Opening the Field

Odgaard, Martin

Publication date:
2012

Document Version:
Tidlig version også kaldet pre-print

Opening the Field - Shaping an Urban Biodiversity

by Martin Odgaard, Ph.D. Scholar, Aarhus School of Architecture

Keywords: Landscape Urbanism, Landscape Ecology, Urban Planning, Landscape Architecture

Abstract:
The perspective of this paper is to showcase the synergy that lies within a new urban-nature ecology framework. The aim is two-sided - on one side it is an exploration of how to work with landscape ecology in urban- and landscape design with a special emphasis on biodiversity. It is my claim, that an increased biodiversity within the urban realm can lead to a larger degree of diversity of usage and of tactile & visual experiences within the architectural planning-realm, and at the same time act as a significant ecological benefactor. Different architectural strategies will be showcased, both as case-readings and as more generic recommendations that attempt to bridge the gap between landscape ecology and urban planning.

Paper:
EU- and UN-treaties have recently been signed, aiming to stop the global decline in biodiversity - a so-called 6th mass-extinction, where the number of species worldwide is declining at least 100 times faster than what historically has happened. The main reason for this, is humanity's consumption of landscapes and natural resources. (Rockström et al, 2009)

Regarding nature area- and biodiversity decline, mixing urban- and nature-planning in a new configuration is an overlooked potential. The main question is now: How can we create attractive urban landscapes that improve biodiversity in the cross field between urban- and nature-planning? The aim of the paper is to present an approach to understanding integration between urban- and nature planning thus promoting biodiversity through urban development.

Working with biodiversity versus working with Nature
Besides the current global discourse on biodiversity, there is also another convenient aspect of choosing the concept of *biodiversity* as a working strategy instead of *nature*. Architects can refer to the notions of nature, nature-planning and nature-preservation when they work in, for instance, municipalities or when working in teams with ecologists in sensitive habitats. The use of *nature* can however be a minefield of different understandings of the concept. Danish philosopher Hans Fink (2003) has unfolded this multiplicity and makes the connection between differences of use of concept, and institutionalised conflicts. His key point is, that there are several different views on what nature as a concept refers to. He lists seven different ways to delineate the 'natural' as: -the untouched, -the untamed, -the rural, -the green, -the physical, -the earthly or -the whole. Different stakeholders that are dealing with 'nature interests' have different agendas and backgrounds and thus different discourses given their view on nature. The problem is not necessarily that *nature* becomes a floating signifier, as Derrida might say, but that it has a number of signifiers that makes shifts - 7 shifts, Fink would argue.

So despite the concept of nature may be widely used, using biodiversity as a strategy may prove to be a much more concise and productive way to go.

So what is biodiversity? To make it short, it refers to the diversity of species in flora and fauna. American ecologist Richard Forman (1995) goes a bit further, and defines it not only as diversity of species, but also genetic variation within species, and different types of ecosystems. The definitions do however trigger questions that link to the geography of biodiversity. A cynical view on biodiversity could be, that if we have the species and ecosystems represented a few places throughout the country, then we as a whole have a high level of biodiversity. That is of course stretching the concept, but it does lead to a discussion of scale and distribution already in the initial definition of biodiversity, since the question almost automatically becomes - "diversity where?". Danish ecologist Peder Agger (2012) discusses this question and argues, that there is a sort of public educative and democratic aspect to biodiversity. If at least not *some* level of this diversity is present all the way down to a local and personally relevant level, we become careless as an overall in our attitude towards our environment. The answer to "diversity where?" becomes "anywhere possible" - and the goal is not only to gain high degrees of diversity a few places, but to gain an overall heightened level. Seen in this light, it becomes clear that urban planning and -design can have a key role in achieving the goal of increasing the biodiversity. (Landscape-)Architects and planners will work wherever there is a project, and 'wherever possible' is exactly where the work is needed to be done. The American architect Kristina Hill has described this intersection: *"The basic idea is not new, but I believe that explicitly creating an infrastructure that supports regional biodiversity on a site-by-site basis while reorganizing cumulative effects would be a new goal for urban design."* (Hill, 2001, p.98) The key question for those who work with shaping our surroundings is however, how do we do that? Is it even possible to predict the ecological outcome of complex landscapes, and thus work with it in a meaningful way? To give some pointers to this, it can be very fruitful to look towards the academic field of landscape ecology

