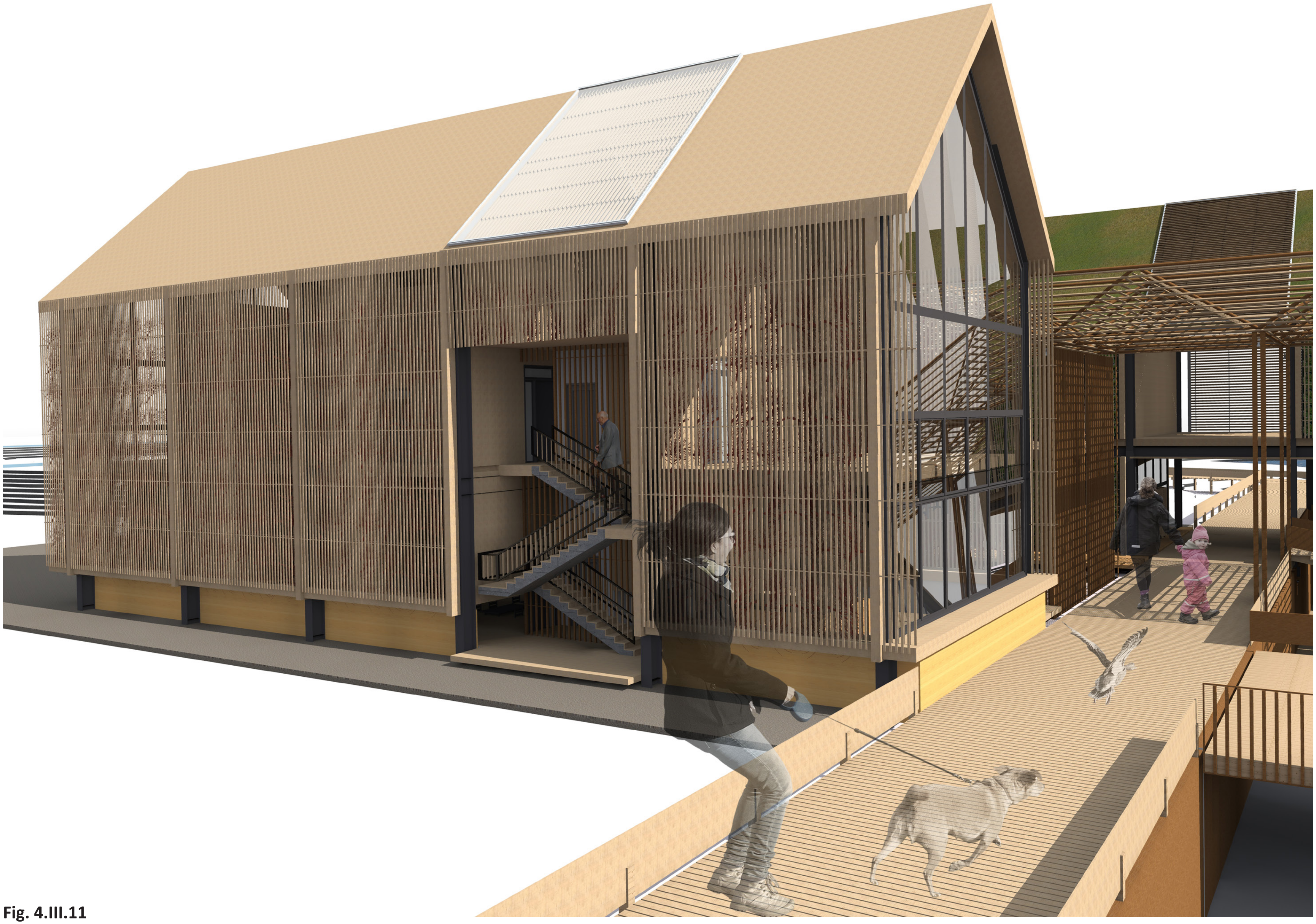


Fig. 4.III.11

2. REHABILITATION / NURSERY

Located on the first and second floor across from the clinic and hospital, the rehabilitation center and nursery provides active care for weak or recently injured birds. A nursery for young birds (nestlings and fledglings) is located on the first floor and is active only in the spring and summer months. Care is provided within the facility by specially trained volunteers and access to the site is restricted while young birds are present. The façade on the facility's walls contain vertical panels with a variety of native plants, promoting biodiversity by attracting bees and birds. The panels also contain unoccupied areas and crates to provide wild birds with shelter and nesting spots. During the late fall and winter, pivoting panels on the façade are rotated inside to protect the vegetation from falling temperatures and is cared for by youth garden volunteers.

The second floor houses the rehabilitation center and cages for recovering juvenile and adult birds. The cages are located between the north and south complexes of buildings, sheltering the birds from unnecessary attention and agitation. These birds, as in the nursery, are cared for by specially-trained volunteers and the general public is not allowed in the area. The roof of the building is insulated by an 18-inch layer of soil with local plants, such as grasses and shrubs, to help regulate year-round temperatures in the building. Rainwater runoff from the roof is channeled through a collection system, some of which runs down to water the plants in the vertical pivoting panels.

