

생태미학 연구의 개념화 및 방법론 탐구

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Establishing a Research Framework for Ecological Aesthetics: A Methodological Review

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ABSTRACT

Landscape design pursues a balance among different values in our society, but aesthetic value and ecological value in landscapes must bring complex relationships into harmony. Ecological aesthetics can be defined as a domain of study that manages the relationship between landscape ecology and landscape aesthetics to create aesthetically attractive and ecologically beneficial landscapes. Despite the importance of the research area, there has been limited empirical research addressing ecological aesthetics. This article aspires to connect and expand the conceptual framework to the research methodologies of ecological aesthetics. First, this study suggests a conceptual framework that examines the relationship between landscape and perceptual process in the context of ecological aesthetics. This framework stresses the importance of information and design intervention as moderators in this relationship. From this framework, three key topics in ecological aesthetics arise: (1) correlation between ecological integrity and aesthetic preference, (2) “compromised” design and management intervention principles that enhance aesthetic pleasure and still have biodiversity, and (3) the impact of information intervention in aesthetic experience. The framework indicated three domains affect each other; thus, when one domain is studied, the other two need to be considered. Secondly, several theoretical and empirical studies on ecological aesthetics will be reviewed from a methodological point of view. This will help to consider ecological aesthetics research, which has primarily been limited to theoretical discourse in empirical research.

Key Words: Ecological Aesthetics Methodology, Design Intervention, Compromised Design, Information Intervention, Culturally Sustainable Landscape Design

국문초록

환경설계는 우리 사회의 생태적, 미적, 사회적 가치들의 조율을 추구하지만, 생태적 가치와 미적 가치는 쉽게 조율되기에는 복잡한 관계를 지닌다. 생태미학이라는 분야는 생태적으로 건강하고, 미적으로도 매력적인 경관설계를 그 목표로

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경관의 지속가능성과 미학의 관계에 대해 탐구한다. 이러한 복잡한 관계를 다루는 학문 영역의 중요성에도 불구하고, 극히 일부의 연구들이 생태미학과 관련된 주제를 경험적 방법을 통해 연구했다. 본 연구는 생태미학의 기존 개념을 정리하고, 이를 연구방법론과 연결하고자 했다. 이를 위해 첫째, 경관과 대중의 인식과의 관계를 나타내는 개념적 틀을 생태 미학적 관점에서 재정의했다. 이 관계에서 특히 디자인 및 정보가 개입하여 나타나는 조절 효과에 대해 보여준다. 이 틀로부터 도출되는 세 가지 하위 주제는 다음과 같다. (1) 생태적 기능과 경관 선호도의 상호관계, (2) 경관중재: 생태적 기능도 보호하고, 미적 가치도 확보할 수 있는 절충된 디자인 전략, (3) 정보중재: 생태에 대한 정보가 미적 경험에 미치는 중재 효과가 그것이다. 세 가지 주제는 개념적 틀에서 보여지듯, 서로 영향을 주고받는 관계이며, 각 영역의 연구 시 다른 영역의 고려가 필요하다. 세 가지 하위 주제에 따라 기존의 이론적, 실증적 연구들을 방법론적 관점에서 검토하고, 한계를 지적하며, 보완 가능한 방법론 등을 제시하였다. 본 연구는 그 동안 해석적이고 이론적인 담론에 그쳐왔던 생태미학을 개념적 틀을 통해 정리하고, 각 영역을 넘어선 방법론적 고려를 제시함으로써 생태미학의 방법론을 보완하는데 그 의의가 있다.

