# Bridging the ecologies of cities and of nature.

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*Abstract.*
*Cities are a type of socio-ecological system that has an expanding range of articulations with nature's ecologies. Today, most of these articulations produce environmental damage. The chapter examines how we can begin to use these articulations to produce positive outcomes – outcomes that allow cities to contribute to environmental sustainability. The complex systemic and multi-scalar capacities of cities are a massive potential for a broad range of positive articulations with nature's ecologies.*

## Introduction.

The massive processes of urbanization under way today are inevitably at the center of the environmental future. It is through cities and vast urban agglomerations that humankind is increasingly present in the planet and through which it mediates its relation to the various stocks and flows of environmental capital. The urban hinterland, once a mostly confined geographic zone, is today a global hinterland. With the expansion of the global economy we have raised our capacity to annex growing portions of the world to support a limited number of industries and places. Here I address the multi-scalar character of cities: the diverse terrains and domains, many non-urban, onto which they project their effects and from which they meet their needs. And I address their ecological character: the multiple mechanisms and feedback loops that articulate urban processes and their consequences, and, furthermore, the emergent articulations between these urban ecologies and nature's ecologies. The multiscalar and ecological features of key city processes need to become part of urban governance so that the process of governing cities becomes also part of the process for developing a more environmentally sustainable society.

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## THE NEED TO DISTINGUISH FORMAT FROM CONTENT

The enormously distinctive presence that is urbanization is directly and indirectly contributing to change a growing range of nature's ecologies, from the climate to species diversity and ocean purity. And it is leading to the formation of new environmental conditions -- heat islands, ozone holes, desertification, and water pollution. Urbanization and industrialization have made humankind the major consumer of all significant ecosystems. There is now a set of global ecological conditions never seen before.

Major cities have become distinct socio-ecological systems with planetary reach, going well beyond urban space. The needs of cities, and the profit logics of agribusiness, have altered traditional rural economies and their long-standing cultural adaptation to biological diversity. Rural populations have become consumers of goods, inlcuding food, produced in the industrial economy, one much less sensitive to biological diversity. The rural condition has evolved into a new system of social relations, one that does not work with biodiversity. These developments all signal that the urban condition is a major factor in any environmental future. It all amounts to a radical transformation in the relation between humankind and the rest of the planet.

But is it urbanization per se or the particular types of urban systems and industrial processes we have instituted? That is to say, is it the urban format marked by agglomeration and density dynamics, or the contents we have historically and collectively produced partly through a processes of path-dependence which kept eliminating options as we proceeded, and partly because of the profit logics of firms. Are these global ecological conditions the result of urban agglomeration and density or are they the result of the specific types of urban systems we have developed to handle transport, waste disposal, building, heating and cooling, food provision, and the industrial process through which we extract, grow, make, package, distribute, and dispose of all the foods, services and materials we use?

It is, doubtless, the latter –the specific urban systems we have made. One of the outstanding features when one examines a range of major cities today is their sharp differences in environmental sustainability. These differences result from diverse government policies, economic bases, cultures of daily life, and so on.[2] Here follow two examples from the US which show that ina country that is deeply anti-regulation and anti-government, good urban leadership can make an enormous difference.
The first case concerns a city in Texas and shows that against all odds, a determination to green a city can be developed and implemented. In 2000 Austin began to implement a Green Buildings Program that has now been recognized internationally as a model program. It is transforming the local building market by providing education, marketing and monetary incentives to develop both the demand side (the buying public) as well as the supply side (building professionals). The program is primarily funded and managed

[2] . For elaboration of a particularly strategic angle that cuts across all these sectors see Box 1, ***Ecological Economics***. This is a type of analysis that becomes particularly significant and useful for cities.

by the city's community-owned utility, Austin Energy. This community utility also develops renewable energy sources for the city—including 59 local wind-turbines, four landfill methane gas recovery projects and three solar energy sites providing over 153 kilowatts of energy. This case is quite remarkable for the US, a country that is deeply anti-government. What makes it even more extraordinary is that Austin is the only city run by a democratic party mayor in Texas, one of the most Republican, free-market, anti-government, anti-regulation states in the US. Having a community-owned energy organization is extraordinary for the US, and even more so under these conditions. It shows how a well-designed effort and determination can succeed even in the most inhospitable situation.

