Architectures of Beneficial Disturbance

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INTRODUCTION

The word 'ecology' appears numerous times in the 2011 ACSA conference session descriptions, testimony to its growing stature in our discipline. And indeed it appears that architects consider ecological concerns in the design process with increasing interest and sophistication. One thinks of recent work by Rana Creek Living Architecture, Behnisch Architects, Mithun, Ken Yeang and many others (1). Examining projects realized by these practices, it seems ecological engagement influences positively architectural quality and performance, as well as the manner in which such projects are situated in and interact with the surrounding landscape.

Despite this hopeful trajectory, architects often rely on what the political ecologist Tim Forsyth describes as environmental "orthodoxies," assumptions about how ecosystems function and how humans can most constructively affect them (2). Uncritical acceptance of particular ecological models, a "reinforcing of blind allegiances," indicates a failure to acknowledge the "multiple paradigms" within ecology itself, and the social dimension - and yes even the linguistic influence - of their construction. This limits the ability of architects to produce critical, transformative, ecologically minded work.

In this essay, I first provide a provisional definition of ecological architecture given a broad spectrum of environmental conditions it might account for. I examine a range of ecological models that architects can work with, and consider the opportunities and limitations that might be associated with the adoption of one model over another. Lastly, I advocate for a critical engagement of multiple or hybrid models during the architectural design process as acknowledgment of the provisional stature of their grounding.

WHAT IS ECOLOGICAL ARCHITECTURE?

An ecological approach to architecture involves optimizing resourceful performance of buildings by taking advantage of on-site resources, passively heating, cooling and ventilating; zoning spaces logically with respect to use and orientation; overlapping occupancy schedules so certain spaces serve multiple uses; in all respects by designing buildings that minimize energy use and that generate as much of it on site as possible. In addition, we would account for how projects are assembled, the energy expended and carbon offset during construction, the ability of assemblies to adapt to changing needs and circumstances over time, and the potential of elements and systems to serve useful roles when the life of a particular building has passed. We consider these efforts 'ecological' in that they concentrate and render more explicit building behavior and reduce reliance on far-flung energy systems, fossil fuel based economies and overflowing landfills.

While climate change may be the biggest monster in the bestiary, a real and severe threat demanding aggressive response on the part of architects and society at large, other environmental issues such as habitat fragmentation and consequent loss of biodiversity also deserve our attention. As political ecologists point out, if our solutions are directed solely at global warming as the problem, we might inadvertently support actions that have the effect of making other environmental problems worse. As an educator and theorist my concern is how designers can contribute to a future in which a diversity of life forms not only can exist, because we have stemmed the worst of global warming, but where they do in fact populate our world and our dreams. With this in mind, we are called upon through our work to address the factors considered above as well as the **functioning of natural systems** on a given site.

The landscape ecologist Richard Foreman challenges us to better understand and work with "site ecologies," the dynamics operating or that could operate locally:

> The major components of a rigorous or small-space ecology exist, but are scattered over several fields. A great opportunity beckons for someone to make the synthesis. It will become a leg of the future design and planning fields.[3]

At the same time trends in landscape ecology lead us to ask what roles individual projects can assume within an ecosystem, even in or especially in urban contexts where projects can participate in processes of repair. Contributing to larger scale ecosystem dynamics may involve collecting and treating water on site so as to improve overall hydrological function and ensure watershed and aquatic habitat health. It might also to pertain to facilitating connectivity for terrestrial and avian species by developing site plans that maintain or establish corridors to neighboring properties. As with energy considerations, specific strategies will depend on the particularities of context and project goals. What is critical is that engagement of ecology encourages us to think about a synergy of built and landscape morphology: we envision architecture as systems situated within and interacting with systems of greater magnitude.

Cities in North America often were founded in areas of high biological value, for example along riparian corridors. Recent urban ecological research indicates that urban environments harbor more biodiversity than commonly thought[4]. Informed by this knowledge, we can more aggressively seek opportunities to improve ecological conditions as part of urban redevelopment. Given that so many sites in urban contexts have been compromised due to past activity, an ecologically minded design approach has the potential to better circumstances dramatically, and in places of high visibility. O'Neill et al suggest that an "ecosystem shows instability whenever the constraint system is broken down."[5] Assuming stability is a desirable characteristic, we might ask in reference to an urban site and neighborhood what constraints have been removed, and speculate as to what sorts of stabilizing elements we might reintroduce.