From a landscape ecological point of view

Landscape Ecology as an academic field refers to the understanding of relations between landscape structures and their ecologies[1]. It has its origins in geography, ecology and land-use planning among others. One of the key-scholars within the paradigm, Richard Forman has identified landscape ecology as the field of relations between landscape elements, wildlife and human interventions (Forman, 1995). In his

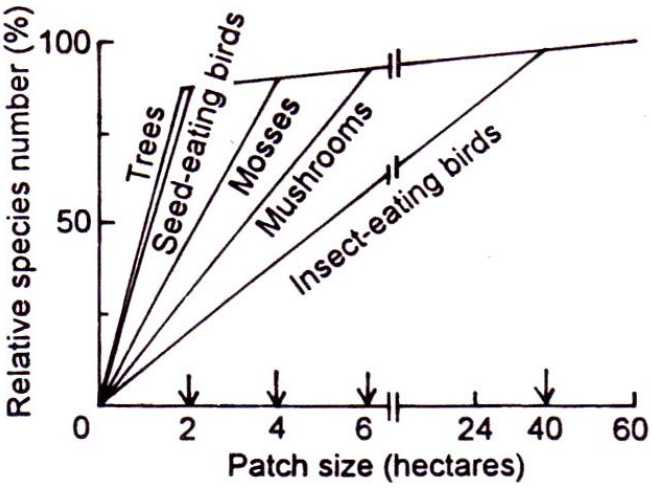


Figure 1 - biodiversities' dependencies on size

[1] Ecology is in here defined as the study of interactions between organisms and their environment

book 'Land Mosaics', he summarizes a review of a wide array of studies, by listing what overall properties has the largest impact on biodiversity. In order he lists 1) habitat diversity 2) (human) disturbances, 3) "landscape patch" interior size, 4) age, 5) differences between neighbouring patches and 6) amount of isolation. This is merely one of the different parameters he highlights, but it functions as a useful starting ground for investigating the relation to specific shape and the urban, and as a beginning of understanding hierarchies in terms of cause and effect. More specifically on the scale dimension, Forman also addresses the relation between scale, biodiversity and classifications of biological organisms. A specific study on old oak forests in New Jersey, has shown at what scale-levels, the 'cost-benefit' of landscape-element sizes is at its best from a biodiversity point of view. The study mentioned here, relates to the different levels of biodiversities based on different patch sizes. Figure 1 shows, for instance, that in order to gain a high biodiversity for insect-eating birds, you need significantly more space than you need for the seed-eating birds. (Forman, 1995, p. 60)

An earlier Danish meta-study made in 1982 by a research-group at the University of Roskilde, made a list of generic "all-other-things-being-equal" recommendations, of how the shaping of different landscape structures can alter the biodiversity potentials of these structures. (figure 2, Agger et al., 1982, p. 26)

These two should only be seen as examples of the field of landscape ecology, but even though these rules-of-thumb from both Forman and Agger are quite generic, from an architect-planners point of view, they have an appeal given their concise spatial expressions and recommendations. The relevance of these spatial recommendations should, from an architect's point of view, seems very obvious to remedy the agenda of biodiversity in the role of designing our environment.

