# Processing Nature, Beyond the Antinomy Of Ecological Pretence In Contemporary Planning. A Critical Understanding Urban Ecosystems, The Epitome Of Liveable Cities

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**Abstract**
*In the still dominant perception of a hierarchical order of nature, humans are disturbing ecosystems factors. We should move away from the one-dimensional dichotomy between natural and human interaction towards a more effective representation without nostalgia. The contact between human and natural habitats is close to the idea of maintaining and conserving a certain state of equilibrium, instead of letting natural habitats evolve into new ecosystems. In other words, energy management and the capacity of a system to self-organize (autopoiesis) defines the difference between human and natural habitats. Where this capacity is not limited, a natural habitat is present. Contemporary landscapes (tourist coasts, reclaimed land, etc.) demonstrate this thesis by highlighting how human intervention is an indispensable factor in their maintenance. It is necessary to provide precise and sophisticated tools capable of synthesizing agents and forces within territorial transformations starting from a global understanding of natural processes. Ecological dynamics must be transformed into project parameters involved within design process. Here a further degree of integration is suggested above the level of simple natural ecosystems, where human is assumed as a key factor in landscape transformation and geography construction. Considering other paradigms that interfere with the same epistemological area, the contribution questions the theoretical and practical implications of rethinking the interaction between natural and artificial ecosystems within the framework of landscape resilience. This perspective allows a territorial update by increasing the level of compatibility between the evolution of human habitat and the maintenance of natural regeneration times. This articulation, however, requires a reconsideration of landscape aesthetics beyond the beautiful and the consolatory, as well as a fundamental shift in landscape thinking from representation to action.*

**Keywords**
Landscape design; Subsidiary energy; Natural–Human habitat; Ecosystem complementarity

## Introduction

The contact between human and natural habitats is close to the idea of maintaining and conserving a certain state of equilibrium, instead of letting natural habitats evolve into new ecosystems. This perspective allows a territorial update by increasing the level of compatibility between the evolution of human habitat and the maintenance of natural regeneration times. The need for professionals who care not only about preserving but also about creating and managing landscapes (McHargh, 1969) is now more pressing than ever. The integrated or balanced approach in which several abiotic, biotic and cultural objectives are pursued simultaneously is part of current planning practice but multipurpose planning necessitates more transdisciplinary approach to address the complexity of the challenge (Ahern, 2005). In addition to environmental factors, landscape modifications are often the result of forces applied on the territory by *drivers* far from the *spontaneous ecological processes* - such as the economy and socio-cultural factors (Farina, 2012). As already stated, humans have become a dominating component after modifying and using approximately 95% of land (Ellis, 2018)[1]. Indeed, with the advent of the industrial revolution and the consequent shift to a global-scale economy, interactions between man and the territory have gone beyond the immediate modification of nearby space. The issue has become of global importance, in the search for resources and energy, in the movement of products and people, in the transformation and modification of landscapes. This represents the passage to an Era in which materials and energy are artificially produced, transformed and moved in a sophisticated and articulated way, altering spontaneous dynamic process.

According to that, it is necessary to provide precise and sophisticated tools capable of synthesizing agents and forces within territorial transformations starting from a global understanding of natural processes in order to achieve a conscious and performative habitat condition. Ecological dynamics must be transformed into project parameters involved within design processes. This articulation, however, requires a reconsideration of landscape aesthetics beyond the beautiful and the consolatory, *images and symbolic values are always in stake within landscape perception, there is no place for division between reality and appearance in the continuous interaction between man and environment* (Furia, 2020). At the same time a fundamental shift in landscape thinking from representation to action is required. Here a further degree of integration is suggested above the level of simple natural ecosystems, where human is assumed as a key factor in landscape transformation and geography construction. Considering other paradigms that interfere with the same epistemological area, this contribution questions the theoretical and practical implications of rethinking the interaction between natural and human ecosystems within the framework of landscape resilience.

Landscape is always in motion, subjected to evolving process that brings to continuous shift of energies and substances flow in a time-space relationship, a perpetual transforming situation that moves with and within reciprocity between ecological, economical and energetic components. Landscape is always in motion, subjected to evolving process that brings to continuous shift of energies and substances flow in a time-space relationship. As highlighted by IPCC (2019) *"'biophysical interactions' are exchanges of water and energy between the land and the atmosphere".*

Talking about heterogeneity and spatial arrangement in an ecological sense, Richard Forman argues that *"form is the diagram of forces"* (Forman, 1995). From this ecology point of view not only do flows create structure, but structure determines flows. Therefore, the configurations that contemporary territories as¬sume follow the flows pulse regulated by economic processes dealing with the management of resources for commercial purposes (Belanger, 2016). Ecology has highlighted the finiteness of resources. It's important to understand the logic and the interpretation of evolving landscape, in order to incorpora¬te it within design processes, as the results between *forces, flows and functions.*