Such an effort does *not* represent an attempt to return to an uncompromised 'state of nature.' Landscapes throughout North America have been managed actively for millennia, making nostalgic retreat indefensible philosophically and impossible practically. Further, for the majority of urban sites human activity will continue to dominate. Such an effort *does* reflect higher performance expectations for our urban lands. As James Evans suggests, "We are placing spatial demands on cities to deliver increasingly developed landscapes while simultaneously becoming more sustainable."[6] Cities typically function as "highly ordered dissipative structures" within complex, global biophysical processes.[7] In order to counteract these entropic tendencies and meet these new spatial demands, we are called upon to embrace a process of *collapsing* natural functions together with human driven patterning and function, a stacking of value in increasingly dense contexts.

Architects can advance these efforts more effectively and create projects of catalytic impact through collaboration with ecologically minded designers and environmental scientists. If we work with these experts at the outset of design investigations, we have the opportunity to embed context specific ecological factors, from habitat types to specific species, in our most basic statements of intention. We also can better apply ecological models in exploring symbiotic interactions between buildings and landscapes.

Specific ecological factors and general ecological models: these are not at odds. When we engage ecological systems in the conceptual organization of a site and project, the particular manners of engagement will depend on the overarching constructs we use in understanding and describing these systems. In other words, our intentions and performance goals for a project will depend on the model of ecology that we assume.

AN EQUILIBRIUM MODEL AND ITS IMPLICATIONS

In countless studio reviews I have attended over the years, well intentioned, green minded architecture students describe as a primary design motivation that of minimizing the impact of a project on a site so as to preserve a precarious natural balance. The curious aspect of this conviction is that in so many cases the sites in question have been degraded significantly due to previous human impact. Why minimize impact in a dysfunctional context?

This outlook would seem to stem from an environmental orthodoxy, a presumed universal law, that healthy ecosystems are those in equilibrium and are characterized by balance, stability and homeostasis. Along with many other environmental advocates, architects and architecture students interested in ‘sustainability’ tend to assume that this “orthodoxy” is grounded in fact, and fail to account for its socially and historically constructed nature. And indeed this view has deep historical roots, as Sharon Kingsland argues:

> This idea of a balance in nature was commonly accepted by natural historians well before Darwin. Forbes integrated this traditional belief, which harkened back to an earlier teleological view of nature as harmoniously regulated for the benefit of all in accordance with divine wisdom, with the new theoretical writing on evolution.”[8]

Even a sophisticated leader in “ecodesign” theory and practice such as Ken Yeang, in attempting to embed human actions in surrounding ecologies, unwittingly relies on environmental ‘purity’ as a basis for action. While Yeang recognizes that “ecoystems are…dynamic systems and are always changing and in a state of flux,” he also speaks of the overarching objective of ecodesign as that of “benign environmental integration,” as “within each ecosystem, then, are the organisms making up the living community in balance with their environment.[9]

Certain assumptions follow from the equilibrium view. To begin, nature’s balance as found in ecosystems deserves our respect and cautions approach, and, when necessary, our attempts at restoration. Implicit is the assumption that the balance requires participation of all constituent ecosystem components, with the removal of any one imperiling the system. Additionally, human activities usually have the effect of disrupting this balance, for the worse. We enter the system clumsily, or worse, violently, from outside.[10] It would be preferred to disengage human and natural systems in order to allow for optimal, unimpeded ecosystem function. When we are called upon to act, to design and ultimately realize a work of architecture, the greenest proposal assumes a very small footprint that causes the least disruption to the natural balance.

Upon scrutiny, several shortcomings of this point of view emerge. To begin, one is challenged to identify the balanced state that one must work to maintain or restore. When did balance best characterize the ecosystem in question and how did species and nonorganic elements interact to establish and maintain this balance? Can we reintroduce these elements and species in the proper quantities and relationships and expect the system to act as before? An additional issue, one that I have alluded to, pertains to the dubious value of minimal intervention in an urban context. If the site in question has little remaining ecological integrity and suffers from biological impoverishment, what impact will minimal intervention have?

Ambiguity complicates our ability to act. A noninterventionist approach tells us very little about how to constructively improve ecological conditions. The ideal of a nature untouched suspends our ability to think substantively about proper human engagement in ecological systems, and the potentially positive contribution of an urban project relative to ecosystem functioning.

A final concern related to the equilibrium orthodoxy is that much recent ecological theory and scientific research focus on disequilibrium, non-equilibrium, patch dynamics and drift, where systems do not necessarily evolve, stabilize and achieve succession in a consistent manner. Instead, disturbances that are commonplace yet of differing magnitudes impact the future trajectory of an ecosystem in profound and profoundly different ways. I believe most designers realize that the equilibrium model is inadequate, but seem to be unaware of its persistent influence or of useful alternatives. A non-equilibrium model, if adopted by designers, has the capacity to provoke dramatically our understanding of the goals and outcomes of an ecologically motivated approach to architecture.