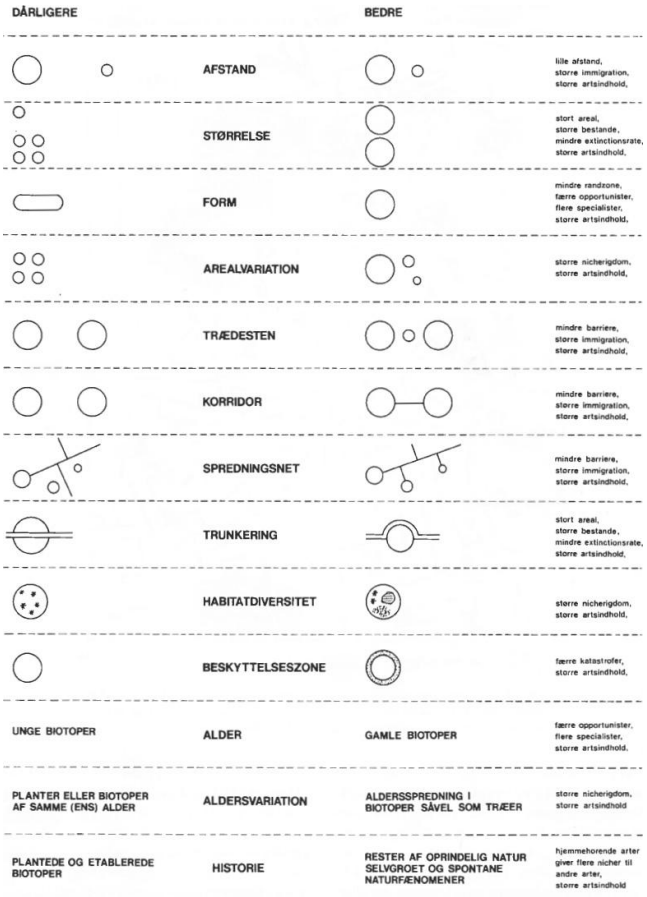


Figure 2 - Catalogue of spatial parameters

A more 'quantitative' approach to evaluate the interactions between man and environment, lies in the realm of simulating ecologies. Ever more powerful computers give the possibility of combining knowledge regarding animals and their relations to different habitats, with a GIS model, that. A model that, in years, can become more and more detailed. Within the simulation, the movement of virtual agents (animals) can be traced. This is now used to evalu-

ate consequences of farm-planning, crop-rotation etc. Different landscape-structures form the base for flora- and fauna movements thus potentially giving way for the testing of different scenarios. Since the approach is based on standard GIS-data, it is, in principle, open for a wider use including urban planning and -design.

Kristina Hill and the Levels of Complexity

In an article from 2001, American architect Kritstina Hill wrote about the connections between biodiversity and urban design. Here she quotes biologist Warren Weaver and his views on different levels of complexity in theoretical problems and couples it with Jane Jacobs' view on the necessity of acknowledgement of complexity in urban design. The main point being, that there are basically three types of complexity (Hill, 2001, p. 95-96):

> *"* [1] "problems of simplicity," or the-variable relationships that can be understood using deterministic equations.
> [2] "problems of disorganized complexity," or problems that have a large number of variables and can be addressed using the theories of probability; and
> [3] "problems of organized complexity," or problems that contain a large number of variables whose behaviour cannot be considered random. *"*

In her article, Hill then continues to couple 'type 3' complexities to the Downsview Park competition, and James Corner's entry in particular. I would however like to elaborate on these different types of complexities and their applications in urban- and landscape-design practice. To build further on Hills points may seem to stretch it a bit too far, but I believe it may serve as a useful exercise to construct an overview on different ecological tools and their applications.