The second case concerns Chicago, with an economic history of vast heavy manufacturing, steel mills, agribusiness, the most important heavy transport center in the country. Today, and again, against all odds, Chicago is determined to establish itself as a premier environmental city, with the goal to get 20 percent of its energy from renewable sources within the next five years. This includes solar, wind, biomass, small hydropower, and tapping landfill gas. Chicago has planted thousands of trees over the last five years, created more than 100 miles of bike paths in the city, installed solar panels on city museums, and built a rooftop garden on City Hall. Chicago has passed legislation to reduce urban "heat island" effect by allowing only reflective roofs or living roofs covered with vegetation.

Across the differences of cities are a few foundational elements that dominate our way of doing things and which are at the heart of what we need to address. One of these is the fact that the entire energy and material flux through the human economy returns in altered form as pollution and waste to the ecosphere. The rupture at the heart of this set of flows is *made* and can, thus, be unmade –as the two examples from one of the most socially regressive countries in the world show. This rupture is present in just about all economic sectors, from urban to rural. But it is in cities where it takes on its most complex interactions and cumulative effects. This makes cities a source of most of the environmental damage, and some of the most intractable conditions feeding the damage. And yet, it is also the complexity of cities that is part of the solution. [3]

[3] That it is not urbanization per se that is damaging but the mode of urbanization also is signaled by the adoption of environmentally harmful production processes in rural economies. Until fifty years ago these had mostly environmentally sustainable economic practices, such as crop rotation, and did not use chemicals to fertilize and control insects. Further, our extreme capitalism has made the rural poor, especially in the Global South, so poor that for the first time many now are also engaging in environmentally destructive practices, notably practices leading to desertification.

**THE COMPLEXITY AND GLOBAL PROJECTION OF CITIES**.

The complexity and diversity of cities can help us engage the legal systems and profit logics that underlie and enable many of the environmentally damaging aspects of our societies. The question of urban sustainability cannot be reduced to modest interventions that leave these major systems untouched; further, the actual features of these systems vary across countries, and across cities within countries. While in some environmental domains (e.g. protecting the habitat of an endangered species) we can make considerable advances by acting simply on scientific knowledge, this is not the case when dealing with cities, or with society at large. Non-scientific elements are a crucial part of the picture: questions of power, poverty and inequality, ideology and cultural preferences, are all part of the question and the answer. Policy and proactive engagement are critical dimensions for environmental sustainability, whether they involve asking people to recylce garbage or demanding accountability from major global corporations known to have environmentally damaging production processes.

The spaces where damage is produced often differ from the sites where responsibility for the damage lies (such as the headquarters of mining corporations) and where accountability should be demanded. A crucial issue is the massive investment around the world promoting large projects that damage the environment. Deforestation, mining, and construction of large dams are perhaps among the best known cases. The scale and the increasingly global and private character of these investments suggest that citizens, governments, NGOs, all lack the power to alter these investment patterns. But particular kinds of cities, global cities, should actually be seen as structural platforms for acting and contesting these powerful corporate actors (Sassen 2005). A firm may have hundreds of mines across the world, but its headquarters might be in one or a few major cities.

The geography of economic globalization is strategic rather than all-encompassing and this is especially so when it comes to the managing, coordinating, servicing and financing of global economic operations. According to two major studies (MasterCard 2008; ATKearny 2008), about 75 cities worldwide contain just about all the headquarters of globally operating firms. The fact that it is strategic is significant for regulating and governing the global economy. There are sites –the network of global cities-- in this strategic geography where the density of economic transactions and top-level management functions come together and constitute a concentrated geography of global decision-making.