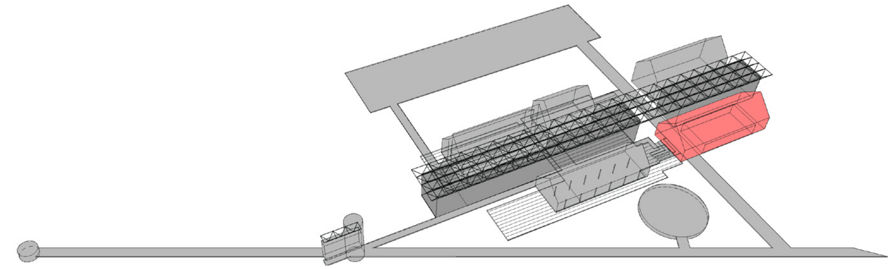


Fig. 4.III.12

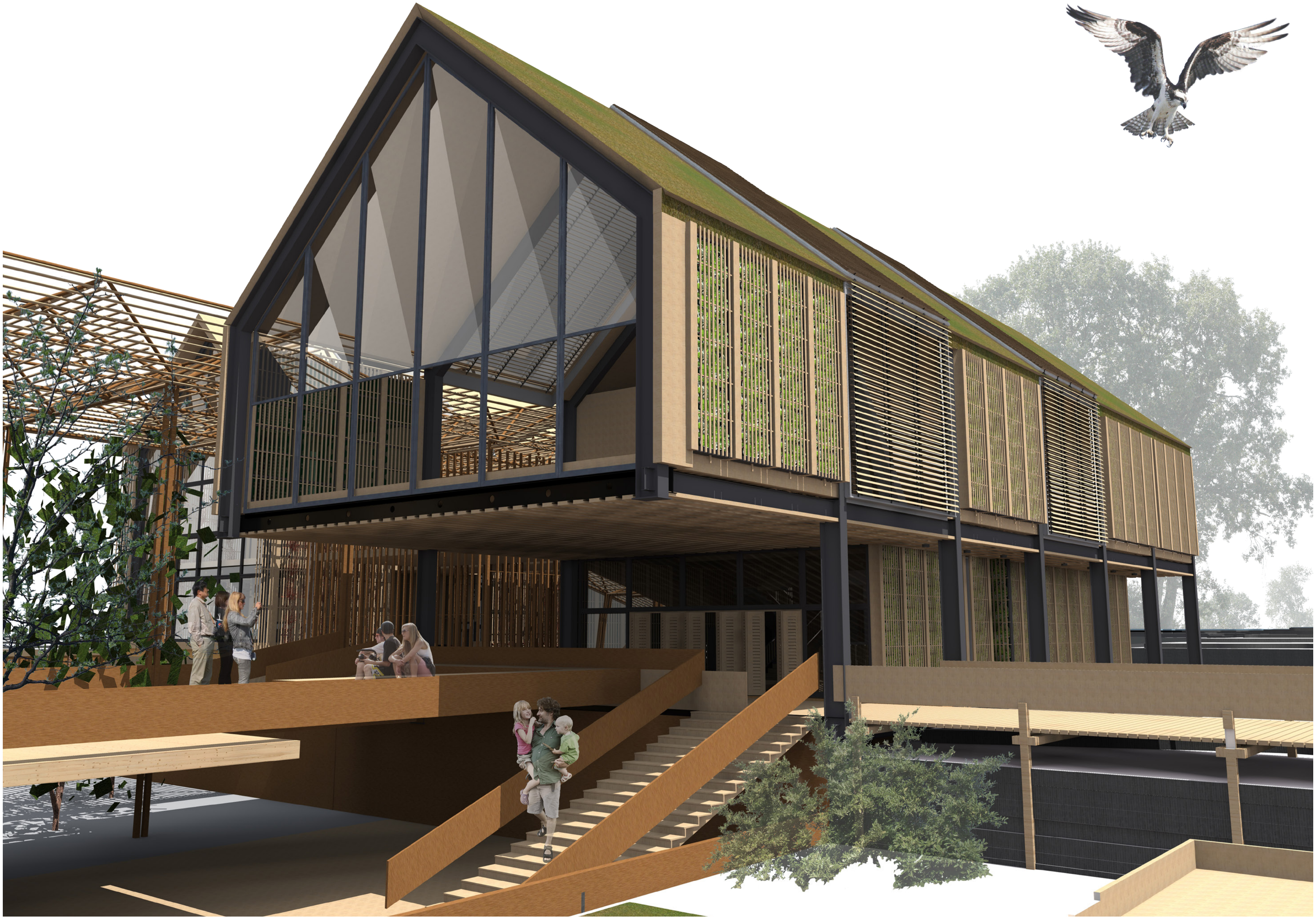
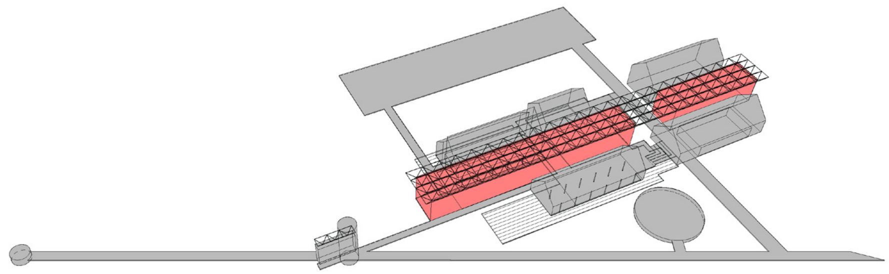


Fig. 4.III.13

3. PRE-RELEASE FLIGHT CAGES (AVIARY)

The last step of treatment program are the pre-release flight cages located off the northeast corner of the building. These are larger cages with minimal adornments, allow birds to regain their strength before their release back into the wild. This is accomplished by giving them enough room to fly as well as to interact with other birds of the same or similar species. Interaction with the volunteer staff is kept to a minimum, as these birds are wild and destined (hopefully) for re-release. The general public is not allowed in this area as the birds need to build strength and confidence and not grow too used to people.



PUBLIC

4. SPECIAL PURPOSE BIRDS (WALK-IN AVIARY)

This two-story high aviary is a permanent home for songbirds that, despite treatment, can not be released back into the wild. As noted previously, federal law prohibits the permanent holding of songbirds except with a license, if the birds are unable to be released, and if the birds are being used to further public education. These birds see a higher volume of visitors and are more accustomed to being handled by center staff, allowing for closer viewing without causing an unacceptable amount of anxiety. Long ramps let visitors see the birds at all levels of the aviary, simulating the several levels of a forest (ground, tree trunks and tree canopy). The roof of the building contains platforms for larger, local or breeding birds.

Fig. 4.III.14
Fig. 4.III.15

PUBLIC

5. PUBLIC RESTROOMS

The public restrooms are located on the main level (1st floor) and include a mudroom, a space to clean rubber boots and shoes before entering the rest of the complex. A lower level below the first floor includes space for storage. The façade off the main level includes a rain collection system, providing water for wild birds for drinking and bathing.

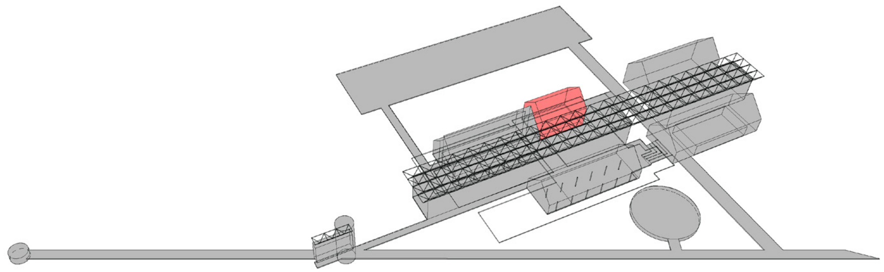


Fig. 4.III.16

Fig. 4.III.17

PUBLIC / EDUCATION

6. RECEPTION, CAFE, GIFT SHOP, LIBRARY

The primary building dedicated to visitors and education is also the only building that has three floors. This building not only houses many of the public facilities, but also houses a collection of special purpose birds that are unable to be released but can be held for educational and outreach purposes. The lower level is dedicated to waterfowl with holding pens that face out on the adjacent pond, where the water birds are able to spend the day if they choose. The 2nd level (the main floor) is split into two volumes on the north and south side. The north half contains a mealworm and cricket vertical farm, which raises insects for bird consumption while educating visitors about one of their primary food sources. Crickets and mealworms are rich in protein and have recently became a fashionable component of some human's diet, but bulk purchasing can be prohibitively expensive so the vertical farms are a necessity. On the south side of the floor are the café, gift shop, and library. Separating the north and south side are free flight aviaries for non-releasable birds, with two-story cages that being on the lower level. Surrounding the main floor are decks and boardwalks where tables and chairs can be placed during warmer months. The 3rd level contains a large, modular room that can be used for meetings, science lectures and teaching. Attic space partially open to the outside, provides space for larger cavity nesting birds such as owls or pileated woodpecker.