The ***"problems of simplicity"*** can be translated into different types of interventions. Basic for them is, that they are deterministic thus easily understandable. Often these types refer to such types as wildlife corridors and 'green connections' They are often used on a relatively high scale-level compared to project-level scales. Often they consist of a not very well-defined mixture of existing conditions, fragments of nature-elements and potentials. They depend on the power on the connection and its generic beneficial properties. Examples of this can be found in municipal/region planning and urban development schemes. In Danish context this type is often seen in architectural competitions as well as in regional planning. An example is the architectural competition on urban devel-

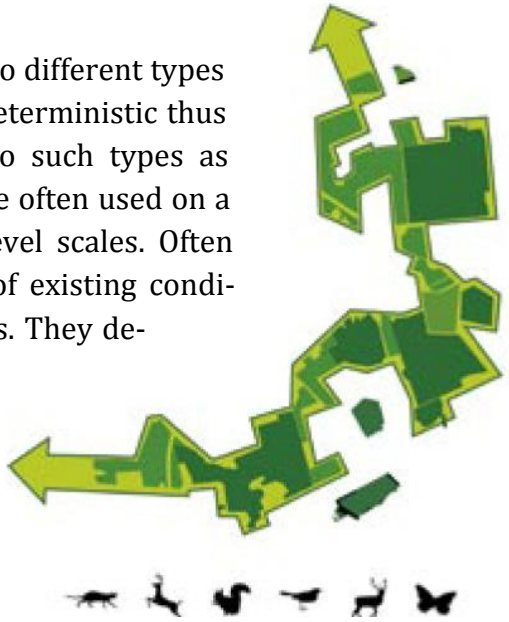


Figure 3
Nature concept diagram from the competition of Tankefuld-Svendborg (DK-2008)

opment in the outskirts of the Danish town of Svendborg. One of the winning entries[2] propose a corridor. The corridor constitutes a spine for recreational- and natural interests as well as a narrative of spatial cohesion. Despite having this role as narrative, the corridor thought can also be seen in regional- and municipal planning as area planning, you can be inside or outside of a proposed corridor-zone. Seen from a landscape ecological point of view, the idea of the corridor is however not the most effective tool for increasing biodiversity, although it is an easily understandable one. Forman, for instance, ranks it relatively low in his overall prioritisations. It does however depend on the level of landscape fragmentation. Specialised species in highly fragmented landscapes are more vulnerable to extinction. It is however important to remember that corridors are not necessarily the same as habitats.

The ***"problems of disorganized complexity"*** can be translated into a practice that relies on 'trial-and-error' design iterations, into evaluating the ecological properties of a design-intervention where a number of different landscape-elements can be viewed as 'a large number of variables'. The specific working with the probabilities can be tested in computer simulation models. This is an approach that goes into finer detail that then simple corridor-models of the *"problems of simplicity"*, since the virtual landscapes for instance of the ALMaSS-system[3] can work with resolutions as fine as 1x1 metres with 48 different landscape types. The system can to a high degree predict animal-movement and population-fluctuations. The main problem from a biodiversity point of view is however, that the diversity is difficult to measure. Forman points out, that diversity of species comes, first and foremost, from diversity of habitats, and the mere categorisation of landscapes is, in this regard counterproductive in principle. Furthermore, the simulation of animal movement means choosing specific species. It is possible to choose some generic species that on the scale level can be relevant to urban- and landscape design (small mammals like field voles for instance) but the inherit contradiction is still present. Compared to the *"problems of simplicity"*, working with *"problems of disorganized complexity"* can lead to much more detailed information on the performance of corridors and prediction of populations in testing of design proposals, but many of the same problems still remain when trying to measure 'performance' from a biodiversity point of view.

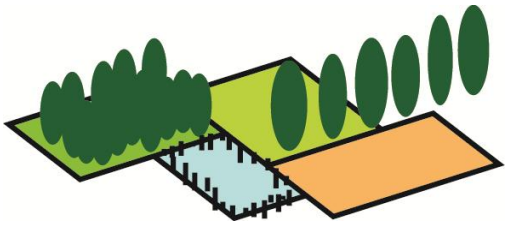
The **"problems of organized complexity"** are problems that can't be solved with probabilistic models, but still deals with a high number of variables. They can relate to specific design on a number of levels, so I will be going more into depth with this paragraph. Working with these 'problems' can be translated into a more holistic practice, where a large number of different landscape properties on different scale levels can be evaluated.