주제어: 생태미학 방법론, 디자인으로 중재, 절충된 디자인, 정보로 중재, 문화적 지속가능성

I. Introduction and Description of the Problem Area

Landscape design pursues a balance among different values in our society, but aesthetic value and ecological value in landscapes have a complex relationship to bring into harmony. Aesthetic and ecological values are positively correlated in some, but not all, cases. This leads to the question of whether aesthetics and ecology have a complementary or contradictory relationship. For example, in the case of an urban forest originally designed to mimic a natural forest, dead materials and bushes were regularly removed to maintain a neat appearance to the public. Also, in an urban setting, many ecologically designed landscapes are not accepted by adjacent neighborhoods due to unappealing appearance, insect activity, and unpleasant odors. It is contradictory that neatly maintained countryside and metropolitan landscapes may be perceived as beautiful sites, while their neat appearances might indicate a poor ecosystem. To address this conundrum, some environmental designers, philosophers, and social scientists have advocated expanding the scope of landscape aesthetics to incorporate ecological processes (Gobster *et al.*, 2007). Landscape aesthetics describes a feeling of pleasure attributable to directly perceivable characteristics of spatially and/or temporally arrayed landscape patterns (Gobster *et al.*, 2007). On the other hand, "ecological aesthetics" are motivated by the idea that disjuncture of aesthetic qualities and ecological processes can spur ecologically damaging landscape changes.

Because the processes of ecological systems are, for the most

part, invisible, it can be difficult to promote people's appreciation and enjoyment of ecological aesthetics. However, if design and information intervention properly reveal the ecological qualities of the landscape in certain ways, it is assumed that people would gain better understanding of the landscape, and thus have positive aesthetic experience. To become ecologically aesthetic, there must be more than simply an understanding of ecological value; the community must have a practical engagement in care and stewardship.

Based on this hypothesis, this study first suggests a conceptual framework examining the relationship between perceiver and landscape in the context of ecological aesthetics. This framework stresses the importance of information and design intervention as moderators in this relationship. From the framework, three topics in ecological aesthetics arise: (1) correlation between ecological integrity and aesthetic preference, (2) compromised design intervention, and (3) the impact of information intervention. Additionally, several theoretical and empirical studies of ecological aesthetics will be reviewed to determine methodological points of view. This will help to expand ecological aesthetics research, which has remained in the theoretical discourse.

Considering that the relationship between ecology and aesthetics is highly dependent on the given context, it would be useful to confine this research to urban settings. In urban settings, landscape change due to aesthetic preference often tends to weaken ecological integrity (Gobster *et al.*, 2007). Therefore, it is even more critical to align aesthetic and ecological goals in this context. Therefore, this study will focus on the interaction between public perception regarding the ecological

landscape and public stewardship in urban landscape.

A study of ecological aesthetics and its domain is significant for the following reasons. First, the study of ecological aesthetics can help to reveal the complex relationship of aesthetics and ecology so that it can guide those interested in landscape ecology, including natural scientists, geographers, landscape planners, designers, and managers. This relationship is also relevant for social scientists and environmental scientists who effect landscape change. In fact, the integration of aesthetic and ecological values is not a new issue in landscape research, but very few studies have been conducted about practical concepts that synthesize both domains (Nassauer, 1995; Gobster *et al.*, 2007). Second, landscape aesthetics and ecological design themselves can be developed through an understanding of ecological aesthetics, since each domain has begun to recognize the value of the other. New landscape aesthetics begin to account for the dynamic processes of motion and change in terms of continuity and evolution that are applied to both culture and nature (Spirn, 1988; Nohl, 2001). Ecological design also stresses that aesthetic visibility be more integrated with public perceptions, contradicting traditional ecology that has been more focused on conservation of nature. Thus, ecological aesthetics has the strong potential to not only mitigate and bridge these two concepts, landscape aesthetics and ecological design, but also further support the notion of each, leading to the growth of both domains.

II. Theories of Landscape Aesthetics for Sustainability

In landscape aesthetic theories, the objective-subjective divide has been a key issue: how much is aesthetic response objective as opposed to one based mostly or completely in the lived experience? This asks whether aesthetics appreciation stems from an objective criterion (Carlson, 2006) or from personal involvement with the landscape (Berleant, 2007). These two approaches can be rephrased as the framework to ask whether landscape quality is inherent in the physical landscape, or is ultimately a personal experience as coming from “the eye of the beholder (Lothian, 1999).”