We can see this also as a strategic geography for demanding accountability from major corporate headquarters about environmental damage. It is precisely because the global economic system is characterized by enormous concentration of power in a limited number of large multinational corporations and global financial markets that makes for concentrated (rather than widely dispersed) sites for accountability and for changing investment criteria. Engaging the headquarters is actually easier than engaging the thousands of mines and factories in often remote and militarized sites, and the millions of service outlets of such global firms. Direct engagement with the headquarters of global

firms is today facilitated by the recognition, among consumers, politicians and the media, of an environmental crisis. The focus on individual cities promoted by notions of inter-city competition in a global corporate economy, has kept analysis and political leaders from understanding the extent to which the global economy needs networks of cities, not just one perfect global city. Thus specific networks of cities are natural platforms for cross-border city-alliances that can confront the demands of global firms. For sure, dealing with the headquarters of large firms leaves out millions of independent small local firms responsible for much environmental damage, but these are more likely to be controllable through national regulations and local activisms

**SCALING.**

These diverse issues can be conceived analytically as questions of scale. City-related ecological conditions operate at a diversity of geographic scales. Importantly, cities incorporate a range of scales at which a given ecological condition functions, and in that sense cities make legible the fact itself of scaling. For instance, the one asphalted street in a village and its few buildings with air conditioners produce some heat emissions; the thousands of such streets and buildings in a city produce new socio-ecological condition –heat islands. This, in turn, signals that cities make the multiscalar aspect of ecological systems recognizable to residents. This urban capacity to make legible should be developed and strengthened as it will become increasingly critical for policy matters concerning cities, as well as regions and beyond.

Scaling is one way of handling what are now often seen as either/or conditions: local vs. global, markets vs. non-market mechanisms, green vs. brown environmentalism. I have found some of the analytic work on scaling being done among ecologists very illuminating in the effort to conceptualize the city in this context. Of particular relevance is the notion that complex systems are multi-scalar systems as opposed to multilevel systems, and that the complexity resides precisely in the relations across scales. “When broad overarching events appear to be closely related to details, a system requires treatment as a complex system.” These authors find that tension among scales is a feature of complex ecological systems, a condition that would certainly seem to hold for cities. Understanding how tensions among scales might be operating in the context of the city strengthens the analysis of environmental damages associated with urbanization as well as ways in which cities are the source for solutions.

A crucial analytic operation involved here is giving spatio-temporal scaling to the object of study. This also entails distinguishing that object of study from contextual variables, which in the case of cities might be population, economic base, etc. Executing such analytic operations would help us avoid the fallacy of holding “the city” guilty of environmental damage. Eliminating cities would not necessarily solve the environmental crisis. We need to understand the functioning and the possibilities for changing specific systems of power, economic systems, transportation systems, and so on, which entail modes of resource use that are environmentally unsound. The fact that these various systems amalgamate in urban formations is an analytically distinct condition from the

systems involved. The distinction between specific systems and background or contextual variables also helps us avoid the fallacy of seeing "the city" as a container, and a bounded closed unit. In my research on cities and globalization, I instead conceptualize the city as a multiscalar system through which multiple highly specialized cross-border economic circuits circulate. This idea can be applied to cities and the environmental dynamic. In this case, the city is a multiscalar system through which multiple specific socio-ecological circuits traverse. It is not a closed system. Cities are amalgamations of multiple "damage" circuits, "restoration" circuits and policy circuits.

There are a set of specific issues raised by research on ecological systems that point to possibly fruitful analytic strategies to understand cities and urbanization processes both in terms of environmental conditions and in terms of policy. One of the reasons this may be helpful is that we are still struggling to understand and situate various types of environmental dynamics in the context of cities and how to engage policy. When it comes to remedial policy and clean-up there is greater clarity in understanding what needs to be done. But understanding the city as a broader system poses enormous difficulties precisely because of the multiple scales that are constitutive of the city, both as a system of distributed capabilities and as a political-economic and juridical-administrative system. That is to say, the individual household or firm or government office can recycle waste but cannot address effectively the broader issue of excess consumption of scarce resources; the international agreement can call for global level measures to reduce greenhouse emissions but depends on individual countries and individual cities and individual households and firms to implement many of the necessary steps; and the national government can mandate environmental standards but it depends on systems of economic power and systems of wealth production. [4]

A key analytic step is to decide which of the many scaled ecological, social, economic, policy processes are needed to explain a specific environmental condition (whether negative or positive) and design a specific action or response. Another analytic step is to factor in the temporal scales or frames of various urban conditions and dynamics: cycles of the built environment, of the economy, the life of infrastructures and of certain types of investment instruments. The combination of these two steps helps us deconstruct a given situation and to locate its constitutive conditions in a broader grid of spatial, temporal, and administrative scales.