[2] made by a team consisting of NORD, Holscher Arkitekter, Arup Group & RTKL, 2008

[3] this refers to the 'Animal Landscape Man Simulation System' - an agent based simulation of the relation between landscape type and animals (Topping, 2003)developed by the Danish Centre for Environment and Energy

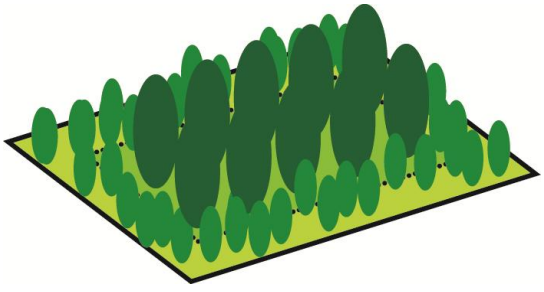
To work with a high number of variables without probabilistic models sets a demand for working with spatial strategies in order to navigate in such complex environments in a meaningful way. Richard Forman's prioritised list of biodiversity-promoting properties can be useful in this regard, and I will use them as examples:

1) **Habitat diversity** - Refers to the simple equation of different habitats -> different species. When working with this as a strategy, it is important to point out, that this does not only refer to the differentiation of landscape types, but also differentiation of sizes. Finely detailed landscapes with many niches has more specialised species of animals and plants than more monotonous landscapes where generalists are relatively more dominant. This can easily be translated into design guidelines with emphasis on multi-scalar approaches and a high degree of differentiation of landscape types across these different scale levels.



2) **(human) Disturbances** - Can refer to a number of different environmental factors. In the Danish context, the disturbance is first and foremost the massive influence of phosphates and nitrates from the use of fertilizers in industrial farming. This highly limits the differentiation of plant-species. The other factor is distance to daily human activities, noise etc. Larger mammals and some birds reacts negatively to this. From a design perspective, it may not be quite so obvious what there can be done to work with the (human) disturbances, but there are however a few things that can be done to remediate these challenges. The removal of top-soil or hay harvesting for a few years can lower nitrate- and phosphorous-levels. The disturbance by human activity/noise can to a smaller degree be influenced by working with different distances to settlements and path-layout.

3) **"Landscape patch" interior size** - Refers to the fact that some species specialize on living along the edge of landscape patches, and others may specialise on living in the interior of a patch[4]. This means, that elongated geometries, that have more a higher edge/area ratio, also have a relatively low interior size, and all others being equal, a lower po-

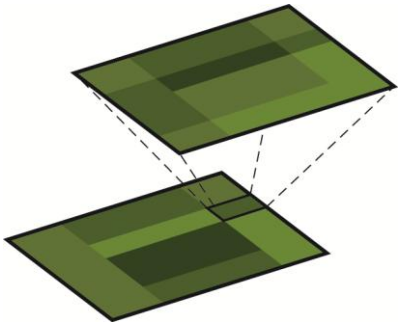


[4] Patch is defined as *"a relatively homogeneous nonlinear area that differs from its surroundings"* (Forman, 1995 p. 39)

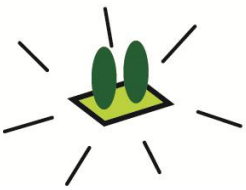
tential for biodiversity. Since this is a matter of simple geometry, it can easily be adapted in designs, but they have to be of a certain size to not only be edge. Forests, for instance, may have a thick edge (20-40 m) while meadows have a significantly narrower one.

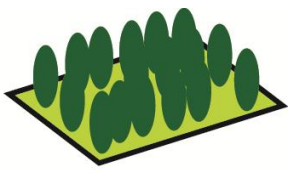
4) **Age** - is a self explanatory - the older the landscape, the more diverse the plant- and animal populations are. There is not much there can be done to plan for ageing of a landscape, there are however possibilities of staging a landscape of differentiated ages through consecutive plantings in a strategy to promote an acceleration of diverse plant communities thus avoiding pioneer species to dominate. This has for instance been promoted in different projects by James Corner like Downsview Park (Czerniak, 2001) and the New York Highline.

