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A framework to enhance urban biodiversity in Egypt, using Animal Aided design method (AAD)

Eng. Lana Ihab El-metwally[1]; Prof. Khaled Mohammed Dewidar[2]; Eng. Eslam Abdelkhalek[3]

[1] Architecture Department – Faculty of Engineering – The British University in Egypt
[2] Vice Dean of Faculty of Engineering – The British University in Egypt
[3] Assistant lecturer – Architecture Department – The British University in Egypt

E-mail: [1] lana181242@bue.edu.eg, [2] Khaled.dewidar@bue.edu.eg,
[3] eslam.abdelkhalek@bue.edu.eg

Abstract

Due to the anthropocentric belief that humans are superior to nature and all other beings, many environmental challenges have appeared. Thus, the world needs to be eco-centric and pay more attention to other beings to assure a better quality of life and enhance the ecosystem. A major environmental challenge is urbanization, it is one of the main causes that made the urban biodiversity in Egypt suffer significantly. As cities grew, natural habitats were lost or fragmented, which caused biodiversity to diminish. Due to current urban expansion, it often appears difficult to strike a balance between human interests and urban wildlife demands. One of the approaches that could be taken to solve this problem is the animal-aided design method (AAD). AAD combines a number of urban planning disciplines, such as architecture, traffic planning, general urban planning, nature preservation, and landscape architecture, into planning and design in order to integrate the needs of animals while maintaining the needs of humans. The research aims to develop a framework based on an in-depth theoretical analysis, case studies, observational studies, surveys and design strategies concerning this topic using the principles and methods of AAD design to integrate animals and their needs in the Egyptian urban landscape in order to enhance the urban biodiversity in the Egyptian context. Moreover, to investigate the possibility of cohabitation designs between humans and animals. In other words, taking into account the presence of animals in the

planning process. This study has both scientific and ethical goals. The scientific goal is to emphasize the importance of integrating animals' needs into the design process in order to enhance the ecological system. While the ethical goal is to provide alternative habitats and a better environment where all beings can live in, and that is through studying both human and animal needs. The final results show the framework that has been tested on three different species, developing various design strategies for laughing doves, and validated by experts in the field of animals and landscape. Following this framework could integrate different species' needs within any chosen location.

Keywords: Urban Biodiversity; Ecology; Cohabitation; Animal Aided Design; Anthropocentrism; Urbanization.

1. Introduction

In ancient Egypt, animals were revered. While today, most animals lost their habitats and are mistreated. Ancient Egyptian temples and tombs are adorned with numerous animals, demonstrating the unique relationships that Egyptians previously had with them. Gamal Eissa, a professor of pharaonic history at Cairo University, stated that "animals were profoundly intertwined with daily life in ancient Egypt." The ancient Egyptians, according to Eissa, did not see humanity as superior creatures to the animal realm in addition to considering animals to be gods. Because both humans and animals were created by divine entities and had the ability to create life, they were seen as partners. The current scene is entirely the contrary; animals are neglected in many aspects of life, especially in the urban context. The contemporary Egyptian cities may be seen as a monoculture that is not shared with animal and plant species. To incorporate conservation into the design of urban open spaces, (Weisser, Hauck 2019) suggests "Animal-Aided Design" (AAD) as a methodology.

The fundamental principle of AAD is to consider the presence of animals at the planning stage so that they become an essential component of the design. Urban regions see the highest levels of human appropriation of net primary output and ensuing environmental impact. Cities provide a crucial home for a substantial number of species, including small arthropods, big mammals, and birds (Klausnitzer 1991). But biodiversity in such regions is declining as cities become increasingly developed and lose more of their open space (McKinney, Grimm, Faeth, Golubiewski, Redman, Wu, Bai, and Briggs 2008). Consequently, urban biodiversity promotion measures are required. Thus, cities need to adopt eco-centric design concepts instead of anthropocentric design strategies. Furthermore, areas that are beneficial to animals are frequently beneficial to people. A built-in environment that is more biodiverse is better for our mental health (Fuller, Irvine, Devine-Wright, Warren & Gaston, 2007). This paper sheds the light on the importance of integrating animal needs and implementing cohabitation designs in modern Egyptian cities to improve biodiversity and provide more habitats for animals while maintaining people's satisfaction.

2. Anthropocentrism

The literal meaning of anthropocentrism is "human-centered", but in its most pertinent philosophical sense, it refers to the moral conviction that only humans have inherent worth. Contrarily, all other beings have value exclusively in how well they can assist people or how useful they are (Fiorentino, 2016). The Anthropocene has been shown to be dangerous not just for human life but also for the ecosystem and many other species (Crutzen, 2006). This is a result of the Anthropocene paradigm's dominating practices for the production, use, and commodification of natural resources, which resulted in an unsustainable planet.

To conclude, the notion that the human being is the primary point of reference for the universe is known as anthropocentrism. The human being can also be seen as having a unique place in the universe, a unique place in relation to other beings, and/or as the origin of all meaning. It has been demonstrated that the Anthropocene poses risks not just for human existence, but also to the ecosystem and a wide variety of other species.

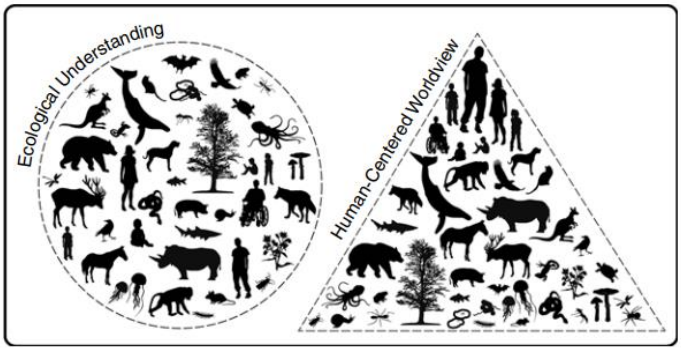


Figure 1. *Ecological and Human-Centered Worldviews (Sanders, 2023)*

2.1. Reflection of Anthropocentrism

An analysis of the literature in several fields (such as law, ethnography, animal ethics, and environmental philosophy) and numerous languages suggests that the global environmental crisis has its roots in anthropocentrism (including English, Spanish, French, German, and Japanese). Regardless of whether the issue is connected to anthropocentrism, it is imperative to recognise that human actions, such as climate change, biodiversity loss, and pollution, are definitely the primary cause of the global environmental catastrophe (Washington et al., 2021).

