Chapter 39
Urbanization and Its Impact on Biodiversity in the Kashmir Himalaya

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Abstract Urbanization, a process currently occurring at an alarming rate, is a global phenomenon with many social, economic and ecological consequences. In Kashmir, rural areas are being transformed into urban areas at a moderate rate with urban population increasing from 18.41% in 1951 to 31.6% in 2011. Although the number of urban centres has increased from 1 in 1901 to 46 in 2011, urbanization has been highly uneven with majority of the population concentrated in Srinagar urban centre. Some of the major consequences of urbanization have been the prominent land use/land cover change associated with impacts on biodiversity which include large-scale simplification of biota, species extinction and promotion of invasion by alien species. Research in Kashmir Himalayan region has revealed that urban areas, in comparison to rural areas, are characterized by higher incidence of alien species. In addition, urbanization has resulted in large-scale homogenization of habitats, which is a serious ecological concern. This uneven and unprecedented urbanization is severely damaging the fragile ecosystems of the Kashmir Himalayan region with grave consequences for sustenance of these ecosystems.

Keywords Biotic homogenization · Biotic invasion · Species diversity · Urbanization

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39.1 Introduction

Urbanization refers to an increase in human habitation linked with increased per capita energy and resource consumption and extensive landscape modification (McDonnell and Picket 1990). In this process, large numbers of people become permanently concentrated in relatively small areas, known as cities. Several criteria are used to define an urban area: administrative criteria or political boundaries (e.g. area within the jurisdiction of a municipality or town committee), a threshold population size (where the minimum for an urban settlement is typically in the range of 2000 people, although this varies globally between 200 and 50,000), population density, economic function (e.g. where a significant majority of the population is not primarily engaged in agriculture or where there is surplus employment) or the presence of urban characteristics (e.g. paved streets, electric lighting, sewerage).

Urban areas, more specifically cities, are known to have a variety of impacts due to conversion of agricultural or forest land for urban uses and infrastructure, reclaiming of wetlands, quarrying and excavation of sand, gravel and building materials in large quantities and, in some regions, deforestation to meet fuel demand. Although large cities are usually dynamic, growing centres for modern production and industry, financial services, internal commerce and foreign trade, education and government, these developmental activities have also resulted in habitat destruction and biodiversity loss.

Globally cities representing a setting in which the effects of human demography on biodiversity, are most evident, are expanding because of increase in urban population, and this increased population size of urban areas is due to both increases in the resident urban population and immigration from rural areas and abroad (Dow 2000; Cincotta et al. 2003). Moreover, the area of most cities is expanding faster than their population, a phenomenon known as urban sprawl (Alberti et al. 2003; Radeloff et al. 2005). This is due in part to shrinking household sizes (Liu et al. 2003) but also to larger parcel sizes in newer suburbs compared to older suburbs or central cities (Heimlich & Anderson 2001).Urban systems can serve as model systems for examining the interaction of social and biophysical patterns and processes (Collins et al. 2000; Redman et al. 2004). It is in this backdrop that the extent of urbanization and its influence on biodiversity were studied in the Kashmir valley which is also witnessing fast urbanization and consequent land-cover/land-use changes.

39.2 Materials and Methods

Both primary and secondary data were used to study the impact of urbanization and its impact on biodiversity in the Kashmir valley. Data from the Census of India (1901–2011) were used to analyse the changes in the demographic profile of the urban centres. Land-use and land-cover change statistics were generated from Landsat images of two time periods of 1992 and 2011.

For estimating extent of plant invasion, similar-sized urban and rural plots were sampled using quadrats of appropriate size. Species presence/absence data were used to make comparisons between urban and rural plots, and beta diversity was calculated using Jaccard's index, which computes binary values with the following algorithm:

$$J = \frac{a}{a + b + c}$$

where J ranges from 0 to 1, a is the number of species shared between two sites and b and c are the numbers of species unique to either site.