5) **matrix heterogeneity**[5] - this cryptic concept fers to the mechanisms that relate to the patterns of an overall landscape, and also the dominating land-use pattern of a larger area. Where the 1st priority of 'habitat diversity' states the obvious, the *matrix heterogeneity* puts an emphasis on the distribution of diversity. Having diverse habitats may be the first step but to go to the next level it may be necessary to ensure both distribution across an area, and working with microhabitats within larger landscape patches. The distinction in scale between patch and working with smaller habitats may be blurry, but the main point here is to ensure a distribution of variations across the whole of the field. This can in a design context relate to an issue of scale. Whereas a classic architectural 'masterpiece' often is seen as a 'gesamtkunstwerk', a successful landscape designed with biodiversity in mind, is one where interventions and variations are thought of across scale-levels into a coherent whole.



6) **Amount of isolation** - the more connected a landscape patch is, the higher the biodiversity potential is. This has to do with different aspects. The first is of course the initial spreading of species to a given landscape patch. The other is the fact that if a patch is too small, the population of a given species becomes more susceptible to





[5] matrix is defined as: *the background ecosystem or land-use type in a mosaic, characterized by extensive cover, high connectivity, and/or major control over dynamics."* (Forman, 1995 p. 39)

diseases and over a long enough course of time, it will be extinct. If the patch is not connected to adjacent patches, then the species will no longer be represented due to lack of remigration - contradictory to the 'older-is-better'- principle of number 4). The issue of connectivity and delayed extinction is a phenomenon that has particular relevance in countries with a high degree of area-usage and habitat-fragmentation ie. Denmark, Holland, northern Germany and southern Sweden. From a design point of view, this can be relevant on different occasions. First of all there is the 'corridor' design as mentioned before - respecting certain zones of interest for migration. The second one can be identifying landscape patches that are separated by urban development. Incorporating a corridor into this development could be a significant driver in securing the separate populations. This is however not a specific design-tool but more of an overall design strategy.

Choosing exactly these strategies from Forman is a choice based on the fact that he not only puts them side-by-side (as Agger et al., 1983 for instance) but ranks them on a prioritised list. This may be an extreme oversimplification of the field of landscape ecology, but it works as a starting point for addressing the issue as an urban designer.

What, when, how?

The main question now is of course - when is what relevant. To gather an initial overview, table 1 sums up the different properties, that are usually tied to the operations that are related to the different 'types of problems'.

Problems	**Subject & representation**	**Operation**	**Biodiversity-potential**
... of simplicity	Green corridors, zoning (ie. municipality plans)	Demarcation - the shaping of one variable	Low
... of disorganised complexity	Proposed design-interventions (ie. site-plan)	Shaping of many variables - testing designs in simulated environments	Medium[6]
... of organised complexity	Concepts, strategies and 'spatial policy' for a given area	Unlocking and evaluating the potentials through strategising	High

table 1

To sum it up and to answer the question put forward in the introduction, is it possible for architects and planners to work with biodiversity in a meaningful way, I argue that it most definitely is. The key is to know what you want to do and to know how to operate with different 'types of problems'. The first type of problems: *"problems of simplicity"* refers to a certain set

[6] I am aware of the contradiction of terms, when simulating a finite number of landscape types with a finite catalogue of animal models. The use of 'indicator-species' can however deliver a more relevant input to the design-process than working with corridors alone - thus the 'medium' biodiversity-potential

of operating environment. Working with the shaping of corridors and zoning-planning may be the viable solution in some cases, it is however not very effective in order to achieve the goal of a higher biodiversity. It may remedy architectural, political and/or narrative ambitions (ie. 'spines' and 'green wedges') and is of course much better than doing nothing. Working with the next type of problems: the *"problems of disorganized complexity"* can more easily be related to the practice of architects, since designs can be tested in a simplified simulation environment. From a biodiversity point of view, this work is however still restricted, although better from a biodiversity point of view, than working with *"problems of simplicity".* Finally, working with *"problems of disorganized complexity"* is the preferred work from a biodiversity point of view. This does however open up a diverse field of different- and sometimes even contradictory strategies that can be much more difficult to navigate in for the planner and the architect.

