1

Regions and land mosaics

Imagine a group of rhinos rampaging through a restaurant, while we concentrate on adjusting the napkins, filling a glass, and brushing up some crumbs. So it seems on land, we focus on our house lots, our housing developments, sometimes our towns, while giant forces are degrading, even transforming, our valuable land. These are new giants, unseen in history. We notice their fingers, an ear, a heel, but rarely see them. Who are they? What's happening to the land? Should we keep fixing the little pieces and hand our land to the giants? Or could we raise our vision . . . and do something?

This leadoff chapter provides a set of unusual regional and land lenses through which to view urban regions, a key analytic foundation for later chapters. Chapters 2 to 4 add the other major foundations: land planning, socio-economics, and natural systems. The resulting synthesis uses three motifs: (1) urban regions; (2) natural systems; and (3) human uses of nature, to open windows and to pinpoint ecological and planning insights ready for use.

A framework

As a student and insatiable traveler, my idealism colored problems and offered ready solutions. But also as a budding scientist I learned to look more deeply, analyze the internal elements of a problem, and try to expunge opinions from my science. Generally, problems were narrow, at my scale of vision. Those were exciting times.

Big pictures were all around, but as solvable problems I missed them. Big wars were leaving scarred lands and people. Waterways were heavily polluted. Traffic and accidents grew. Road building accelerated through the terrain. Distinctive spread-out suburbs were just appearing. Many national populations

were growing at 3 % per year, doubling in a bare 23 years. Now, a generation or two later, most land problems seem much bigger and also widely recognized (McNeill 2000). Yet hardly anyone seems to have a real solution.

In spots, problems have been solved. Many waterways are cleaner but others dirtier. Some war-torn areas have partly healed, while new ones have appeared. Some population growth rates have dropped, yet the total population and its proportion of pre-reproductive people remain high. Road building has decreased here and increased there. New big problems have emerged. Megacities have mushroomed. Rapidly growing poor areas mark most cities around the globe. Sprawl has blanketed some valuable land areas. Freshwater has become scarce and expensive over large areas. Topsoil for food production has thinned with wind and water erosion.

So what can be done? The so-called "paradox of management" is useful. Focus on a solution that is big enough to have some chance of continued success, and small enough that your efforts are visible (Forman 1995, Seddon 1997). For instance, it is hard to have an effect on the globe which is likely to muddle along in similar form, no matter what you do. But also, whereas it is easy to affect your garden, over decades, the plants there are likely to fluctuate widely, never reaching any semi-stable sustainable state. So, to solve big problems, address the middle spatial scales such as landscapes and regions, which are most promising for combining the visible effects of your effort and a reasonable chance of success.

Or, to solve big problems, break them into parts, and address enough to tip the balance toward solution (Gladwell 2000). Or establish a promising trend, and wait (Ozawa 2004). Or do not wait; keep adaptively adjusting the trajectory. In all the cases, of course, a key first step is to recognize big problems as tractable, rather than hopeless or too complex.

Urban regions have half the world's population, three billion people. Consider some big problems at the urban-region scale such as megacities, rapidly growing poor areas, and outward urbanization (*State of the World's Cities* 2006). Then add overwhelmed sewage wastewater systems, threatened water supplies, public health, traffic jams, and growing urban air pollution. Worldwide all of these patterns are worsening. Yet a city's urban region is a useful scale for addressing such problems and offering solutions that last.

What does the future promise? No one knows, but, according to the United Nations Population Division, population trends point to nearly 200 000 people added daily to the urban population (70 million people per year). In the onrushing year 2030 (hopefully both author and reader will be here then), some five billion people, about 60 % of the world's population, are expected to live in urban areas. So, today's urban problems are big. How about tomorrow?

Figure 1.1 "Natural" disaster. In this area earthquakes are natural and frequent, while the "disaster" resulted from a bridge in this location which was unable to withstand the earthquake. Gavin Canyon, Los Angeles County, California; earthquake 6.8 on Richter scale. The absence of housing on these slopes near Los Angeles prevented worse effects. Photo courtesy of US Federal Highway Administration.

