6. Changes in land use and urban ecology

Changes in land use are mapped in Corine Land Cover — a database that is compiled by using a uniform methodology and includes spatial data on land use across Europe. Corine Land Cover provides information on land covers of the mapped areas. The data are used for spatial analysis as well as for identifying changes and trends in land use, etc. An analysis of Corine Land Cover 2006 showed that the areas of artificial surfaces, urban sprawl and infrastructures increased in the period 2000–2006 on account of agricultural lands, grasslands and wetlands. The trend is similar in Estonia — numerous newly developed areas are appearing, primarily substituting for former agricultural lands. After an area has become artificial it is impossible to use it for its former purpose. A new Corine Land Cover database will be available in 2014. Therefore, this analysis of changes in land use is based on the available sources and information systems because the updating cycles of Corine Land Cover and the environmental performance review are different.

Urbanised areas affect various aspects of the environment: pressures grow on water resources and soil; waste generation increases; there is a need for more efficient transport, which will fragmentise habitats and prevent the movement of wildlife, etc.

The lifestyles of many people have become increasingly urbanised and governments are looking for ways to make urban areas as people-friendly as possible. About 75% of Europeans live in urban areas and their number is expected to rise to 80% by 2020. People have realised that green spaces improve the quality of life in cities. The process of urban sprawl described in the previous environmental performance review ("Environmental Review 2009", Chapter 7.3) has continued over the past four years. This is evident from the concentration of people around bigger cities and towns (see Chapter 1.1 "Population") and from the growing number of cars (see Chapter 1.2.5 "Transport").

6.1 Changes in land use

The way we use our territory is largely reflected in the changes in land use. As there are numerous ambiguities in the land use data, we will only provide a general overview of the trends across Estonia and in larger regions.

The changes in land use in 2009–2012 are analysed on the basis of the following three sources: the changes reflected on the base map of Estonia (The Estonian National Topographic Database (ENTD) maintained by the Estonian Land Board); the changes in the intended purposes of cadastral units (data from Statistics Estonia as presented by the Land Board) and the changes in the data from the Estonian Nature Information System (EELIS) (Environmental Register; Environmental Agency). The latter mainly concerns areas subject to different protection regimes.

6.1.1 Changes reflected on the base map of Estonia/in ENTD

A logical method of analysing land use is to compare the Estonian National Topographic Database base map data for different years. The ambiguity of the comparison is caused by the fact that the base map is updated by regions and therefore, only a part of the Estonian territory is updated each year. This means that the base map is not reflecting the actual situation for the whole country and at any time, up-to-date data are only available for certain regions.

The base map is derived from the most important Estonian topographic database. The digital mapping of Estonia began in 1996 and the whole territory of the country had been base-mapped at least once by 2007. The second round of base-mapping started in 2003 and by 2013, 56% of the base map sheets had been mapped once, 40% twice and nearly 4% three times. When looking at the base map sheet by sheet we can see that as of 2013, 15.6% of the sheets have been updated in the past four years (2009 and later). Therefore, the comparison of the data collected at two different moments in time partially reflects the actual changes in land use as the data have essentially only been updated for one sixth of the territory.

The ENTD dataset includes, among others, a parameter “last update”, which shows the date of most recent changes made in relation to an object. When looking at the dates of last updates of different types of areas, the situation appears to be much better — 27.9% of all areas (covering only 15.8% of the whole territory of Estonia) were last updated before 2009. This means that the data for 5/6 of all areas (by surface area) were updated in 2009 or later. Table 6.1 shows the share of areas updated more than four years ago (broken down by land cover types).

The table suggests that the areas for which the data were updated most recently are forest stands. There are no land cover types for which the areas updated earlier constitute more than half of the total surface area. Unfortunately, this reflects the technical development of ENTD, not the accuracy or time of mapping. After the preservation of data by sheets of the base map was abolished, the areas on different sheets were merged and the most recent updates are related to changes in boundaries, not the actual changes in land cover types. The ostensible reason for forest stands being updated most recently is the relative size of such areas — they stretch across several sheets.

Therefore, the following changes are based on only one sixth of the base map. Whether these trends can be extended to the remaining five sixths, i.e. whether the results can be multiplied by six, is debatable, but we can assume that the changes are several times bigger than shown on the following figures.

The ENTD areas referring to land covers are divided into 11 categories (see tables 6.1 and 6.2). Seas are not included.

Figures 6.1 and 6.2 as well as Table 6.2 indicate that populated areas and peat extraction areas have increased more than other areas (one sixth of the total territory of Estonia and 2.3% of the total surface area of the relevant land cover), while the surface areas of natural open areas, wetlands and arable lands have decreased. It is not clear whether an increase in the area of watercourses reflects the actual change in land use /land cover type or the changes in mapping.