Non-anthropocentrism, draws the conclusion that people who live in anthropocentric cultures will not care about the misery nonhuman species endure as a result of anthropogenic mass extinction, inversional breakdown, global warming, and other factors. Similarly, if fundamentally valued the rest of nature, Homo sapiens would not be in the current ecological crisis (Rae, 2014)**.**

In conclusion, anthropocentric ideologies are frequently criticized for having an adverse effect on the environment since they really respect humans while just assigning nonhumanity a utilitarian value. The current ecological catastrophe would not exist if Homo sapiens fundamentally appreciated the rest of nature.

3. Urban ecological biodiversity

All ecosystems, whether they are managed or not, are included in biodiversity. Sometimes it is assumed that biodiversity is solely an important characteristic of unmanaged ecosystems, like wildlands, nature reserves, or national parks. That is untrue. Whether they are agricultural zones, rangelands, public parks, or man-made ecosystems, managed systems all have their own unique biodiversity (Kopnina & Cherniak, 2015). The preservation of biodiversity in these mostly manmade systems, which today make up over 24% of the Earth's terrestrial surface, must be considered in any decision relating to biodiversity/ecosystem services (Breuste & Qureshi, 2011; Ouyang et al., 2018). The foundation of life itself is biodiversity. Living things depend on healthy ecosystems, so progress cannot be described as "sustainable" if we do not pay attention to protecting the world's biodiversity (Niemelä et al., 2011).

To sum up, biodiversity includes all ecosystems, whether they are controlled or not. The preservation of biodiversity in these primarily anthropogenic systems, which today make up more than 24% of the terrestrial area of the Earth, must be considered in any decision relating to biodiversity/ecosystem services. Species may become endangered or perhaps locally extinct as formerly wild places are devoured by the urban jungle in cities.

3.1. Urbanization effect on biodiversity

More than 85% of the world's wetlands have been eliminated, 75% of its land surface has undergone human-caused change, and 2/3 of its seas are in danger. Nonhuman species have experienced a decline in average abundance of more than 20 percent in their natural habitats, and 1 million species face imminent extinction (IPBES, 2019). In light if this, urbanisation could have a negative impact on biodiversity all over the planet. Around 60% of the world's territory is expected to be occupied by urban areas by the year 2050. (United Nations 2013).

By better planning for urban expansion, managing protected areas close to cities, integrating habitat for biodiversity within cities, and implementing nature-based solutions to urban issues, the negative effects of cities on biodiversity can be lessened (The Nature Conservancy, 2018).

3.2. Architecture for Animals

Animals, like plants, are an important part of the urban ecosystem. However, due to environmental pollution, construction modernization, and a reduction in urban vegetation, there has been a discernible decline in animal species in populated regions (Mollashahi & Szymura, 2021). Designers and activists are attempting to change this by creating unique environments or shelters that allow people and animals to live together in harmony once again. The future of architecture must include an objective to coexist with plants and animals in a constructed environment (Deb, 2017).

As architects expand their focus beyond buildings for people, they are focusing on various enclosures and open spaces that rethink interactions with animals and their welfare (Deb, 2017; Mollashahi & Szymura, 2021). There are different constructions that have been built for animals, where architects considered the animals' needs to design the space, such as

Birdhouse in Turkey, the Penguin enclosure in London, the Elephant house in Denmark, the Bat Tower in the USA, etc.

3.2.1. Birdhouse in Turkey

Birdhouses have a long history in Turkey, dating back to the Ottoman era. During the empire, builders constructed shelters for little birds, primarily sparrows, on the sides of mosques and other stone structures to protect them from the weather and give them somewhere to breed (Gül & Tunay, 2016). They constructed birdhouses at an elevated height on the exteriors of mosques, madrasahs, and palaces that received direct sunlight and no wind (Erman, 2014). Additionally, they positioned little plates on graves so that birds might drink from them. In Turkish culture, bird homes that were built with an artistic and aesthetic perspective served as the foundation for an architectural element (Çinar & Yirmibeşoğlu, 2019). The birdhouses were made to protect every bird that was flying around freely, including pigeons, wisecracks, swallows, sparrows, and storks (Erman, 2014).

Figure 2*. Birdhouses in Turkey* (Çinar & Yirmibeşoğlu, 2019; Gül & Tunay, 2016)

3.2.2. GBHNPCB in Cali, Colombia

GBHNPCB (GARDEN BUILDING WITH HOSTS AND NECTAR PLANTS FOR CALI'S BUTTERFLIES), built in 2010, is on of the initial interferences to contribute to environmental conservancy in the city of Cali, Columbia, and promotes a network of citizen gardeners that could take care of the local ecosystem. It was commissioned as part of the building design for a small business (Wall, 2022). The GBHNPCB serves as a home for humans, birds, butterflies, and other creatures. Additionally, it has workspaces for a design studio owned by women. The design and construction of a bioclimatic building in the heart of the city of Cali, as well as the administration of many following actions to encourage environmental care among residents and visitors, have all been parts of this ten-year-old

project. It is a Host and Nectar Garden Building with living quarters and workspaces (Wall, 2022). The structure employs the presence of butterflies as a biometer to assess the environmental quality and highlight the special significance of the biodiverse habitat where it was constructed. Since this region is home to the highest diversity of butterflies in the world, butterflies are typically one of the best indicators of the quality and richness of an environment (Wall, 2022).

Figure 3. *Facade with Butterfly shelters* (Garcia & Salinas, 2011)

Figure 4*. Atelier space* (Garcia & Salinas, 2011)

Figure 5. *Host and nectar garden building (Garcia & Salinas, 2011)*

4. Animal-Aided design method (AAD)

Urban planning procedures must actively incorporate activities that promote biodiversity in light of the significant urban growth. Due to current urban expansion, it frequently appears difficult to strike a balance between human needs and the requirements of urban animal species. Hence, Animal-Aided Design (AAD) emerged in order to include animal needs in urban and open space planning, steps in at this point. AAD is a planning and design approach that integrates a variety of urban planning disciplines, including architecture, traffic planning, general urban planning, nature preservation, and landscape architecture (Hauck & Weisser, 2019). The AAD collaborative planning approach aims to specifically account for and incorporate animals into the design of urban open areas**.** The concept of animal-aided design was developed through a research completed by Professor Wolfgang W. Weisser and Dr.

