Chapter 8

Combining the Aesthetic and Ecological Aspects of Man-Made Structures on Coastal Wetlands

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Additional information is available at the end of the chapter

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Abstract

Man-made structures are used as adaptive solutions to natural and urbanization stressors of coastal wetlands. These structures alter the wetland environment not only impacting ecological value and habitats but also landscape esthetics. A green structure approach aims to re-establish the natural functions of wetlands; however, landscape esthetics of the relationship between man-made structures is required that also should not be neglected. Physical structures are tangible and shape the visual environment, which can influence people's esthetic preference. Pleasing scenery can arouse protective instincts and motivate public participation in wetland conservation. Man-made structures changed and limited landscape room, resulting in homogeneous environmental information in the landscape foreground, while hindering collection of environmental information from the background. The discordance of contextual cues between coastal wetlands and man-made structure affects the esthetics and preference of landscape. Therefore, consideration of both landscape esthetics and the ecological impact of man-made structures is an optimal coastal wetland restoration strategy. Here, a conceptual common ground between the visual and ecological aspects of man-made structures is proposed. This concept is applied to design man-made structures that will benefit landscape esthetics and mitigate wetland ecological impacts.

Keywords: environmental information, landscape preference, landscape room, shifting baseline, target scenery, viewing place

1. Introduction

Coastal wetlands are located in the terrestrial-aquatic transverse zone and are an important landscape type and ecosystem. These wetlands have high biodiversity, serve as a buffer zone

for adjacent upland development, and provide multiple services such as protection of water quality, and flood and erosion control. Furthermore, coastal wetlands provide visual diversity and unique visual character, which significantly influences the well-being of people and their emotional attachment to the environment. For various reasons, half of the world's wetlands have disappeared since 1990, and therefore, wetlands have become the most threatened landscape type. Anthropogenic activities can impact the coastal wetland environment in different ways. Furthermore, coastal marshes and swamps are vulnerable to climate change and sea level rise.

Land use, economic development demands, reclamation of land from the sea, and natural oceanographic processes can alter the coastal wetland environment. To manage these anthropogenic and natural factors, man-made structures have been applied to protect and maintain the intertidal zone. Man-made structures can affect the coastal wetland ecology by reducing coastal area, disrupting natural water flow, and threatening species survival. Furthermore, such structures hinder people close to water, change the visual perception of the landscape, decrease the esthetic value, and weaken the environmental attachment for local people.

Although support for wetland conservation is strong, wetlands are disappearing. Urban sprawl and increase in population density are primarily attributable for wetland loss. Environmental education, besides policies and legislations, is a commonly adopted strategy to encourage public participation in wetland protection activities. Widespread wetland degradation and loss may imply a generational knowledge gap about environmental issues.

Due to land development activities, man-made structures are playing an increasingly dominant role in shaping the coastal wetland environment [1]. People were surrounded by the scenery in their daily life. Both older and younger generations are affected by modified coastal wetlands environments frequently. An understanding of the healthy ecological conditions in the past is lacking, and therefore, environmental norms continue to change. Loss of an ecological baseline will bring about still unknown challenges for coastal wetland conservation [2, 3].

It was widely hypothesized that landscape esthetic is a stimulus–response relationship based on the interaction between humans and the environment. The human perception of the environment is immediate and is accompanied by short-term emotional pleasure, while ecological esthetic is a knowledge-based cognitive experience where long-lasting pleasure is obtained through understanding. It is debated whether people can directly sense ecological quality; however, based on evolutionary and cultural theory, good landscape esthetics is associated with high ecological quality. For survival, people choose suitable habitats and alter them to suit their needs, while there is a sense of enjoyment and desire to live among scenery perceived as beautiful. There are common physical environmental elements, which affect landscape, ecological function, and the composition of visual image, individually. For example, ecological functions affect the appearance of a landscape and people appreciate the appearance; therefore, good ecological health would be inherently included in the landscape esthetic.

Ecologists have worked toward improving the public's environmental protection awareness through environmental education. The willingness to protect a habitat will triple if the

target species is beautiful or if its habitat is attractive [4]. Therefore, environmental perception and experience can influence conservation behavior [5, 6]. In addition to wetland protection through policy and legislation, conservation approaches should consider both the esthetic and ecological impacts and aim to promote public participation in protection activities.

Man-made structures are built in the coastal intertidal area and as a result dominate the landscape and ecology of many coastal wetlands. To overcome the negative ecological impacts of man-made structures, environmentally friendly structures had been applied to coastal wetlands. Man-made structure changed the scale and openness of landscape room, and the state of environmental information, thus had effects on esthetic value and preference. The drawback to this purely ecological approach is that landscape esthetics have not been deeper considered.

The known influence of landscape esthetics on public ecological protection action implies that esthetic consideration during the development and application of man-made structures in coastal wetlands is necessary. The initial objective of man-made structures was to protect coastline and human habitats; however, protection of sensitive and ecologically important coastal wetlands should also be considered due to the knock-on benefits for humans and the environment. Under the coastal defense and undamaged habitat objective, an approach that improves landscape esthetics and healthy ecological functioning through refinement of the visual landscape of man-made structures could be crucial for influencing public perception and conservation action.

2. Landscape esthetic and ecology of healthy coastal wetlands

2.1. Experience of landscape with ecology

Landscape esthetic is based on the idea that human preference for a particular physical landscape is rooted in biological or evolutionary adaption [7–9]. The habitat theory and the information-processing theory provide insight into why people may prefer certain landscape characteristics. These theories suggest that human interactions with the environment are related to various survival behaviors. An environment benefited to people that provided those with the capacity to observe without being seen meant both prospect- and refuge-dominant landscape settings were more preferred.