A NON-EQUILIBRIUM MODEL AND ITS IMPLICATIONS

In a non-equilibrium model, *disturbance regimes* assume significance relative to how ecosystems function and change, how stable they are and what comprises them. Outside influences, some more regular and some highly sporadic, shape ecological dynamics to the point where me might characterize ecosystems as fundamentally 'open systems.'[11] Fred Swanson at the Pacific Northwest Research Station of the USDA Forest Service, in speaking of forest ecosystems, summarizes the role of windstorms, floods and fires as that of "knocking nature around."[12] Much of what we witness when we visit a forest ecosystem is the consequence of tumultuous events that occurred in the past. Some ecologists suggest that for many ecosystems, intermediate levels of disturbance, versus very minor or catastrophically large disturbances, can have the most positive impact on long term ecosystem health.[13]

One of the most compelling aspects of working with a non-equilibrium ecological model in architectural design is that it prompts us to speak with nuance regarding the intersection of human activity and environmental health, that we focus more intently on compatibilities between building and landscape dynamics, and hybrid processes that we set in motion. Do we and do our projects contribute to disturbance? How? The temporal dimension assumes heightened significance. How might a work of architecture, both during construction and throughout its life, participate in and respond to evolving ecological conditions? The non-equilibrium view requires attentiveness to things on the ground (and in the air and water), that we articulate intentions with greater particularity as we commit to working methods that resonate with observed dynamics of ecological systems.

Might our projects engage in *regimes of beneficial disturbance?* We might identify a gradient of possible interactions and interventions, with level and type of disturbance related to site conditions and degree of historic degradation and simplification. Projects as disturbance regimes could conceivably increase biological resiliency, complexity and diversity, others might mitigate "stressors," still others might intensify a desired set of processes, flows and interactions. As one example of project as disturbance, we might adopt a "patch dynamics" non-equilibrium approach and create 'gaps' within the impervious urban canopy of parking lots, roads and rooftops as part of a larger redevelopment strategy (similarly, a biogeography model may prompt us to establish 'islands' of open land in the urban tarmac).[14] Such gaps could improve linkages between sun, sky, rain, plants, soil, and elevate such interactions in human experience. Gaps become "orderly frames for messy ecosystems," a notion championed by the landscape architectural theorist Joan Nassauer, prompting processes that elevate locale specific urban identity.[15] New buildings fill in gaps strategically at the same time new gaps form.

In another example of a work of architecture as urban disturbance, a project could participate more effectively and aggressively in the watershed by helping establish conditions akin to pre-development hydrology. Foundations hold up buildings *and* potentially hold back, filter, direct and purify water, and/or help establish more habitat rich stream channel dynamics - the actual role depending on a thoughtful consideration of where the project sits within the watershed. Decelerated water performs work and delights. More than Low Impact Development (LID), this high impact approach inspires morphological expression; water becomes the connective tissue linking formerly disparate worlds.

Compelling, challenging questions present themselves: Once an initial built disturbance has improved site conditions, what then? Have we reached equilibrium? Or might the project instigate further disturbances? And/or might it anticipate and respond to future disturbances? For the 'hydrological' architecture discussed previously, we might establish as a physical presence numerous routes for water to flow from the building to the landscape, with the severity of the future rain event dictating the course. A multiplicity of watercourses might surprise us and reinvigorate our everyday experience as well as support aquatic habitat by ensuring flows that enlarge urban stream 'refugia' for small fish during peak events.

A non-equilibrium model provokes. It calls upon architects to scrutinize more critically project goals. It fosters a tremendous sense of responsibility, as we must pay attention to how our acts affect the trajectories of ecosystems where we work. It encourages humility given fundamental uncertainties about the kinds of processes and disturbance regimes that will shape the future. Acknowledging and working with open systems invites the sorts of 'events' ecologies that political ecologists speak of.[16] Works of architecture as constructive mediums in ecological processes require long-term adaptive management strategies that entail, among other commitments, a willingness of communities to engage new disturbance regimes if original intentions differ from unforeseen eventualities.[17]

A HIERARCHY MODEL AND ITS IMPLICATIONS

Hierarchy theory attempts to reconcile population/community and process/function understandings of ecosystems, two constructs often viewed as incompatible.[18] Proponents of hierarchy theory suggest that the conclusions we draw about the characteristics of ecosystems depend largely on the spatio-temporal scale of observation. Looking at one set of conditions we are led to believe that equilibrium prevails; with another observation set, a non-equilibrium view holds sway. Ecosystems are thus not discrete entities but models about systems derived from particular framings (this is a primary lesson as we relate ecological and post-linguistic understandings of the world). Acknowledging this, one might even find and harmonize evidence of two seemingly competing tendencies operating simultaneously; for example instances where function in an ecosystem is stable despite highly unstable populations.