The connection between spatial and temporal scales evident in ecological processes may prove analytically useful to approach some of these questions in the case of cities. What may be found to be negative at a small spatial scale, or a short-time frame, may emerge as positive at a larger scale or longer time frame. For a given set of disturbances, different

[4] Some kinds of international agreements are crucial –for instance, when they set enforceable limits on each national society's consumption of scarce resources and their use of the rest of the world as a global sink for their wastes. Other such agreements I find problematic, notably the market for carbon trades which has negative incentives: firms need not change their practices insofar as they can pay others to take on their pollution. At the limit , there is no absolute reduction in pollution.

spatio-temporal scales may elicit different responses from ecosystems. Using an illustration from ecology, we can say that individual forest plots might come and go but the forest cover of a region overall can remain relatively constant. This raises a question as to whether a city needs a larger system in place that can neutralize the impact on the overall city system of major disturbances inside the city. One outcome of the research by ecologists in this domain is that movement across scales brings about change which is the dominant process: it is not only a question of bigger or smaller, but rather that the phenomenon itself changes. Unstable systems come to be seen as stable; bottom-up control turns into top-down control; competition becomes less important. This also is suggestive for thinking about cities as the solution to many types of environmental damage: what are the scales at which we can understand the city as contributing solutions to the environmental crisis.

An important issue raised by scaling in ecological research is the frequent confusion between levels and scales: what is sometimes presented as a change of scales is actually a translation between levels. A change of scale results in new interactions and relationships, often a different organization. Level, on the other hand, is a relative position in a hierarchically organized system. Thus a change in levels entails a change in a quantity or size rather than the forming of a different entity. A level of organization is not a scale, even if it can have scale or be at a scale. Scale and level are two different dimensions.

Relating some of these analytic distinctions to the case of cities suggests that one way of thinking of the city as multi-scalar is to note that some of its features, notably density, alter the nature of an event. The individual occurrence(e.g. a high-risebuilding) is distinct from the aggregate outcome (density). It is not merely a sum of the individual occurrences, i.e. a greater quantity of occurrences. It is a different event. The city contains both, and in that regard can be described as instantiating a broad range of environmental damage that may involve very different scales and origins yet get constituted in urban terms: $CO_2$ emissions produced by the micro-scale of vehicles and coal burning by individual households becomes massive air pollution covering the whole city with effects that go beyond $CO_2$ emission per se. Air and water borne microbes materialize as diseases at the scale of the household and the individual body and become epidemics thriving on the multiplier effects of urban density and capable of destabilizing operations of firms whose machines have no intrinsic susceptibility to the disease.
A second way in which the city is multiscalar is in the geography of the environmental damages it produces. Some of it is atmospheric, some of it internal to the built environment of the city, as might be the case with much sewage or disease, and some of it in distant locations around the globe, as with deforestation. The case of ozone holes is one of the most serious instances of scale-up: the damage is produced at the microlevel of cars, households, factories, buildings, but its full impact becomes visible/measurable over the poles, where there are no cars and buildings.

A third way in which the city can be seen as multiscalar is that its demand for resources can entail a geography of extraction and processing that spans the globe, though it does so in the form of a collection of confined individual sites, albeit sites distributed

worldwide. This worldwide geography of extraction instantiates in particular and specific forms (e.g. furniture, jewelry, machinery, fuel) inside the city. The city is one moment—the strategic moment—in this global geography of extraction, and it is different from that geography itself. And a fourth way in which the city is multiscalar is that it instantiates a variety of policy levels. It is one of the key sites where a very broad range of policies—supranational, national, regional and local—materialize in specific procedures, regulations, penalties, forms of compliance and types of violations. These specific outcomes are different from the actual policies as they get designed and implemented at other levels of government.