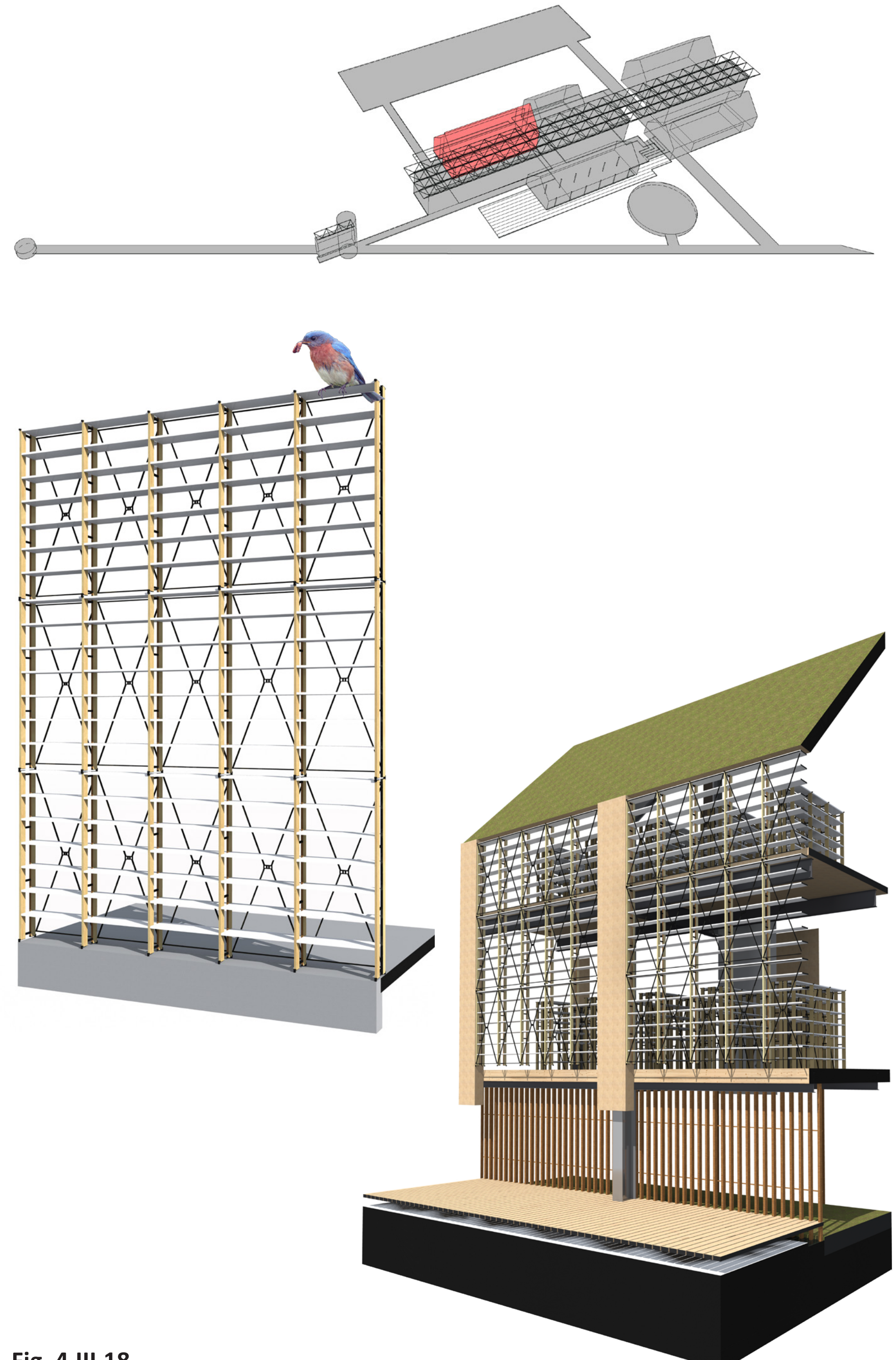
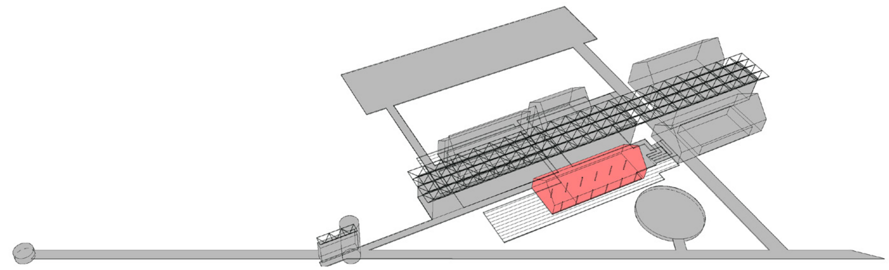


Fig. 4.III.18

Fig. 4.III.19

7. VISITOR CENTER

The visitor center is a large and flexible space for exhibitions, public and continuing professional education and outreach. Primary topics, as discussed in Chapter 2, include understanding birds, the threats that urban environment represents to the local and migratory bird species, and a special focus is given to bird-window collisions. To that purpose, different mock-ups of dangerous and safe window treatments is presented to illustrate the issue. A large conference room is available for volunteer training or educational lectures by guest speakers (UW professors, Audubon representatives, window manufacturers) on various avian topics. The façade of this building contains multiple nesting boxes for resident and short-distant migrant birds that seasonally visit the Union Bay Natural Area. It is not expected that all boxes will be occupied by birds, but the repetitive form of the wall also presents an attractive, aesthetic quality to visitors.



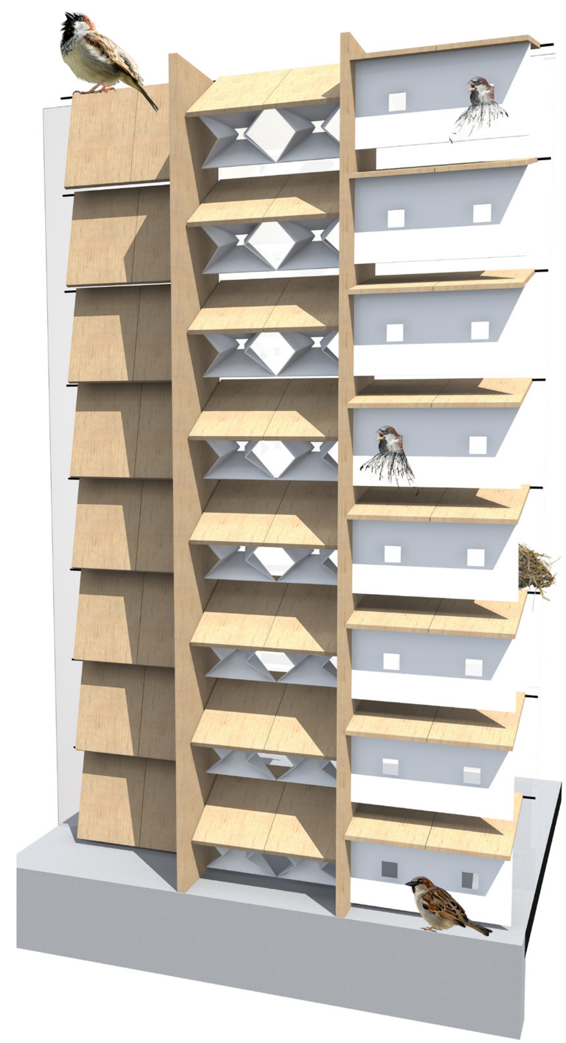


Fig. 4.III.20

Fig. 4.III.21

SITE:

8. HABITAT POOL (FOR WATERFOUL AND SHOREBIRDS)

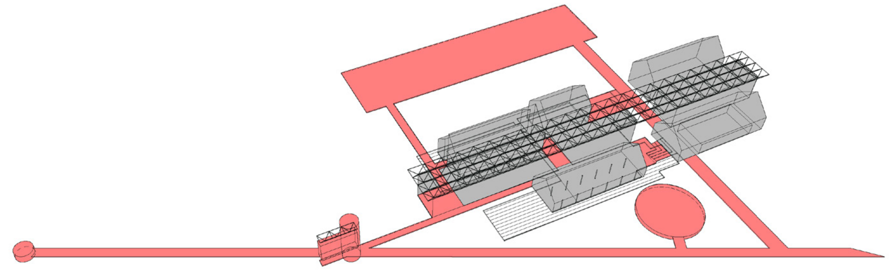
This pond is an extension of an existing one, serving as place for non-releasable waterfowl (ducks, geese and shorebirds) to swim, clean and forage. By opening up of the border of the pond and extending it, a greater number of wild birds will also be able to access the water. This site not only caters to water birds and local residents, but also gives visitors an opportunity to observe them closely in a controlled and stable environment.

9. SPACE FOR OUTDOOR FREE FLIGHT SHOWS

A central outdoor area with amphitheater seating is used for free-flight demonstrations and to show the mostly non-releasable raptors. The central positioning of the space allows public to enjoy scheduled shows from the main level balcony or from outdoor seating surrounding the central platform. The location and more dramatic nature of the show also serves to attract passersby from the boardwalks and is a primary attraction for visiting school students.

10. FLOATING PLATFORM

Placed in front of the visitor center on an otherwise empty platform, a series of birdfeeders will attract multiple bird species, allowing new and young birdwatchers to observe and learn to identify birds. On cold winter days, it might even be used by experienced birdwatchers, enjoying resident birds from within the warmth of the visitor center. The platform currently rests on the ground but is constructed to float and rise with incoming water, which is expected to seep into the site in the coming years as the earth settles.



11. OBSERVATION TOWER

The observation tower is located in the southwest corner of the rehabilitation center, connected to the primary complex of buildings by two separate walkways. The largest human-made object in the area, the tower acts as a local dominant feature and can be seen from the CUH, attracting distant visitors to the site. The tower itself is accessible by the public and is used for local observations and birdwatching. In addition, the outside façade of the tower contains baked clay elements which provide nesting sites for Swallows.