Humans require environmental information to understand their surroundings. According to the information processing theory [9, 10], human perception is oriented to understand and react to the environment. High coherence setting means that the setting is orderly, and legibility can be more preferred. An environmental setting with high species richness and diversity indicates complexity. The human environmental perception of this situation could be mysteriousness in which humans react by exploring their surroundings and discover valuable resources. Conversely, highly homogenous or too heterogeneous environmental setting could induce an uninterested or fearful environmental perception, provoking a reaction to escape. The human perception of environmental settings and information provides critical guidance for determining which habitats are suitable.

When people interact with environment, they have an esthetic experience and emotional response. Together, these reactions influence the choice of the landscape. Spatial and temporal changes of landscape can result from ecological functions. These landscape changes, stemming from various ecological functions, will influence the esthetic perception of a landscape through time.

Positive responses to characteristics of a setting generally increase chances of survival or well-being. On the other hand, esthetic is also shaped by cultural expectations [11–13] and contemporary environmental behaviors [13]. Esthetic experiences drive landscape change in the context of habitat, leisure, recreation activities, and daily life. For example, in an esthetically pleasing environment, people are more prone to enjoy, have a connection with, and protect it. In an esthetically unpleasing, ugly, or unsafe environment, people would avoid it or seek to improve it (**Figure 1**). Environment in which improvements are usually made tends to be those which people enjoy or are preferable for land use. The resulting changes may or may not benefit landscape esthetic and ecology. The esthetic experience provides a good linkage between the human benefits of landscapes and healthy ecological functions, which is based on the evolutionary theory that a healthy ecological setting is associated with landscape characteristics that are esthetically preferable.

The perceptual cues stemming from the interaction between humans and environment can be used to assess which settings evoke particular reactions (**Figure 2**). Both evolutionary and cultural drivers suggest that ecological health is associated with a pleasing esthetic landscape.

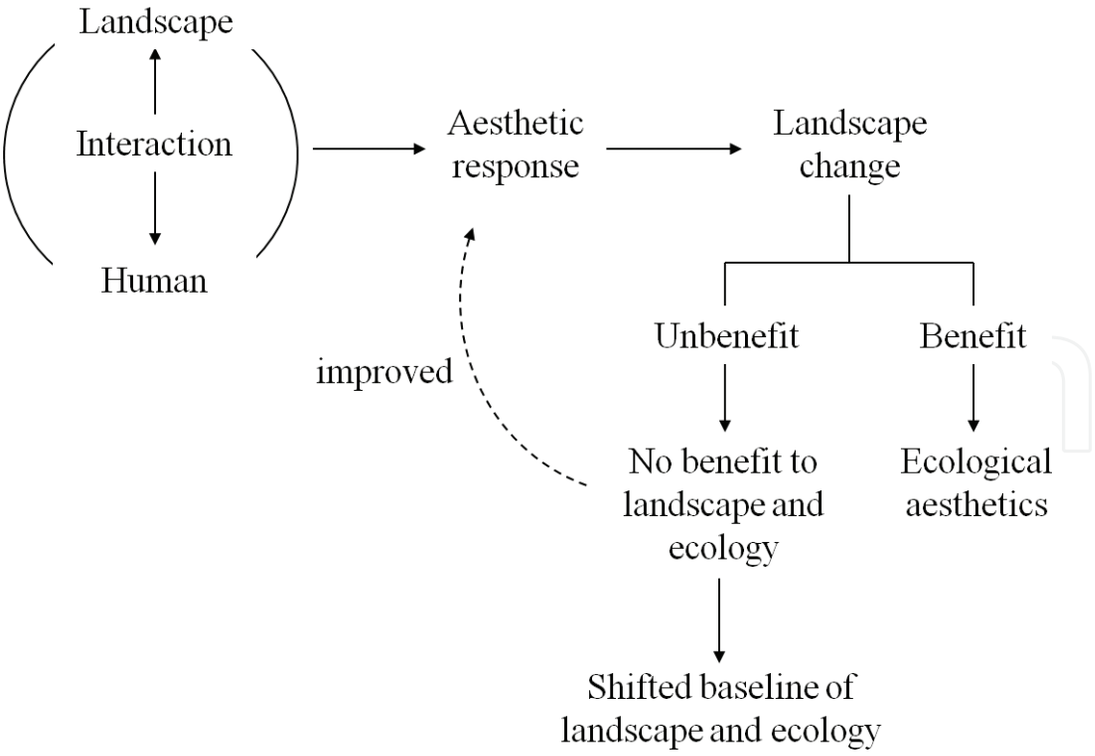

Figure 1. The process of landscape experience and resulting landscape change. The esthetic component was affected by the interaction between human and landscape. Therefore, landscape change may benefit both landscape and ecology (ecological esthetics). Otherwise, the existing situation will lead to generational knowledge gaps and shift the baselines of landscape and ecology. Therefore, integrating esthetic and ecological design approaches to improve unfriendly landscape and ecology coastal wetland is important.

