Defining Regenerative Zoo Exhibits: A Cross-Cultural Evaluation of Visitor Preferences to Enhance Experience and Animal Welfare through landscape-Based Design

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Defining Regenerative Zoo Exhibits: A Cross-Cultural Evaluation of Visitor Preferences to Enhance Experience and Animal Welfare through landscape-Based Design

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Abstract. Zoos, as part of the components of urban parks, offer significant potential for integrating sustainability and regenerative landscape principles within city environments. Although these principles have been widely applied in urban and ecological contexts, their specific application in zoo environments, particularly in balancing visitor experience, animal welfare, and enhancing urban overall livability remains underexplored. This study investigates regenerative zoo exhibit strategies by evaluating visitor preference towards landscape elements. The research was conducted through two previous case studies: Ragunan Zoo in Jakarta, Indonesia, and Kyoto City Zoo in Kyoto, Japan. Visitor preferences were assessed through surveys and visual simulations of various exhibit design models, focusing on key landscape elements such as trees, water features, shrubs, and environmental enrichment. The findings show that while naturalistic elements consistently enhance animal welfare, visitor satisfaction is often influenced by visibility and spatial openness, highlighting a potential trade-off in exhibit design. Cross-cultural analysis shows both Japanese and Indonesian preferred a naturalistic landscape setting for the visitor satisfaction and animal welfare. The most influential landscape elements that influence the naturalistic landscape setting are trees, water features, and shrubs on both case studies. However, the degree of naturalistic landscape setting tends to be higher in the Japanese case study compared to Indonesian case, which may be influenced by cultural perceptions of animals and recreational expectations. This study proposes a framework for regenerative zoo exhibit design that integrates ecological aesthetic, animal behavioral enrichment, and human-animal interaction. These findings contribute to the practical strategies for supporting both sustainable and inclusive landscape design, especially in zoological settings.

Keywords: animal welfare; landscape design; regenerative landscape; visitor preference & experience; zoo exhibit

1. Introduction

The role of zoo has been evolved through generations, from the collection of exotic specimens to the effort to conserve biodiversity. Before the 18th century, the initial zoo was associated with the symbol of a wealthy society which collected unusual specimens from other regions, and later in 18th century, the terminology of zoo became established as the rise of scientific knowledge and the increased public interest in exotic animals [1]. Compared to the early zoo, the modern zoos have a large responsibility in conserving biodiversity as a gene bank, influencing environmental education, while committing a high standard of animal welfare [2]. Despite the high expectations of zoo, the complication of purposes in many ways are contradict each other and become a burden for zoo institutions to fulfil the best strategies to achieve all goals. For example, the limited space of the zoo becomes a trade-off between providing various animal species for education, entertainment purposes, and securing the foremost animal natural behaviors [3].

In recent decades, researchers and zoo institutions tried to find an equilibrium point between animal welfare and visitor satisfaction for optimal utilization of zoos. Previous studies found that the improvement of visitor satisfaction by refining exhibit design into a naturalistic setting indirectly influences the betterment of animal welfare [4,5]. However, there is no adequate information about detailed terminology in a naturalistic environment, which become a fundamental basis of this research. The landscape ecological design approach can be adopted as an instrument to quantify naturalistic environments for zoo exhibits. It was derived from applied art and science through the configuration of landscape elements in an ecological way, including the appropriate selections and configuration of vegetations as well as integrating landscape elements and other organisms [6].

The prior research investigated the relationship between ecological landscape design of zoo exhibits, animal welfare, and visitor satisfaction in the case study of Ragunan Zoo in Indonesia and Kyoto City Zoo in Japan [7,8]. From the base of previous research, this research addressed the influence of cultural aspect in the ecological landscape design of zoo, especially the design of animal exhibits. It is worth noting that the cultural aspects in the previous studies are recognized by the level of environmental awareness, which are driven by the educational systems, traditional customs, and socio-economic factors. These cultural differences in previous case studies fundamentally influence how the public perceives the necessity of landscape design of zoos. Therefore, the purpose of this research is to analyze the similarities and differences in a various aspects and elements that influence the improvement of animal welfare and visitor satisfaction of the zoo from visitor perception and preference of Indonesian and Japanese people. In particular, the study aims to compare the visitor perception and preferences of Indonesian and Japanese people through the zoo animals and exhibits design and the relationship between visitor preference of zoo exhibits design to animal welfare as well as to visitor satisfaction. The result of the study can be used as alternative literature for zoo institutions and zoo design practitioners to evaluate zoo performance and its management.

