

Spatial Zoning Analysis of Zoo in Urban Area as a Preliminary Assessment for Improving the Education and Recreation Roles

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3 Spatial Zoning Analysis of Zoo in Urban Area as a Preliminary Assessment for Improving the Education and Recreation Roles

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Abstract. Zoos have an important role as an animal conservatory. An ex-situ animals conservation should have a living space that resembles its natural habitat while also functioning as an exhibition space for educational purposes. While in nature, animals require a large landscape as their habitat. Unfortunately, most zoos' limited land areas impede them from doing so, especially for zoos in a dense urban area. As a form of public space in the city, zoos not only serve as an educational means for the urban community but also a recreational facility to withdraw from the urban life that is far from the natural environment. Several Indonesian zoos that occupied the minimum land areas in an urban context are Bandung Zoo, Surabaya Zoo, and Batu Secret Zoo. Unfortunately, the two first received relatively bad visitor reviews regarding the lack of animal exhibition space, entertainment space, and supporting space. Meanwhile, the more recently built Batu Secret Zoo, which shares a similar land area, continuously receives good visitor reviews because they feel it simultaneously meets their educational and recreational needs. Improvement is sorely needed for the other zoos. This paper analyzed the spatial zoning of the three zoos' landscapes and associated them with the visitor experience. It is a preliminary step in assessing the zoo for further improvement in educational and recreational roles. The result shows that the animal exhibition zoning based on a specific design base plays a significant role in improving the educational and recreational function.

1. Introduction

Designing a zoo is not merely an architectural work related to the user and space components, but rather a comprehensive work involving various disciplines, such as biology, landscape, and utility [1]. The zoo's main room plays a role in animal conservation and research, and as an educational institution and a recreational vehicle for the community [2]. The natural animal habitat is a large landscape space. Meanwhile, the ex-situ conservation space has a limited land area, especially if it is located in a dense urban area. However, its existence in the city space as a form of public space is very important because not only can offer educational opportunities to the people, a zoo is also a recreation facility to withdraw from the urban life that is far from the natural environment. With this limited land area, the field of design science must be able to organize spaces in order to effectively convey the role of the zoo.

The zoo exhibition space is undoubtedly the main space unit in a zoo, which should have been facilitated with the situation of its natural habitat in its new living space while also displaying an

interactive exhibition space for the visitors [3]. Many recent developments in zoos in Europe, America, and Australia have been done to foster a sense of attachment by creating a more natural feel of the exhibition space, although it is still not as perfect and sufficient as an animal's natural habitat [2].

Visitors are the main target of building a zoo. A visitor's attachment to the object they are observing, which in this case is the animals, is critical to the effectiveness of zoo designs that effectively perform their educational role. Visitors gain an educational and entertaining experience through a walk-through exploration of effective space units that can be achieved by creating a dynamic. Torre compared it with a movie [4] [5]. Besides, the spaces in the zoo also include space for recreational facilities, such as amusement rides, as well as supporting space, such as management facilities, research, and other facilities to meet the visitors' needs like shops [6]. It is necessary to evaluate the zoo design to ensure the zoo can continue to meet visitors' evolving needs over time [7].

Bandung Zoo, Surabaya Zoo, and Batu Secret Zoo are examples of zoos in an urban setting. They are one of the educational and recreational spaces that are always crowded with people. All three zoos are located on the same land area, which is about 15 hectares. The Bandung and Surabaya Zoos were founded in 1916 and 1933 [8] [9], respectively, while the Batu Secret Zoo was established much more recently in 2008 [10]. Unfortunately, the two first receive relatively poor visitor reviews regarding the lack of animal exhibition spaces, entertainment spaces, and supporting spaces. Meanwhile, Batu Secret Zoo continuously receives good reviews from the visitors because they feel the zoo met their educational and recreational needs simultaneously during the visit. Research that discusses the three zoos is very limited in number. They mostly discuss visitor satisfaction, as seen from its service aspect [11] [12]. Other research is limited to the diversity of entertainment in the Surabaya Zoo [13]. The three zoos have carried out spatial improvements, especially at the Bandung Zoo and Surabaya Zoo.

Massive repair efforts are certainly not easy and cheap. Landscape assessment to see the zoning division of spaces is helpfully needed to see how effective the zoos' zoning space is to carry out their educational and recreational roles. Through spatial analysis, in which this research is increasingly developing, it is urgently needed to observe spatial patterns. In addition to that, the zoo's broad scope demands a comprehensive range of ecological thinking [14].