## Landscape as a dynamic system: a contextual thinking

Scientific theories and studies envisioned landscape as a dynamic system, anticipating of decades the current debate on landscape design praxis and theoretical speculation. Starting from the paradigm of complexity, the ecologist Almo Farina (2012) argues that *"the landscape is not just a heterogeneous spatial configuration of objects and processes, thus landscape has to be defined as a domain, a system, an unit".* A *system* is a *cohesive conglomeration* of interrelated and interdependent parts that is either natural or man-made[2]. Changes in one part affects other parts and the whole system - with predictable patterns of behaviour -, subject matter of the research *in system theory. Systems theory*[3] is an interdisciplinary field of study between mathematics, physics and natural scien¬ces. Along last decades, several scholars contributed to set out theoretical and comprehensible formu¬lation for describing the principles and the opportunity of *systemic thinking* applied to landscape and ecology. Significant references can be found in the written production of Ramon Margalef, Zed Naveh, Almo Farina, Frit-

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*[1]Phenomenological and physical consequences of human activities are related to the upgrade of tools and technologies that leads to constantly shift the way of shaping landscape and territory in comparison with previous periods. Thus human activities have become the main drivers that can transform and alter the environment (Wu), and can be considered an integral part of environmental dynamics by landscape ecologist (Farina, 2012).*

*[2]Every system is: delineated by its spatial and temporal boundaries; surrounded and influenced by its environment; described by its structure and mainly expressed in its functioning. In this regard the system resulting from elements aggregation is not merely their addition, but it's something different, with new and emerging properties, because of the interactions between the system's elements.*

*[3]It was founded during the first half of the 20th century as a result of the great shock, in which the scientific sector has realized that systems cannot be understood through analytical investigation (Capra, 1996). Analysis proceeds isolating to the object of the study in the attempt to understand it. While systemic thinking frames this object within of the context of a higher whole (Capra, 1996). Thus systemic thinking is contextual, and opposed to classic analytical approach*

jof Capra. Although, the higher contributions are due to Howard Odum, an American ecologist celebrated for his pioneering work on *ecosystem ecology.* He's well-known for his provocative proposals for additional laws of thermodynamics, informed by his work on general systems theory which includes the study of landscape and their components. In Odum's outline l*andscape* is conceived as an *open, dynamic* and *complex system*, in which part of its elements are organized by a *spontaneous emergence of order,* defi¬ned as *self-organization* and *autopoiesis* (Odum, 1971). He synthetized the energy and matter flows in the Energy Systems diagram (Fig. 1). The text *Ecology: bases scientists for a new paradigm* (Odum, 1953) influen¬ced an entire generation of ecologists, lately also inspiring landscapers and designers.

### Energy, ecology, economy

By associating the environmental relationship with the energy control of economy, H. T. Odum predicted their social-political implication in a time when this pheno¬menon was at its very beginning. In 1973, he formulated in a famous essay entitled *"Energy, ecology and economics": "There is a unit of the single system of energy, ecology and economics. The world's leadership, however, is mainly advised by specialists who study only a part of the system at a time".* In contemporary interdisciplinary debate Odum's theories are taken as reference by prominent authors, such as Nina Marie Lister (Lister & Reed, 2014) and Pierre Belanger (2016)[4], for contextualizing *land¬scape design praxis* in the framework of *systemic thinking* through ecological models of spatial organiza¬tion suggested by Odum's *open-system theories.* In this view mankind activities became the main vector between forces that are involved in *building and transforming geography,* overcoming and often disrupting the threshold of nature regenerative time, sel¬f-organization capability and *autopoiesis.* In Belanger's reinterpretation of Odum's: *"Vectors cause storms that we call economies, across different tides of supply and demand, a morphology of socio-economic ebbs and flows. Infrastructures, fixed or fluid, are their landfalls and landfills." (2014).*