2. Research Methods

2.1 Site of study

The study reviews the previous research which was conducted at Ragunan Zoo in Indonesia and Kyoto City Zoo in Japan [7,8]. These sites were selected as both zoos were recorded as one of the oldest municipal zoos in their respective countries, which has been established since the late of 19th and early of 20th centuries. The selection of site studies also allows for a comparative analysis

of wildlife conservation in Southeast and East Asia. The total area of Ragunan Zoo is 147 ha, which is diverse in several facilities such as zoo exhibits, information centers, Schumtzer's Primate Center, children zoo, reflection park, amusement park, food court, and lake. The collection of Ragunan Zoo consists of 2,101 specimens form 220 species during the research between 2019 and 2022. In the other hand, the total area of Kyoto City Zoo is 4.1 ha, and it is divided into six main areas which are Fierce Animal World Zone, Forest of Kyoto, Forest of Elephant, African Grassland, Children Zoo, and Monkey World. 118 animal species are living in the zoo during the moment of research in 2021, which consist of 40 mammal species, 43 bird species, 34 reptile, and amphibian species, and 1 fish species. The zoo has been redesigned several times, and the animal species have been reduced from their peak at 200 species as a part of efforts to improve welfare and quality of life for animals (Fig. 1).

Figure 1. Research location; Ragunan Zoo (left) and Kyoto City Zoo (Right) [7,8].

2.2 Data collection

This study is a continuation of two previous studies [7,8] which conducted a qualitative and quantitative evaluation of landscape elements composition through animal wefare and visitor satisfaction in zoo. This study collects data form both studies including visitor preferences, landscape elements preferences, as well as the correlation between naturalistic design and visitor satisfaction. Those previous data were collected in two-stage questionnaires which were distributed to the visitor of zoos. Data collection methods were adapted to the specific COVID-19 conditions and regulations in each country during the previous research period. In Kyoto City Zoo, data were collected through a hybrid approach which included on-site questionnaires and off-site/online questionnaires. On the other hand, data from Ragunan Zoo were collected exclusively online due to the peak of pandemic cases making the on-site surveys impossible. Therefore, the sample size of Ragunan Zoo was smaller than Kyoto City Zoo, which had 99 Ragunan Zoo's participants in the first questionnaire compared to 535 participants in Kyoto City Zoo. The similar ratio was also found on the second questionnaire which had 37 participants in Ragunan Zoo study compared to 109 participant in Kyoto City Zoo study.

The first questionnaire was utilized in examining the visitor preferences of zoo exhibits design and favorite as well as least favorite animals in each zoo while gathering demographic data of participants. The second questionnaire was addressed in evaluating visitor perceptions and preferences of exhibits design that best fit their satisfaction perspective and for the animal welfare perspective. In this questionnaire, the top three most and least favorite animals were selected based on the first questionnaire. The photo of animal exhibits were modified into some models

that reflected various environmental conditions which represented a degree of naturalistic habitat. This method was adapted by previous study related to different design intensities on site [9]. Participants evaluated the models using a Likert scale rating system with a seven-scale range of scores. Furthermore, the questionnaire resulted in data of visitor's landscape element preferences throught their satisfaction as well as animal welfare perception (Fig 2).