The hierarchical model organizes elements in ecosystems in levels that correspond to rates and frequencies. Lower frequency components such as large stands of trees are of higher order, less subject to perturbation, and influence lower orders much more than the other way around (layers are asymmetrical in influence). Higher frequency components such as microorganisms in the soil are lower in order, highly subject to perturbation and influence higher orders much less than the other way around. Again, the hierarchy model offers a means of explaining dynamic conditions where some ecosystem elements gain in structural complexity while other elements undergo decay. We might link this hierarchical structuring with the previous discussion of intermediate levels of disturbance in a non-equilibrium model and speculate as to whether 'intermediate' built interventions might produce the most positive, sensitive long-term impact. A design investigation becomes that of explicitly teasing out the interactions of selected 'in-between' layers and seeing how these can catalyze project identity and behavior. The 'EcoDistrict,' as opposed to the building or the city, becomes the focus of our efforts, linking layers up and down the hierarchy.

For the purposes of architectural design what may be of greatest significance in hierarchy theory is the idea that poorly connected systems can benefit and gain stability by the introduction of connecting elements (conversely, strongly connected systems may be tenuous, fragile and susceptible to high impact disturbance, and may benefit from the introduction of elements that decrease connections). Given this understanding of weak vs. strong connectivity, we might speculate as to the impact of the introduction of connective elements such as canopies (built or vegetated) in linking urban gaps inspired by patch dynamics. Or, returning to the notion of a project as part of the urban watershed, we might look at a building intervention as a disturbance that establishes greater connectivity in a manner beneficial for aquatic systems…and to humans as well. We link cold water, oxygen, nutrients, shade, and populations of predators and prey, and, at the same time, address the ambiguities of human involvement in the watershed. Our explicit connection to the system as a stabilizing event causes favorable constraints in subsequent behavior.

PROVISIONAL CONSTRUCTS

Our brief and highly speculative consideration of a small number of ecological models and what they suggest for architectural design points to the incompleteness of any one model given the complexities to be reckoned with. For every model, even the non-equilibrium model that resonates in many ways with our emerging understandings of the world, certain conditions become obscured as others are highlighted. With this in mind, rather than shifting from one pole to another, we might instead entertain the interplay of multiple models. We might also track syntheses of thought occurring with ecology itself, for example the development of the 'neutral' theory that focuses on 'drift' and that attempts to reconcile the longstanding rift between equilibrium and non-equilibrium views.[19] By embracing these debates, architectural explorations may even rebound to influence how ecologists think and work.

Whatever conceptual frameworks we deploy in incorporating ecological concerns in the design process, the very engagement of ecology alerts us to our inherent lack of mastery with regard to the fundamentally open systems we are dealing with. Even the most accepted concepts and theories are subject to scrutiny, as Evans' critique of the wildlife corridors reveals.[20] Given the overwhelming complexity in addressing living systems (vs. a more limitable notion such as energy efficiency), nothing even remotely approaching 'synoptic rationality' is possible.[21] Rather than presenting a problem, this uncertainty and lack of clarity become the very gap within which creative speculation resides. As the environmental philosopher Kerry Whiteside suggests, "Some disorder allows a society to be receptive to sources of creativity."[22]

As we engage environmental issues, as we advance the building sciences, and as we importantly consider how ecology may positively influence architectural design, we should remain ever receptive to the poetic dimensions of architecture. The notion of "buildings as disturbances," timely in capturing a contemporary tension and with any good metaphor indicative of an ethical imperative, inspires us to reconsider our acts as designers.[23] Yet if the notion gains traction, the road leads not to codification but the prompting of new questions and the reconsideration of alternative models. This specific example and the overall focus of this paper suggest that the continued relevance of linguistic theories and conceptual models in a post-linguistic world lies not so much in their direct appropriation as with stylistic borrowing, but in their helping us to see the tentativeness of our borrowings, regardless of the seeming realism of their source. In the ongoing dialog between builtscapes and landscapes, architecture and ecology, we continually and provisionally avail ourselves to new forms of expression in remaking our world.