12. BOARDWALK

A network of boardwalks connects the rehabilitation center to the various corners of the Union Bay Natural Area and surrounding facilities. Two short paths lead from the university parking lot to the center on its northwestern façade. To the southeast, a long path connects Yesler Swamp and the CUH to the rehabilitation center. Further to the southwest of the center, another boardwalk takes you to Ravenna Creek and a floating birdwatching platform. From there, you can return to the East towards the center or make a long loop to the southeast, eventually reconnecting with the CUH.

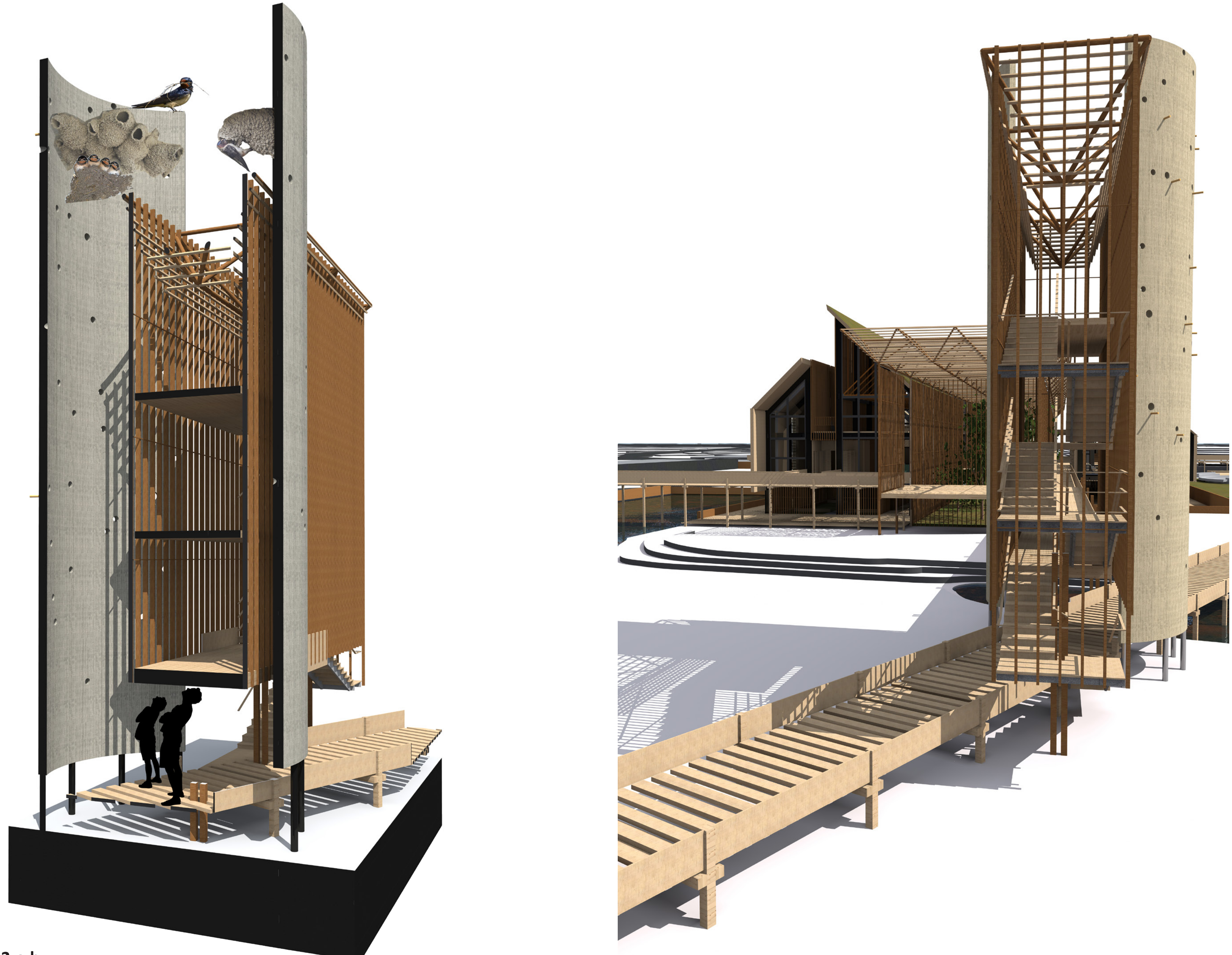
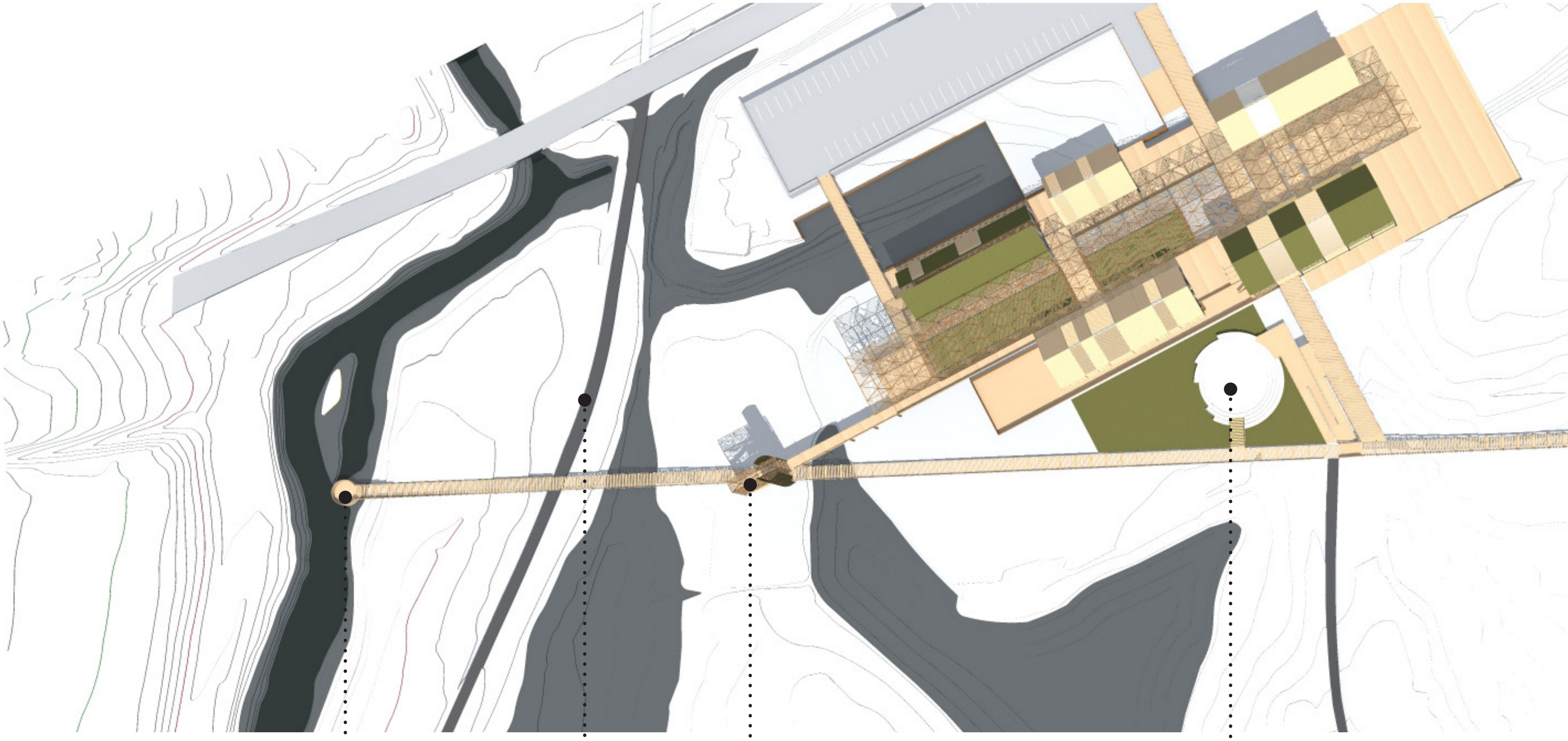
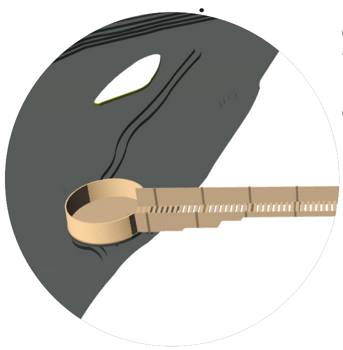