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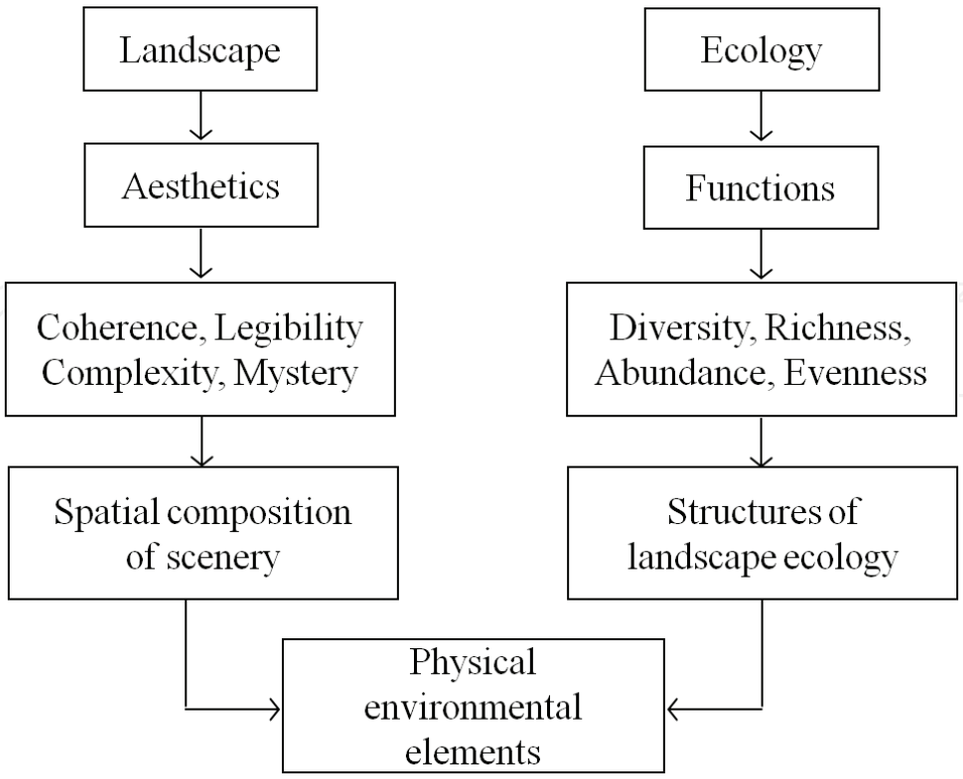

Figure 2. Landscape versus ecological experience. Landscape and ecology have common physical environmental elements, which include scenery and structure of landscape ecology. Four cognitive attributes of environmental information influence people's landscape esthetic preference. There are four ecological indicators of ecological health.

In this way, humans can sense environmental information, landscape esthetic, and ecological health. The arrangement of the physical characteristics of landscape significantly affects the perception of the landscape esthetic and thus ecological function. Environmental information culminates in four attributes to derive landscape preference. A coherent and orderly setting is easy to understand and as such enables people to feel legibility and secure; conversely, a complex setting made people fell mystery would encourage curiosity and stimulate exploration. A more detailed description of preferable landscape characteristics is shown in Kaplans' environmental preference matrix [9, 10, 14]. Ecologically, these characteristics correspond to species diversity, richness, evenness, and abundance, which taken together, constitute landscape ecology. Further aspects of landscape ecology include patch heterogeneity, disturbance, size, and edge structure and habitat naturalness and continuity [10]. Humans ascertain environmental information from the diversity and evenness of a patch, this setting is favorable as it is representative coherence and legibility and thus security. Natural landscapes are favored by human; the continuity of patches implies that plenty of environmental information is available in the middle to background, which could induce curiosity and exploration [15].

Humans are closely linked to the wetland environment and as such, human activity has altered the wetland landscape and ecological function. A wetland model of landscape esthetics versus ecological processes was created (**Figure 3**). At the opposite ends of the ecological processes, axes are ecological services and human activities, while on the landscape esthetics, axes are natural beauty and formal beauty. There were four principal types of wetlands included: (1) natural wetlands, (2) modified wetlands, (3) recreational wetlands, and (4) artificial wetlands, divided into the four quadrants in **Figure 3**.

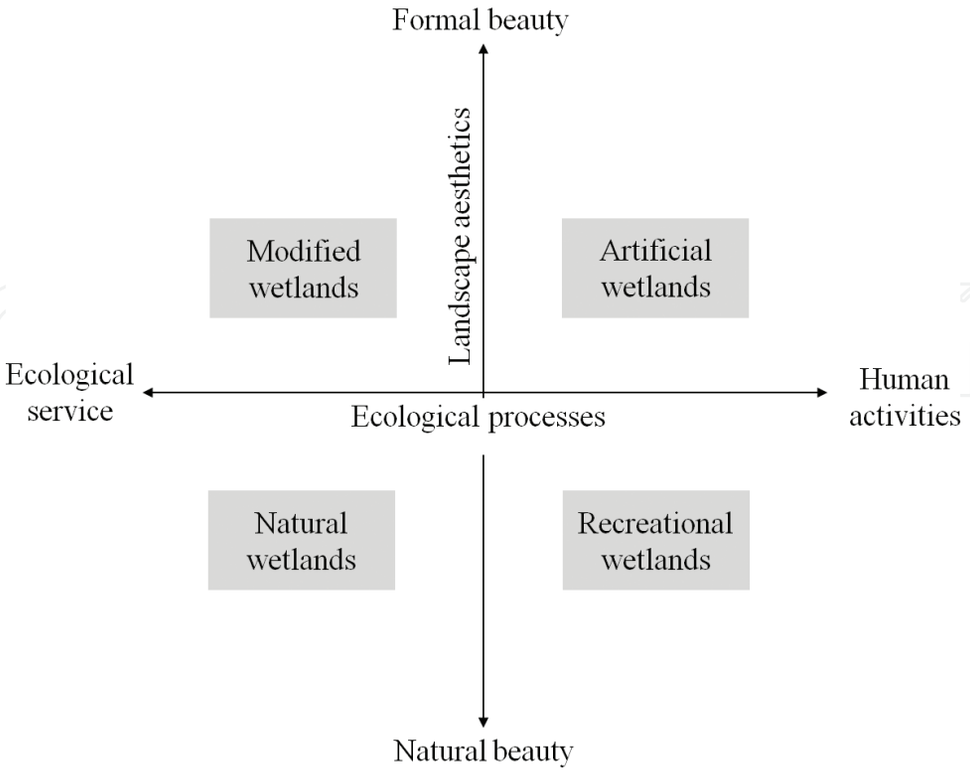

Figure 3. A matrix of the four types of wetlands in terms of landscape esthetics and ecological processes.

The natural wetland quadrant is united by ecological services and natural beauty. This indicates that natural interference of ecological process affected the ecological health of the wetland, and the natural process is the dominant pattern. Here, is more stability with fewer disturbances, and to affect ecosystem health coupled with landscape naturalness to deliver a high esthetic value.