ENDNOTES

1 See: http://www.ranacreek.com/
Behnisch Architekten and Transsolar ClimateEngineering, *Ecology. Design. Synergy* (Berlin: Aedes International Architecture Forum, 2006);
David R. Macauley, *Integrated Design – MITHUN* (Bainbridge Island, WA: Ecotone Publishing, 2008);
Ken Yeang, *Ecodesign: A Manual for Ecological Design* (London: Wiley Academy, 2006).

2 See: Tim Forsyth, *Critical Political Ecology: The Politics of Environmental Science* (London: Routledge, 2003).

3 Richard T.T. Foreman, "The Missing Catalyst: Design and Planning with Ecology Roots," in Bart R. Johnson and Kristina Hill, *Ecology and Design: Frameworks for Learning* (Washington: Island Press, 2002), p. 90.

4 See for example: S.T.A. Pickett et al, "Beyond Urban Legends: An Emerging Framework of Urban Ecology, as Illustrated by the Baltimore Ecosystem Study," in *BioScience*, February 2008, Volume 58, No. 2, pp. 139-150.

5 R.V. O'Neill, D.L. DeAngelis, J.B. Waide, and T.F.H. Allen, *A Hierarchical Concept of Ecosystems* (Princeton, N.J.: Princeton University Press, 1986), p. 211.

6 James Evans, "Wildlife Corridors: An Urban Political Ecology," in *Local Environment*, Volume 12, No. 2, April (2007): 129-152, p. 132.

7 For a consideration of cities as dissipative structures, see: William Rees and Mathis Wackernagel, "Urban Ecological Footprints: Why Cities Cannot be Sustainable – and Why They are Key to Sustainability," in *Environmental Impact Assessment Review*, 16:223-248 (1996).

8 Sharon E. Kingsland, "Foundational Papers: Defining Ecology as a Science," in Leslie A. Neal and James H. Brown, *Foundations in Ecology: Classic Papers With Commentaries* (Chicago: The University of Chicago Press, 1991), p. 3.

9 Ken Yeang, Ec*odesign: A Manual for Ecological Design* (London: Wiley Academy, 2006), pp. 37, 24, 31

10 Might a mobile offer an appropriate metaphor for this view? The mobile moves gently as the summary of rotations of individual pieces. We touch it, prod it, redirect it, disrupt it and perhaps even damage it irrevocably.

11 See: Beth Dempster, "Boundarylessness: Introducing a Systems Heuristic for Conceptualizing Complexity," in Chalres S. Brown and Ted Toadvine, *Nature's Edge: Boundary Explorations in Ecological Theory and Practice* (Albany: State University of New York Press, 2007).

12 Personal correspondence, May 1, 2010

13 See for example: Bart R. Johnson and Harold Pulliam, "Ecology's New Paradigm: What Does It Offer Designers and Planners," in Bart R. Johnson and Kristina Hill, *Ecology and Design: Frameworks for Learning* (Washington: Island Press, 2002).

14 See: S.T.A. Pickett and P.S. White, eds., *The Ecology of Natural Disturbance and Patch Dynamics* (Orlando: Harcourt Brace Jovanovich Academic Press, 1985).

15 See: Joan Iverson Nassauer, "Messy Ecosystems, Orderly Frames," in *Landscape Journal*, Vol. 14, No. 2, pp. 161-170

16 See Forsyth, p. 233, also pp. 223-224

17 For a thorough treatment of the purpose and potential of adaptive ecosystem management, see Bryan G. Norton, *Sustainability: A Philosophy of Adaptive Ecosystem Management* (Chicago: University of Chicago Press, 2005)

18 R.V. O'Neill, D.L. DeAngelis, J.B. Waide, and T.F.H. Allen, *A Hierarchical Concept of Ecosystems* (Princeton, N.J.: Princeton University Press)

19 See Stephen P. Hubbell's *The Unified Neutral Theory of Biodiversity and Biogeography* (Princeton, N.J.: Princeton University Press, 2001).

20 James Evans, "Wildlife Corridors: An Urban Political Ecology," in *Local Environment*, Volume 12, No. 2, April (2007): 129-152.

21 See Forsyth, p. 47.

22 Kerry Whiteside, *Divided Natures: French Contributions to Political Ecology* (Cambridge, MA: The MIT Press, 2002), p. 285.

23 For a consideration of the ethical dimensions of metaphor, see Wayne Booth's essay "Metaphor as Rhetoric: The Problem of Evaluation" in Sacks, Sheldon, ed., *On Metaphor* (Chicago: University of Chicago Press, 1978) pp. 47-70.