We calculated three measure of beta diversity (1-Jaccard's index), i.e. βo (all species included), β_N (only native species included) and β_A (only alien species included). Then significance of mean values of β_O, β_A and β_N was tested using Howell's resampling programme. The significance of these mean values was tested by one-way ANOVA at 5% (0.05) probability. This one-way ANOVA was done using Howell's resampling programme. Level of invasion was expressed as proportion of aliens:

$$\text{Proportion of aliens} = \frac{\text{Total number of alien species occuring at a site}}{\text{Total number of species}} \times 100$$

39.3 Results and Discussion

39.3.1 Urbanization Trends

Currently, rural areas are being transformed into urban areas at an alarming rate throughout the world. Although much of this transformation has taken place in regions like South America (82.8% urban), USA (82.1%) and Europe (72.7%), developing regions, such as China (49.2%), Africa (39.2%) and India (39.2%), are just beginning to undergo this urbanization process. In fact, levels of urbanization are closely correlated with national income – the more developed countries are already mostly urbanized – and in almost every country, urban areas account for a disproportionate share of the gross national product (GNP). Developing countries are likely to witness greater impact of this process as the progress of urbanization in these areas has been found to be highly uneven (World Urbanization Prospects, the 2011 Revision, United Nations 2012).

It has been estimated that the world population living in cities is expected to reach 60% by 2030, which was only 49.2% in 2005 (United Nations Population Fund 2007). Proportion of population in metropolitan cities of India has already increased to 37% in 2001, which was just 19% in 1950. Kashmir valley has also witnessed moderate urban growth with urban population increasing from 18.41% in 1951 to 31.6% in 2011. However, majority (62%) of this urban population is

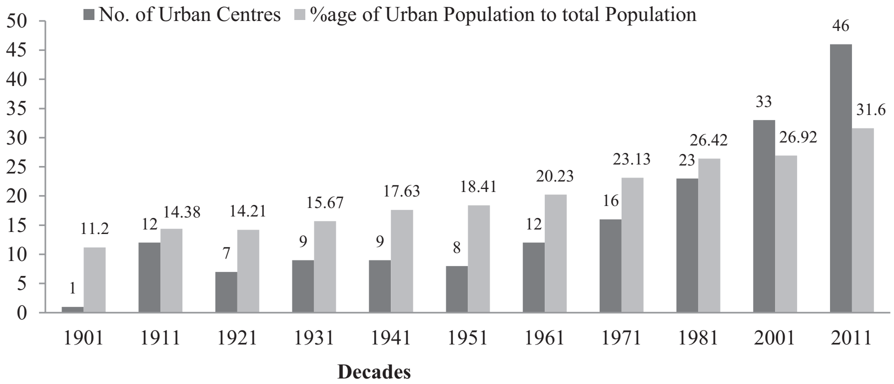

Fig. 39.1 Increase in number of urban centres in Kashmir division during 1901–2011

Table 39.1 District-wise distribution of urban centres and population in the Kashmir division 2011

S. no.	Districts	No. of urban centres	Total population (persons)	Urban population (persons)		Share of urban population (percentage)
				Absolute	Percent	
1	Anantnag	12	1,078,692	282,887	26.22	12.99
2	Bandipora	3	392,232	65,361	16.66	3.02
3	Baramulla	7	1,008,039	182,500	18.10	8.38
4	Budgam	6	753,745	97,912	12.99	4.49
5	Ganderbal	1	297,446	47,039	15.80	2.16
6	Kulgam	7	424,483	80,613	18.99	3.70
7	Kupwara	2	870,354	104,729	12.03	4.80
8	Pulwama	5	560,440	80,462	14.35	3.69
9	Shopian	1	266,215	16,360	6.14	0.75
10	Srinagar	2	123,6829	1,219,516	98.60	56.02
	Kashmir division	**46**	**6,888,475**	**2,177,379**	**31.67**	**100**

Source: Compiled from Census of India, 2011

concentrated in Srinagar urban centre alone. In fact, Srinagar is the rapidly growing urban centre amongst all the Himalayan urban centres (Bhat 2008). The number of urban centres in Kashmir division increased from 1 in 1901 to 46 in 2011 (Fig. 39.1). Although this urbanization rate is low, the pattern of urbanization is highly uneven, with its main centre being Srinagar city. Consequently, much of the attention has been paid to the urbanization of Srinagar city (Bhat 2008). District-wise distribution of these 46 urban centres is given in Table 39.1.