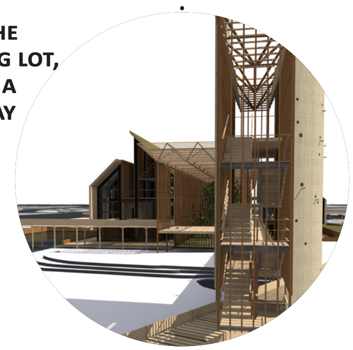
Fig. 4.III.22-a,b



OLD ROAD TO THE
"DIME" PARKING LOT,
CONVERTED TO A
GRAVEL PATHWAY

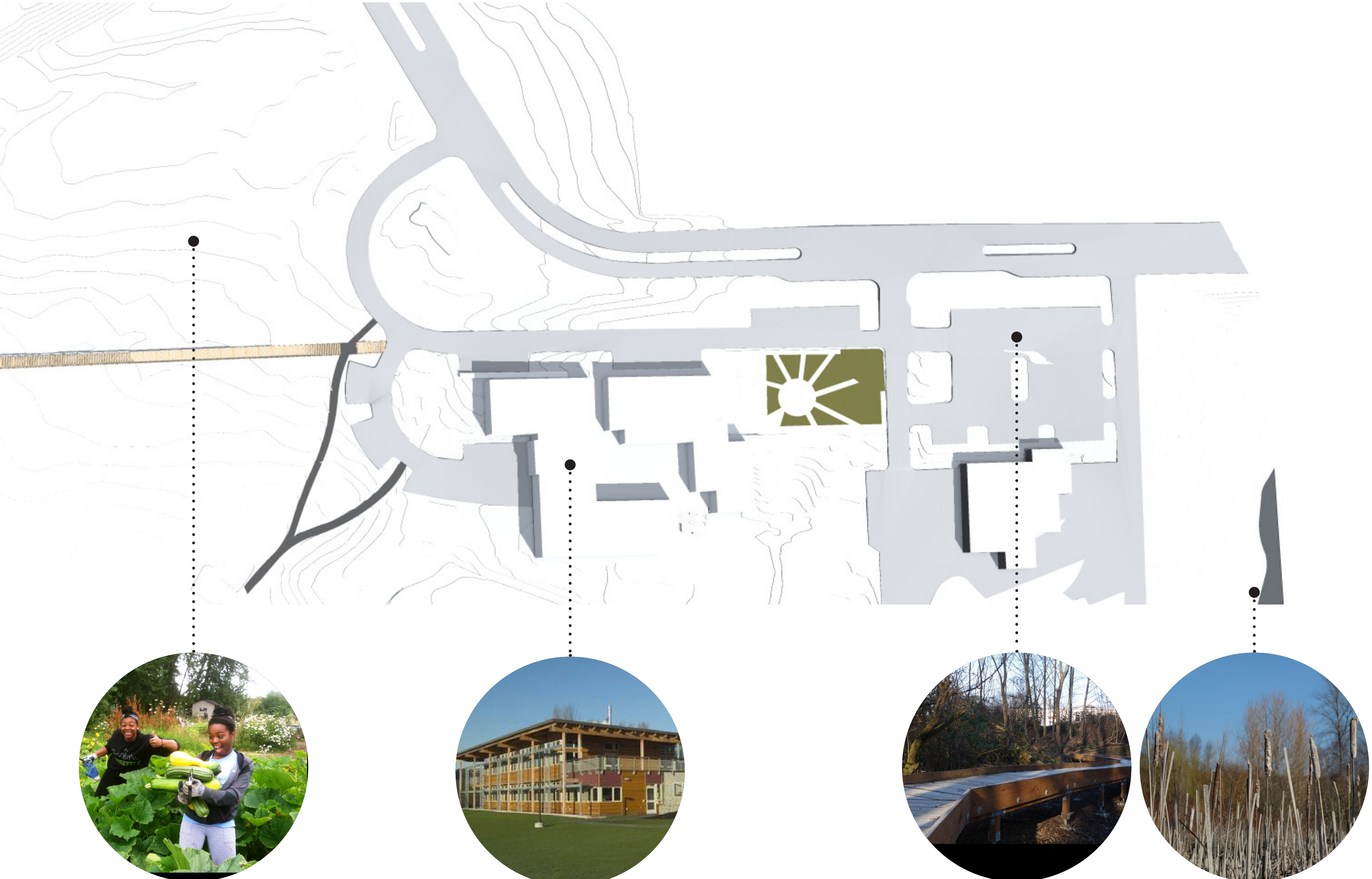


FLOATING BIRD HIDE
(RAVENA CREEK)



OBSERVATION TOWER,
ACCESSIBLE FROM THE BOARDWALK

OUTDOOR AMPHITHEATER FOR
RAPTOR FREE FLIGHT SHOWS
AND LARGE PUBLIC EVENTS



Seattle Youth
Garden Works /urban farm

CENTER FOR URBAN HORTICULTURE

NEWLY CONSTRUCTED
BOARDWALK (2015)