City populations grow over time as a consequence of births and immigration exceeding deaths and emigration. Economic fluctuations may especially affect immigration and emigration rates, producing short-term population rises and drops. Urban population drops, usually short term, may also result from human conflict (Leningrad, 1930s; Hiroshima, 1940s; Bujumbura, Burundi, 1970s–80s) or so-called "natural" disasters (Kobe, Japan earthquake, 1990s; Aceh, Indonesia tsunami, 2000s; New Orleans, USA hurricane, 2000s) (Figure 1.1). Still, cities usually grow in population, today commonly at a 3–5 % annual growth rate, with some sections or municipalities growing at 5–10 % annually. With cities as the major central portion of urban regions, many of these trends also apply widely to urban regions.

Consider the land surface of the urban region. Land is home and heritage, and therefore a source of sustenance and inspiration to be cared for. Land is also capital and investment to be bought, used, and sold. Furthermore, nature depends on land, and we depend on nature. Yet curiously, "We're wasting land!" (Josep Acebillo, Chief Architect for the Mayor of Barcelona, 2000), particularly in the urban region.

So, focusing the lens on patterns and processes within an urban region reveals a dynamic mosaic of people and nature (Forman 2004a). Nature varies from some relatively large natural pieces to many highly degraded pieces. Society is arranged in a single huge central aggregation plus numerous dispersed places. The region works as a system, with flows and movements across the mosaic. Also, the great mosaic changes over time, especially as human pieces expand and natural pieces shrink. This leaves nature further degraded, and the fundamental human dependence on nature's resources riskier, less sustainable. Plato even described what his ancestors did to Greece, leaving him only a late stage of this process, a skeleton of the once-rich land and water.

Nature's flows and movements across the land are particularly important in the urban region, partly because they are so buffeted by human activities. Surfacewater flowing in streams and rivers supports many human needs, from clean drinking water to recreation, wastewater treatment, and aesthetics. Groundwater flows create "underground reservoirs" that support wells, agriculture, and diverse natural plant communities. Wildlife disperses and migrates across the land, a key value for recreation and even human culture. In effect, important natural flows inexorably permeate the region.

Meanwhile urbanization spreads across the same region. Traffic jams increase. Energy efficiency drops, leaving less-sustainable built areas. Clean unpolluted water becomes scarce and expensive. Highways form barriers that subdivide the remnants of nature. Appealing recreational and tourism sites degrade. Hard surfaces spread and flood pulses get worse. Productive agriculture and family farms shrink. Forestry withers. Biodiversity is threatened and erodes. All so familiar.

People of the region, long dependent on the local resources and benefits of natural systems, must increasingly depend on more distant, more expensive resources. Concurrently the value of natural systems drops, as nature-dependent aesthetics, inspiration, ethics, and resources for future generations erode. This disconnect between nature's fundamental patterns and processes and current development trends could lead to crises, forcing prompt costly actions. Irrespective, it calls for new thinking or vision, with the core objective to mesh nature and people so they both thrive (Forman 2004a).

Usually it costs money to do something. Yet also it is costly, and penalizes both citizens and nature, to do nothing. Solutions to quickly address crises

are normally expensive. To gradually address a legacy of cumulative impacts or accomplish a major new initiative, solutions are costly, but spread out over time. Finally some solutions cost little to provide significant benefits. Planning that heads off crises or creates positive legacies for a region is good economics.

Economic gains also can be expected from many solutions involving natural systems. Consider: (a) maintaining diverse productive agricultural landscapes on the best soils; (b) concentrating rather than dispersing growth to reduce infrastructure and servicing costs; (c) investing in key areas for nature protection and nature-based tourism; (d) rethinking floodplain design to reduce flood-damage costs; and (e) targeting a handful of pollution sources, plus creating stormwater wetlands, to increase a scarce supply of costly clean water. Such investments in natural systems pay dividends.

Social patterns and municipalities are equally central to planning and natural systems. Towns whose edges have light and medium industry tend to have both nearby jobs and fewer traffic problems and costs. Towns whose edges have parks with nature and recreation may have nearby stable appealing neighborhoods. Housing that is relatively concentrated rather than dispersed, has a much lower impact on natural systems. Strategically focusing population growth and urbanization in areas of low ecological value enhances the regional natural-systems' value. Creating a convenient efficient large-industry center or a truck-transportation center in such a location does too.

These many benefits to both society and natural systems are explored in the pages ahead. Such benefits emphasize that, rather than overwhelmingly concentrating on the traditional socioeconomic aspects of public transit, highways, housing, employment, urbanization, and economic development, which often can be provided in many places across the region, we should begin with best uses for the fundamental distinctive and somewhat fixed land resources for the future of a region. The many specific socio-economic aspects, of course, are also critical and likely to be addressed in most regularly updated planning. Plans for specific issues as well as specific areas can be readily meshed spatially with the land-use frameworks presented in the chapters ahead.