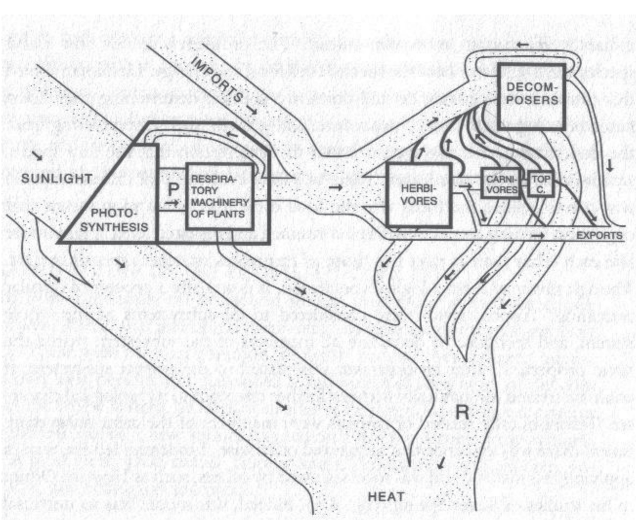


**Figure 1.** Energy Systems Diagram. Energy and matter flows through an ecosystem. The diagram shows the interrelationship between the components of an ecosystem. H are herbivores, C are carnivores, TC are top carnivores, and D are decomposers. Squares represent biotic pools and ovals are fluxes or energy or nutrients from the system. Source: Odum, 1971

In conclusion, the main difference between these models of spatial organization - made by *networks* and *systems* - demonstrates how the modern concept of networks addresses form and physical space (opera¬tionalized through a closed systems of points and lines), compared to how the post-modern concept of systems addresses *fluidity* and *flows* (animated through vectors, flows, fields, inputs, outputs, energies, exchanges, patterns, processes). If *network thinking* characterizes the mid-century approach to urban design, then open systems thinking - that is the ecologic optic - is applicable to c*omplex, indeterminate conditions, risks* and *hazards* that are typical of contemporary and future *urban patterns.*

### Resilience as adaptive system across natural and human habitat

According to Zed Naveh (2000), *"In ecology, undisrupted systems have relatively high organizational level that can renew, repair, and replicate themselves as networks of interrelated component producing proces¬ses, in which the network is created and re-created in a flow of matter and energy, are called auto-poietic systems (self-creation)."* In other words, the *energy management* and the capability of a system to *self-organize* define the diffe¬rence between *human* and *natural habitat.* The *human habitat* can be defined *as the set of areas where the human population lives or is active permanently (also through the contribution of subsidiary energy), limiting the self-regulation capability of natural systems* (Treccani, 2020). Where this capability is not limited, it is in the presence of natural habitat. A large amount of protected areas have lost their natural features and connections with water and ma¬terial flows that generated them. Thus, without anthropic works for their maintenance they would face many environmental criticalities. In this regards, common examples are: coastal dune systems, that often have to be restored with human intervention (Fig. 2); numerous wetlands, that need to be provi¬ded with fresh water for maintaining their ecological functions; forests, that need management in order to keep them safe from fire and other disruptions. Rather than aspiring to develop an idealised spatial form with associated ecosystem services, the quest for sustainability is necessary to implement the resilience of anthropogenic and

*[4]In particular Pierre Belanger argues As mutual agents, capitalism and ecology coexist and co-evolve from islands of exclusion toward an open sea of materials, elements, and entities through the opening of resource streams, the weaving of material sheds, the preordination of processes, the generation of ground effects, and superintendence of time. (Belanger, 2014)*
*[5]Novel ecosystems key characteristics are (1) novelty: new species combinations, with the potential for changes in ecosystem functioning; and (2) human agency: ecosystems that are the result of deliberate or inadvertent human action, but do not depend on continued human intervention for their maintenance. Such ecosystems result from biotic response to human-induced abiotic conditions and/or novel biotic elements (e.g. land degradation, enrichment of soil fertility, introduction of invasive species). (Hobbs, 2006, 2)*

**Figure 2.** Human intervention as necessary interference. Even in seemingly uncontaminated environments, traces of human activity can be found. In this case on Breton sea, north of France, we notice the wooden piles used to protect the coastal dunes. Source: author, 2017

non-anthropogenic spatial systems (Ahern, 2012).

In this view the contact between human and natural habitats is very profound and close to the idea of *maintenance* and *conservation of nature* at a certain state of equilibrium, instead of let natural habitats evolve towards *novel ecosystems*[5]. The emerging concept of resilience as adaptive system tries to overcome this limitation. According to its original definition: *"Resilience is the capacity of a social-ecological system to absorb or withstand perturbations and other stressors such that the system remains within the same regime, essen¬tially maintaining its structure and functions. It describes the degree to which the system is capable of sel¬f-organization, learning and adaptation"* (Holling 1973, Gunderson & Holling 2002, Walker et al. 2004). *Landscape design praxis* involves such systems, where climate, socioeconomic trends, built systems, and riverine processes affect flood hazards and disasters. They operate like both evolving ecosystems (cha¬racterized by complex behaviours associated with nonlinearity, emergence, uncertainty, and surprise) and engineering systems that should keep urbanized areas safe (Fig. 3). The paradigmatic difference between *engineering* and *ecological resilience* can be illustrated by the ball-and-cup heuristic (Scheffer et al. 1993, Walker et al. 2004) (Fig. 4; Tab. 1). The *engineering resilience* concept assumes only *one regime,* hence only one possible basin of attraction; and the very bottom of the basin represents the ideal steady state. The *ecological resilience* concept as¬sumes *multiple regimes,* hence more than one *basin of attraction.* The system may move about within the basin, never settling at the bottom; it may also overcome a threshold and settle in a new basin of attraction. The notion of *engineering resilience* is concerned with whether the system can remain at the bottom of the basin; while the notion of *ecological resilience* is concerned with whether the system can remain within the current basin.