This shift towards a dominantly urban world is not simply a demographic phenomenon characterized by an anticipated population movement and change from one locale and profile to another, but it is a multifaceted process permeating many aspects of global development. It is in this backdrop that urban ecology is emerging as an important field of research in which biologists collaborate with anthropologists, sociologists and geographers to understand complex processes in these highly dynamic ecosystems. Apart from its ecological importance, aesthetic or ethical appeal of urban biodiversity is often considered as the most important reason for its study (Szlavecz et al. 2011). Historically, human beings are attracted to nature and its living creatures; E.O. Wilson called this phenomenon ‘biophilia’ and defined it as our ‘innate tendency to affiliate with life and lifelike processes’ (Wilson 1984). Being surrounded by plants and animals creates a sense of peace and tranquillity (Coley et al. 1997; Frumkin 2001).

39.3.2 Characteristics of Urban Ecosystems

Urban ecosystems are those in which people live at high densities and where built structures and infrastructure cover much of the land surface (Pickett et al. 2011). All ecosystems are affected by the same broad suite of state factors (Chapin et al. 2002), including (1) the prevailing climate, (2) the substrate, (3) the resident organisms and their residual effects, (4) relief (including elevation, slope, and aspect) and (5) the time over which the first four factors have been acting, which can be summarized as the history of the system. Urban areas are characterized by relatively intense stress levels due to sewage, nutrients, toxic chemicals, heat and biological pathogens associated with increasing human population (Pickett et al. 2001; Freedman 2004). According to Bryson and Ross (1972), three main factors distinguish cities from other environments: (a) physical changes in soil surface, which promote environmental aridity, (b) air turbidity that causes reduction in luminosity due to air pollution and (c) variation in heat production, which makes cities warmer than other environments. During urbanization, large parcels of land are devegetated, paved and dramatically modified in ways that often greatly exceed habitat changes that occur from logging, traditional farming and many other land uses (Marzluff and Ewing 2001). Also, land modifications during urban growth are usually long-term and indeed often intensify with time, because of which there is no opportunity for successional recovery. Much of this urban growth is expected in areas where human–environment interactions are quite common.

Urban growth in Kashmir valley has been associated with significant land-use/land-cover transformation. Table 39.2 gives the percentage change and growth of the various land-use classes in the selected urban centres. Agricultural land, forests, vacant/barren land and water bodies have decreased in all the urban centres, while built-up area and horticulture have shown a positive growth.

The analysis revealed that the agricultural land in the urban centres has decreased by 38% and forest area has reduced by almost 4%, while water bodies and wetlands have decreased by 2%. On the other hand, the total built-up area has registered a positive growth of 112%, plantations and scrublands a positive growth of 3% and horticulture has increased by 59% in the region during the period 1992–2011.

Table 39.2 Average change in land-use classes for medium-sized urban centres of Kashmir valley

Land use/cover classes	Area (km^2) 1992	Area (km^2) 2011	Change in area (km^2)	Change (%)
Agriculture	31.26	19.31	−11.95	−38.23
Forests	1.56	1.5	−0.06	−3.85
Horticulture	5.22	8.32	3.1	59.39
Vacant/barren	5.07	3.61	−1.46	−28.80
Water bodies and wetlands	4.24	4.17	−0.07	−1.65
Plantations and scrubland	11.7	12.09	0.39	3.33
Built-up area	8.95	18.96	10.01	111.84

Source: Generated from Landsat data (1991 & 2011)

An important phenomenon associated with the urban ecosystems is the 'urban heat island' effect. Heat islands represent the difference between urban and rural temperatures that are directly related to urban land cover and human energy use (Oke 1995). In general, cities have been found to be few degrees warmer than nearby urban areas, e.g. cities in midlatitudes of the USA are typically 1–2 °C warmer than the surroundings in winter and 0.5–1.0 °C warmer in summer (Botkin and Beveridge 1997). The duration and magnitude of the temperature differential between urban and surrounding non-urban areas depend on the spatial heterogeneity of the urban landscape (Arnfield 2003), city size and population density (Oke 1973; Brazel et al. 2000).