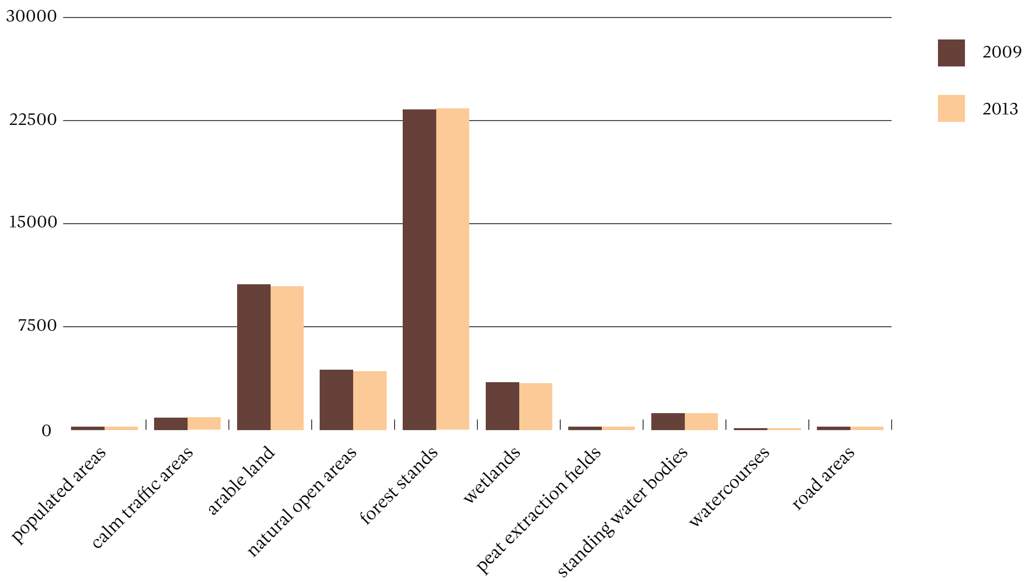
In absolute terms, the land cover type that has decreased most is arable land, followed by natural open spaces (Figure 6.2).

Table 6.1. The share of ENTD areas (by surface area), for which the parameter values were updated before 2009 (by land cover types; as of 31 January 2013).

	updated before 2009
populated areas	17,90%
calm traffic areas	45,06%
arable land	19,84%
natural open areas	39,39%
forest stands	5,72%
wetlands	27,58%
peat extraction fields	48,76%
standing water bodies	29,59%
watercourses	17,44%
road areas	19,19%
sea	100,00%

Table 6.2. Ratio of surface areas reflecting the change in the total surface area of ENTD areas in 2013 and 2009. The ratio has been calculated for the whole respective land cover type in 2009, but the data concern only one sixth of the total territory of Estonia.

	Ratio 2013/2009
populated areas	1,023
calm traffic areas	1,012
arable land	0,987
natural open areas	0,974
forest stands	1,002
wetlands	0,985
peat extraction fields	1,016
standing water bodies	1,001
watercourses	1,026
road areas	1,001