Thomas E. Hauck, both landscape architects from the University of Kassel (Chair for Terrestrial Ecology, Technical University of Munich).

The authors assert that AAD is a strategy that seeks to adjoin landscape architecture with efforts to conserve biodiversity (Eggermont et al., 2015) In order to guarantee that diverse species may survive in cities even in the future, Hauck and Weisser (2015) contend that just creating green spaces, for example public parks, is insufficient. Instead, it is critical to take into account the real requirements of various animal species throughout the design stage (Hauck & Weisser 2015, p. 5). According to Hauck and Weisser, AAD is a method that includes the presence of certain species into the design phase (Hauck & Weisser 2015, p. 4).

The goal is to evolve public spaces for people while simultaneously providing habitats for one or more animal species (Hauck & Weisser 2015, p. 28). This approach suggests that before beginning the design process, planners and landscape architects should determine which animal(s) can co-exist on site. Knowing a species' life cycle and its requirements from conception through all of its stages is a fundamental necessity for designing with AAD, claim Hauck and Weisser. Depending on the stage of life the animal is in, these needs can alter, but they frequently include a place to give birth, availability to food, a place for mating, and safety from predators. AAD must take into account any additional species (plants and/or animals) that rely on the chosen species, such as if they serve as food resources (Hauck & Weisser 2015, pp. 18-19).

In conclusion, AAD is a method of planning and designing that combines several aspects of urban planning, such as architecture, traffic planning, general urban planning, nature preservation, and landscape architecture. The AAD cooperative planning method seeks to particularly take into account and include animals in the design of urban open areas. The AAD strategy aims to integrate initiatives for landscape architecture with biodiversity protection.

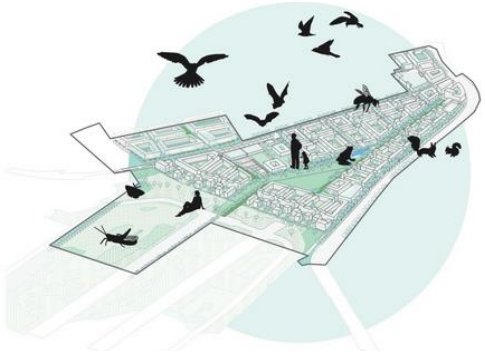


Figure 1. *Illustration of city biodiversity (Archivibe, 2021)*

4.1. AAD design steps

Both the requirements of the human stakeholders and the needs of the animals must be taken into consideration during every AAD planning stage. Target species are chosen during the analysis and draught phase (A). Potential target species include both those that are already present at the project location as well as those that could reasonably travel to it from nearby places. To select fewer target species, the potential habitat at the project location as well as its constraints are examined. The stakeholders who are people are also identified along with their values, needs, and worries (Shwartz et al., 2013). Using the results of these assessments, the target species are chosen, and a spatial plan is created to accommodate their habitat needs. The species' important requirements are used to include the habitat-related needs of the animals in the site design as soon as possible throughout the detailed planning and design phase (B) (Lendi-Ziese, 2019).

It is the intention to design areas where people can interact with nature. It is crucial that all provisions are correctly carried out during the realization and building phase (C). For instance, a focused training program for the staff of the building company could do this. Existing animal populations should be taken into account during the planning and building stages. Construction should be done as gently as possible and at a time when the animals are least likely to be disturbed. If Animal-Aided Design is to be successful, post-occupancy monitoring must be carried out after the project (D) (Lendi-Ziese and Weisser, 2019). The project's ecological, social, and economic components are tracked and evaluated in order to determine its success and to allow for any necessary adjustments. Did the target species accept the rules that were established? What do the locals think of the initiatives? Have the measures raised maintenance expenses, or did they result in financial savings? The outcomes ought to be discussed with the stakeholders, if at all possible. They can also be used to optimize the upcoming planning process or to further enhance the site's structural components.

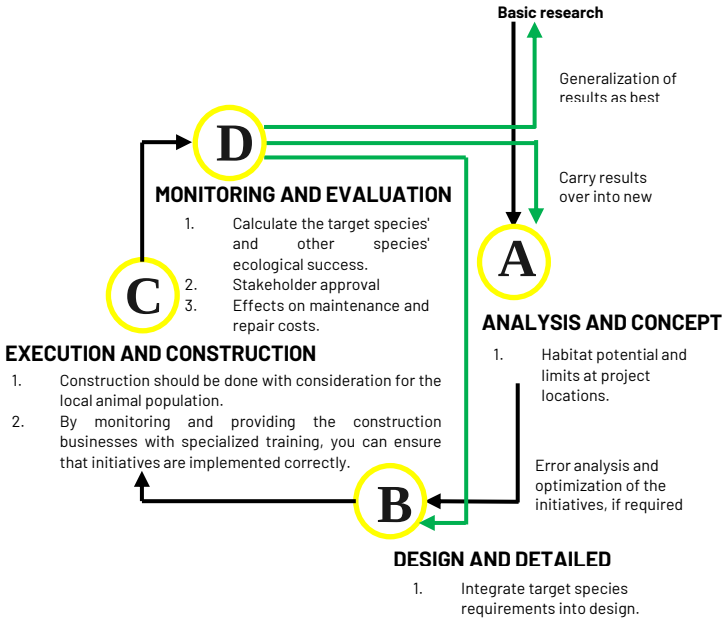


Figure 7. *Graphic showing the AAD planning cycle (Author, 2023)*

4.2. Animal-aided reflection on urban practices

When both conservation and landscape architecture accept the methodology and approach of the other field, the gap between the two will be closed. The foundation of AAD is that for conservation and landscape architecture to successfully coexist, biodiversity preservation must be incorporated into the design process of landscape architecture. Good design for humans that benefits animals is the aim of AAD (Hauck & Weisser, 2019). Their method may also include plants, fungi, or other categories of species, but as animals make up the majority of conservation efforts, they concentrate on them. Deciding the target species at the beginning of the planning phase, determining the essential needs of the targeted species, and influencing the green spaces are the foundation of the AAD refer to fig.8.