Other characteristics of urban areas include greater precipitation because of greater cloudiness and fog (Botkin and Beveridge 1997), reduced wind velocities due to increased surface roughness (Hough 1995), accumulation of carbon dioxide partly due to increased combustion of fossil fuels (Brazel et al. 2000) and depositions in the form of nitrate (as against ammonium in rural areas). In addition, the hydrology in urban areas has been severely modified by rapid urbanization with continuous ecological degradation of streams, referred to as 'urban stream syndrome' (Walsh et al. 2005a). This degradation includes elevated nutrient levels, increased organic and inorganic contaminants, increased hydrologic flashiness and altered biotic assemblages. In particular, streams draining urban areas have been found to differ from streams draining forest, with urban streams having elevated concentrations and loads of nitrogen (Groffman et al. 2004; Wollheim et al. 2005; Bernhardt et al. 2008; Kaushal et al. 2008) and phosphorus (Brett et al. 2005). Other alterations in urban hydrology include magnification of runoff during storm events, erosion, sediment transport, reconfiguration of stream channels and alterations in the timing and amount of nutrient transport (Walsh et al. 2005a, b; Pizzuto et al. 2008; Shields et al. 2008).

Urbanization also causes drastic changes in soil structure and other soil-related features because of anthropogenic disturbance. As such, many soil studies in urban areas have typically focused on highly disturbed and human-constructed soils along streets and in highly developed areas (Craul and Klein 1980; Patterson et al. 1980; Short et al. 1986; Jim 1993, 1998; Pouyat et al. 2007), and urban soils have been viewed as drastically disturbed and of low fertility (Craul 1999). The characteristics of soil, however, can vary greatly across the entire urban complex, including not only highly disturbed but also relatively undisturbed soils that are modified by urban environmental factors (Schleub et al. 1998; Pouyat et al. 2003).

39.3.3 Floristic Diversity and Urbanization

Human activities and the inherent structure of cities have produced similar ecological characteristics in urban areas (such as the prevalence of artificial soils, the 'urban heat island' effect, comparable patterns of disturbance, etc.), even in different biogeographic regions. The response of vegetation and flora to these environmental changes can be traced through the decline of elements of native and natural vegetation and the spread of alien species (Sukopp and Trepl 1987; Kowarik 1990). It has become apparent that different cities, particularly in the inner areas, share a high proportion of spontaneous species. Urban areas, being largely the result of anthropogenic activities, have been found to harbour different floristic elements than surrounding natural areas, with urban areas being dominated by alien invasive species. Anthropogenic activities, such as vehicular movement, industrialisation, etc. often create conditions more suited for alien invasive species.

Further, urban areas, being direct result from human activities, may juxtapose species that have evolved on different continents and under different biophysical conditions (Hobbs et al. 2006). The human-mediated conversion of wild or rural lands to urban lands generally produces reduced diversity of native flora and fauna and elevated numbers of exotic species (Kowarik 1995; Marzluff 2001; McKinney 2002), but there are exceptions to this pattern (Davis 1999; Samu and Szinetár 2000; Niemeleä et al. 2002). In addition, the characteristics of these human constructed communities depend on choices made by organizations, communities of people, households and individuals (Odum 1970; Whitney and Adams 1980; Hope et al. 2003; Martin et al. 2004; Kinzig et al. 2005; Grove et al. 2006).