Objectivist theorists believe in distance or separation between the object and the subject who experiences the landscape. The appreciation of nature is a crucial consequence of acquiring

some level of scientific information about it, i.e., “scientific cognitivism(Carlson and Lintott, 2008).” The idea is that scientific knowledge about nature can reveal and enhance the aesthetic qualities of nature.

On the other hand, for subjectivist theorists, aesthetic appreciation of nature lies in direct perceptual engagement, which involves a complex situation of interacting and interpenetrating features (Berleant, 2007). Berleant does not regard subjectivity and objectivity as binary sets. He considers aesthetics an engaged experience of connection shaped by cognitive, cultural, and personal influences (2007). The consequence of this approach is greater sensory engagement and depth of appreciation, called “synaesthesia (Ward and Travlou, 2009).”

Based on the public’s recognition (objectivist) of ecology, people may be able to experience more aesthetic pleasure (subjectivist) from an ecological landscape. On the other hand, this recognition of ecology may occur separately from the aesthetic pleasure. It is the heart of the aesthetics-ecology controversy whether the pleasure that is derived from recognizing ecological value “counts” as an aesthetics experience (Gobster *et al.*, 2007).

One study attempting to solve this conundrum (Ward and Travlou, 2009) indicates ecological psychology could be an alternative. “Affordance” is not a mental construct that a perceiver subjectively imposes on the world, nor is it an interpretation of a physical world that occurs only in the “head” of a perceiver (Heft, 2015). Properties of the environment are both objectively real and psychologically significant; thus, perception is the organism as a whole in its environment. This study focuses on public perception and its relationship to the environment and how it relates to the functions and systems of the environment. Thus, ecological psychology could offer a bridge between objective and subjective reality, by regarding them as a whole.

Other than the objective-subjective divide, many environmental aestheticians have focused on scenic-ecological aesthetics divide. Some criticized scenic beauty, asserting scenic aesthetics pervades design and management practice and results in picturesque and “naturalistic” landscape rather than natural (Saito, 1998). Environmental aestheticians support “ecological aesthetics” based on the biocentric ethics of Aldo Leopold. This ecological component of aesthetics approaches landscapes with an interest in ecological health rather than the aesthetic appeal of the ecosystem (Ward and Travlou, 2009).

Min(2012) synthesized distinctions between scenic aesthetics and ecological aesthetics: while scenic aesthetics are emotional, static, and object-oriented, ecological aesthetics are cognitive, dynamic, and experiential. Gobster *et al.*(2007) further argues that passive aesthetic experiences, traditionally called “scenic beauty,” have different context from the one that stimulates different aesthetic experiences, such as perceived care, attachment, and identity. These activities are aligned with the dynamic processes of motion and change in terms of continuity and evolution in landscape aesthetics (Spim, 1988; Nohl, 2001).

III. Conceptual Framework and Research Questions

Only limited research has identified conceptual models that attempt to create a relationship between ecological landscape and perception in the context of ecological aesthetics (Gobster *et al.*, 2007; SadeghI *et al.*, 2014). Recent research has tried to expand Gobster’s framework by incorporating models of cognitive process (Vickers, 1965; Nasar, 1997). Vickers’ appreciative system (Vickers, 1965; Checkland, 2005) focused on appreciation as an epistemology for navigating the social process. Vickers described an appreciative system as the activity of attaching meaning to communication. In an appreciative system, we gain experience of the landscape, and new interpretation (cognition) is generated. Experience also affects our standards and values (preference). Our interpretations and standards together enable us to make judgments (attitudes), which are the sources

of action. “Aesthetic response” (Nasar, 1997) has a flow similar to the process of Vicker’s appreciative system but focuses particularly on the environment as an object of appreciation. This includes the series of affective appraisals, emotional episodes, reactions and changing behaviors. These models would offer a bridge between the objective-subjective divide in that they deal with both understanding and emotional attachment.