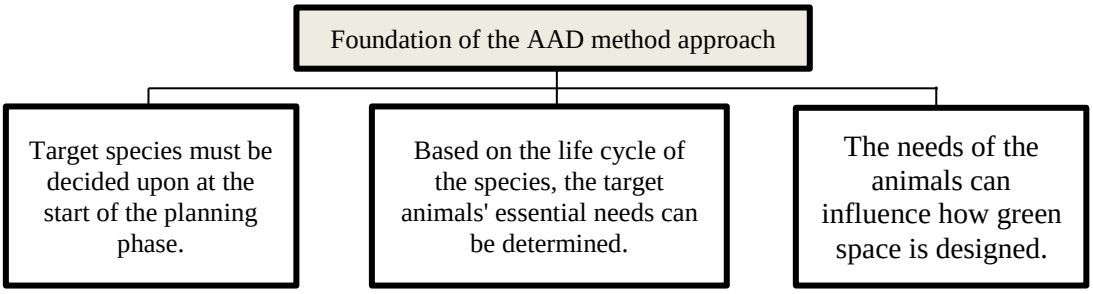


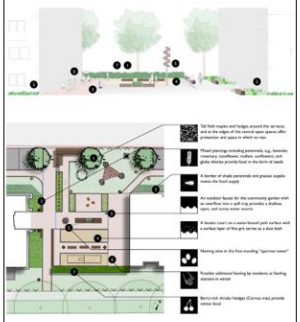
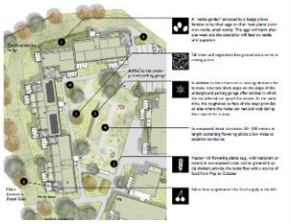
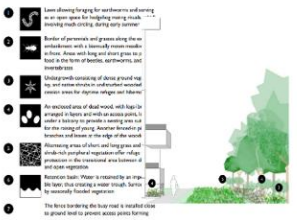
Figure 8. *Foundation of the AAD method approach (Author, 2023)*

5. Case studies

Three different case studies were analysed in order to gather more data on how to implement the AAD method in urban areas (Hauck & Weisser, 2019) .

Table 1. *Case studies comparison (Author, 2023)*

Case studies	Case study (1) KAISERLAUTERN, FRIEDENSTRASSE	Case study (2) FRANKFURT AM MAIN, LEUCHTE	Case study (3) INGOLSTADT, STARGARDER STRASSE
Constants	• Each project contains different strategies that suit the selected species. • All three projects apply the Animal-aided design method. • All three projects are located in Germany		
Area	4,950 m^2	12,493 m^2	10,527 m^2
Construction type	Point block buildings (56 apartments)	Group of multi-story buildings with central open space (87 apartments)	(High-rise) point block buildings with central open space (161 apartments)

Selected Species	Species-specific design elements for the house sparrow	Species-specific design elements for the red admiral	Species-specific design elements for the European hedgehog
Design strategies			

6. Animal-Aided design framework

In order to enhance urban biodiversity and to integrate animal's needs in the urban context, a framework of four main phases has been established. The four phases are, developing a conceptual framework, interviewing animal experts and landscape engineers, testing the framework, and validating the conceptual framework, refer to fig.9.

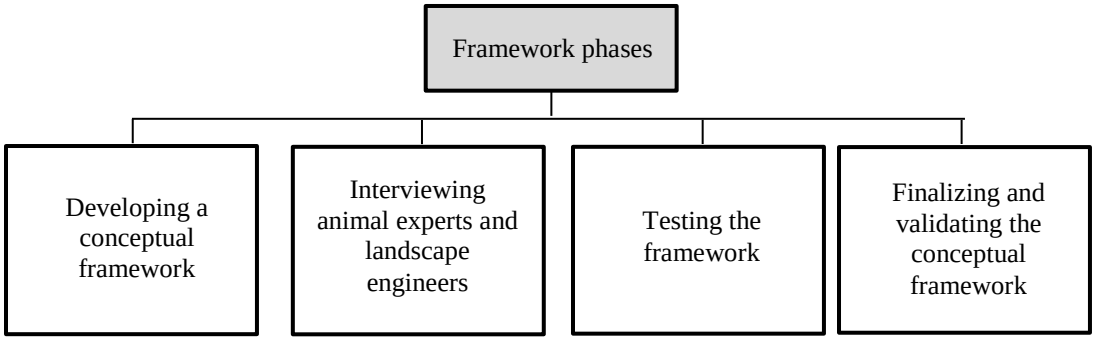


Figure 9. *Framework phases (Author, 2023)*

6.1. Phase one: Conceptual framework:

The first phase will comprise developing the conceptual framework as analysed from the collected data in the literature review. The conceptual framework consists of three phases, observational phase, selection phase, and design phase, each phase covers all steps needed to integrate different species into any chosen area, see fig.10.

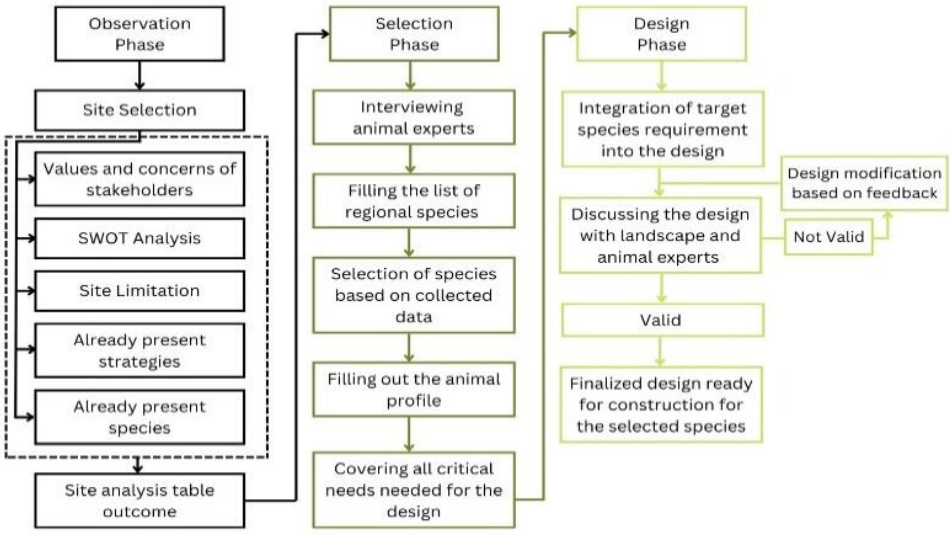


***Figure 2**. Conceptual Framework (Author, 2023)*

6.2. Phase Two: Interviews with animal experts and landscape engineers

After finalizing the conceptual framework, a semi-structured interview was conducted with animal experts and landscape engineers to discuss and check each step while identifying the gaps. A modification was made after the expert's comments on the framework, which was developing the survey in the selection phase rather than the observation phase in order to be specified for the targeted species.