Several recent studies have attempted to quantify differences in diversity of flora and fauna between urban and rural areas, which, in general, have found that urban areas are more species rich than rural areas (Kowarik 1995; Kühn et al. 2004; Wania et al. 2006). It is well documented from several areas in Central Europe and the USA, and across several spatial scales (from a few hundred m^2 to several hundred km^2), that urban areas harbour more plant species than surrounding (non-urban) areas. Several hypotheses have been proposed to explain this pattern, and the most popular ones explaining this pattern are (i) introduction of alien plant species, (ii) a sampling artefact, (iii) anthropogenic land-use heterogeneity and (iv) human settlement in biodiversity hotspots. Occasionally, e.g. in Germany, cities have been found to be rich in native plants than rural areas, and this pattern can largely be explained by the richness of different geological substrates (a natural phenomenon) (Kühn et al. 2004). It is also a well-established fact that urbanisation leads to the loss of rare native (and maybe the increase of common native) species, as well as the increase of different neophytic alien species (Kühn et al. 2006).

Recently, many studies have also pointed out the importance of particular urban habitats for biodiversity, including gardens (Thompson et al. 2003; Loram et al. 2008), abandoned, semi-natural habitats (Lenzin et al. 2007; Knapp et al. 2008) and artificial habitats, such as walls or green roofs (Láníková and Lososová 2009; Lososová and Láníková 2010; Lundholm and Richardson 2010) as these habitats have been found to harbour species (not found in wild) which have become extinct in natural habitats. For a deeper understanding of biodiversity within urban habitat mosaics, comparative studies across different urban habitat or land-use types are needed. However, studies comparing the effects of several urban land-use types on species assemblages are scarce, and most are concerned with the biota of a single city (Godefroid and Koedam 2003, 2007; Zerbe et al. 2003; Sudnik-Wójcikowska and Galera 2005; Muratet et al. 2008) or a few cities (Maurer et al. 2000; Horsák et al. 2009).

Surveys by Dar (2011) at 14 urban sites in the Kashmir valley revealed occurrence of 236 species belonging to 158 genera in 44 families. Alien species were represented by 156 (66%) species, leaving only 80 (34%) species as native (Fig. 39.2). Of all the alien species, 59 were invasive, 86 naturalized and 11 species casuals (Table 39.3). Representation of native and alien species in various families varied considerably. The most representative families were Asteraceae (37 spp.), Poaceae (31 spp.), Fabaceae (17 spp.), Brassicaceae (17 spp.) and Lamiaceae (13 spp.). The most representative genera were *Poa* (06 spp.), *Ranunculus* (06 spp.), *Veronica* (06 spp.), *Galium* (05 spp.), *Polygonum* (05), *Artemisia* (04 spp.), *Geranium* (04 spp.) and *Medicago* (04) (Table 39.4)

The invasive species that were found growing around these areas include *Achillea millefolium*, *Aegilops tauschii*, *Amaranthus caudatus*, *Anagallis arvensis*, *Anthemis cotula*, *Arctium lappa*, *Arenaria serpyllifolia*, *Cannabis sativa*, *Capsella bursa-pastoris*, *Carduus edelbergii*, *Centaurea iberica*, *Chenopodium foliolosum*, *Cichorium intybus*, *Cirsium arvense*, *Convolvulus arvensis*, *Conyza canadensis*, *Crepis sancta*, *Cyperus difformis*, *C. rotundus*, *Dactylis glomerata*, *Datura stramonium*, *Daucus carota*, *Epilobium hirsutum*, *Eryngium billardieri*, *Euphorbia helioscopia*, *Galinsoga parviflora*, *Iris ensata*, *Juncus articulatus*, *Leucanthemum vulgare*, *Lithospermum arvense*, *Lolium temulentum*, *Marrubium vulgare*, *Medicago polymorpha*, *Mentha longifolia*, *Oenothera rosea*, *Plantago lanceolata*, *Plantago major*, *Poa annua*, *Polygonum aviculare*, *P. hydropiper*, *Ranunculus arvensis*,

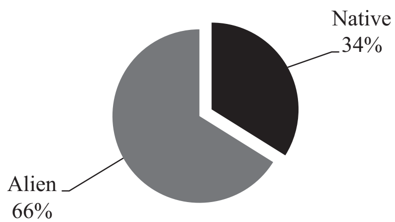

Fig. 39.2 Percentage of native and alien species at some urban sites in the Kashmir valley