The current research proposes a conceptual framework explaining the affective appreciation process in the context of ecological landscape. In this model, human and environments are separate but interacting sets. The perceptual process consists of (1) cognition, (2) aesthetic preference and (3) attitudes about ecological landscape, showing a similar process to that mentioned above(Figure 1). This model pays attention to the certain scale of landscape patterns that human perceives, the “perceptible realm” where aesthetic experience occurs, and the intentional action that affects ecological functions (Gobster *et al.*, 2007). Gobster’s work asserts that the perception of a larger pattern such as forest or wildlife and a smaller pattern such as flowers or butterflies also affect the ecological system. However, those exist beyond the human scale, so they are less likely to induce action. In the affective appreciation process in the context of ecological landscape, three questions were identified:

1. Are aesthetic experience and ecological value positively congruent? We assume that if design and management intervene with appropriate manner, aesthetic pleasure of ecological systems would increase.
2. What “compromised” design and management intervention principles could enhance aesthetic pleasure and still have bio-

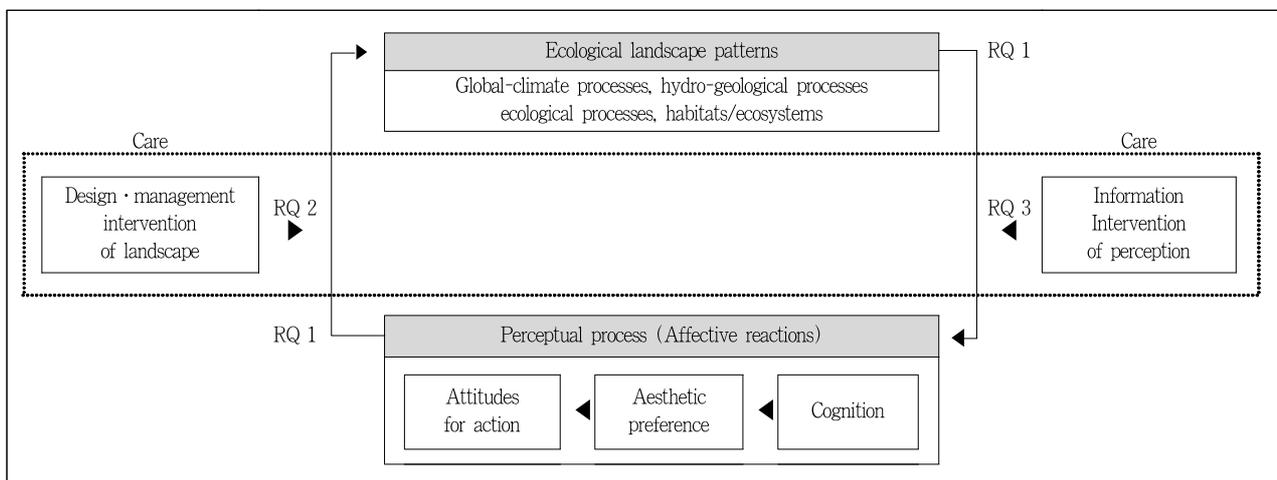


Figure 1. Broad conceptual framework (developed based on Gobster *et al.*, 2007)

diversity?

3. How does the information about the ecological landscape affect the aesthetic experience of the landscape? A core possibility that springs from this question is that information about ecology raises positive aesthetic experience.

These questions are not exhaustive. These three questions were formulated based on existing theoretical and empirical works. The following section reviews previous research that attempted to answer these three questions in terms of their methodologies. The first section deals with the relationship between ecology and aesthetics, and the second and third sections examine intervention through design and information respectively.

IV. Review of Methodology

1. Correlation between Aesthetic Perception and Ecological Integrity

One study of landscape perception (Taylor *et al.*, 1987) suggests paradigms for landscape assessment: expert, psychophysical, cognitive, and experiential paradigms. Much of the research employed expert and psychophysical photo questionnaires to examine landscape quality. Researchers developed a set of exemplary photographs to be rated for scenic quality, which offers a reliable tool for characterizing preference of one environment over another (Tilt *et al.*, 2007), and this has been refined over time (Kaplan and Kaplan, 1989).