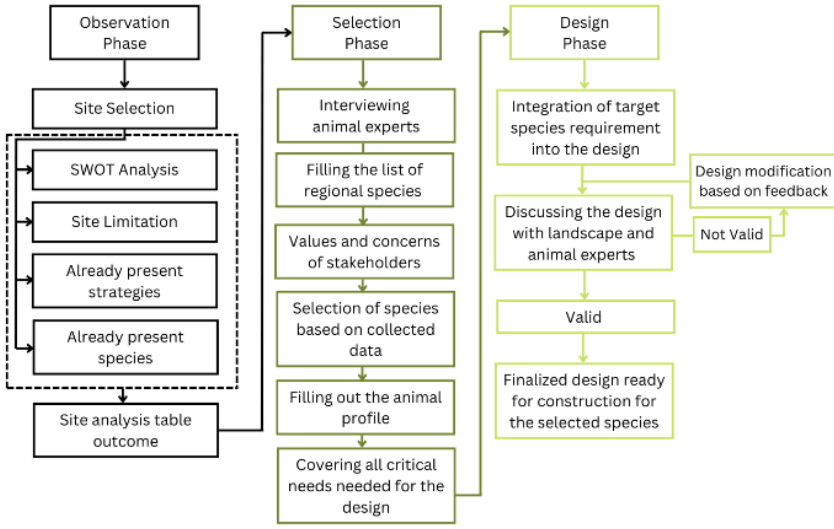


***Figure 3.** Modified Framework (Author, 2023)*

6.3. Phase Three: Testing

Throughout this phase the framework will be tested through 5 steps, filling the site analysis table, filling out the list of regional animals, conducting a survey with different users of the selected area, creating the animal profile for the selected species, and finally creating the design strategies table for the selected species, see fig.12.

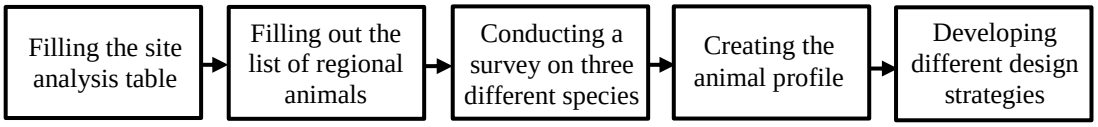


Figure 12. *Testing phases (Author, 2023)*

6.3.1. Site analysis table

The site analysis table involved conducting a SWOT analysis, which assessed the area's opportunities, challenges, and restrictions, at the Child's Park, located in Nasr City.

Table 2. *The completed Site Analysis Table (Author, 2023)*

Site Location	Child's Park, Nasr city
Potentials	• Suitable plants as a food source for some species • Wide spaces • Plants   
Constraints	• Large trees • Climate
Problems	• Lack of water features • A large number of seasonal trees • Lack of shelters • Dead grass 
Present species at the time of observation	**Mammals:** Cats and Dogs  **Birds:** House sparrow, Laughing dove, White wagtail, Crow  **Reptiles:** None **Insects:** Butterflies, Worms, Bees, Ants 

6.3.2. List of native animals

A list of regional species was filled out with the help of experts in the field of animals. The list was divided into four categories, birds, mammals, reptiles, and insects, each species category includes all the animals that have the potential to be integrated into the selected landscape.

Table 3. *The completed list of regional animals (Author, 2023)*

List of regional animals that may be suitable for the selected location	
Birds	• Feral or Rock pigeons (also known as city pigeons) • Indian house crows • House martins • Common Bulbul • Greenfinches • Hooded crows • Common swifts • Black kites • Common kestrels • Rose-ringed parakeets • Eurasian collared doves • African collared doves • Blackbirds • Eurasian sparrowhawks • Laughing doves • Hoopoes • Nile Valley sunbird • Little Owl • House sparrows
Mammals	• Egyptian fruit bats • Cats (including feral and domesticated cats) • Dogs (including stray and domesticated dogs) • Egyptian spiny mice • Egyptian slit-faced bats • Greater mouse-tailed bats • Egyptian free-tailed bats • Egyptian gerbils
Reptiles	• Egyptian tortoises • Common chameleons • Egyptian toads • Mediterranean house geckos • Spur-thighed tortoises • Ornate spiny-tailed lizards • Common wall lizards
Insects	• Praying mantises • Dung beetles • Butterflies (including the monarch butterfly and painted lady butterfly) • Moths (including the sphinx moth and death's-head hawkmoth) • Dragonflies and damselflies • Honeybees and bumblebees • Ants (including the Egyptian ant and red ant) • Mosquitoes • Scarce swallowtail butterflies • Paper wasps • Carpenter bees • Cockroaches (including the German cockroach and Oriental cockroach) • Crickets • Grasshoppers • Lady beetles (also known as ladybugs)

6.3.3. Survey

Three surveys were created on three different animals in order to assess the values and concerns of stakeholders. The three different species, laughing doves, cats, and dogs, were already found in the selected location and the list of regional animals. Each survey includes ten questions related to the topic and targeting the selected species. From the three surveys, the most selected species with the most positive answer was the Laughing Dove, followed by the Cats, then finally the dogs with the most negative answers due to safety concerns from the stakeholders.