2. Method

This research used two phases of analysis by mapping the zoo landscape's spatial zoning then inspecting visitor experience in each spatial zone. Basically, these two phases have also been carried out in a research by Yilmaz, et al [15] with different emphasize, that are analyzing the typology of three zoos, then asking some questionnaire to visitors to explore their interaction experiences during their visit in the zoo. However, in this research, due to the limitation of conducting field observation during the COVID-19 pandemic, the primary data for analysis were obtained from available public sources, such as satellite imagery maps, the zoo plan published on each official internet page, animal collection, and visitor review submitted through public internet webpages.

The first phase started by grouping the zoo landscape space into three zones, namely animal exhibition zone, entertainment zone, and supporting zone. Animal exhibition zone is the animal living space that also serves as the exhibition for educational purposes. The data of animal species and the number of animal collections are also included within the process of identification. Entertainment zone is of the space used to keep amusement rides that also offer additional activities that don't involve animals. Meanwhile, the supporting zone is the zoo's managerial space and supporting visitor facilities, such as a parking lot, an entrance gate, and other recreational service functions.

Using zoo plan and satellite imagery maps, the mapping phase involved landscape spatial identification, zone classification, and then assigning each zone with colors (Figure 1). Several actual pictures depicting the situations of each space to assist the determination of zones in the design concept were also collected. This stage resulted in a spatial zoning layout of the whole landscape and animal exhibition zoning—containing information such as animal species, collection number, and the setting characteristics of unit spaces. The discussion of this stage covers the physical aspect of the zoo landscape.

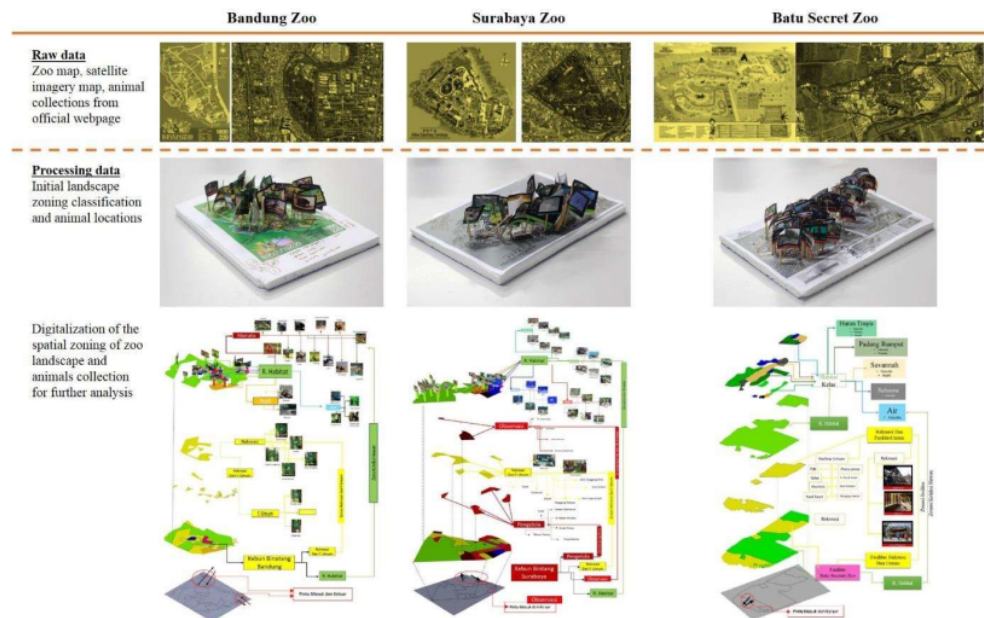


Figure 1. The process on spatial zoning layout of the three zoos at the first research phase.

In the second phase, the discussion is about the landscape zoning layout and the exhibition zoning to find the correlation between the spatial zones with the visitors' experience regarding a zoo's educational and recreational roles. The visitor experiences were obtained from open public commentaries found through Google Review page that were submitted from September to October 2020 [16]. Only commentaries containing keywords related to the animal exhibition space, entertainment space, supporting space, and any visitors' experience regarding a zoo as an educational and recreational facility were selected. These findings then were linked with the spatial zoning layout of each research object to answer how the zoo can effectively perform its educational and recreational role for the visitors.

3. Results and Discussion

3.1. Spatial Zoning in a Zoo Landscape

The zoo's spatial landscape is classified into three zones, namely the animal exhibition zone, the entertainment zone, and the supporting zone. The three zones' composition may vary in every zoo. All zoos in these case studies use more than half the landscape area for the animal exhibition zone. This zone includes exhibition cages, animal treatment cages, and visitor pathways (Figure 2). The requirement for a larger land area for the animal zone, particularly in Bandung Zoo and Surabaya Zoo, comes from their specific need for a research facility. Surabaya Zoo also provides animal health observation facilities, animal quarantine facilities, library, and guest houses within its supporting zone area larger than Bandung Zoo.