In a positivistic research, Steinitz(1990) uses spreadsheet analysis model with visual preference and ecological integrity using geographic information system (GIS) mapping. The study utilized visual preference methods in which variables for landscape characteristics were synthesized based on the Bureau of Land Management(1980), Shafer(1969), Kaplan(1979) and Appleton(1975). Ecological integrity was measured by "indicator species approach" – species included were river otter, ruffed grouse, and black bear – that examine environmental condition for those species in the Acadia National Park, US. As a result, ecological integrity and visual preference were not always positively congruent: around 15% of the study area had either high visual preference with low ecological integrity or low visual preference with high ecological integrity. These incongruent combinations, high visual-low ecological and low visual-high ecological landscapes, need improvement

in either value to become high visual-high ecological landscape. By combining these results with user's preconceptions on the park landscape change, Steinitz's analysis yielded planning and policy implications for conservation strategies.

Gobster(1999) argues that this conflict exists because of our limited concepts in aesthetics in relation to ecology, which means that the questions deals with appreciating only formal and static composition. Thus, he claims ecological and aesthetic values should be seen as an integrated concept. Nonetheless, in one study (Gobster *et al.*, 2007), he points out how considering aesthetics helps to anticipate landscape change and its environmental impacts based on human environmental context such as wildland, agricultural, European cultural, and metropolitan landscape. For decision making in large-scale sites such as national parks, simply overlaying and comparing the map of aesthetic preference and ecological integrity can be useful.

It remains to be seen how Steinitz's mapping can be used in a smaller scale landscape. Research of urban landscape assessment also utilizes "simulated images" to articulate the levels of ecological integrity. For example, in a study of residential gardens (Nassauer *et al.*, 2009), conventional type consists of mown turf and horticultural trees and shrubs. Ecological types consist of native sun-loving prairie plants, shrub, and canopy trees. The level of ecological integrity created different combination of ecological plantings. Usually images used in the photo questionnaire show not the plan but a three-dimensional perspective, so that the amount of ecological vegetation is considered as relative rather than absolute compared to other pictures in the three-dimensional perspective. Lastly, conservation type (100% ecological integrity) shows native deciduous canopy trees, with the assumption they have been protected during development. In addition to ecological integrity, vegetation patterns (Table 1) need to be integrated. Five ecological vegetation patterns include locality, diversity, thickness, irregularity, and connectivity. Crossing these five vegetation characteristics across the degree of ecological integrity enables us to suggest a diverse combination of ecological planting patterns and integrity.

Many have questioned the use of a photo questionnaire, stating such questionnaires have limitations in that two dimensions do not completely reflect real environment. However, while the technique has been heavily used by Kaplan and Kaplan, they discovered that how people perceive two-dimen-

Table 1. Ecological vegetation pattern characteristics for simulation

Vegetation pattern characteristics	Locality: Native species	Diversity: Number of species	Thickness: Vegetation layer	Irregularity: Shape of planting	Connectivity: Succession
How pattern is related to ecological health	Native species increase adaptability	Diverse mix of planting increases immunity	Vertical layering increases biodiversity	Irregularity of shape increases biodiversity	Successive planting increases biodiversity

sional representation is similar to how they do in the real setting. Much of the information that we typically consider reaches us by means of two-dimensional representation such as television images or paintings. In addition, the style of simulation could affect participants' aesthetic experience. Even though simulations are created to show certain ecological characteristics, issues such as the quality of the image, the use of color or black-and-white imagery, and the style of simulation could lead to different results. Thus, determinations of whether the images can really reflect degrees of ecological integrity and how different style of images can affect preference should be developed. Nassauer(2004) conducted a similar study without using photo questionnaires. She directly asked users and compared restored and referenced wetlands on several ecological and cultural (aesthetic) measures including land-use context, cultural perceptions, and management practices. She discusses how cultural measures are related to biodiversity measures and suggests design implications.