YESLER SWAMP

Fig. 4.III.23

Fig. 4.III.24

Fig. 4.III.25

Fig. 4.III.26

Fig. 4.III.27 - Site plan

Fig. 4.III.28 Site Plan, 2025

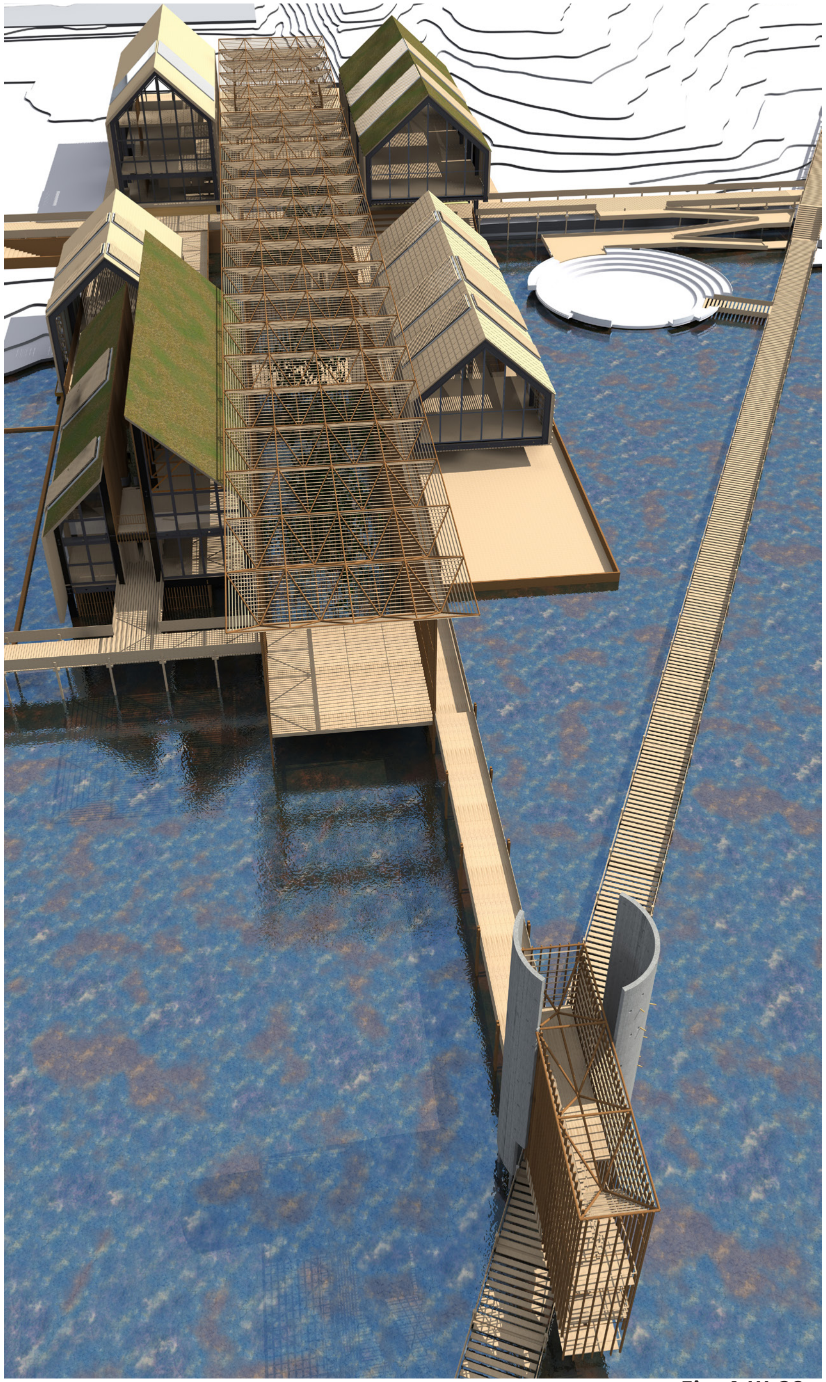
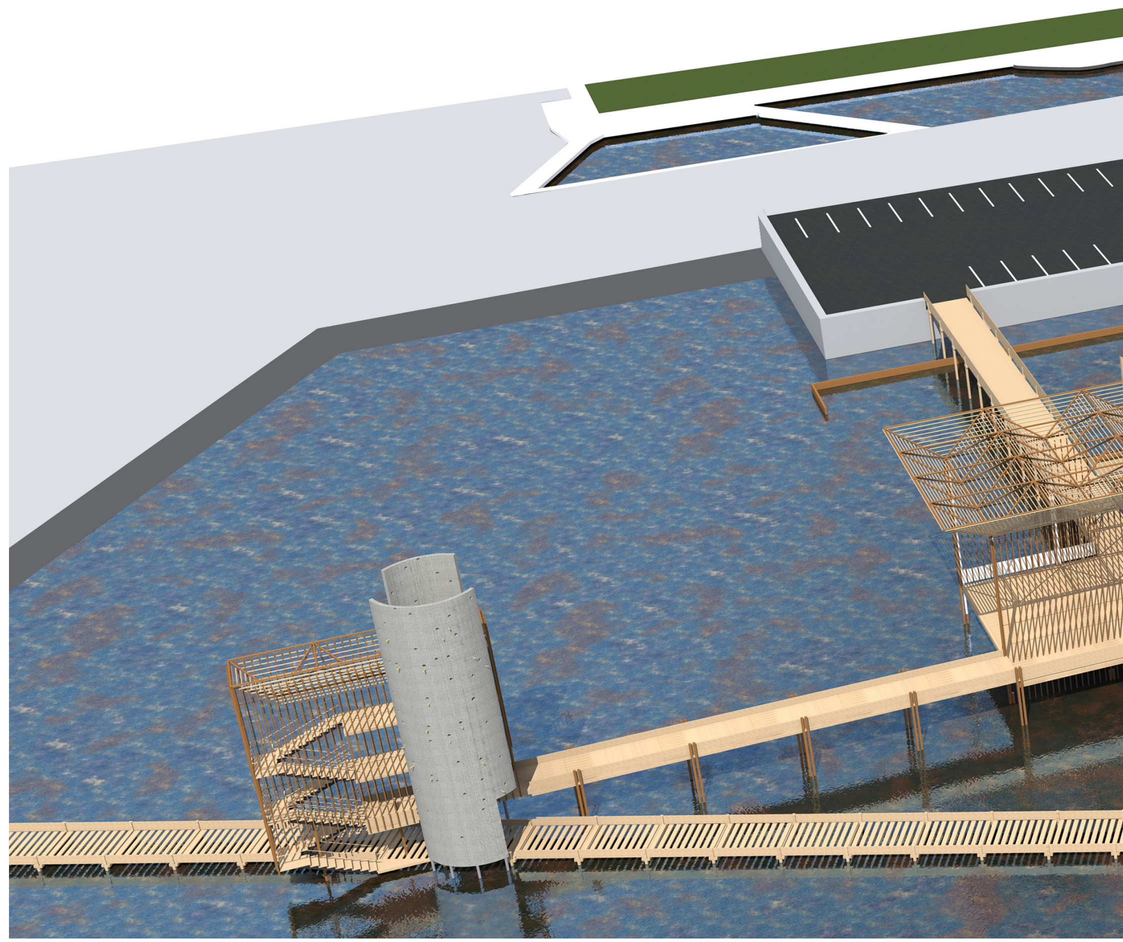


Fig. 4.III.29



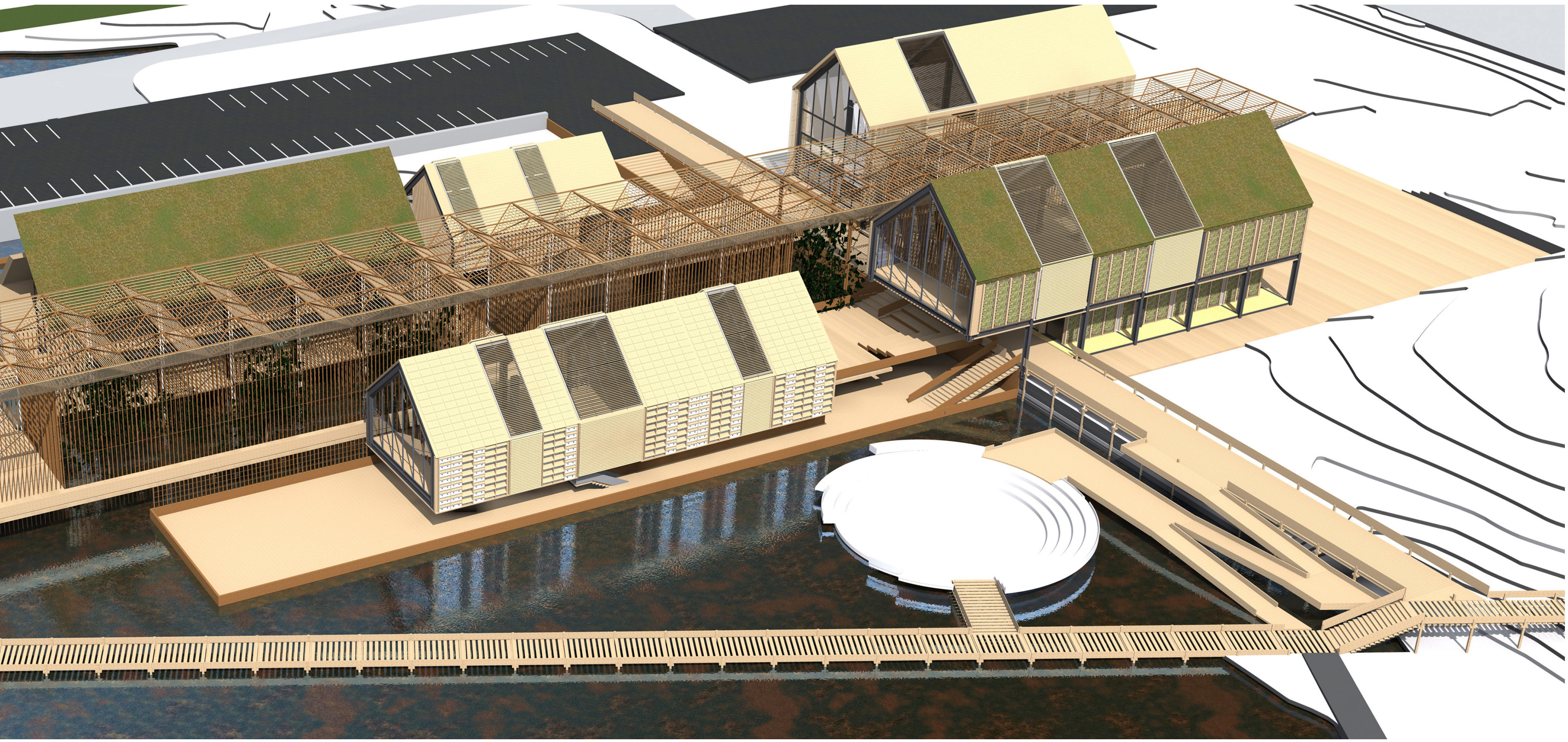


Fig. 4.III.30

CHAPTER 5: CONCLUSION

"Architecture can pick up a spirit of nature. As architects we have an ability to compose...beautiful, natural things."
Conversation with Glenn Murcutt
(University of Washington, Alder Commons Auditorium, January 13, 2015)