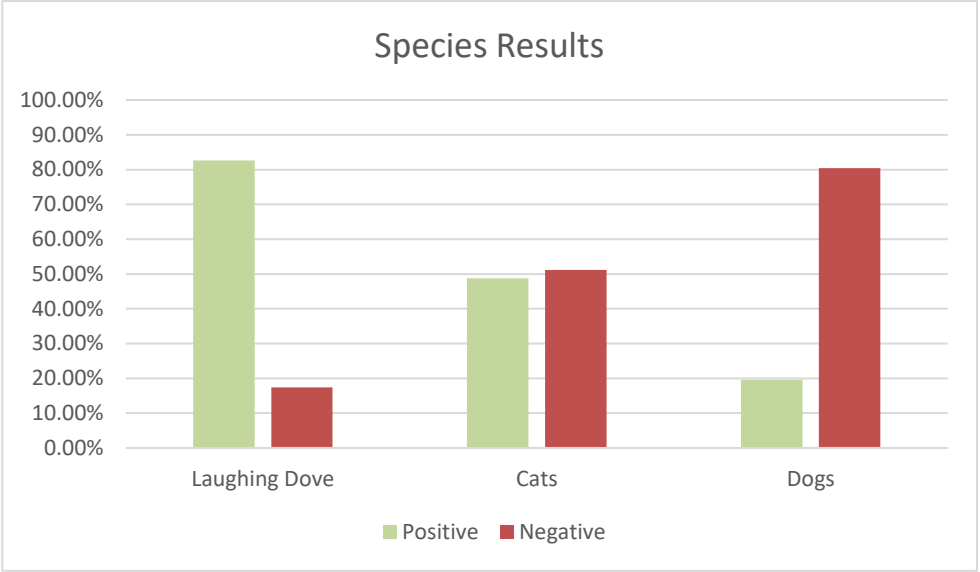


Figure 13. *Species survey results (Author, 2023)*

6.3.4. Animal profile

After analysing the survey results, the most suitable species to be integrated into the landscape are laughing doves. A detailed animal profile for doves was conducted to cover all the needs and design requirements of the species

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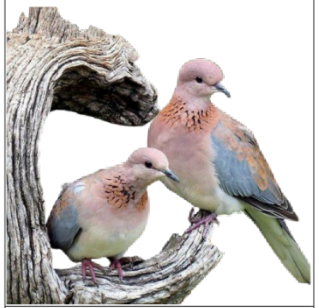
Table 4. *Laughing dove profile (Author, 2023)*

Laughing Dove



- Scientific name – Spilopelia senegalensis
- Weight – Male 150-196 g, female 125-196 g
- Length – 25 – 27 cm
- Wingspan – 40 – 45 cm
- Age – Between 5 and 10 years.
- Range: The laughing dove is a widespread species found throughout much of Africa, the Middle East, and South Asia. In Egypt, they are commonly found in urban areas and agricultural fields.

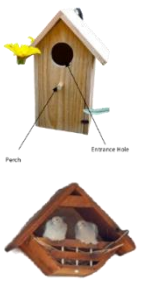
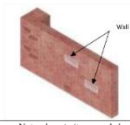
Animal Portfolio

Habitat Requirements	Predators	Behaviours	Importance to humans	Critical needs for each life stage	
Availability of water: They require access to water for drinking and bathing. They are often found near sources of water. Dense vegetation: They prefer areas with dense vegetation cover, which provides shelter and nesting sites. They are commonly found in shrubby areas. Open ground: They require areas of open ground for foraging. They feed primarily on seeds but also consume insects and other small invertebrates, which they find on the ground. Nesting sites: They build flimsy, bowl-shaped nests made of twigs and grasses in trees, shrubs, or other vegetation. They prefer to nest in areas with good cover and protection from predators, such as thorny bushes or dense foliage. Human-modified environments: They are adaptable birds that can also thrive in urban and agricultural areas. They can be found nesting on buildings and in gardens. Disturbance: They are generally tolerant of human activity, but they may avoid areas with high levels of disturbance, such as areas with heavy foot traffic or loud noises. Competition: Laughing doves may compete with other bird species for resources, such as food and nesting sites. In areas with high bird diversity, laughing doves may be less common or may be found in specific microhabitats where they can avoid competition. Diet: They are primarily granivorous, meaning they feed on seeds and grains. They may also feed on small fruits and insects. In urban areas, they may scavenge on human-provided food such as bread crumbs or bird seed.	Birds of prey: Birds of prey such as hawks, eagles, and owls are natural predators of Laughing doves. They hunt these birds for food, especially when they are nesting or roosting in trees or other elevated structures. Snakes: Some species of snakes are known to prey on Laughing doves, especially when they are nesting on the ground. Mammals: Mammalian predators of Laughing doves include domestic cats and dogs, as well as wild animals. These animals are known to hunt Laughing doves for food, especially when they are nesting on the ground or in low shrubs. Humans: In some areas, humans are also a major predator of Laughing doves. This includes hunting and trapping for food or sport, as well as habitat destruction and fragmentation due to urbanization and agricultural practices. Rats: Rats are another common predator of Laughing doves, particularly when they are nesting on the ground or in low shrubs. Rats are known to raid bird nests and consume eggs and chicks. Harvester ants: In some areas, harvester ants are known to prey on Laughing dove eggs and chicks. These ants can cause significant damage to nesting sites and impact the reproductive success of Laughing doves. Domestic and feral cats: Cats, both domestic and feral, are a significant threat to Laughing doves, particularly in urban areas where they are abundant. They are skilled hunters and can quickly decimate bird populations in their vicinity.	Social behaviours: Laughing doves are social birds that are typically found in pairs or small groups. They are known to engage in a variety of social behaviours, such as preening, billing, and cooing, and are often seen perching close to one another. Flight behaviours: Laughing doves are strong fliers and are able to fly swiftly and maneuver through dense vegetation. They typically fly low to the ground and use rapid wingbeats to gain altitude. Feeding behaviours: Laughing doves are primarily seed eaters and are often seen foraging on the ground for seeds and other plant material. They are also known to feed on insects and other small invertebrates. Nesting behaviours: Laughing doves typically build their nests in trees, shrubs, or other vegetation, often near a source of water. They build a simple platform nest out of twigs, leaves, and grass; male and female birds participate in nest building. Roosting behaviours: Laughing doves often roost in trees or on buildings at night, usually in small groups. They are known to return to the same roosting sites night after night.	Aesthetic value: Many people enjoy the sight and sound of Laughing doves, and they can add to the aesthetic value of parks, gardens, and other natural areas. Cultural significance: Laughing doves have cultural significance in many parts of the world, and are sometimes considered symbols of peace or love. Connection to nature: The sounds of Laughing doves are a reminder of the natural world and can help people feel connected to the environment. Pest control: Laughing doves are sometimes used to control insect pests in crops, as they eat insects such as grasshoppers and caterpillars. Bioindicators: Laughing doves can serve as bioindicators of the health of the environment they inhabit. If their populations decline or disappear, it may be an indicator of environmental degradation or other problems. Therapy animals: Some people keep Laughing doves as pets and find them to be therapeutic. Watching and interacting with these birds can provide stress relief and relaxation.	**Egg laying and larval stage**	Nesting sites: Laughing doves require a suitable nesting site to lay their eggs and rear their young. They prefer to nest in trees or shrubs, and will also use man-made structures such as buildings, ledges, or nesting boxes. Nesting materials: Laughing doves build their nests using twigs, grasses, and other plant materials. Providing suitable nesting materials in the vicinity of the nesting site can help to ensure successful breeding. Food sources: Laughing doves require a variety of food sources to maintain their health and successfully reproduce. They feed on seeds, insects, and other small invertebrates. Water: Access to clean water is also important for laughing doves, particularly during the breeding season. Providing a bird bath or other water source can help to ensure they have access to the water they need. Protection from predators: Providing suitable cover and protection in the vicinity of the nesting site can help to ensure the safety of the birds and their young.
				Adult	Food and water: They primarily feed on seeds and grains, but also eat fruits and insects. Providing bird feeders and water sources can help to attract and support their populations. Suitable habitat: Laughing doves require suitable habitat with adequate vegetation cover for foraging and shelter. Protection from predators: Providing suitable nesting sites and vegetation cover can help to protect them from predators. Suitable temperature and climate: Laughing doves are adapted to warm, arid environments and require suitable temperatures and climate to thrive. Access to suitable nesting materials: Providing suitable nesting materials can help to attract breeding pairs and support successful breeding.
				Winter hibernation	Laughing doves are not known to hibernate or migrate during winter. However, during winter, laughing doves may face additional challenges such as cold temperatures, scarcity of food, and limited daylight. Therefore, some critical needs for winter survival for laughing doves may include: Access to food and water During winter: laughing doves may experience scarcity of food. Providing supplemental food sources and water such as bird feeders and water fountains can help to support their survival during this time. Shelter: Laughing doves may require shelter from the cold temperatures during winter. Providing suitable roosting sites, such as dense vegetation or roosting boxes, can help to protect them from harsh weather. Protection from predators: Laughing doves may face increased predation during winter when food is scarce. Providing suitable cover and protection from predators, such as bird netting or predator deterrents, can help to protect them from harm. Access to sunlight: Limited daylight during winter can impact the behaviour and health of laughing doves. Providing access to sunlight and a suitable place to sunbathe can help to support their health and wellbeing.
				Mating	Breeding opportunities: They require opportunities to breed and establish territories. Suitable nesting sites and resources can help to attract breeding pairs and support successful breeding. Suitable nesting sites: Laughing doves build simple, bowl-shaped nests made from twigs, grasses, and other plant material. They prefer to nest in trees or shrubs, but will also use man-made structures such as ledges, eaves, or even abandoned nests of other birds. Adequate food and water: Laughing doves require a reliable source of food and water to support their breeding efforts. They primarily feed on seeds, grains, and other plant material, but will also eat insects and other small invertebrates. Protection from predators: Laughing doves are vulnerable to predation during the mating season, particularly when they are nesting or caring for young. They may seek out protected nesting sites or other strategies to minimize their risk of predation.