2. Design Intervention on Landscape

It has been suggested that the public prefers a simple planting design that has relatively low ecological value (Nassauer, 1995; Thayer, 1998). Further studies suggest that the public can enjoy more diverse vegetation types that represent "naturalness" and biodiversity (Kaplan and Kaplan, 1989). The degree to which one prefers ecological design is different. Van der Ryn and Cowan(1996) introduce one of the principles for ecological design as "make nature visible," meaning to infuse design with an explanation of the ecological system. The physical revelation of ecological processes in the landscape encourages users to value those ecological processes differently than they otherwise would (Eisenstein, 2005). Thayer has called this concept aesthetic visual ecology (Thayer, 1998). Making nature visible is a process that informs us about the ecological consequences of our activities. This approach favors designed environments that can help us see and become more aware of the abstractions we superimpose on the land that make hidden complex natural processes visible and understandable. Thus,

the essential question for ecological designers is what part of the ecological process can actually be visible to form the landscape. On this issue, Nassauer(1992) concludes that many parts of ecological processes are invisible. The processes may not be as readily engaged as current thinking in ecological design suggests. What is visible is the surface manifestation of ecosystems and the material conclusion of ecological process. For example, layers of rock are not a part of ecological process, but the result of it.

Mozingo(1997) mentions a "hard read" versus the "easy read" about the landscape features of ecological systems. For example, an orchard in a rural landscape is perceptually clear and open, so we can see the surface manifestations of ecological systems, such as a stream running through the orchard. In contrast, in the urban context, for example, the ecological functions of streams have been hard to read. For the most part, it is not because ecological system is inherently ungraspable but because the urban fabric is set to ignore and obscure ecological process. To make an ecological system visible, providing legible surface manifestation and the access to its components are critical.

Nassauer(1995) suggests "cues to care," visible indicators that show landscape is intentionally cared for. Maintaining a neat and tidy appearance is a major determinant of landscape attractiveness. However, signage or interpretation of "messy" planting that explains the ecological function can indicate the appearance is intentional and not due to neglect.

Many studies propose design and management interventions of "cues to care" could have broader extent beyond mere neatness. The interventions could be any of the following:

- Neatly mown strips and areas of turf alongside meadows (Smith *et al.*, 2008).
- Use of traditional planting design rules of color composition and structure, and attractive foliage to accentuate the appeal of both exotic and native species, particularly near paths (Nassauer, 1993).
- Juxtaposition of naturalistic plantings with more formal planting treatments, such as a limited number of clipped shrubs (Smith *et al.*, 2008).

These “compromised” habitats as garden-like eco-systems can still have a high variety of species and conservation value (Smith *et al.*, 2008). More specifically, in ecological planting techniques, it has been suggested that biodiversity in urban green space is driven by the number of plant species and vegetation layers present. Tree canopy layers are especially important for supporting invertebrate diversity. There is also some evidence that residential street trees can indirectly increase long-term biodiversity of a site by discouraging residents from laying turf on their front yard. Because shading from the trees prevents the turf from establishing, residents select shade-tolerant plants, which are much better in terms of habitat diversity (Dunnett and Hitchmough, 2007).

In promoting habitats’ complexity and spatial structure in a site’s planting, research pays attention to public perception of ecological design. For example, much research of vegetated sustainable urban drainage system (SuDS) developed prototypes of design and examined public preference. This research could be developed to imply compromised design principles of SuDS. Little empirical work explicitly proposes compromised design. Possibilities exist for correlational research between aesthetics and ecology to select images that satisfy both public perception and ecological quality.

3. Information Intervention on Perception

While the previous section deals with physical design intervention, this section focuses more on cognitive process and the impact of information. Given the nature of landscape perception, cognitive research concentrates on meaning and experience of landscape. Much of the cognitive research work has been concerned with verbal assessments of landscapes using survey questions, adjective checklists, or semantic differentials (Taylor *et al.*, 1987).