Urbanized floodplains are such systems, where climate, socioeconomic trends, built systems, and riveri¬ne processes affect flood hazards and disasters. They operate like evolving ecosystems rather than engi¬neering systems and are character-

**Figure 3.** Infrastructure approaches: dynamic system and hard system. Two example of dynamic and hard infrastructure in Ravenna (Italy). Left: Sand protection embankment in winter season. Right: suspended riverbed. Source: author, 2019

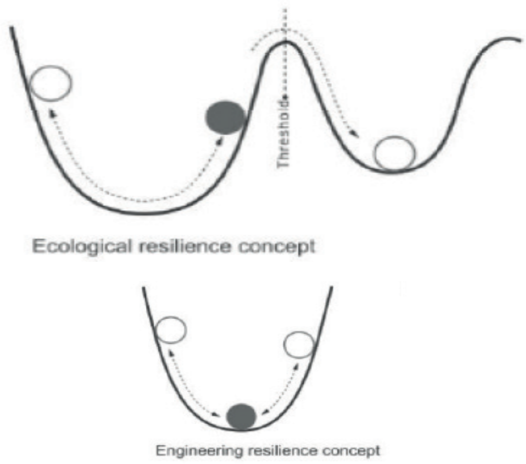


**Figure 4.** Difference between engineering resilience and ecological resilience (to be redrawn) The cup represents the region in the state space or “basin of attraction”, in whi¬ch the system tends to remain, and includes all possible values of system variables of interest. The ball represents the state of the system at any given time.
Source: “A Theory on Urban Resilience to Floods—A Basis for Alternative Planning Practices”, Kuei-Hsien Liao, 2012

| Ecological resilience | Engineering resilience |
|---|---|
| **DYNAMIC**: embrace the perturbation | **RIGID:** reject the perturbation |
| Tolerance + reorganization | Resistance + recovery |
| Multiple regime: dynamic equilibrium | One regime: Static equilibrium |
| Unpredictability and uncertainty | Predictability |
| Disturbances as learning opportunities | Disturbances as threats |

**Tab 1.** Types of behaviour towards spatial adaptation approach

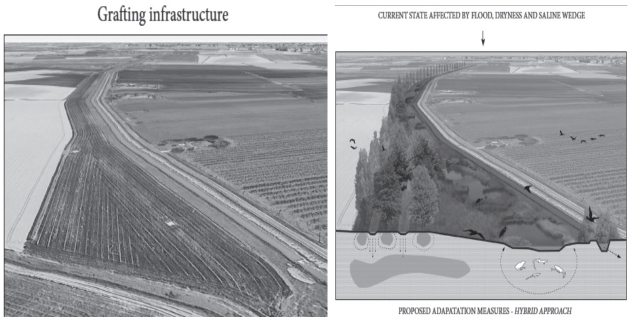


**Figure 5.** Hybrid resilience. Grafting infrastructure. Left: current state of agricultural soil affected by floods, droughts and saline wedges. Right: proposed adaptation measures using a hybrid approach with the aim of increasing resilience and create new habitat. Source: author, 2020

ized by complex behaviours associated with nonlinearity, emergence, uncertainty, and surprise. According to Lister (2014) *"Ecological thinking remains a powerful lens for understanding complex adaptive systems."* Several solutions proposed in the field of landscape design are an hybridization of these two kind of resilience (Fig. 5).

**Conclusion**

The knowledge required to address sustainability and landscape resilience must rapidly evolve in an integrated planning and design praxis, as a complement to urbanisation and territorial transformations processes, through a merging of theoretical and practical content. The provided insights can add to both substantive and procedural design elements within landscape architecture by paving the way for an integrated understanding of landscape components that can fully account for ecological resilience. Design praxis needs a broader vision capable of integrating these concepts from the preliminary and study phases of the project. Acting with ecological resilience in mind would increase the adaptive capacity of the territory, opening up new transformative scenarios without fossilising within rigid engineering schemes.

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