Figure 2. Spatial zoning layout and characteristics of three observed zoos.

Meanwhile, the implementation of recreational roles from the entertainment zone where facilities for amusement activities like amusement rides are located. In Surabaya Zoo, the allocation for the entertainment zone is relatively smaller compared to the others, which implies that it is not a priority since the zoo has a vision about animal research. However, Bandung and Batu Secret Zoo allocate relatively big land areas for the entertainment zone. Bandung Zoo has many small amusement rides spread within the zoo's area, such as children's playground and boat rides. Batu Secret Zoo has some bigger amusement rides, which are put together in one big space. Besides the entertainment zone, Batu Secret Zoo also offers amenities to entertain the visitors within its supporting zones, such as a large reception space, souvenir shop, dining area, and other space to meet the visitors' needs that are not educational nor entertaining.

3.2. Spatial Units in Animal Exhibition Zone

As the main zone that contains prominent education activities in the zoo, it is important to have a thorough understanding of the exhibition zone arrangement and its spatial unit. Animal exhibition zone consists of many spatial units that display the animal, which is placed, grouped, and gathered based on a particular reference. The main findings are two particular references of arranging the animal exhibition zone arrangement found on the three case study objects. Those references are animal taxonomy, specifically the animal class level, and the animals' biome habitat (Table 1).

Table 1. The types of animal exhibition zoning of the three zoos.

Zoo	Animal exhibition zones based on animal class	The settings of animal exhibition spatial units			
		Grass field	Tree trunks	Pond	Aquarium tank
Bandung Zoo	1. Primate zone	●		●	
	2. Mammals zone	●		●	
	3. Reptile zone			●	
	4. Aves zone		●		

Surabaya Zoo	1. Primate zone	●				
	2. Mammals zone	●			●	
	3. Reptile zone		●		●	
	4. Aves zone	●	●		●	
	5. Pisces zone					●
	Animal exhibition zones based on animal biome	The animal class collections				
		Primate	Mammals	Reptile	Aves	Pisces
Batu Secret Zoo	1. Tropical forest	●	●	●	●	
	2. Meadow	●	●			
	3. Savannah		●	●		
	4. Waters		●			●
	5. Safari		●			

The first one is the basic zoning arrangement. Even though the three zoos possess basic zoning arrangement, it is most apparent in Bandung Zoo and Surabaya Zoo. It consists of at least four to five animal zones based on the animal kingdom class—mammals, primate (specific under mammals class), reptile, aves, and pisces. Each animal zone has a specific exhibition spatial unit setting designed to imitate the animal natural habitat characteristics (Figure 3). The spatial unit settings that are often used are open field, tree trunks, outdoor ponds, and aquarium tanks. The animal exhibition zones in these zoos are outdoor. There is not much indoor environment. Between these two zoos, it is only found in Surabaya Zoo, which has pisces collection exhibited in a building that houses aquarium tanks.

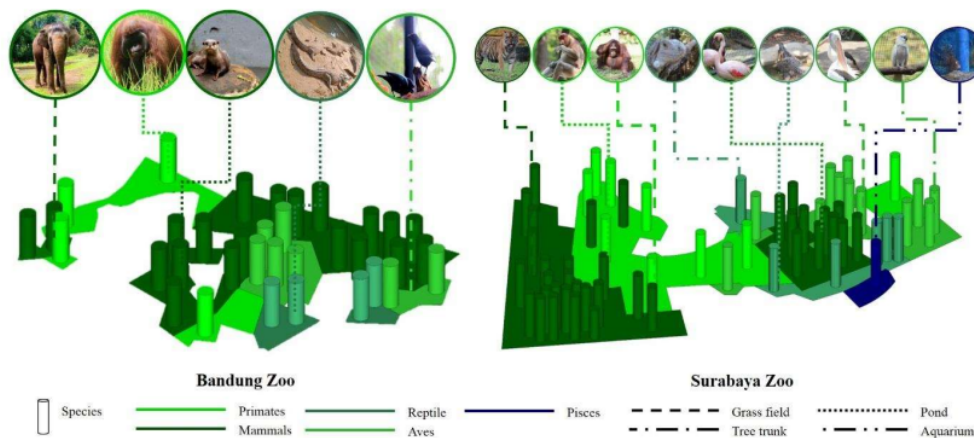


Figure 3. The animal exhibition zoning in Bandung Zoo and Surabaya Zoo.