In 1958 Jane Jacobs proclaimed, "downtown is for people in response to the modernist approach to urban development. While referring to design approaches and livability, this phrase encapsulates a design paradigm that is hopefully coming to an end -- human-centric design without thought to other living beings or considerations for environmental impact. Continued rapid demographic growth and global urbanization will place further strains on natural habitats and animal species, as greater numbers of people move into cities. Those species that are able to adapt to human presence (or even thrive in it) will still face a gauntlet of threats that will reduce their numbers and cause unnecessary deaths. As shown with birds, core design choices like the glass used for a building's façade can significantly worsen or exacerbate the problem, leading to a greater number of injuries or deaths.

Despite Seattle being considered one of the greenest cities in the United States, it nevertheless suffers from a lack of avian biodiversity and has witnessed incredible levels of natural habitat loss over the city's history. After 150 years of clear-cutting the forests in the Puget Sound area for industrial, urban and agricultural purposes, little natural forest land remains. Of the almost 83 square miles (53,000 acres) of old growth forests that used to be found inside Seattle's modern boundaries, only an estimated 200 acres currently remain. With the exception of a small number of adaptable species such as Gulls, House Sparrows, European Starlings and Crows, native and migratory bird populations have been declining in the Seattle area. Bird populations react to even minor environmental changes in an ecosystem and therefore can be used as an indicator for an environment's health and diversity. By this gauge, declining populations should stand as a warning that something needs to be improved.

Architects are increasingly concerned about the impact that buildings have on the environment – current trends including sustainable and green building design serve as evidence of the statement. Sustainable architecture provides multiple economic benefits to a client, in terms of efficiency, reduction of energy use, costs and promoting a healthier environment. While focusing on carbon footprints, material sourcing and energy savings, many architects do not take into consideration the impact that buildings have on the wildlife and biodiversity. Sustaining and promoting biodiversity are fundamental goals for the wellbeing of the planet and are the moral obligation of humans. Informed architects should embrace this obligation and incorporate design measures that mitigate threats to wildlife and even promote biodiversity.

The overarching goal of this thesis was to propose a means for meeting this moral obligation by creating a more informed public and architecture community. To achieve this goal, it explored the five main factors needed for healthy bird populations, which are food, shelter, a place for nesting, water and environmental security. It demonstrated that these factors shape the compositional biodiversity of birds in an area and are all affected by the loss of natural habitats and increasing in urbanization. It showed that while some cities or urban environments may seem relatively green and contain a number of parks, the change in the composition of habitats and fragmentation of what remains will not necessarily support a diverse or abundant wildlife population. It explained that birds do not recognize and understand glass like humans and that the presence of human-made structures and large windows kill hundreds of millions to a billion birds worldwide, every year. It revealed that during a limited period of monitoring of one migratory season in downtown Seattle, a number of dead and injured birds (including several uncommon birds) were found around buildings with large glass facades. Having documented the treacherous situation for birds in Seattle, the thesis recognized how difficult it would be (though not impossible) to change an entire city as it now exists to make it more bird-friendly, but changes to individual homes and high-rise buildings could reduce the threat and even improve urban bird habitat. The challenge the thesis took on was how to instigate such changes through education and increased awareness of the problem.

To this end, the thesis offered a model of how Seattle's citizens and architects could become aware of the increasing threats to the thousands of birds that pass through or live in this city—and a model of how medical assistance could be provided inexpensively to the city's many injured birds. In short, the thesis proposed a center dedicated to medical treatment and rehabilitation of local and migratory birds in the Seattle metropolitan area that would also cultivate in citizens and architects a moral obligation to fix the problems that cause injury and death to birds. By focusing on public outreach and involvement in the center as well as educational opportunities for students, this thesis asserted that issues in urban design would become more commonly understood as well as those practices that address the issue. It envisioned incorporating this facility into the Union Bay Natural Area. Designed as an example of bird-safe practices, this facility would draw many visitors and help spread its primary message of moral responsibility. Though intended as a specific facility for the University of Washington, the approach to rehabilitation that was offered could be used throughout the state where issues of deforestation, overfishing and marine habitat destruction, and agriculture-related pollution pose increasing threats to Washington's biodiversity. Indeed, the approach proposed herein could be a model for a nation in which people and wildlife co-exist in mutual harmony.

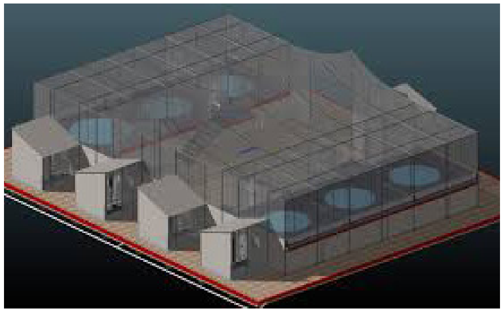
6. APPENDIX:

FLIGHT CAGES

Water bird and waterfowl pre-release cages

Waterfowl and water birds not only need areas to exercise and regain the strength for flight, but also need an enclosure with a pool to exercise in the water. Deeper and larger pools are required for diving birds such as grebes and loons while shallow pools that allow for surface swimming are generally sufficient for other species.[107] A pool 6-feet in diameter, 2-feet deep is needed for Eared and Horned Grebes and a pool 8-feet in diameter, 2-feet deep for is needed for loons.[109]

The West Sound Wildlife Shelter waterfowl enclosure (Western Edge Architecture and Design) (Fig. 6.I.1 a,b) located on Bainbridge Island, is a 40-feet by 50-feet framed structure covered with netting. It has six separate, 4-feet deep pools and can accommodate as many as 70 water birds, such as ducks, geese, sandpipers, herons and cormorants. This enclosure has an innovative water filtration system which not only minimizes water use by recirculating it, but also eliminates the labor-intensive process of cleaning and refilling the pool twice a day, reducing an additional stress for the birds.[107]



Flight cages for songbirds

Songbirds (Passeriformes) or perching birds, vary in size from the Calliope Hummingbird (3-inches long and weighing 0.1 oz.) to the largest representative of the group, the Common Raven (exceeding 3.3 lbs. in weight, 28-inches in length).[110] Cages of varying sizes are required for this group of birds, with the following minimum sizes:[111]

a. For small sized birds: 2’ x 4’ x 6’ for hummingbirds and songbirds smaller than 5-inches; 4’ x 8’ x 8’ for songbirds larger than 5-inches
b. For medium-sized birds: 16’ x 8’ x 8’ for the majority of medium sized birds, such as Pigeons, Doves, Swifts, Nighthawks, Woodpeckers
c. For larger-sized birds: 10’ x 30’ x 15’ Members of Corvidae family (Crows, Ravens, Jays and Magpies)

Fig. 6.I.1 a,b (Left)

Raptor flight cages:

Cage size requirements differ, depending on the size of the raptor species:

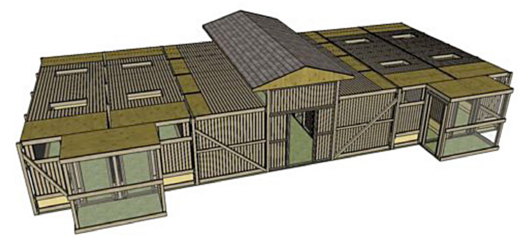
a. Small bird cages (small raptors such as small Owls, and Falcons): 6’ x 6’ x 8’ for limited activity; 8’ x 16’ x 8’- for unlimited activity

b. Accipiter Cages (small to medium raptors such as small Hawks): 8’ x 16’ x 8’ for unlimited activity cage required