Artificial wetlands are formed by human activities and constitute formal beauty. Artificial wetlands are related to in varying degrees of anthropogenic utilization, distributed from the center city to urban the fringe. Contrary to natural wetlands, human interventions, such as design-orientation, engineering, and maintained works, are practiced in here. Human activities highly limited ecological processes and functions but increase formal beauty.

Ecological services form modified wetlands, which are esthetically pleasing. These wetlands were modified to protect coastal from erosion or to meet land use demands. Ecological services decline as the number of man-made structures increases. Finally, recreational wetlands facilitate human activities and natural beauty. In recreational wetlands, recreational intensity directly disturbed to ecological quality, together with the naturalness of beauty.

In addition to the described two-dimensional framework, a Z-axis depicting design approaches is overlaid to form a three-dimensional model. The two ends of design approach are eco-oriented and engineering-oriented and would promote either natural beauty or formal beauty. This will impact the landscape esthetics, which, as previously described, influences ecological processes (**Figure 4**).

Natural beauty corresponds to an ecologically esthetic landscape, where the appearance of ecological function is visible, emphasizing the visual enjoyment of natural scenery. In

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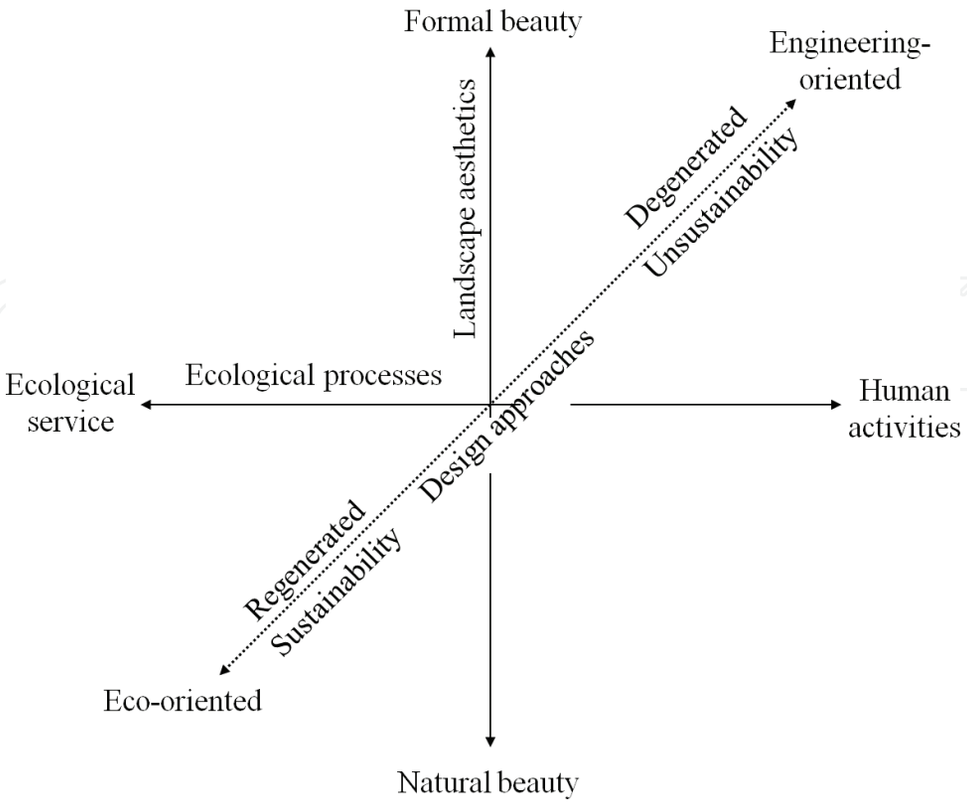

Figure 4. The three-dimensional model consisted of ecological processes, landscape esthetics and design approaches. Design orientation can lead to sustainable or unsustainable wetland development.

this scenario, ecological health and landscape esthetic are mutually reinforcing each other. Designs can be introduced to achieve a particular ecological esthetic preference. The impacts of human activities will be minimized by eco-oriented approaches, as these approaches can regenerate damaged wetlands and particularly aim to improve the ecological functioning and maximize the naturalness of beauty.

Formal beauty is associated with landscapes that are dominated by human activity. The engineering-oriented design puts human activity at the forefront within these settings. Deterioration of ecological services and functions are foreseeable. The characters of engineering-oriented approaches are degenerated that may show the tendency of unsustainable wetland development.

Increasing population and urban sprawl led to reclamation of natural wetlands, habitat loss, and shifting of wetland types in the affected areas. Thus, the ecological baseline has shifted, increasing the difficulty of wetland conservation. Throughout the history of land protection, esthetic factors are given great importance [16]. That means human esthetic preference and ecological goals are aligned. Therefore, improved esthetics is a key component for ecological restoration of threatened wetlands.

2.2. Impact of man-made structures on coastal wetland

Coastal wetlands are areas where different habitat overlap, such as sea and land, river and estuary, and brackish water and freshwater. Vegetation and animals from both adjoining

ecosystems overlap here, resulting in ecotones which are species rich and diverse. Increasing modification of coastal wetlands is a symptom of increasing urbanization and contemporary behaviors.

The coast offers an open ecological environment, rich in scenic beauty that provides enjoyment and contributes to the well-being of people who experience it. Populations in coastal areas are increasing, and the resulting urbanization intensifies the conflict between anthropogenic activities and the coastline. Man-made structures (e.g., seawalls and breakwaters) protect the coastal environment from the impacts of waves, tides, and storms. These structures affect the natural ecosystem and ecotones [1], undermine the coastal scenic value, and obstruct the human access to coastline.