In reality, information intervention comes in many forms: on-site signage, brochure, information through the media, guided and self-guided tours, and more extended experiential activities such as involvement in ecological restoration programs. A study about a knowledge-based intervention for promoting carpooling (Kearney and De Young, 1995) shows that story-based information about environmental issues affects participants’ knowledge and attitude more effectively than fact-sheet-based information. The study (Kearney and De Young, 1995) describes that mere provision of information has typically

been ineffective in changing behavior. The effectiveness of stories in transferring information and impacting decisions has been extensively studied in the field of education. Several studies have explored the effectiveness of stories in encouraging conservation behavior. Frequency and duration of information will significantly affect participants’ cognition. In Kearney and De Young’s research, participants received information every day for 2 weeks (1995), which might lead to more lasting cognitive change. However, because the information is not always delivered and measured in a controlled setting, after participants receive the information, the researcher is not likely to know how well they read and understood the information.

To explore participants’ cognitive perceptions of ecological and aesthetic landscape, cognitive mapping such as conceptual content cognitive mapping (3CM) can be utilized. The 3CM methodology is proposed to understand people’s mental model or an approach to knowing a particular domain. Cognitive maps are hypothesized knowledge structures embodying people’s assumptions, beliefs, “facts,” and misconceptions about the world. These assumptions and beliefs, in turn, provide a framework for interpreting information on environment and for determining responses to new situations (Kaplan and Kaplan, 1989). Hence, current cognitive maps can exert significant influence over how new information is understood and whether or not that information will influence behavior (Kearney and Kaplan, 1997). While early cognitive mapping studies employed drawings and interviews to capture people’s mental maps or knowledge structures of a physical environment such as a city, campus, or building (in Lynch’s research), 3CM, in contrast, focuses on conceptual content rather than physical (Wells, 2005). The 3CM procedure involves multiple steps posing a question, selecting items, negating items if necessary, grouping and labeling, and reflecting. The words related to landscape description could be selected from the descriptions in semantic scale (Taylor *et al.*, 1987). 3CM has been employed to investigate topics from large-scale environmental issues, including wild and scenic rivers designation (Amtmann, 1996); forest management (Irvine, 1997; Kearney *et al.*, 1999); and rural landscape (Tilt *et al.*, 2007) to small scale housing (Wells, 2005). Some study employed 3CM dealt with the subject with an approach that incorporates a strong ecological aesthetics perspective. For example, the research of Kearney *et al.*(1999) dealt with stakeholders’ perception on management issues to understand their mixed perspectives and enhance participation

in environmental management. The results showed that different stakeholders have different concerns on aesthetics (visuals) in the forest management process. In other words, stakeholders perceived that some discrepancies exist between economic value (by timber harvesting), biological issues, aesthetic beauty, and recreational values. These perceptions were categorized in the perspectives of timber industry and environmentalists.

4. Limitation and Suggestions for Approaches

The conceptual framework (Figure 1) suggests that three domains of topics affect each other and are therefore inter-dependent. The first domain looks at the ecological aesthetics relationship as it is. The second domain examines design intervention in the landscape that protects ecological integrity. The third domain reviews the intervention on perception that enhances the public's understanding of design manifestation. If the second and third domain improve, it is expected that the relationship of aesthetic perception and ecological integrity would be more congruent. This is because the effects of intervention by design and information have influence on the

process of correlation between public perception and ecological landscape.

However, each domain looks at the partial aspect of ecological aesthetics research instead of the holistic approach within the conceptual framework. To enhance validity of the research, each domain needs to deal with the topic by considering the other two domains. Table 2 suggests the three domains' purpose of the study, provides examples that this study examined, and offers methodology, limitation and suggestions for consideration to incorporate other two approaches.

The purpose of the first domain is to explain the relationship between public perception and ecological integrity as it currently exists. Given the assumption that information can change preference, correlational research needs to consider participants' level of information as control variables.

The second approach has been limited to the conceptual discourse or professional advice rather than research with empirical data. Thus, this approach might need to ask people's preference to obtain compromised and easily read design strategies and techniques. In this process, the traditional landscape visual assessment tool would be utilized (Taylor *et al.*, 1987) in ecological aesthetics context.