Table 39.3 Characterization of plant species growing in urban areas in relation to their stage of invasion

Plant groups	Total number of native species	Total number of alien species	Number of casual species	Number of naturalized species	Number of invasive species
Dicotyledons	64	131	10	72	48
Monocotyledons	14	25	1	13	11
Pteridophytes	–	–	–	1	–
Total	**80**	**156**	**11**	**86**	**59**

Table 39.4 Most representative genera and families at some urban sites in the Kashmir valley

Most representative genera		Most representative families	
Genera	Number of species	Families	Number of species
Poa	06	Asteraceae	37
Ranunculus	06	Poaceae	31
Veronica	06	Fabaceae	17
Galium	05	Brassicaceae	17
Polygonum	05	Lamiaceae	13

R. laetus, *R. muricatus*, *Rubus ulmifolius*, *Setaria viridis*, *Siegesbeckia orientalis*, *Sisymbrium loeselii*, *Sonchus oleraceus*, *Sorghum halepense*, *Stellaria media*, *Taraxacum officinale*, *Trifolium pratense*, *T. repens*, *Urtica dioica*, *Verbascum thapsus*, *Veronica persica*, *Vulpia myuros*, *Xanthium spinosum* and *X. strumarium*.

39.3.4 Urbanization and Plant Invasion

Urbanization acts in many ways on existing biodiversity (Sukopp and Werner 1983; Gilbert 1989;Wittig 1991; Collins et al. 2000; Pickett et al . 2001), e.g. by altering quality of air, water, and soil (Sukopp and Starfinger 1999), temperature regime and rainfall patterns (Landsberg 1981; Oke 1982), habitat fragmentation and disturbance (Kowarik 1995). Although urbanization results in native habitat destruction and is regarded as a major threat to biodiversity (Wilson 1988; Thompson and Jones 1999; Liu et al. 2003; McKinney 2004a), cities are richer in plant species than surrounding areas (Walters 1970; Haeupler 1975; Klotz 1990; Pyšek 1993, 1998; Kowarik 1995; Blair 2001; Dobson et al. 2001; McKinney 2002; Araújo 2003; Hope et al. 2003). It is partly due to the influx of alien species (McKinney 2002, 2004b; Kühn et al. 2004) both from intentional and from unintentional introductions, and partly due to natural factors, as at least in some regions, cities were built up in areas of natural heterogeneity which supports natural biodiversity (Kühn et al. 2004).

Urbanization leads to increase in non-native species richness in two ways: (1) increasing importation of non-native individuals, intentional as well as unintentional and (2) creation of favourable habitat for the establishment of non-native species. Driven by their personal interest, human beings import non-native species for several reasons, ranging from the accidental importation by traffic (trucks, planes and ships) associated with centres of commerce to the intentional importation of species for cultivation, pets and other human uses (Mack and Lonsdale 2001).

Anthropogenic activities in urban areas also create the environmental conditions that allow many of the imported non-native species to become established. Disturbance being a key factor in urban areas, much evidence indicates that disturbance promotes the establishment of non-native species (see D'Antonio and Meyerson 2002 for review). Disturbance alters the natural selection regime, often putting native species at a competitive disadvantage (Byers 2002). However, as Simberloff (1997) has noted, many habitats classified as 'disturbed' could equally be termed 'new' and 'human produced', and it is these features rather than the disturbance per se that often render them vulnerable to invasion. Certainly, many such novel habitats are created by the complex physical alterations of the local environment caused by urbanization.

Shea and Chesson (2002) offer a useful framework for understanding urban disturbance and invasion by focusing on 'niche opportunity'. This defines conditions that promote species invasions in terms of three key variables: resources, natural enemies and the physical environment. An invasion-promoting disturbance, thus, increases the population growth of an invading species by providing resources, reducing the threat of natural enemies and/or altering the physical environment (e.g. temperature) to improve habitability for the invader.

