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.

1 THE NEED TO DISTINGUISH FORMAT FROM CONTENT

The enormously distinctive presence that is urbanization is changing a growing range of nature's ecologies, from the climate to species diversity and ocean purity. And it is creating new environmental conditions -- heat islands, ozone holes, desertification, and water pollution. We have entered a new phase: for the first time humankind is the major consumer in all the significant ecosystems. And urbanization has been a major instrument. There is now a set of global ecological conditions never seen before. And major cities have become distinct socio-ecological systems with planetary reach. Cities have a pronounced effect on traditional rural economies and their long-standing cultural adaptation to biological diversity. Rural populations have become consumers of products 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. 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 develop 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.[1] Across all these differences are a few foundational elements that now increasingly dominate our way of doing things. 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 –and some cities are working on this. This rupture is present in just about all economic sectors, from urban to non-urban. 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. But it is also the complexity of cities that is part of the solution. [2]

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 theoretically, one can say that in so far 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 allows us to recognize that what is inefficient or value-losing according to market criteria with short temporal evaluation frames, can be positive and value-adding using environment driven criteria.

2 THE COMPLEXITY AND GLOBAL PROJECTION OF CITIES.

As has been much documented, cities have long been sites for innovation and for developing and instituting complex physical and organizational systems. It is within the complexity of the city that we must find the solutions to much environmental damage and the formulas for reconfiguring the socio-ecological system that is urbanization. Cities 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.

Urban systems also entail systems of social relations that support the current configuration. Beyond adoption of practices such as waste recycling, it will take a change in this system of social relations itself to achieve greater environmental sensitivity and efficiency. For instance, a crucial issue is the massive investment around the world promoting large projects that damage the environment. Deforestation 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 investments patterns. But there are today structural platforms for acting and contesting these powerful corporate actors (Sassen 2005). 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. The fact that it is strategic is significant for a discussion about the possibilities of regulating and governing the global economy. There are sites –the network of global cities--

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[1] . 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.

[2] 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 by pre-modern rural societies. Until recently these had environmentally sustainable economic practices, such as crop rotation and no use of 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.

in this strategic geography where the density of economic transactions and top-level management functions come together and represent a strategic geography of decision-making. We can see this also as a strategic geography for demanding accountability 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 a very different type of action from engaging the thousands of mines and factories, and the millions of service outlets of such global firms. This engagement is today facilitated by the recognition, among consumers, politicians and the media, of an environmental crisis. For sure, it leaves out millions of small local firms responsible for much environmental damage, but these are more likely to be controllable through national regulations and local activisms.

A crucial issue raised by all the above is the question of the scales at which damage is produced and intervention or change should occur. These may in turn differ from the levels and sites for responsibility and accountability. The city is, in this regard, an enormously complex entity. Cities are multi-scalar systems where many of the environmental dynamics that concern us are constituted and in turn constitute what we call the city, and where different policy levels, from the supra- to the sub-national, get implemented. Further, specific networks of mostly global cities, also constitute a key component of the global scale and hence can be thought of as a network of sites for accountability of global economic actors.

Urban complexity and diversity are further augmented by the fact that urban sustainability requires engaging 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. And the actual features of these systems vary across countries and across the North-South divide. While in some of the other environmental domains it is indeed possible to confine the treatment of the subject to scientific knowledge, this is not the case when dealing with cities. Non-scientific elements are a crucial part of the picture: questions of power, of poverty and inequality, ideology and cultural preferences, are all part of the question and the answer. One major dynamic of the current era is globalization and the spread of markets to more and more institutional realms. Questions of policy and proactive engagement possibilities are a critical dimension of treatments of urban sustainability, whether they involve asking people to support garbage recycling or demanding accountability from major global corporations known to have environmentally damaging production processes.

3 SCALING

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 visible the fact itself of scaling. Further, cities make the multiscalar property of ecological systems present and recognizable to its residents. This urban capacity to make visible should be developed and strengthened as it will become increasingly critical for policy matters not only of cities, but also at the regional, national and global level. For the majority of those writing about environmental regulation in and of cities, the strategic scale is the local one (Habitat II; Local Agenda 21). Others have long argued that the ecological regulation of cities can no longer be separated from wider questions of global governance (Low, 2000); this is also a long-standing position in general, non-urban, analyses about the "economy and the environment" (e.g. Etsy (1998; 1999).

Beyond regulation, the city is a also key scale for implementing a broad range of environmentally-sound policies and also a site for struggles over environmental quality of life for different socio-economic classes. Air, noise, and water pollution can all be partly addressed inside the city, even when the policies involved may originate at the national or regional level. And indeed thousands of cities worldwide have initiated their own de fact environmental policies to the point of going against national law, not because of ideals but because they had to, in a way that national governments are far more removed from the immediate catastrophic potentials of poisoned air and floods. The acuteness of environmental challenges at the urban level has been further sharpened by the current phase of economic globalization which puts direct pressures on cities. One example of these pressures is the global corporate demand for the extreme type of built-environment epitomized by Dubai. The other side of this is the sharply increased demand for inputs, transport and the infrastructure for mobility: the enormous demand for wood, cement, non-renewable energy,

airflight, trucking, shipping, and so on. A second element that the current global corporate economy has brought with it is the World Trade Organization's subordination of environmental standards to what are presented as "requisites" for "free" global trade. Finally, privatization and deregulation reduce the role of government, especially at the national level, and hence weaken its mandatory powers regarding environmental standards.