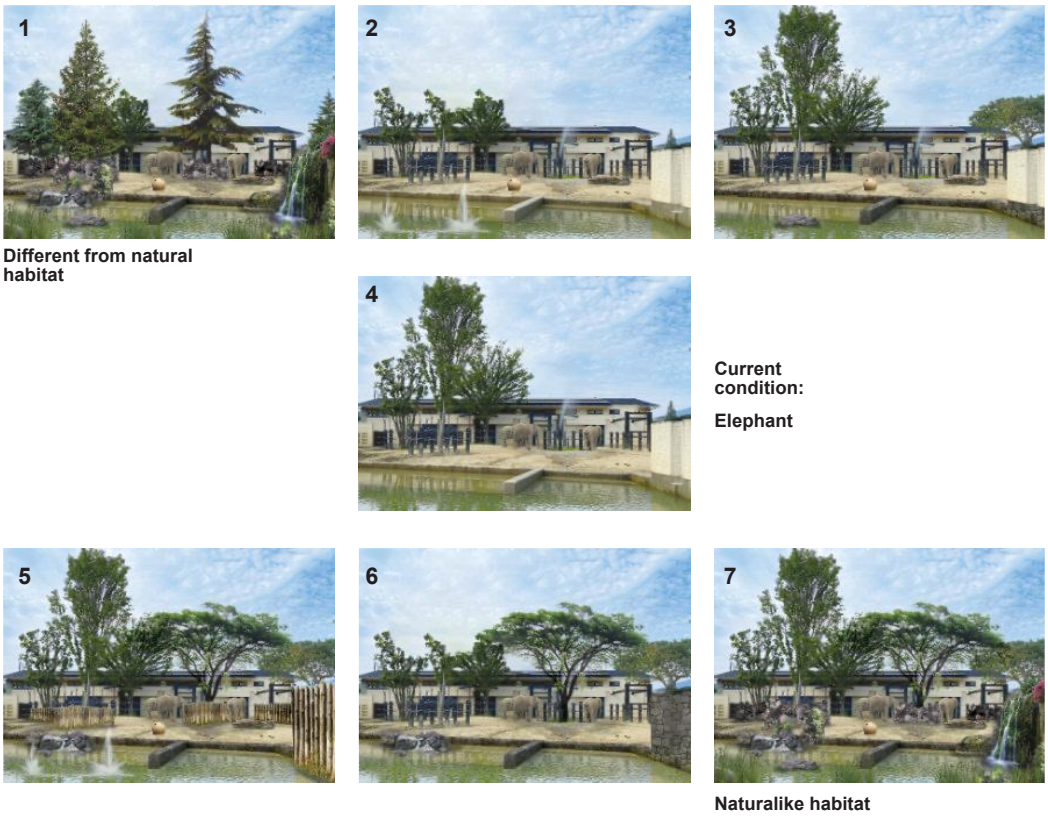

Figure 2. Variation of elephant exhibits' model at Kyoto City Zoo [8]

2.3 Analysis method

The study conducts a descriptive comparative approach utilizing qualitative methods. The analysis starts from the data interpretation from both previous studies, including visitor preferences, landscape elements preferences, as well as the correlation between naturalistic design and visitor satisfaction. The analysis of visitor preferences were done in the previous studies by the questionnaire distribution, which evaluated in descriptive statistical analysis [7,8]. The data are compared in equivalent variables to ensure a valid comparison. Althought some data were different due to the context of site studies, this study incoporated similar data such as the class of favorite and least favorite animals as well as the type of landscape elements. A descriptive comparison is also provided to determine the similarities and differences between case studies. The findings of both studies are formulated into an integrated conclusion, which provide a comprehensive set of recommendations for zoo landscape design.

3. Result and Discussion

3.1 *Visitor's most favorite and least favorite animal preference comparison*

The most favorite and least favorite animals were evaluated in both previous studies by mentioning the zoo's animals from each zoo. The comparison between Kyoto City Zoo (n=535 participants) and Ragunan Zoo (n=99 participants) shows the similarity in visitor preferences regarding favorite and least favorite zoo animals even there were differences in total of animal species listed in the questionnaire. In Kyoto City Zoo, the most favorite animals were dominated by flagship big mammals which are the elephant (13.5%), followed by giraffe (11.2%), and tiger (10.1%). The similar result from Ragunan Zoo showed a consistent pattern where the Sumatran tiger (14.7%), girrafe (10.3%), and elephant (9.0%) becomed as the most favorite species as well.