Certain physical attributes of coastal wetlands have influenced on both the landscape esthetic and ecological health including the water body, water shore, and terrestrial vegetation. Each of these attributes constitute to the overall coastal wetland landscape. Environmental perception is derived from the environment, which physically surrounds people [17–19]. Therefore, if man-made structures were constructed, the shoreline is altered and access to the physical environment could be prohibited; this is the primary issue of man-made structures in coastal wetlands.

Characteristics of man-made structures, such as length, shape, height, slope, material, type, and location, influence the perception of the coastal wetland. The length of structures would reduce the attractiveness of the coastal landscape [20] and also decrease landscape room. Landscape room is a perceptual unit related to a visual scale. It takes into consideration the ecological patch size. The view and size of landscape room determines the degree of openness, which affects visual pleasure. Man-made structures fragment coastal wetlands and can limit the exchange of seawater with freshwater, resulting in ecotone loss.

Man-made structures can increase edge abruptness and inflict straight boundaries, both edge effects tend to decrease species movement across an edge. These structures are generally straight, hard edged, and simple and have produced monotonous and visually uninteresting coastal wetlands. The less variety of landscape elements produces a setting that fails to induce curiosity, indicated are unlikely to explore for more environmental information. Furthermore, a completely blocked view or landscaping barrier fails to go deeper to get more environmental information and thus is not favorable landscape. The height of typical man-made structures obstructs visual penetration and esthetic value [21] and reduces species movement, eco-hydrological function, and energy flows [1, 22].

The different types of man-made structures are discrepancy in location, width, height, and slope, etc. Coastal ecotones have vanished due to the wide, tall, and steep design of man-made structures [23], which limited "accessibility." Limited accessibility has several implications which can affect perception and include the distance a person can stand from seawater, decreased visual penetration, and a decrease in obtainable environmental information. More important, species movements of both adjacent land and sea were interrupted. Each of these implications could reduce the likelihood of individuals to connect with and pursue conservation action of the coastal wetland environment. Environmental information is not readily available in the current setting; water and land are separated and the coastal wetland has lost its landscape ecology characters.

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Landscape esthetic impacts	Characteristics of man-made structures	Ecological function impacts
Diminished scale of the landscape room and reduced environmental information.	Length	Reduced area and quality of coastal wetland, increased probability of species loss.
Altered skyline to monotonous spatial landscape.		Habitat fragmentation could reduce population size, habitat diversity, and species diversity.
Visual landscape diversity weakened, decreased availability of environmental information.	Shape	Man-made structures made the patch boundaries straight, hard, and homogeneous.
		The edge effect influenced the flow of nutrients, water, energy, and species movement.
Obstruction of visual penetration.	Height	Ecotones vanished because man-made structures serve as barriers that divide sea and land, and restrict species movement and energy and water flows.
Reduction in the openness of the spatial landscape. The closed setting reduces available environmental information.		
Water and coastline accessibility decreases with increasing slope.	Slope	The near-vertical slope of structures reduces the available inter-tidal habitat on seawalls, which could reduce species richness and abundance.
Unvaried surfaces make the spatial landscape is too tidy, uninteresting and unliving, reduction in the amount of environmental information available.	Material	The substrate is different between levee and natural ecotone and does not support species endemic to coastal wetlands.
Structures type can influence accessibility and visual variety.	Type	Different types of levee may receive either daily or less frequent tidal inundation which could affect vegetation and decrease or fragment coastal wetlands.
For example, structures upon which vegetation can grow increases the amenity of the setting.		
Improper structure location will affect the holistic coastal wetland, thus the size of landscape room.	Location	The location of a structure affects habitats redistribution. The sea and land both could be damaged from segmented habitats.

Table 1. The impacts of man-made structures on landscape esthetics and the ecology of coastal wetlands.

Finally, the material in which man-made structures are made from is associated with a lower probability of species colonization. The shape and material of the structure are two key factors that will influence their performance as ecosystem services providers [23]. **Table 1** details the impacts of man-made structures on the landscape and ecology of coastal wetlands.

3. Esthetic and ecology aspects of man-made structures

Many approaches have been applied to mitigate the ecological impacts of man-made structures on coastal wetlands as reported by Wiecek [24]. These mitigation efforts also need to incorporate a landscape approach to improve esthetic value [25]. Landscape esthetic preference stems from the evolutionary survival experience. In this way, landscape esthetic is aligned with

ecological health. The application of landscape approaches to the development of man-made structures aims to benefit the landscape esthetic and thus ecological health coastal wetlands.

Coastal wetlands were fragmented by man-made structures. The modified coastal wetland and natural coastal wetland can be interconnected by ecological esthetic approaches. The concept of esthetic ecology introduces aspects to the man-made structures that simulate the natural landscape esthetic of coastal wetlands (**Figure 5**). If the boundary of a man-made structure does not coincide with the natural wetland boundary between both seawater and land, the landscape esthetic and ecological quality will be reduced. The concept of landscape esthetics to improve modified coastal wetland ecology involves linking the existing man-made structures and coastal wetland. The aim is to keep or restore the ecological baseline through landscape esthetics to benefit coastal wetland habitats and conservation.

Coastal man-made structures were constructed to reduce erosion and flood risk and to maintain human activities and safety. When ecological esthetics is considered, the prime objective of the man-made structure is still to protect humans and coastal stability and then fundamentally set to ensure landscape esthetics.

Landscape perception is individualistic and related to the spatial landscape composition. Esthetic appreciation indicated the perception response when people enter a landscape room. Naturalness and openness of the landscape room is highly favorable, while a unitary atmosphere also affects landscape esthetic preference. A distinctive landscape could stimulate interest and for this reason, preservation of esthetic scenery generally appreciated by many is highly important. People will stand at a spot to absorb a pleasing view; this spot is the viewing place, and the view is the target scenery. This interaction between human selection of a viewpoint and the landscape is similar to the preferable prospect-refuge character landscape setting according to habitat theory.