Also by focusing on land use, rather than regulatory and legal approaches that can change "overnight," the approach helps provide a solid long-term future for a region. Political leaders with foresight, along with planners, engineers, economists, ecologists, and others who can think big, collaborate, and effectively mesh regional land uses, can accomplish a vision. They hold and will mold the future of a region in their hands.

Urban planning often highlights the quality of people's life and promotes intelligent growth (Fainstein and Campbell 1996, Hall 2002), whereas conservation planning highlights the natural systems and nature on which people

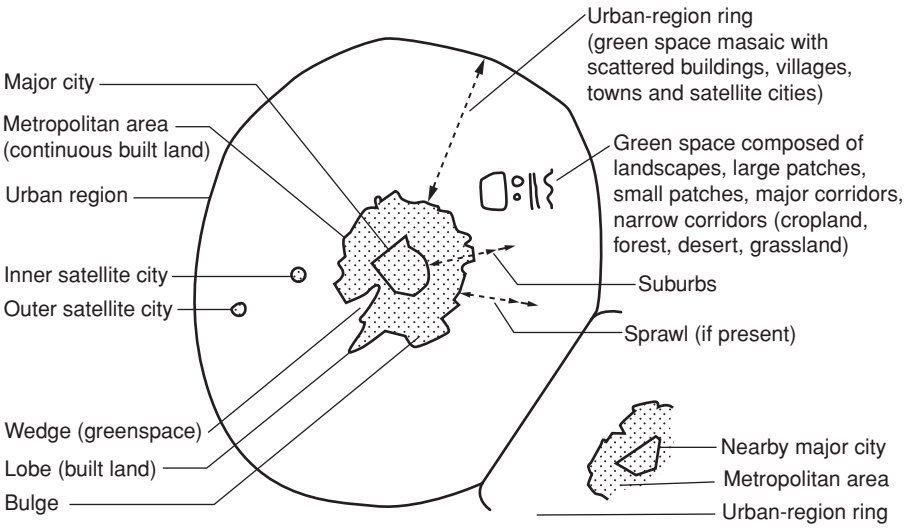

Figure 1.2 Concepts and terms for urban regions.

live and depend (Noss and Cooperider 1994, Dale and Haeubner 2001, Marsh 2005). No models were found that provide for sustained viable natural resources and nature around cities. Clearly a new strategic approach is needed to mesh both halves, people and Nature, and create a whole.

Terms and concepts to reveal urban regions

Concepts are usefully grouped into three clusters: (1) urban region and its built areas; (2) greenspaces and natural systems; and (3) urbanization.

Urban region and its built areas

A *city* is a relatively large or important municipality. Cities analyzed in this work range from just over 250 000 to over 10 million population, though the basic city concept includes smaller important population centers, even down to 10 000 in the Amazon Basin (Browder and Godfrey 1997). The *urban region* is the area of active interactions between a city and its surroundings (Figure 1.2). Thus the outer boundary of an urban region is determined by a drop in rate of flows and movements as one proceeds outward from the city.

From the eye of a satellite, the boundary delineating a city is normally invisible. Instead the *metropolitan area*, or *metro area*, the nearly continuously built, or all-built, area of the city and adjoining suburbs, is prominent as a visible object. Here, the metro area is not defined as a "commuter-shed," as in the USA (Office of Management and Budget 2000), since extensive commuting beyond the

built metro area is limited in most cities worldwide. A *built area* is land with continuous closely spaced buildings, as on small properties or (p)lots.

Suburbs are mainly residential municipalities, such as towns, close to a city. A suburb may be entirely within, partially within, or altogether outside a metropolitan area. *Suburbia* (or *the suburbs* or the *suburban landscape*) refers to adjoining, or all, suburbs around a city. The area on both sides of a metro-area border, where built and unbuilt areas intermix, is the *peri-urban area* (though some scholars use the term, peri-urban, in the more general sense of around the city).

The *urban-region ring* refers to the area outside the metropolitan area and inside the urban-region boundary (Figure 1.2). This variable-width ring is a mosaic of greenspace (or unbuilt) types of land interwoven with built systems and relatively small built areas. Towns and villages are distributed over the urban-region ring. Also *satellite cities* (here, <250 000 population) are normally present, *inner satellites* and *outer satellites* in the inner and outer portions, respectively, of the urban-region ring. Major highways, railroads, and powerline corridors are the prominent built systems criss-crossing the urban-region ring.