The city becomes a strategic space for the direct and 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. International and national standards are likely to have to be implemented and enforced at the urban scale.3 There are limits to the urban level, especially in the Global South where local governments have limited funds. But it is one of the scales at which many concrete goals can be achieved. Local authorities are in a strong position to pursue the goals of sustainable development as direct or indirect providers of services, as regulators, leaders, partners, and as mobilizers of community resources.4 Each urban combination of elements is unique, and so is its mode of insertion within local and regional ecosystems. Out of this specificity comes place-based knowledge, which can the be scaled-up and contribute to the understanding of global conditions. The case of ozone holes illustrates this 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 debate that gathered heat beginning in the 1990s and remains unresolved pits the global against the local as the most strategic scale for action. Redclift (1996) argued that we cannot manage the environment at the global level. Global problems are caused by the aggregation of production and consumption, much of it concentrated within the world's urban centers. For Redclif first we need to achieve sustainability at the local level; he argues that the flurry of international agreements and agencies are international structures for managing the environment that bear little or no relation to the processes through which the environment is being transformed. Not everyone agrees. Thus Satterthwaite has long argued that we need global responsibilities and cannot do that without international agreements (Satterthwaite 1999). And Low (2000) adds that we have a global system of corporate relations of which city administrations are increasingly part. This complex cross-border system is increasingly responsible for the health and destruction of the planet. Today's processes of development bring into focus the question of environmental justice at the global level, a question that , if asked, would have been at the national level in the early industrial era.

I would make two observations here. One is that what we refer to or think of as the local level may actually entail more than one scale. For instance, the operations of a mining or manufacturing multinational corporation involve multiple localities, scattered around the globe. Yet these localities are integrated at some higher organizational level into what then reemerges as a global scale of operations. Much clean-up and preventive action will indeed have to engage each locally produced set of damages. But the global organizational structure of the corporation involved needs to be engaged as well. Along these same lines, 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 that global economy needs networks of cities, not just one perfect global city. Hence, specific networks of cities are natural platforms for cross-border city-alliances that can confront the demands of global firms. One key benefit for cities of international agreements is to prevent some countries and cities from taking advantage of others that are instituting environmentally sound policies. Implementing such policies is likely to raise costs, at least for the short term thereby possibly reducing the "competitiveness" of such cities and countries, even if in the long

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3 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.

4 For instance, instituting a sustainable consumption logic can be aided by zoning and subdivision, regulations, building codes, planning for transport, for water and waste, recreation and urban expansion, local revenue raising (environmental taxes, charges, levies) and through the introduction of environmental considerations when designing budgets, purchases, contracting and bidding (see Satterthwaite's and other researchers' work on the IIED website for one of the most detailed and global data sets on these issues).

term this is likely to enhance their competitiveness. Cities that succeed in instituting such policies should not carry the costs of the absence of such policies in other cities, whether at the national or international level. This will at times require policies that restrain the transfer of environmental costs to other locations. 5

The second observation is that an enormous share of the attention in the literature on urban sustainability has been on how people as consumers and as household-level actors damage the environment. When measuring cities, inevitably individuals and households are by far the most numerous units of analysis. Yet there are clearly shortcomings to this focus. In terms of policy it leads to an emphasis on household recycling activities without addressing the fundamental issue of how an economic system prices modes of production that are not environmentally sound. In this regard, an urban focus can easily leave out global economic and ecological systems that are deeply involved yet cannot be addressed at the level of households or even many individual firms. For instance, those who insist that greenhouse gas emissions will have to be controlled at the local level are, in many ways right. But these emissions will also have to be addressed at the broader macro levels of our economic systems.

4 CONCLUSION:
TOWARDS A MULTI-SCALAR ECOLOGICAL URBAN ANALYSIS

These various questions can be analytically conceived of as questions of scale. Scaling can be seen as 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 might strengthen the analysis of environmental damages associated with urbanization, and the ways in which cities are also the source for solutions. "Until ecologists become adept at addressing the scale issue, the discipline will remain stuck in detailed descriptions at one level. Trying to deal with everything at one level, on the other hand, is unwieldy and messy". One could clearly make a parallel argument for the case of cities, particularly in the insistence on emphasizing the local scale for research and implementation.

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

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5 For instance, the vast fires to clear big tracts of the Indonesian forests in order to develop commercial agriculture (in this case, palm oil plantations geared to the world market) have regularly produced thick smoke carpets over Singapore, a city-state that has implemented very stringent air pollution controls at often high tax costs to its inhabitants and firms.

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. 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 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 is distinct from the aggregate outcome; 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.

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.

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 in the preceding section 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.

All of the above brings out the multiple ways in which the city scale is present. The city is a multi-scalar system in the double sense of what instantiates there and of the different policy frameworks that operate in cities—national, supranational, sub-national. 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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