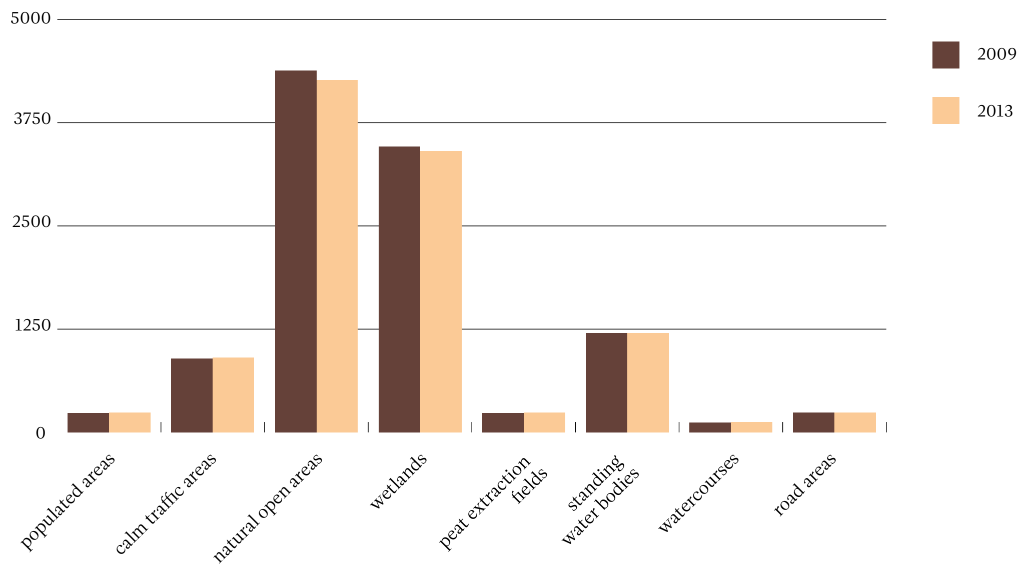
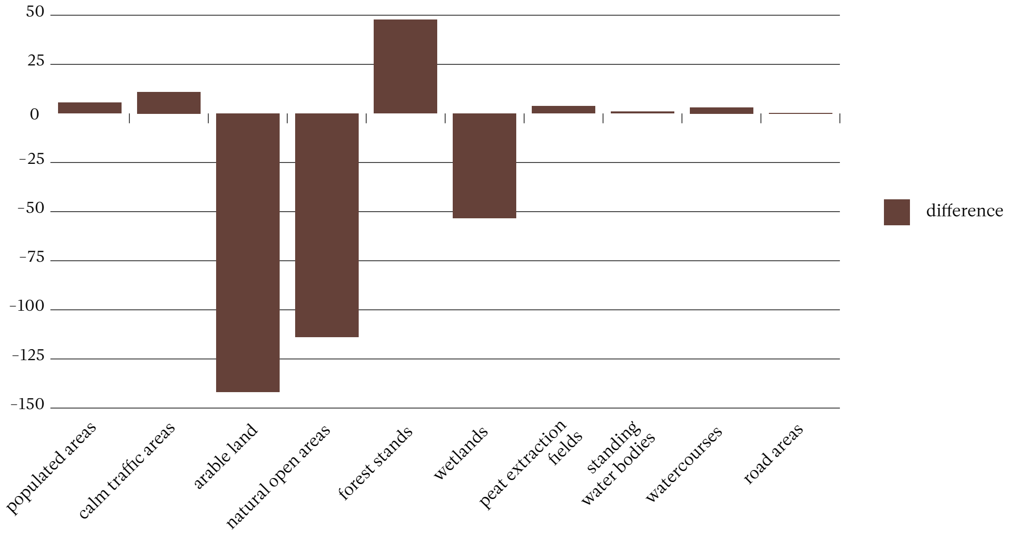


Figure 6.1. Land use by the Estonian National Topographic Database (ETAK) (km²); on top: all types of land use; on bottom: types of land use excluding the two types of largest areas (to amplify the differences and changes in types of land use of smaller areas).



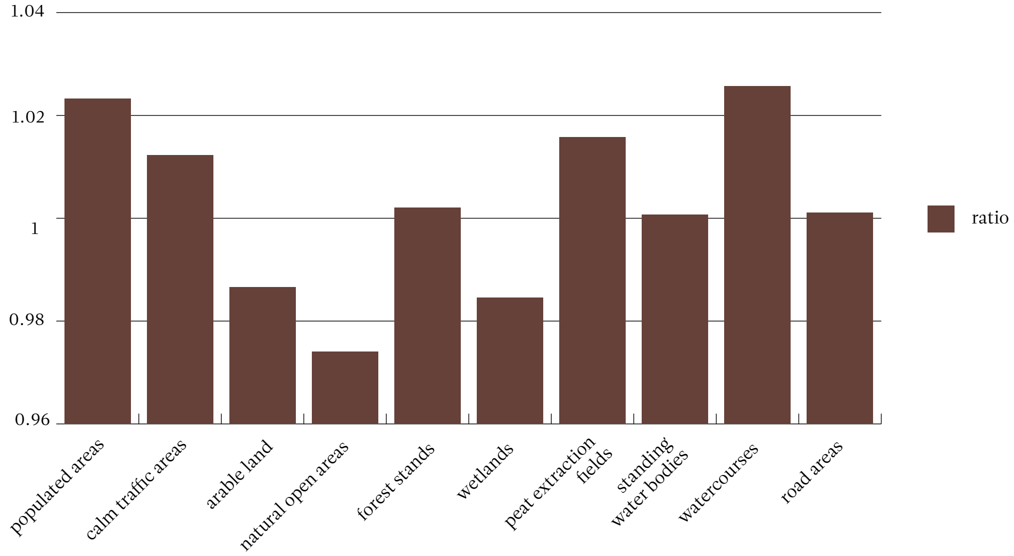


Figure 6.2. Differences in and ratios of the areas of types of land use by ETAK (difference km²) in 2013 and 2009.

6.1.2 Changes in land use by the intended purpose of cadastral units

Another way to analyse changes in land use is to look at the intended purposes of cadastral units recorded by Statistics Estonia and their changes. The data from Statistics Estonia show the areas of cadastral units for administrative units of different levels. The following data are presented for Estonia as a whole and separately for five regions.