Man-made structures have often been constructed to truncate the landscape room. Since the visual field is bounded by the structure, the middle to background of the landscape is often subject to disappearance. The first step to improve the landscape esthetics in this scenario is to identify and preserve the optimal viewing place that provided a view of the target of scenery prior to the construction of the man-made structures. The alternative option is to preserve the target scenery and recreate new viewing places. The former ensures a unitary atmosphere and that the landscape room is not affected by the construction of man-made structures. The latter ensures that the accessibility to appreciate target scenery is not compromised by structures. The mitigated approaches of man-made structure for landscape aesthetics and ecologic health as shown as **Table 2**.

Wherever possible, minimized length of structures could moderate the impact on coastal wetland fragmentation, which is also beneficial to landscape beauty. The boundary between the sharp outline of man-made structures and the dyke foot needs to be blurred in order for the structure to integrate into the landforms of the coastal wetland. The dyke foot on the land side of the structure can be rebuilt using natural materials, such as boulders, stones, and fill soil, along with vegetation planting to make the simple boundary become various visual pictures. These settings may provide more environmental information to people than previously.

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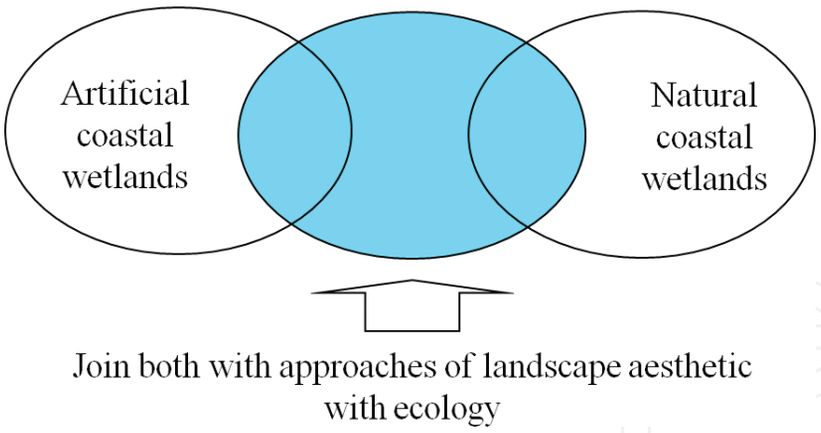

Figure 5. Framework of the integrated consideration of the esthetic and ecologic aspects of man-made structures.

Characteristics of man-made structures	Artificial structure mitigation for landscape esthetics and ecologic health
Length	Minimize, keep the landscape room is given in terms of human scale, reduce habitat fragmentation.
Shape	Use the shape of the existing shoreline for guidance in order to promote naturalness across the visual landscape and landform.
Height	Raise the viewing point and merge the structure into the existing landform. Moderating the impact from obstructed views will help renovate the landscape room.
Slope	Gentler slopes broken up with vegetation and natural materials could make the man-made structure more visually pleasing. If the change of slope is in accordance with existing landforms of coastal wetlands, it is good for environmental compatibility.
Material	Use of natural material could help blend the man-made structure with existing landforms and the overall coastal wetland landscape.
Type	Minimize size and combine the man-made structure with vegetation to create visual variety and improved accessibility.
Location	Immerse the structure into water or move away from the ecotone. The former preserves landscape room perfection, whereas the latter could reduce visual impact, as it is important to maintain the ecotone.

Table 2. The concepts of landscape esthetics and ecologic health applied to man-made structures on coastal wetlands.

The shape of man-made structures is often straight and rigid. This is due to the stability needed for coastal defense, but the visual character is tall, wide, and long and is thus perceived as arid, too orderly, and ecologically unhealthy. The setting is unattractive, and therefore, the shape of the structure must be in accordance with the coastline characteristics. This may transform the straight and hard impression left by the structure, to a gentler, more interesting, and preferable landscape. If no structural alterations can be made to improve the structure beauty, vertical lines can be applied to the surface of the structure to potentially mitigate the initial perception of a solid image.

When a structure is higher than the line of sight, the view and access to the sea is blocked. This violently decreases the landscape room and has significant impacts on landscape esthetic preference. The height of a man-made structure is the one of the most important landscape esthetic issues facing coastal wetlands, as the height with material influences visual penetration, water accessibility, sea and land ecology, and ecotones [26]. In the optimal approach, the height of a man-made structure is determined by whether people view and access the coastline from land. Moderate raises in land elevation could improve visual accessibility and decrease the influence of the man-made structure on the landscape. Other mitigation efforts, such as filling in soil on dyke foot and planting vegetation, may smooth the visual constraint imposed by the height of the structures.

When a structure is steep, the view field is narrowed and the middle to background environmental information is no longer visible. This setting is not favorable. To mitigate, decreasing the slope gradient is an option; however, this may enlarge surface area. Thus, the surface area can be divided to make the slope appear more interesting, or vegetation along with natural material can be applied to create features consistent with the adjacent landform to help visual integration with the coastal wetland. These approaches could create new target scenery, improve diversity of visual landscape, and enhance visual and water accessibility.

A variable of landscape esthetic experience is the viewing distance, as it is concerned with both long- and short-range views [27]. People view an overall landscape using a long-range view, of which landscape room is an important consideration. The short-range view is more concerned with the amount of detail which can be seen. Therefore, the scale of the relationship between observer and landscape is important.

Landscapes in the short-range view require finer consideration of constructional details, such as material and the texture of surface finish design [18, 28]. An inviting foreground setting, which is part of the short-range landscape, is critical for attracting viewers and provides the starting point for the sequential visual experience of the landscape. This could entice people to explore the coastal wetland landscape further and then would relate to the long-range landscape.

Natural materials were blended with the man-made structures, which contribute to the continuance and unification of the landscape and ecology. Natural materials can be used to reconstruct local characteristics to recover the relationship between humans and the environment; visual preference could achieve by through the use of “vernacular cues to care” [15]. Soft, curvilinear boundaries constructed from natural materials at dyke foot on the land side of a structure could create micro-patches capable of providing a number of ecological benefits. This also promotes a more interesting spatial landscape providing support for more environmental information than previously available in the short-range view.