Urban regions have a city-center nucleus and are generally rounded. The all-built metropolitan area surrounded by an urban-region (or urb-region) ring is reminiscent of a gargantuan donut, and indeed a *donut model* is later used for analysis.

The term *megacity*, used occasionally, refers to a city with a population of >10 million. The concepts of city size and urban region size are discussed more fully in Chapter 5. The term *megalopolis* refers to a group of adjoining urban regions of major cities (each with >250 000 population), such as Boston to Washington or Amsterdam–Utrecht–The Hague–Rotterdam (Carbonell and Yaro 2005).

Greenspaces and natural systems

Greenspaces are unbuilt areas in an urban region, i.e., areas without continuous closely spaced buildings. Greenspaces (sometimes called open spaces) often have no buildings, but may contain a small number of relatively scattered structures. Numerous important greenspace types are present, including playing fields for sports, wetlands that reduce floods, nature reserves that protect biodiversity, tree corridors providing cool shade in summer, and market-gardening areas that produce fresh vegetables and fruits close to a city. Greenspaces range from tiny city parks to extensive woodland landscapes, and from rounded spots to linear greenways and river corridors. Greenspaces, evident on aerial photos and satellite images, may or may not be protected or have public access. Thus the many types of greenspaces parallel the many types of built areas, such as industrial, commercial, high-rise-apartment, and single-family-home. Most types of both greenspaces and built areas are useful to society.

Nature, natural systems, and natural areas are terms widely used in this book, yet, as noted in numerous treatises, defy easy definition (Peterken 1996, Kowarik and Langer 2005). Here *nature* refers to what humans have not made or strongly altered (Williams 1983, Buell 2005). Normally a frog – or a mud bank, a gust of wind, a woods, an aquifer, or even the Universe – is an example of nature, and therefore is natural. A caveat is important for a world long populated by people, namely that some things like a hedgerow or desertified area, if human-created long ago, may be considered naturalized, or simply nature.

Natural system refers to nature, but focuses on its structure, functioning, and change. Nature has a form or anatomy. Nature works, as energy, material, and species flow and move. And nature changes both its form and functioning over time. The *ecosystem* concept is used where organisms play major roles in the structure, function, and change of the system. In urban regions, the somewhat broader natural system concept is helpful in order to include important aquifer systems, subsoil groundwater flows, earthen- and rubble-fill systems, and wind transport systems, as well as ecosystems. *Natural resources*, both in-place (e,g., for recreation and aesthetics) and extractable (e.g., mineral and wood removal), are characteristics of nature with value to people.

The concepts of *natural area*, *natural habitat*, *natural vegetation*, *natural community* (or assemblage), and *natural land*, on the other hand, denote a type of space, an area unplanted and without intensive human management or use. Thus a *woodlawn* area, as a mowed grassy space often with scattered trees and shrubs, such as a typical golf course, cemetery, or city park, is not a natural area. But as something in between, a *semi-natural area* is commonly dominated by natural vegetation patterns with intensive-human-use unbuilt spaces intermixed. Semi-natural areas are especially characteristic of metropolitan areas, though widely present in the surrounding urban-region ring. To enhance readability in the text, semi-natural areas are commonly lumped under the term natural area or natural land. The idea of "native vegetation," not used here, contrasts with vegetation dominated by non-native species, whereas natural vegetation contrasts with that degraded by human activities.

Degradation is the human-activity process of decreasing natural vertical structure, horizontal pattern, and/or flows in a natural area. Habitat perforation, dissection, fragmentation, and isolation, as well as familiar processes such as polluting and overgrazing, cause habitat degradation (Odum 1982, Forman 1995, 2006, Lindenmayer and Fischer 2006).

A *nature reserve* is an area established mainly to protect nature or biodiversity. *Protected areas* are spaces that have legal constraints or are guarded to maintain valuable resources, such as nature, historic structures, scenic roads, forestry tracts, game, diverse recreational opportunities, flagship features of the land,

and much more, for the long term. Normally each protected area accomplishes multiple functions and objectives for society.

