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Introduction to the AGS Urban Futures initiative

An ecologists view on urban complexity

The population shift facing the world is an epoch-making process. Today, around half of the world's population lives in urban areas. By the year 2050, the proportion in urban regions is expected to grow to 70%, and the total urban population will have doubled. Cities will grow in size and number. Is this level of growth a recipe for chaos or our best hope for achieving global sustainability?

It is clear that no one scientific discipline has all the answers, but that the viewpoints of different disciplines must be combined. I am an ecologist, and ecologists analyse the urban environment as an ecosystem. Two characteristics of ecosystems are nutrient cycling and the influence of infectious diseases, and these examples illustrate how ecological ideas can contribute to understanding and meeting the challenge of urban population growth.

Most natural ecosystems are characterised by a closed nutrient cycle, in which the nutrients that plants and animals need are recycled within the system and only very small amounts are lost into other systems. Natural ecosystems that are dependent on external inputs and lose alot of nutrients to other ecosystems are generally instable - and therefore are not sustainable. Cities are characterized by such largely open nutrient cycles–they are dependant on large inputs of food from distant areas and dispose of large quantities of waste into surrounding areas. This huge quantity of nutrients being taken out of agricultural areas, transported to cities, and then rapidly transferred to the sea, is leading to severe environmental problems. For example, off the coasts of urban areas around the world, the oxygen depletion and eutrophication caused by these nutrients lead to marine dead zones[1]. Meeting the challenge of how to close the nutrient cycles of cities will require an ecological understanding.

Another important ecological consideration is the threat of infectious diseases. Cities have an enormous impact on the epidemiology of human diseases. Highly contagious diseases require large, dense populations of hosts to continue to exist in their virulent form. In small populations, individuals either die or develop immunity, and eventually the virulent form of the disease disappears. In large, dense, mobile populations, the rates of immigration and births ensure that there are always susceptible people to act as reservoirs. For example, a study of measles in the UK shows how outbreaks of infection spread from cities into rural areas, then disappear[2]. Until the next outbreak, the disease can only persist in cities with populations above 200 to 500 thousand. Without the high population density of cities, some diseases would not exist.

A number of further ecological characteristics make cities places where established diseases can evolve, and new diseases emerge. These include close contact of humans with animals and animal diseases in peri-urban areas, reduced natural control of disease vectors such as mosquitoes or rats in the

[1] Mee, L. (2006) Reviving dead zones. Scientific American 295(5): 78-85.

[2] Grenfell, B.T., Bjørnstad, O.N. and Kappey, J. (2004) Travelling waves and spatial hierarchies in measles epidemics. Nature 414: 716-723.

highly simplified ecological communities in the urban environment, and high human mobility that brings together new genetic information to which diseases adapt. As urban populations grow, infectious diseases will continue to provide us with new challenges.

To conclude, if science is to tackle the complexity of cities, we need intensive interdisciplinary and transdisciplinary discussion. The growth of cities presents many problems, none of which is the domain of any one discipline. We will need close cooperation between a wide range of disciplines. The research and discussions presented at the AGS Urban Futures seminar highlight examples of how this has been done.