Expanding urbanization often creates niches for synanthropic species, those that are most strongly associated with humans and highly urbanized areas. Examples include the rock dove (*Columba livia*), house mouse (*Mus musculus*) and feral house cats (*Felis catus*), all being very dependent on food resources provided by humans (McKinney 2006). As these so-called 'subsidized species' are imported from outlying areas in large numbers, they are not only able to colonize cities, but they can attain population densities far above those found under natural conditions (Buijs and Van Wijnen 2001). Humans also provide niche opportunities by reducing (and often eliminating) natural enemies, e.g. the elimination of large carnivores (Crooks and Soulé 1999), and geographic expansion of raccoons and other mesopredators (see Byers 2002 for review). Finally, human alteration of the environment can create physical conditions allowing a non-native species to thrive in an area where it would otherwise not survive.

Many studies have quantified the percentage of alien species growing around urban centres. In 54 European cities the average value was 25.2%, ranging from 11% to 48% (Pyšek 1993). The majority of studies dealing with urban flora are limited to inner cities where the representation of aliens is higher (Wittig 2002). The value obtained for the city of Plzeň in 1990s (22.6%) is well within the European average.

Andrabi (2012) reported that urban habitats differ from the corresponding rural habitats in their extent of invasion, species number and other phytosociological attributes. Urban landscapes in the Kashmir valley were found to support higher percentage (64.82) of alien species, compared to rural landscapes (58.77%).

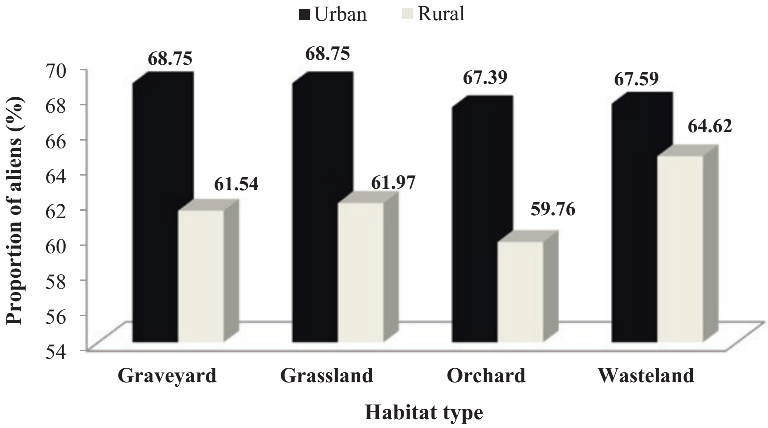

Fig. 39.3 Level of alien plant invasion in various habitats and landscapes in urban and rural areas of Kashmir valley, expressed as the proportion of the alien to all species

Analysis of level of invasion (Fig. 39.3) revealed that, in general, all urban habitat types in the Kashmir valley were significantly invaded by alien plant species. It varied between 67.39% and 68.75% with a mean value of 68.12%, whereas all rural habitat types were relatively less invaded by alien plant species. The proportion of alien species in rural habitats varied between 59.76% and 64.62%, with a mean value of 61.97%. It clearly indicated that urbanization promotes the invasion of surveyed habitats.

39.3.5 Urbanization and Biotic Homogenization

Biotic homogenization is the increased similarity of biotas over time caused by the replacement of native species with alien species (Rahel 2000). According to McKinney and Lockwood (1999), biotic homogenization occurs when a widespread environmental change promotes the geographic expansion of some species ('winners') and the geographic reduction of others ('losers'). Although many human activities promote biotic homogenization, urbanization is the most homogenizing factor (Blair 2001; Miller & Hobbs 2002; McKinney 2006). The process of urbanization has resulted in expansion of alien plant species and decline of native species, particularly the already rare native species, and has caused a greater similarity between different urban regions, i.e. biotic homogenization (Kühn and Klotz 2006). Dar and Reshi (2015) have shown that roadsides (habitats with greater urban impact) are more homogenous than grasslands and forests in the Kashmir valley. In order to determine which habitats are more homogenized, Dar and Reshi (2015) used three measures of beta diversity, i.e. overall beta diversity (β_O), beta diversity for natives (β_N) and beta diversity for aliens (β_A), to assess the role of alien plant invasions in