Meanwhile, the biome arrangement is found explicitly in Batu Secret Zoo, which is more recently established than the other two zoos. Biome in nature is a specific environment suitable for certain types of plants and animals to live. There are five biomes in Batu Secret Zoo; tropical forest, meadows, savannah, safari, and waters (Figure 4). Water environment has several ponds designed as shallow water habitat and also aquarium tanks for deep-water habitat. Zoning arrangement using animals' biome habitat is more advanced than the basic one that only uses animal taxonomy. As Mehta and Singh have identified that the basis for animal display could be arranged by geographic condition, ecosystem type, taxonomic classification [1]. There are some animal species from some classes living in the same biome zone. Each animal needs a particular setting for their living space. The outdoor and indoor environment also becomes another consideration in zoo design. Outdoor environments are typically found in all

biomes, except for aquarium tanks. On the other hand, the indoor environment is designed for reptile zones and for visitors' pathways to protect them while walking through wild animal space.

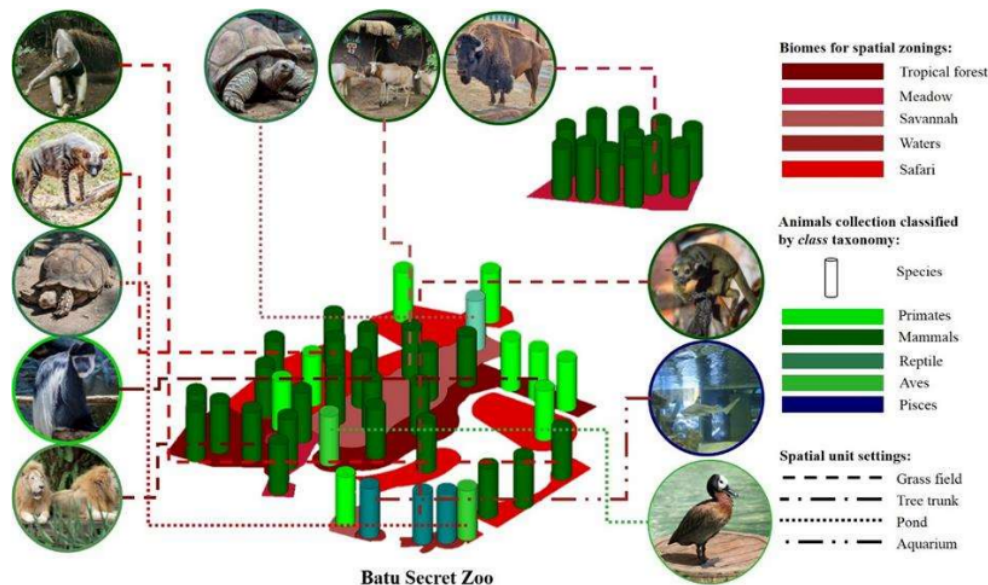


Figure 4. The animal exhibition zoning in Batu Secret Zoo.

3.3. Zoo Spatial Zoning Based on Visitors' Experience

After analyzing the zoo landscape' spatial zoning, it is important to consider the visitors' experience regarding the zoo design's effectiveness in performing its educational, and recreational roles. The design of animal exhibition space, entertainment space and supporting space was valued with a scale ranging from poor, fair, and good (Table 2). In the animal exhibition zone, visitors of Bandung Zoo and Surabaya Zoos rated them poor to fair. The visitors reported they experienced confusion regarding the route because of the lack of signage along the pathway to guide them to see all animal collections. Another bad review was found in Surabaya Zoo related to the design of animal exhibition space. In some exhibition spaces, visitors couldn't have a comfortable visual interaction with the animal due to the use of tight bars cage. Nevertheless, the number of animal collections is rated fair because each zoo has a complete animal collection from the five animal classes. On the other hand, the animal exhibition zone in Batu Secret Zoo is rated good by visitors. This rating covers their experience on a relatively complete animal collection, the use of biome theme that effectively depicts animal's natural environment, as well as clear and comprehensive visitor pathways that only has a one-way route. The exploration should clearly indicated by the route as intuitive way-finding in zoo [17].

Table 2. Visitors experience of the three zoos towards the spatial zones.