6.3.5. Design Strategies

By considering the data collected in the animal profile, the design strategies for the selected species were developed. For each requirement, different design strategies were suggested in addition to their details. By finalizing this table, the laughing dove's needs can be covered by implementing the design strategies in the selected location.

Table 5. *Design strategies for laughing doves (Author, 2023)*

Requirements	Design strategies	Design Requirements	
Water Source	Water Bath 	Size	The bird bath should be at least 0.45 meters in diameter to allow the doves to comfortably bathe and drink water.
		Material	Can be made of a variety of materials such as ceramic, plastic, metal or stone. It should be sturdy and durable to withstand weather changes.
		Depth	A depth of 2 to 7.5 cm is ideal. The water should be shallow enough for the doves to readily stand in and wash without being too deep to risk drowning.
		Safety	It should also be placed in an area that provides cover such as trees or bushes and in a safe area away from predators.
		Accessibility	It should be placed on the ground or on a low pedestal, for easier accessibility for the Doves.
		Water	It is a good idea to add a few stones or pebbles to the bottom of the bath to provide a grip for the doves while they bathe.
Food	Bird Feeders 	Size	Feeder must be sturdy and large enough to accommodate them. A hopper or platform feeder, which can hold a larger amount of seed and provide space for multiple birds to feed at once is a suitable design idea.
		Location	Feeder location is important to ensure that doves can access it easily while also minimizing potential problems such as mess and damage to nearby plants. Location should be sheltered from wind and rain.
	Plants 	Types	Sunflowers: favourite food of doves. Wildflowers: such as coneflowers, black-eyed Susans, and tickseed. Grasses Berries: including shrubs of elderberry, dogwood, and hawthorn. Millet: Millet is a type of grain that doves love to eat.
Shelter	Bird Boxes 	Size	Entrance hole: 10.5 cm in diameter Nesting Chamber: should be about 20cm x 20cm x 20cm Perch: near the entrance hole, about 5 cm wide
		Distance from food and water sources	Maximum 30 m away
		Location	Height: 1.8 to 3 meters from the ground is recommended. Orientation: Entrance hole should face the prevailing wind and towards the morning sun. Protection from predators: they can be mounted on poles or attached to buildings but should not be placed in trees as this can make them vulnerable to predators. Spacing between each other: should be at least 25.5 cm to 38 cm apart to prevent overcrowding.
	Wall Cavities 	Size	Must be at least 20 cm deep and 15 cm wide
		Location	Should be in a quiet, sheltered area away from predators. Avoid placing the cavities near windows or doors, as it may cause disturbance
		Materials	Must be non-toxic and durable, avoid using treated wood or other materials that may harm the birds
		Ventilation	They should be properly ventilated by installing a small vent or drilling a small hole near the top of the cavity, to prevent building up moisture and molds.
	Natural nests (trees and shrubs) 	Size	Should be large enough to provide adequate cover (0.9m to 3m high)
		Density	The foliage should be dense enough to provide shelter and protection. Avoid over-pruning the plants since this might make them less suitable as nesting locations.
		Location	Trees and shrubs should be located in a sheltered area and protected from predators. Place them far from windows, doorways, and other locations where the birds could be startled.
		Type of vegetation	Doves prefer nesting in trees and shrubs that have horizontal branches or dense foliage, such as: juniper, pine, cedar, and spruce trees, as well as hawthorn, sumac, and viburnum shrubs.
Socialization	Interaction with humans 	Open spaces	For the people to interact with the doves through feeding them seeds.