On the other hand, the least favorite animals in Kyoto City Zoo were snake (17.4%), followed by frog (14.3%), and iguana (7.9%). In a slightly different result, Ragunan Zoo's study shows snake (12.9%), crocodile (8.7%), and monkey (5.5%) as the least favorite animals among the visitors. Snake is the least favorite animals in both case studies, and the crocodile become the third least animals in Ragunan Zoo indicates the reptiles become the least favorite animal class. The similar result also found in other studies which mentioned snakes as one of the least favorite animals at Durrel Wildlife Park, UK and Unilorin Zoo, Nigeria [10,11]. The result also shows frog as amphibian class become other non-preferable animals from the perspective of visitor. However, please note that the frog is only found in Kyoto City Zoo and not in Ragunan Zoo. The interesting result of monkey in Ragunan Zoo as the third least favorite animals may be influenced by the specific type of monkey which is long-tailed macaque as the image represent in questionnaire that has an undesirable physical trait (Fig. 3).

Figure 3. Most favorite and least favorite animals in Kyoto City Zoo and Ragunan Zoo [7,8]

3.2 *Visitor's preference through exhibit landscape design elements comparison*

The previous studies examined the visitor preferences on the landscape elements of zoo exhibits. In the case of Kyoto City Zoo, there are seven major elements which being recognized as important elemets which are trees, flowers, shrubs, grass, wood/logs, water features, and fencing. In the other hand, elements such as stones and environmental enrichment (toys) were have a fewer score of importance. This indicated that visitors in the Japanese context are more likely prefer a lush, natural elements over an artificial elements in the exhibits.

In the case of Ragunan Zoo, the data showed that Indonesian visitors identified trees (27.2%) and water features (26.8%) as their primary favorites landscape elements, followed by wood/branches (12.8%). The least favorite landscape elements were stones (21.3%), climbing vines (20.7%), and environmental enrichment/ toys (19.0%). This indicated that vieweing artificial elements or barren materials such as stones as less visually appealing within the zoo's ecological landscape.

The findings of both studies show a similar visitor preferences despite the differences of geographical and cultural context. In both Kyoto City Zoo and Ragunan Zoo, trees and water features consitently emerged as the most important elements for an ideal exhibit design. The similar result also found on the least favorite landscape elements for environmental enrichment (toys) and stones in both studies which indicates while these elements are beneficial for animal welfare, it may be reduces visitor satisfaction. These finding underscore that universal preference for naturalistic, green-dominated landscape exists among zoo visitors, which should be a primary consideration for future exhibit redesigns in both case studies.

These preference data were further evaluated in the second questionnaire, which required participants to assess various landscape settings through photographic models. In the Kyoto City Zoo case study, the majority of visitors preferred landscape settings with a naturalistic aesthetic, incorporating a combinatioin of elements such as trees, water features, wood, stones, and environmental enrichment (toys). Similar findings were observed in the Ragunan Zoo case study, where the exhibit models featuring a comprehensive landscape element composition, including trees, shrubs, water features, wood, stones, and environmental enrichment (toys) consistently emerged as the primary preferences of visitors. Also there is an interesting finding in the Ragunan Zoo case was that the addition of water features and shurbs was more favored by visitors than the addition of trees. This suggest that trees may obstruct visitor visibility of the animals, thereby diminishing satisfaction with the exhibit's visual quality. Furthermore, the lower preference for tree elements may be attributed to the limited size of the enclosures, where the scale of trees appeared disproportiionate to the overall area. Stones and environmental enrichment (toys) elements consistently received lower preference score compared to trees, water features, and shrubs. In this assessment, the presence of wood/ log/ branches was generally less favored, although this outcome varied significantly depending on the specific animal species.

3.3 *Zoo exhibit design guideline based on the visitor preference*

Based on the research findings, the presence of complex landscape elements within animal exhibits significantly enhances visitor perception of exhibit quality. Visitors generally agree that increased complexity in most case studies correlates with improved animal welfare. However, it is essential that the composition of these landscape elements is designed strategically to ensure that visitors can observe and enjoy animal activities without obstruction. Consequently, the concept of visibility emerges as a critical factor in the design considerations for zoo exhibits.