Important also is the need to factor in the possibility of conflicts in and between spatial scales. Environmentalists can operate at broad spatial and temporal scales, observing the effects of local activities on macro-level conditions such as global warming, acid rain formation and global despoliation of the resource base. Environmentalists with a managerial approach often have to operate at very short time frames and confined levels of operation, pursuing clean ups and remedial measures for a particular locality, remedial measures that may do little to affect the broader condition involved and may, indeed, diminish the sense of urgency about larger issues of resource consumption and thereby delay much needed responses. On the other hand, economists or firms, will tend to emphasize maximizing returns on a particular site over a specific period of time.

## CONCLUSION:
## URBAN ECO-GOVERNANCE.

The city is today a strategic space for the direct and often brutal encounter between forces enormously destructive *of* the environment and increasingly acute needs *for* environmental viability. Much of what we keep describing as global environmental challenges becomes concrete and urgent in cities. This points to two critical dimensions. One is that urban governance must aim at corresponding with the development of environmentally sustainable urbanization. Secondly, this correspondence should, in turn, maximize recognition of the multiple ecologies in, respectively, cities and nature. Each point in these ecologies should be a bridge articulating the city and the environment.

Diverse empirical conditions both push towards and enable this complex articulation between urban and nature's ecologies. For instance, most international and national environmental standards will also have to be implemented and enforced in cities, besides national and international levels. This is partly because cities incorporate a large share of all environmentally destructive processes, including many that are not exclusively urban, and partly because the multi-scalar character of cities entails incorporation of national and global processes. The obverse of this specificity is that each city's mix of elements has a certain particularity – as does its mode of insertion within local and regional ecosystems. Out of this particularity comes place-based knowledge, which can then be scaled-up and contribute to the understanding of national and global conditions.

All of this matters because it is now urgent to make cities and urbanization part of the solution: we need to use and build upon those features of cities that can re-orient the material and organizational ecologies of cities towards positive interactions with nature's ecologies. These interactions, and the diversity of domains they cover, are themselves an emergent socio-ecological system that bridges the city's and nature's ecologies. Part of the effort is to maximize the chances that it has positive environmental outcomes. Specific features of cities that help are economies of scale, density and the associated potential for greater efficiency in resource use, and, important but often neglected, dense networks of communication that can serve as facilitators to institute environmentally sound practices in cities. More analytically, insofar as cities are constituted through various processes that produce space, time, place and nature, cities also contain the transformative possibilities embedded in these same processes. For example, the temporal dimension becomes critical in environmentally sound initiatives: thus ecological economics helps us recognize the efficient and value-adding character of the longer temporal frames of environmentally sound criteria. Conventional market criteria, with their increasingly shorter temporal evaluation frames, might characterize much of this as inefficient or value-losing.

Cities have long been sites for innovation and for developing and instituting complex physical and organizational systems. Up till now many of these systems have been driven by narrow market criteria and coporate profit logics. Here we need to return to the distinction between format and content: it is now time to develop and implement complexsystems that address our environmental challenges. It is within the complexity of the city that we can find solutions to at least some of the environmental damage and that we can find some of the key formulas for reconfiguring the socio-ecological system that is urbanization. Cities also contain the networks and information loops that may facilitate communicating, informing, and persuading households, governments, and firms to support and participate in environmentally sensitive programs and in radically transformative institution building.

A city is a microcosm of the complex mix of variables we need to factor into our programs of change. Urban systems entail systems of social relations that support the current politico-economic organization, systems which we will have to dismantle partly, or dully in some cases. Cities are complex systems in their geographies of consumption and of waste-production and this complexity also makes them crucial to the production of solutions. Some of the geographies for sound environmental action in cities will also operate worldwide. The network of global cities described earlier becomes a space at the global scale for the management of investments but also potentially for the re-engineering of environmentally destructive global capital investments into more responsible investments. It contains the sites of power of some of the most destructive actors but potentially also the sites for demanding accountability of these actors. The scale of the network is different from the scale of the individual cities constituting this network.The circular logic environmentalists want to introduce in the functioning of cities, i.e. maximum re-use of outputs to minimize waste, will entail spatial circuits that operate at different scales. Some will be internal to households, others will be city wide and yet others will go beyond the city and run through places around the globe.

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