The large and fair surface of existing man-made structures make the landscape setting highly homogeneous and monotonous, thus decreasing landscape esthetic and as a result is not a visually favorable landscape. Natural materials can be associated with man-made structures

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to improve visuals could also lead to the creation of ecological corridors. Furthermore, the vegetation structure and floristics could be aligned with the adjacent habitat, possibly facilitating species movement and recolonization.

Different types of man-made structures have different impacts on coastal wetland landscapes. No matter which types of structure to create visual variety could enhance the spatial landscape attractive is primary. The surface of man-made structure is commonly flat and monotonous. If the surfaces were divided into small parts, and finished by composite materials; which landscaping approaches could create more interesting setting. Step-type dike is a good option. Planting short vegetation is an excellent way to recreate habitats at low steps, especially using native vegetation. Meanwhile, taller vegetation, such as trees, and the interaction with sunlight provide shade at the up-steps area, providing a more color-rich and interesting setting. Vegetation also varies surface structure, while clusters of trees create various heterogeneity of spatial landscape which is attractive.

The relationship between coastal wetland and man-made structures can also divide into two types. The first type is when a structure is parallel with the coastline, such as seawall or an offshore breakwater. These structures separate seawater and land, therefore destroying the ecotone and causing coastal wetland destruction. Approaches to improve the landscape esthetic and ecological quality in such cases are similar to those previously discussed. The second type is perpendicular to the coastline, such as jetty, and breakwater. These structures fragment coastal wetlands. Reducing the height of a structure can mitigate this impact and help maintain landscape room integrity.

It is well known that coastal ecotones are among the most productive ecological habitats and provide many functions which benefit humans and the environment. For this reason, man-made structures immersed in seawater are preferable as impacts on the coastal wetland landscape esthetics are minimized. An alternative option is moving the structures away from the intertidal zone to land, increasing the capacity for coastal wetland environments. This also supports the notion that increased spatial scale improves landscape room and thus preferable for landscape esthetics. However, in this case, the man-made structures may cause loss of littoral forest, and smaller patches may lead to decreased habitat diversity and the number of species. The naturalness of the landscape could become spoiled, thus impacting perception of the landscape. Coastal wetlands are important landscapes and recreational areas for local people. If man-made structures are built adjacent to communities or crowded areas, easy access to coastal wetlands must be maintained using the previously mentioned strategies to improve landscape esthetics.

Vegetation planting is the most common option to mitigate the visual impacts of man-made structures, which approaches could make structures merge into the coastal wetlands landscape. Compared with the mismanagement of modified setting, trees could be used to spatially vary the visual perception of the landscape as a greater diversity in landscape preferred by people. Structure edge can also be mitigated by adding edge vegetation of high diversity both vertically and horizontally to soften the edge and enrich landscape diversity [29]. The desirable mitigation approach encourages the diversity of habitats concurrently.

Furthermore, the sequences of landscapes are important [30]. The coherence of environmental information in the foreground and the setting is legibility that will make people feel secure. Following the complexity and mystery landscape at middle-ground to background encourages viewers to look further into the next setting to gain more environmental information. That landscape is favored by people. Furthermore, image congruity between the residential environment and the coastal wetland, promotes a sense of place attachment and landscape esthetic preference, potentially promoting conservation actions. As a result, the landscape arrangement of man-made structures accords with the local fabric, especially in coastal communities and fishing villages.

4. Conclusion

Coastal wetlands are under constant pressures resulting in habitat loss and degradation. To prevent further losses, environmentally friendly man-made structures which mimic the foreshore environment have been applied to minimize negative environmental impacts and maximize environmental value. Wetland conservation, specifically through esthetic awareness would more benefit to maintain, protect, and restore wetland habitats. However, many existing wetlands are of low environmental quality, convoluting the ecological baseline and landscape esthetics. Shifting baseline is a phenomenon where successive generations accept unknowingly the degraded quality of coastal wetlands as pristine, thus conservation action becomes less of a priority for younger generations.

The role of familiarity is important in terms of landscape preference, as it has a positive correlation with landscape preference. Consciousness of the impact man-made structures have on landscape perception of coastal wetlands may diminish over time. Will people have a continued interest on the impacts of man-made structures on coastal wetland landscape and healthy ecological functioning as familiarity of the modified or artificial coastal wetlands increases?

Environmental legislation and policy have set the protection of coastal wetlands as a priority; however, increasing economic and land use pressures continue to reclaim land from the sea, made possible by man-made structures, still impacts the coastal ecotone. The optimal scheme is for man-made structures to not only to protect the coastline but also to create high-quality landscape, through mitigation measures such as beach nourishment and artificial headland. These options can minimize disturbance to the natural coastline, while having a positive effect on the sediment downstream. Landscape esthetics can be preserved, thus limiting the negative impacts of man-made structures on coastal wetlands. Artificial reefs and submerged dikes could form underwater habitats, maintaining landscape esthetics. Offshore breakwaters can fall below the mean tidal level, ensuring that visual impacts are minimized while also achieving preferable ecological benefits [1, 22].

If there is no immediate pressure for land expansion, man-made structures should not be built or, if possible, kept away from coastal wetlands, located it on the land side. And to retain a buffer zone between ecotone and man-made structure, reasonable landscape room is required to satisfy esthetic, and this must be considered prior to determining the layout of man-made structures.

Climate change and sea level rise pose increasing coastal erosion and seawater instability risks. If wetlands are flooded, vegetation cannot grow and the edges of coastal wetlands are degraded. This makes maintaining healthy coastal wetlands even more challenging. Man-made structures are required to protect coastal wetlands; stability and safety of the coastline are the primary objective. Thus, consideration of landscape esthetics, which promotes healthy ecologic functioning, needs to be put into practice to optimize coastal wetland structures for enhanced conservation of these sensitive environments.