Habitat refers to a relatively distinct area and its physical and biological conditions where an organism, population, or group of species mainly lives. For example, a panda or metasequoia habitat refers to an area with suitable conditions for those populations or species, and an aquatic or grassland habitat applies to the area with suitable conditions for the community of species present. A *multi-habitat species* regularly uses two or more habitats. When used alone, the term habitat means natural habitat.

Biodiversity or *nature's richness* refers to biological abundance. The focus is primarily on native species and secondarily on natural communities, in both cases highlighting their number and the presence of rare ones. Thus a *biodiversity area*, whether protected or not, harbors a large number of native species or natural communities, or supports one or more rare species or community.

Conservation, as long-term protection of natural resources, apparently first focused on water, especially water quantity and to a lesser extent on water quality and fish (Pinchot 1967, Nash 1982, Schrepfer 1983, Robin 1998). Park conservation for stunning natural features and scenic value quickly followed. Also forest conservation focusing on trees, soil, and flooding came to the fore. Soil conservation, emphasizing erosion, sedimentation, and vegetation cover, was next. Finally biological or biodiversity conservation highlighting species and natural communities reached center stage. The long-term protection of the combined interacting components of a natural system, whether of direct value to society or not, is *nature conservation*. The concept of nature conservation (Saunders and Hobbs 1991, Peterken 1996), long familiar and understood by scientists and the public, is therefore used in this book.

Given the rates of urbanization and other land-use changes and the limited resources available for conservation, a site-by-site or species-by-species approach to nature conservation is of limited or local value. Instead, the focus here is on landscape pattern and (multi-species) communities. Not every water body, scenic feature, erosion-free site, or species will be conserved with this approach. However, the bulk of Nature and its most important known components should be sustained for the future.

Urbanization

Urbanization is the combination of densification and outward spread of people and built areas. In *densification*, the density of people and building units increases, for example, by infilling greenspaces or by changing from low- to high-rise apartment buildings. In addition or alternatively, the city grows by expanding outward. The *outward urban expansion* or spread may occur in many

spatial ways, such as expanding concentric zones or extending out transportation corridors or dispersing small developments outward. Cities may urbanize by rolling over suburbs, and suburbs urbanize by rolling over farmland or natural land. The outward spread of a town or village is sometimes included in the urbanization concept.

Outward urbanization may or may not involve sprawl. Webster's dictionary, consistent with the roots of the word, defines the verb, sprawl, as to spread out or stretch out awkwardly. For urban expansion, awkward is perhaps best translated as unsatisfactory or unsuitable or uncoordinated. This concept is relative to numerous characteristics of importance to society, from transportation, public health, and sense of community to loss of valuable farmland and disruption of nature (Bullard *et al.* 2000, Benfield *et al.* 2001, Lopez 2003, Frumkin *et al.* 2004, Burchell *et al.* 2005). Therefore *sprawl* is the process of distributing built structures in an unsatisfactory spread-out (rather than compact) manner or pattern. The concept can refer to constructing single-family rather than multiple-unit buildings, houses on large rather than small lots, and many rather than few separate developments. (Note that some authors use the term sprawl as essentially a low-density concept without the dictionary dimension of awkward or unsatisfactory [Antrop 2000]). The term *sprawl* also refers to an area with relatively new residential structures in an unsatisfactory spread-out or low-density pattern. In this sense, the process of sprawl produces sprawl as a recognizable form on the land.

An alternative pattern, especially in much of Europe, is effectively *nucleus expansion* or *growth*, where a village or town expands outward with adjacent compact urbanization. This approach capitalizes on an existing central cultural and commercial center and on the people's sense of place. Later, however, near a major city such expanding nuclei may threaten to coalesce, or indeed coalesce, and produce a huge disjointed urbanized landscape, yet which is not a city (Forman 2004a).

Some related terms are usually avoided: (a) "open space," because sometimes it implies a low-value space waiting to be filled or built upon (most types of greenspaces are highly valuable), and sometimes it implies non-forest, which is inappropriate in mainly forested portions of a region; (b) "urban edge," "urban fringe," and "urban-rural fringe," because typically these seem to be lines or narrow zones, nearly equivalent to the metropolitan-area border and considerably narrower than the peri-urban zone described above; (c) "exurban zone," which is similar to the urban-region ring, but with an uncertain inner boundary, an unspecified outer boundary, and the suggestion of an outside void rather than valuable area; and (d) "rural area," since the outer boundary is unspecified, and also because the term refers to the country, usually farmland, whereas in urban