Table 39.5 Mean values of β_O, β_A and β_N for beta diversity and one-way ANOVA for testing the significance of mean values (1000 resamples)

	β_O			β_A			β_N		
Habitat	Mean	F-value	p-value	Mean	F-value	p-value	Mean	F-value	p-value
Grasslands	0.742 ± 0.3	13.011	0.023	0.721 ± 0.3	11.473	0.011	0.788 ± 0.4	2.683	0.071
Forests	0.749 ± 0.2			0.742 ± 0.3			0.806 ± 0.3		
Roadsides	0.649 ± 0.3			0.624 ± 0.3			0.755 ± 0.3		

biotic homogenization of different ecosystems in the Kashmir valley. The study revealed that the beta diversity for aliens, i.e. β_A, was lower than the overall beta diversity, i.e. β_O (Table 39.5), which indicated that alien species decrease beta diversity and as such increase the similarity.

Urban biotic homogenization is a huge challenge to conservation for at least two fundamentally different but important reasons. One reason is its dominant role in the loss of native species and the consequent homogenization of the world's biota. Another reason is the impact of urbanization on human perceptions of nature. Because so many people live in cities and because so many urban plants and animals are not indigenous to the local urban environment, the human species is becoming increasingly unfamiliar with their native biological environment. Olden et al. (2005) argued that the social repercussions resonating in the wake of biotic homogenization must not be ignored, and there is an urgent need to consider the idea that the increasingly global uniformity in biological life may be linked to the loss of traditional values and quality of life, which could have significant consequences for conservation-oriented advocacy and ecotourism. Thus, the concept of biotic homogenization is important not only for conserving biodiversity but also for maintaining the quality of human life, which may otherwise get degraded if not addressed appropriately.

39.3.6 Urbanization: Planning and Development Problems

Urban pattern in Kashmir region has been found to be spatially and functionally imbalanced as it exhibits high concentration of economic activities and urban population in Srinagar city and virtual stagnation in the other urban centres of the region (Bhat 2008). The city has assumed very high degree of hypertrophy dwarfing in population size, rendering activities of all other urban centres within this region as insignificant. This unplanned and imbalanced urban growth has posed a serious threat to the sensitive geo-ecological set-up of the region which has already degraded the various life-sustaining ecological systems, like wetlands and water bodies, forest areas and green spaces. Keeping in view the unbalanced urban development of the region, Bhat (2008) has suggested two-pronged planning strategy for spatially balanced urban growth and development of the region. The planning strategy constitutes the decentralized growth centre strategy with special focus on integrated development of small- and medium-sized urban centres to make them economically productive and functionally vibrant centres in order to enhance their population retaining capacity. This strategy has to be in consonance with comprehensive land-use planning and policy to be devised for regulating the ecologically and environmentally sustainable urban development process in the region.

39.4 Concluding Remarks

Urbanization is one of the most significant global trends of the twenty-first century. Given its expanding impact, urbanization has become a major concern in conservation biology, as it involves one of the most extreme forms of land-use alteration, generally leading to a complete restructuring of vegetation and species composition. Based on the foregoing discussion, it can be safely concluded that the studies so far carried out in the Kashmir Himalaya reveal that urbanization has led to greater establishment and expansion of invasive alien species which are going to affect not only the aboveground biodiversity but its belowground component as well. Urban habitats have already been invaded to a great extent, and in future these are likely to act as repository of alien invasive species which is going to put natural areas at greater risk of invasion.

The unusually high percentage of alien species in urban landscapes is certainly a threat to the overall integrity of the whole region, in general, and to the natural resources of this Himalayan biodiversity hotspot, in particular. It is true that we should not lag behind the world in terms of economic development, but, at the same time, we should take necessary steps to protect our native habitats and endemic species. How to minimize the risk of invasive species proliferation as a result of growing urbanization is a challenge for biodiversity managers!

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