Zoo	Animal exhibition zone	Entertainment zone	Supporting zone
Bandung Zoo	Poor to fair	Fair	Poor to fair
Surabaya Zoo	Poor to fair	Fair	Poor to fair
Batu Secret Zoo	Good	Good	Good

Compared to the animal exhibition zone, the area of the entertainment zone is smaller. Visitors in Bandung Zoo and Surabaya Zoo rated it fair for the availability of amusement rides. However, visitors in Batu Secret Zoo rated the entertainment zone good. From the commentaries' description, the number of ride variations is not a major factor in the satisfaction of entertainment activities. Interestingly, the visitors regarded the interaction with the animals along their exploration in exhibition zones as an entertainment. Therefore, activities in exhibition zones are also recreational activities and not only educational activities. At last, the supporting zones deliver a special impression for every visitor. At Bandung Zoo and Surabaya Zoo, visitors rate poor to fair in terms of provision for eating areas and souvenir shops. Meanwhile, Batu Secret Zoo's supporting zone has met the visitors' needs so the visitors rated it good.

3.4. Spatial Zoning Basis at the Three Zoos

As the most extensive area that occupies the landscape in the three zones, the animal exhibition zone plays a critical role in educational and recreational implementation through a specific zoning design basis. Arranging spatial units in animal exhibition zone based on the animal taxonomy is the basic way. Arranging spatial units using biome is preferable. It is a more optimal way to keep animals in their habitat (Figure 5). This strategy can balance the educational and recreational purposes while the visitors explore the animal exhibition zone. Spatial units in the supporting zone can be any facilities that meet the needs of the visitors'. It depends on the vision emphasized by the zoo management, even though it can be balanced for both purposes. At last, the entertainment zone for recreational purposes can only be designed either by scattering several small spatial units in the zoo area or by placing them in one large area. The entertainment zone placement can be put alternately with the other zones, in the middle of the zoo, or at the end of the visitor's pathway after they explore the zoo.

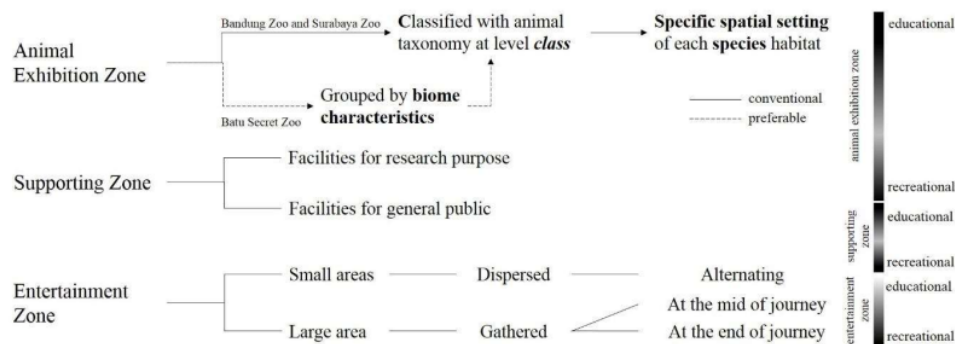


Figure 5. Spatial zoning basis in the zoo landscape implementing educational and recreational roles.

The zoning of animal exhibition spaces classified by using habitat characteristics will be increasingly preferable in the future. People awareness on sustainable environment awareness becomes insightful background on this demand. The design of a zoo that is able to implement the relationship between animals and their natural environment is the responsibility of human to the environment [18]. The zoos as a means of ex-situ conservations in urban areas have clearly created an intervention to the natural space they occupy. Artificial spatial planning by imitating biomes, thus, is not merely to only accommodate the social needs of animals in interacting with their communities and, furthermore, these interdependences on certain plants and animals, but to create healthy interactions among animals and its environment so that human can learn a comprehensive picture of natural life [19] [20].

4. Conclusion

The zoo landscape plays a vital role as an educational and recreational function through the animal exhibition zone, the entertainment zone, and the supporting zone. After analyzing the three zoos located in urban areas with the land area of 15 hectares, it is found that the composition of zones from the largest to the smallest are the animal exhibition zone, the entertainment zone, and the supporting zone. As the largest zone in a zoo, the animal exhibition zone is the key to implement educational and recreational roles in the zoo design. It could be done by grouping the animals based on the animal taxonomy or the biome. Using the biome can improve spatial units in the animal exhibition zone because it can depict the animal in its natural habitat for educational purposes in a more comprehensive manner. The entertainment zone, where the amusement rides are usually placed, is a spatial zone that remains necessary even though it is not the primary concern as long as it can entertain the visitor during their exploration in the animal exhibition zone and regard it as a recreational activity. At last, the supporting zone is necessary both for educational and recreational purposes. Taking the zoo's vision is important as well to understand which facilities should be prioritized, such as research facilities or general public space.

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