Table 2. Comparison of ecological aesthetics research domains

	Correlation between aesthetic preference and ecological integrity	Design intervention: Intervention on landscape by compromised design	Information intervention: Intervention on perception by information
Purpose of the study	<ul style="list-style-type: none"> To explain the relationship between two public perception (preference) and ecological integrity as it is. 	<ul style="list-style-type: none"> To understand compromised design strategies that the public may prefer To suggest compromised design techniques 	<ul style="list-style-type: none"> To understand the effect of information and testing impact on information
Example	Steinitz (1990); Nassauer, Wang, and Dayrell (2009); Nassauer (2004)	Van der Ryn and Cowan (1996); Thayer (1998); Mozingo (1997); Nassauer (1995); Smith, Dunnett, and Clayden (2008); Nassauer (1993)	Kearney and De Young (1995) Kearney and Kaplan (1997); Wells (2005); Amtmann (1996); Irvine (1997); Kearney, Bradley, Kaplan and Kaplan (1999); Tilt <i>et al.</i> (2007)
Methodology/ methods mainly used	Survey research GIS Typology of ecological integrity Photo questionnaire	Heuristic inquiry Case study Design critics Observation	Grounded theory Phenomenological research Experimental study Interview, Narrative Cognitive mapping, 3CM
Limitation	<ul style="list-style-type: none"> Two dimension do not completely reflect real environment Style, color of images may lead different results on perception 	<ul style="list-style-type: none"> Limited in conceptual discourse or professional advice rather than research with empirical data 	<ul style="list-style-type: none"> Limited in testing the effect of information in changing the perception on ecological landscape
Suggestions for consideration	<ul style="list-style-type: none"> Need to examine a participant's level of knowledge and information on ecological value and use them as control variables 	<ul style="list-style-type: none"> Need to ask people's perception on their preference to obtain compromised & easily read design strategies and techniques Need to utilize evaluation assessment tool to draw design implications 	<ul style="list-style-type: none"> Need to incorporate landscape characteristics details to reveal what kinds of landscape characteristics that one prefer could be changed by information.

Testing the effect of information has been a primary goal of the third approach. If a study tries to reveal how information changes one's perception on the ecological landscape, the study needs to incorporate more details on the landscape's characteristics. This will reveal what kinds of preferred landscape characteristics could be changed by information, which would yield more specific implications for planning, design, and management strategies.

V. Conclusion

The International Reference Group on Great Lakes Pollution from Land Use Activities noted that techniques to protect environmental quality would "require a high degree of public acceptance not only to ensure the commitment of municipal officials, but also to maintain the long-term integrity of these measures" (Nassauer, 2004). Since ecological aesthetics is interested in ecological health rather than only the aesthetic appeal of the ecosystem, it provides a theoretical foundation to resolve the disjuncture of ecology and aesthetics, and understand them as an entire organism.

Nevertheless, for the field of ecological aesthetics, not many empirical studies have been conducted and few researchers have theoretical discourse. Some studies have explored the relationship of biodiversity and urban vegetation. Other studies have suggested using public perception of ecological vegetation patterns and design implications to increase public aesthetic pleasure to maintain ecological integrity. To research this field more systematically, beyond techniques such as studying simple scalar reactions to photographs, a conceptual framework of ecological aesthetics should be established.

This article examines previous ecological aesthetics research from the methodological point of view. This article develops the theoretical framework of ecological aesthetics established by Gobster (Figure 1), and specifies three research areas that emerge from that theoretical framework: (1) correlation between ecological integrity and aesthetic preference, (2) compromised design intervention, and (3) information intervention.

According to three research areas, the current research introduced the representative research work and discussed their research methods. This study has several limitations. The selection of works in ecological aesthetics is not exhaustive: it is based on several traditional and seminal ecological aesthetics works. Thus, the review of methodology is also selective.

However, this research is meaningful in that it presents the possibility of examination of ecological aesthetics across all three approaches within the holistic conceptual framework.

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