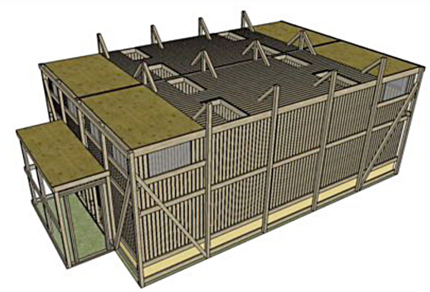
c. Medium Flight cages (medium size raptors such as Barred Owl, Barn Owl and Red-shouldered Hawks): four 12’ x 30’ cages, with airlocks for each pair of cages.[107]

d. Large bird flight cages (large Hawks, Owls and Falcons): 8’ x 10’ x 12’ limited activity cages with an airlock for access; 4’ x 20’ x 50’ flight cages allowing for full flight with an airlock for access

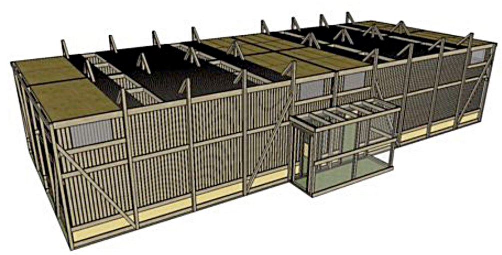
e. Bald Eagle flight cages have a minimum requirement of 100-feet in length (20’ x 100’ x 16’). Both rectangular cages are used as well as L-shaped cages, which allow birds to practice turning and angling in flight.



a. Small raptor cages



b. Accipiter Cages



c. Medium Flight cages

d. Large bird flight cages

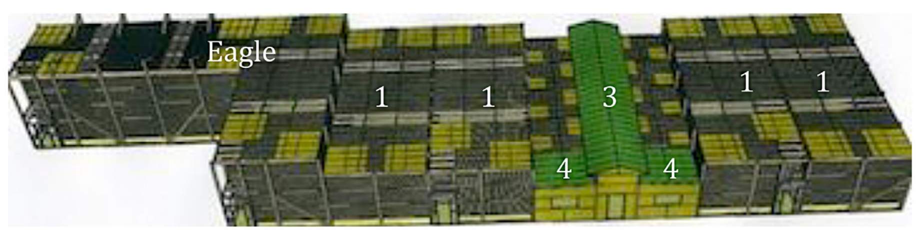


Fig. 6.I.2 a,b,c,d Raptor flight cages

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IMAGE SOURCES

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Fig. 2.I.1 Addressing the need for bird conservation

Fig. 2.II.1 Declining bird populations and the primary causes of bird mortality

Fig. 2.II.2 North American Bird Conservation Initiative, and US Committee.

“The State of the Birds 2014 Report.” *US Department of Interior, Washington, DC 16 pages* (2014).

Fig. 2.II.3 North American Bird Conservation Initiative, and US Committee. “The State of the Birds 2014 Report.” *US Department of Interior, Washington, DC 16 pages* (2014).

Fig. 2.III.1 Pacific Flyway, http://amigosalados.org/Contact_Us.html

Fig. 2.III.2 Migratory Cycle, http://www.nature.com/nclimate/journal/v3/n2/fig_tab/nclimate1810_F1.html

Fig. 2.III.3 National composite radar, https://birdsoverportland.wordpress.com/#jp-carousel-4020

Fig. 2.III.4 Birds of Seattle in their urban habitat

Fig. 2.IV.1 Changes from human related activities which cause threats to biodiversity

Fig. 2.V.1 Habitat loss in Washington State

Fig. 2.V.2 Ecoregions

Fig. 2.V.3 Puget Trough Ecoregion

Fig. 2.V.4 Puget Trough, http://www.marineplanning.org/images/Biodiv_puget_small.png

Fig. 2.V.5 Population growth in Washington State,

http://www.wsdot.wa.gov/planning/wtp/datalibrary/population/PopGrowthCounty.htm

Fig. 2.V.6 Map of Puget Trough sustainability index,

http://archive.ecotrust.org/placematters/images/assessment_map_large.jpg

Fig. 2.V.7-a Ecoregions and habitats

Fig. 2.V.7-b Anthropogenic threats to Avian biodiversity

Fig. 2.V.8 King, Kitsap, Pierce and Snohomish Counties

Fig. 2.V.9 Loss of native avian species, gain of synanthropic bird species

Fig. 2.V.10-a,b Predicted changes in land cover, http://s1.dmcdn.net/LXd4U/280x157-VEB.jpg

Fig. 2.V.11 Effect of land cover changes on native avian biodiversity,

http://s1.dmcdn.net/LXd4U/280x157-VEB.jpg

Fig. 2.VI.1 Bird-window collisions

Fig. 2.VI.2 Bird flight ceiling

Fig. 2.VI.3 Hazard 1: Reflection of vegetation, Seattle

Fig. 2.VI.4 Hazard 2: Vegetation behind reflective glass, Seattle

Fig. 2.VI.5 Hazard 3: Lighting, Seattle

Fig. 2.VI.6 Hazard 4: Fly-through effect, Seattle

Fig. 2.VI.7 Hazard 5: Weather conditions, fog

Fig. 2.VI.8 Birds killed in collisions,

https://ghostbirdmovie.files.wordpress.com/2009/06/birds_lg.jpg?w=600&h=380

Fig. 2.VI.9 State of urban threats in Seattle

Fig. 2.VI.10 Urban nature conservation

Fig. 2.VIII.1 Minnesota Raptor Center

Fig. 2.VIII.1 Grange Insurance Audubon Center, http://www.dispatch.com/content/stories/home_and_garden/2014/10/05/01-during-big-sit-bird-watchers-await-wings-all-night-and-day.html

Fig. 2.VIII.2 Tåkern Visitor Centre,

http://www.archdaily.com/297108/facts-takern-visitor-centre-wingardh-arkitektkontor-ab

Fig. 2.VIII.3 Urban Ecology Center,

http://urbanecologycenter.org/our-branches/riverside-park.html

Fig. 2.VIII.4 Bird park, Villars-les-Dombes,

http://tectoniques.com/en/projects/25_bird-park-villars-les-dombes

Fig. 2.VIII.5 Brike, http://www.adream2012.eu/en/node/1252

Fig. 2.VIII.6 Creature Code, http://www.u-m-a.se/CREATURE-CODE

Fig. 2.VIII.7 Animal wall, http://blog.sub-studio.com/2009/08/gitta-gschwendtner-animal-wall/

Fig. 2.VIII.8 Bird-apartment, http://www.nendo.jp/en/works/bird-apartment-2/

Fig. 3.1 Coexistence with nature

Fig. 3.I.1 Union Bay Natural Area with the view to the Mount Rainier

Fig. 3.I.2 Union Bay Natural Area map

Fig. 3.II.1 Union Bay Natural Area on UW campus

Fig. 3.II.2 Union Bay Natural Area accessibility

Fig. 3.III.1 History of the site

Fig. 3.III.2 Metamorphosis

Fig. 3.IV.1 Union Bay Natural Area site map

Fig. 3.IV.2 Union Bay Natural Area site use by people

Fig. 3.IV.3 Union Bay Natural Area, future site improvements

Fig. 3.IV.4 Union Bay Natural Area current use by local and migratory birds

Fig. 3.IV.5 Potential subsidence in future

Fig. 3.IV.4 2025 Shoreline advance, predicted

Fig. 3.V.1 Site use

Fig. 4.I.1 Ven diagrams of site program

Fig. 4.I.2 Programmatic relationships

Fig. 4.I.3 Program of spaces

Fig. 4.II.1 Existing conditions at the site

Fig. 4.II.2 Proposed location of the Center on the UBNA site