The concept of visibility can be implemented through the configuration of landscape elements that allow visitors to observe animal activities comfortably. This configuration should not only be applied within the exhibit itself but must also account for visitor observation behavior. Providing supporting facilities such as shelters, benches, plazas, interpretation boards, and shade trees can effectively direct visitor "hotspots" for observation. These facilities are also key to exhibit planning, as they help align active animal areas (e.g., sunbathing, feeding, drinking, or playing) with established visitor viewpoints and gathering areas. Conversely, passive or private animal activities, such as sleeping, should be directed to areas distal to visitor congregations.

Spatially, the visibility concept can be formulated by dividing the exhibit into several functional zones based on animal activity. Active zone, which area supports high-energy animal behaviors such as playing, feeding, and drinking. The landscape composition in this zone is configured to provide an impression of openness and spaciousness from the visitor's perspective. Low shrubs and grasses should be the dominant elements here, while sightline obstructions such as dense trees or high bushes should be avoided. Supporting facilities like benches or shelters can be positioned to orient visitor attention toward this side of the exhibit. The buffer zone area is positioned between visitors and animals, particularly in larger exhibits, this zone serves as a boundary to mitigate risks. It prevents unwanted interactions, such as animals attacking visitors or visitors feeding animals, aids in disease transmission prevention, and helps dampen noise that could cause animal stress. The primary landscape elements in this zone typically include water features (e.g., moats or canals), stone walls, and low-growing shrubs or flowering plants. Semi-active zone, which is designed to accommodate animal activities that require moderate privacy. Landscape elements such as trees, branches, environmental enrichment, and stones can be introduced here to facilitate diverse behaviors distinct from the active zone, such as perching, grooming, and resting. From a visitor's standpoint, this area enriches the visual characteristics of the exhibit by providing visual variety. Secondary facilities like benches and interpretation boards can be used to encourage visitors to gather near this section. Passive or privacy zone, which supports the animals' most private activities, including sleeping, nesting, or egg-laying. It is created by establishing a buffer from the active and semi-active zones, ensuring it remains largely shielded from the visitors' view. Dense trees, stones, high shrubs, shelters, and branches are used to block sightlines and visitor noise. Nonetheless, keeper visibility remains necessary for monitoring animal health and behavior. Specialized facilities, such as designated monitoring areas for zoo staff, should be integrated to facilitate this process. This concept can be tailored to the unique characteristics of each animal species within the zoo. Therefore, integrating other factor such as animal behavior should be discussed and consulted with zoologists and veterinarians.

4. Conclusions and Suggestions

The study reveals that visitor preferences in both Japan and Indonesia are closely aligned regarding animal charismatic appeal, with flagship species and large mammals such as tigers, giraffes, and elephants, consistently identified as favorites. Conversely, amphibians, reptiles, and smaller animals, including snakes, crocodiles, frog, iguana, and macaques, are among the least favored. This suggests a cross-cultural tendency to prioritize charismatic megafauna in zoo experiences.

In terms of exhibit design, visitors in both countries strongly prefer for naturalistic landscape settings, perceiving them as the most beneficial for both animal welfare and their own satisfaction. However, a notable cultural nuance was observed in Japanese visitors exhibited a higher degree of environmental awareness, showing a more consistent and positive trend toward

highly naturalistic settings compared to Indonesian visitors. A critical finding of this research is the trade-off between naturalism and visibility. While trees, water features, and shrubs are ranked as the most essential landscape elements, in the case of smaller exhibits tended to compensate for the presence of trees to ensure better visibility of the animals. This indicates that while green elements are desired, they should not obstruct the visual quality of the exhibit. Interestingly, while environmental enrichment (toys) is vital for animal welfare, it remains the least preferred element for visitors, whereas stones and logs are viewed neutrally and are highly dependent on the specific species and exhibit scale.

Finally, this study proposes a spatial zoning framework to balance animal privacy with visitor visibility. The recommended design incorporates five distinct zones: Active, Semi-Active, Passive, Visitor-Animal Buffer, and Active-Passive Buffer. Each zone utilizes a specific composition of landscape elements to harmonize the animals' biological needs with a high-quality, unobstructed viewing experience for the public. These findings provide a strategic foundation for zoo practitioners to implement more effective, ecologically driven exhibit designs.

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