Conclusion

The discourse on biodiversity can, not unlike the discourse on climate change, sometimes be difficult to navigate in. Every action taken by humans leave a carbon footprint, and every clearing of forest lead to a decline of biodiversity. This fatalism may lead to apathy if concrete strategies are not being developed to act on the problems of our environment. At the same time it is important to know the tools, to know when they can be used, and to know how to prioritise the resources available. In this case - knowing how to prioritise different spatial strategies that can sometimes be overlapping or contradictory. In this paper I have tried to place fundamentally different ways of viewing the "problems" of biodiversity in their relation with one another. The reason for this has been to even be able to navigate as a designing architect and planner. It is the prerogative of the designer to look forward and bring new suggestions to the table. In the infinite complexity of landscape processes, it is important to be able to work on designs and spatial strategies at the same time thus viewing the subject of biodiversity as different "problems of complexity", otherwise the high potentials for biodiversity will never 'trickle down' to the actual plans and built landscapes. There is however still a need to be able to view the issue as a "problem of simplicity" simply because it is the way there is being planned within municipalities, and because the need for strong narratives should not be underestimated. It is my view, that the navigation between viewing the issue of biodiversity from different positions, and knowing how to prioritise the different elements of a design, is the main key to develop a truly successful biodiversity-driven urban design practice.

References:

Agger, Peder et. al. (Biotopgruppen) (1982) *Biotopmønstrets betydning for forekomsten af vilde dyr og planter: en ø-teoretisk synsvinkel.* Institut for Geografi, Samfundsanalyse og Datalogi, Roskilde Universitetscenter

Agger, Peder (2012) 'Naturens Værdi' in *Danmarks Natur frem mod 2020 - om at stoppe tabet af biologisk mangfoldighed*, Hans Meltofte (red.), Det Grønne Kontaktudvalg, København

Czerniak, Julia (ed.) (2001) 'CASE: Downsview Park Toronto', Prestel Verlag, New York

Fink, Hans (2003) 'Et Mangfoldigt Naturbegreb' in *Naturens værdi. Vinkler på danskernes forhold til naturen,* Peter Agger et al (red.), København

Forman, Richard T. T. (1995) *Land Mosaics - The Ecology of Landscapes and Regions,* Cambridge University Press, Boston

Hill, Kristina (2001) 'Urban Ecologies: Biodiversity and Urban Design' in *CASE: Downsview Park Toronto*, Julia Czerniak (ed.), Prestel Verlag, New York

Lister, Nina-Marie (2007) "Sustainable Large Parks: Ecological Design or Designer Ecology", in Julia Czerniak, *Large Parks*, Princeton Architectural Press, New York

McHarg, Ian (1992) [1967] *Design With Nature*, John Wiley & Sons, New York

Rockström, Johan et. al. (2009) 'A Safe Operating Space for Humanity' *in* Nature vol. 461 pp. 472-475

Tankeufld Competition (2008) - Jury-report, Danish Architectural Association, http://curis.ku.dk/ws/files/13924560/Dommerbet_svendborg_lav (acc. on 29/5-2012)

Topping, Christopher .J et al. (2003) "ALMaSS, an agent-based model for animals in temperate European landscapes", *in* Ecological Modelling, 167(1-2), p. 65-82

List of illustrations:

Figure 1 - biodiversities' dependencies on size - from Forman, 1995

Figure 2 - spatial parameters and biodiversity - from Agger, Peder et. al., 1982

Figure 3 - Concept diagramme from Tankefuld-Competition, 2008