6.4. Phase Four: Final framework

After testing the framework phases, validation from landscape engineers and animals' experts is needed to come up with the final framework. The framework was finalized and validated through reviewing the collected data of the site analysis table, analysing the survey results, checking the animal profile, viewing the laughing dove critical needs, and finally analysing the different design strategies for the laughing dove.

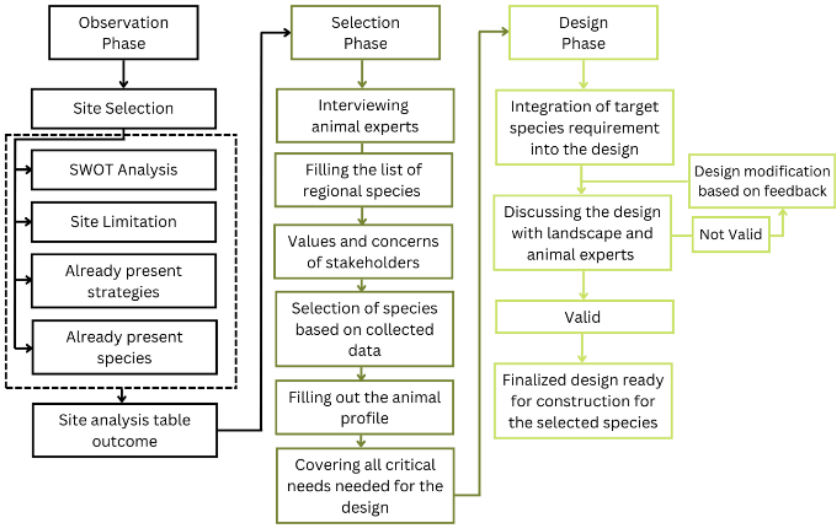


Figure 14. Finalized Framework (Author, 2023)

7. Findings

Throughout analysing the applied studies data, several key findings were concluded; The first phase, also known as the conceptual framework consisted of three phases; observational phase, selection phase, and design phase. While the second phase had an impact on the framework, the interviews led to a modification in the sequence of the framework where the surveying step was moved from the observation phase to the selection phase. In the third phase, however, the testing was essential to assure the workability and reliability of the framework as it included filling out the site analysis table and the list of regional species that narrowed down the animal selection for the potential integration.

Furthermore, the survey created took into consideration the concerns of the stakeholders and narrowed down the species selection with the highest potential to integrate their needs which is the laughing dove. Moreover, it included filling out the animal profile for the selected species with the help of experts which led to an easier identification of the design strategies to integrate the needs of the laughing doves. The fourth and final phase, also known as the validation phase, was easier as the testing phase made it more accurate and reliable for the experts to inspect and validate.

8. Conclusion

To conclude, urban biodiversity refers to the variety and quantity of life within a city. Urban biodiversity is a result of the profusion of many tree species, birds, frogs, fish, and beneficial microorganism species. As more people move to cities, urbanized habitats are the habitat type that is now expanding at the quickest rate worldwide.

The research hypothesis, implementing animal-aided design methods in the Egyptian urban context would help enhance urban biodiversity, thus; improving urban dwellers' quality of life, and providing a sense of connection with nature, was validated by the research literature review and the theoretical studies. Anthropocentrism and urbanization have caused a significant impact on different environmental aspects, such as pollution, biodiversity, and resources. Moreover, urbanization caused habitat fragmentation, which caused a negative impact on both humans and animals. It became hard for other species to strive in cities, where they cannot easily find shelters and sources of food and water, causing a loss of city biodiversity. The animal-Aided design method is a process to integrate the animal's needs within the planning process, which will definitely enhance the urban biodiversity as it provides alternative shelters and environments for other species. Furthermore, the applied studies part of the research has added to the hypothesis, where a framework including all steps needed for the animal integration, was conducted. Additionally, the framework was tested on laughing doves, to finally reach a design strategy covering their needs which could be integrated in the chosen area.

There were four phases of the applied studies, phase one involved creating the conceptual framework that could be used to accomplish the main goal. Modifications were made in phase two, based on semi-structured interviews with specialists concerning the framework steps. Additionally, in phase three, the framework steps were put to the test by observing the chosen area, Child's Park, creating a list of local animals with the assistance of animal experts, carrying out three surveys on various species, choosing the laughing dove and creating a thorough animal profile to address all of its design requirements, and finally coming up with various design strategies that could be implemented in the chosen area in phase four. The framework was validated in the last stage by returning to the specialists to examine and verify the findings.

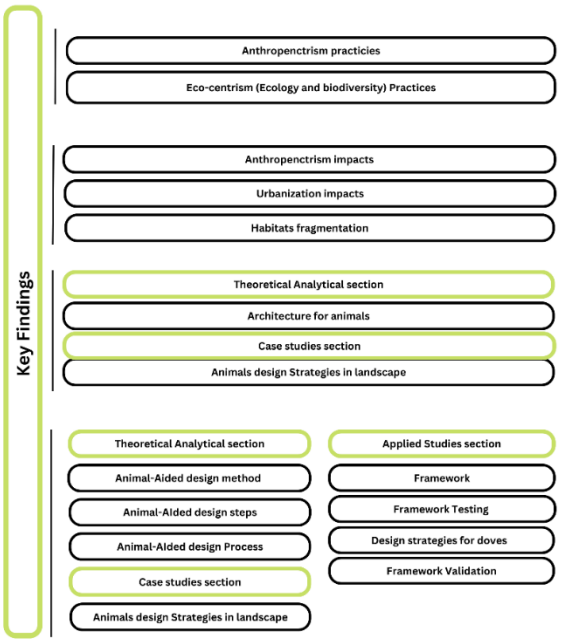


Figure 15. *Key Findings (Author, 2023)*

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