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References

[1] Bulleri F, Chapman MG. The introduction of coastal infrastructure as a driver of change in marine environments. Journal of Applied Ecology. 2010;**47**(1):26-35

[2] Alleway HK, Connell SD. Loss of an ecological baseline through the eradication of oyster reefs from coastal ecosystems and human memory. Conservation Biology. 2015;**29**(3):795-804

[3] Bull JW, Gordon A, Law EA, Suttle KB, Milner-Gulland EJ. Importance of baseline specification in evaluating conservation interventions and achieving no net loss of biodiversity. Conservation Biology. 2014;**28**(3):799-809

[4] Knight AJ. "Bats, snakes and spiders, Oh my!" How aesthetic and negativistic attitudes, and other concepts predict support for species protection. Journal of Environmental Psychology. 2008;**28**(1):94-103. DOI: 10.1016/j.jenvp.2007.10.001

[5] Papworth SK, Rist J, Coad L, Milner-Gulland EJ. Evidence for shifting baseline syndrome in conservation. Conservation Letters. 2009;**2**(2):93-100

[6] Carrus G, Passafaro P, Bonnes M. Emotions, habits and rational choices in ecological behaviours: The case of recycling and use of public transportation. Journal of Environmental Psychology. 2008;**28**(1):51-62

[7] Appleton J. Landscape evaluation: The theoretical vacuum. Transactions of the Institute of British Geographers. 1975:120-123

[8] Appleton J. The Experience of Landscape. Chichester: Wiley; 1996. 293p

[9] Kaplan R, Kaplan S. The Experience of Nature: A Psychological Perspective. New York, NY, US: CUP Archive; 1989. 340p

[10] Kaplan R, Kaplan S, Ryan R. With People in Mind: Design and Management of Everyday Nature. Washington, D.C.: Island Press; 1998. 225p

[11] Carlson A. Aesthetic preferences for sustainable landscapes: Seeing and knowing. In: Sheppard SRJ, Harshaw HW, editors. Forests and Landscapes: Linking Ecology, Sustainability and Aesthetics. New York: CABI Publishing; 2001. pp. 31-42

[12] Fry G, Tveit MS, Ode Å, Velarde MD. The ecology of visual landscapes: Exploring the conceptual common ground of visual and ecological landscape indicators. Ecological Indicators. 2009;**9**(5):933-947

[13] Gobster PH, Nassauer JI, Daniel TC, Fry G. The shared landscape: What does aesthetics have to do with ecology? Landscape Ecology. 2007;**22**(7):959-972

[14] Kaplan S. Aesthetics, affect, and cognition: Environmental preference from an evolutionary perspective. Environment and Behavior. 1987;**19**(1):3-32

[15] Hands DE, Brown RD. Enhancing visual preference of ecological rehabilitation sites. Landscape and Urban Planning. 2002;**58**(1):57-70

[16] De Nogueira E, Flores C. Aesthetic values and protected areas: A story of symbol preservation. The George Wright Forum. 2004;**21**(2):45-55. Available from: http://www.jstor.org/stable/43597900

[17] Kaymaz IC. Landscape perception. In: Ozyavuz M, editor. Landscape Planning. Rijeka, Croatia: Intech; 2012. pp. 251-276

[18] Smardon RC, Palmer JF, Felleman JP, editors. Foundations for Visual Project Analysis. New York: Wiley; 1996. 374p

[19] Swanwick C. Landscape Character Assessment: A Guidance for England and Scotland. On behalf of the Countryside Agency and Scottish Natural Heritage [Internet]. UK. 2002. Available from: http://www.naturalengland.org.uk/Images/lcaguidance_tcm6-7460.pdf

[20] Hamilton JM. Coastal landscape and the hedonic price of accommodation. Ecological Economics. 2007;**62**(3-4):594-602

[21] Friesema HP, United States. National Park Service.Golden Gate National Recreation Area (N.R.A.), Point Reyes National Seashore, Marin County, Giacomini Wetland restoration project: environmental impact statement [Internet]. 2006. Available from: https://catalog.hathitrust.org/Record/100981803

[22] Chapman MG, Bulleri F. Intertidal seawalls-new features of landscape in intertidal environments. Landscape and Urban Planning. 2003;**62**(3):159-172

[23] Kozlovsky R, Grobman YJ. The Blue Garden: Coastal infrastructure as ecologically enhanced wave-scapes. Landscape Research. 2016;**42**(5):439-454

[24] Wiecek D. Environmentally Friendly Seawalls. A Guide to Improving the Environmental Value of Seawalls and Seawall-lined Foreshores in Estuaries. Sydeny, AUS.: Department of Environment and Climate Change NSW on behalf of Sydney Metropolitan Catchment Management Authority; 2009. 34p

[25] Strang GL. Infrastructure as landscape [Infrastructure as landscape, landscape as infrastructure] [Internet]. Places. 1996;**10**(3):8-15. Available from: https://escholarship.org/uc/item/6nc8k21m

[26] Bulleri F, Chapman MG, Underwood AJ. Intertidal assemblages on seawalls and vertical rocky shores in Sydney Harbour, Australia. Austral Ecology. 2005;**30**(6):655-667

[27] Thomas RS, Hall B. Seawall Design. Oxford, UK: Butterworth Heinemann/CIRIA; 2015. 359p

[28] Boris SD. Urban forest and landscape infrastructure: Towards a landscape architecture of open-endedness. Journal of Landscape Architecture. 2012;**7**(2):54-59

[29] Dramstad W, Olson JD, Forman RT. Landscape Ecology Principles in Landscape Architecture and Land-Use Planning. Washington, DC: Island Press; 1996. 80p

[30] Liu BY, Zhang T. Landscape space sequence organization based on visual sense. Chinese Landscape Architecture. 2010;**11**:31-35

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