The largest area, about 90%, is profit yielding land, which according to ENTD includes both arable lands and forest stands (with some exceptions, such as protected forests). Therefore, the decrease in the area of arable land is balanced by an increase in the area of forest stands. However, in the case of profit yielding land it is relatively easy to switch between land use types and forestation can be considered a temporary or at least reversible phenomenon. On the other hand, the expansion of populated areas is not reversible. Since the area of profit yielding lands is by an order of magnitude larger than the total areas of units of other intended purposes, it is excluded from Figure 6.3 for greater clarity. Likewise, lands without intended purpose and lands for which the intended purpose has not been defined are excluded. Their total surface area and decrease (Figure 6.4) mainly reflects the process of entering land units in the cadastre. In 2009–2012, the total area of cadastral units increased by approximately 5% and now covers nearly 90% of the Estonian territory.

The areas of nearly all cadastral units with intended purpose has increased (Figure 6.3). In order to compare the changes in intended purposes, which best reflect the changes in land use, the following aggregated data (column “Total”) have been calculated based on the data of 2009 and the data on areas of different intended purposes have been calculated based on the total areas of cadastral units in the relevant year (Figure 6.4).

The shares of land under protection and public land have increased most in all regions (North-, South-, Central-, West- and Northeast Estonia). The area of water bodies has also increased in all regions. Although the area of national defence land has increased in several regions, it is probably due to cadastral acts rather than a change in the actual use of the land.

The shares of the intended purposes of cadastral units are ambiguous because it is difficult to differentiate the changes arising from cadastral acts (made in the course of the land reform) and those in actual land use. The land reform is assumed to progress proportionally in the case of cadastral units of different intended purposes but it is likely that this assumption does not apply to all intended purposes.

Table 6.3. Total surface area of cadastral units by intended purposes in 2009–2012 (as of 31 December each year)

	2009	2010	2011	2012
residential land	1,96%	1,97%	1,98%	1,98%
commercial land	0,17%	0,18%	0,18%	0,18%
production land	0,61%	0,61%	0,62%	0,62%
mining industry land	1,11%	1,08%	1,04%	1,05%
public land	0,45%	0,49%	0,51%	0,53%
water areas land	0,12%	0,12%	0,13%	0,14%
transportation land	1,13%	1,15%	1,17%	1,18%
waste storage land	0,14%	0,14%	0,15%	0,14%
national defence land	0,27%	0,46%	0,47%	0,46%
land under nature conservation	3,64%	3,63%	3,74%	4,07%
profit yielding land	90,29%	90,05%	89,91%	89,55%
land without intended purpose	0,11%	0,11%	0,10%	0,10%
undefined intended purpose	0,00%	0,00%	0,00%	0,00%

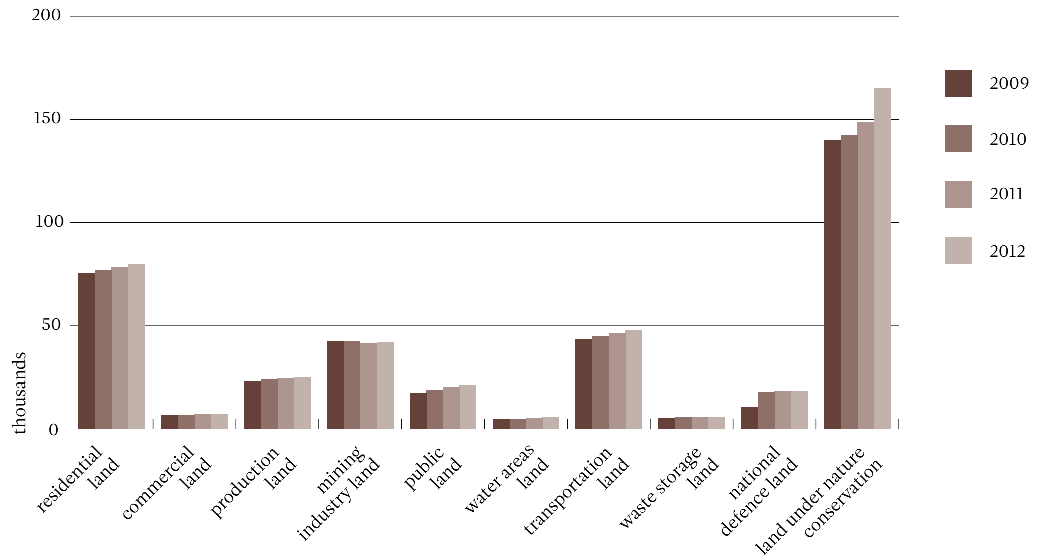


Figure 6.3. Total areas (ha) of cadastral units of different intended purposes in 2009–2012.

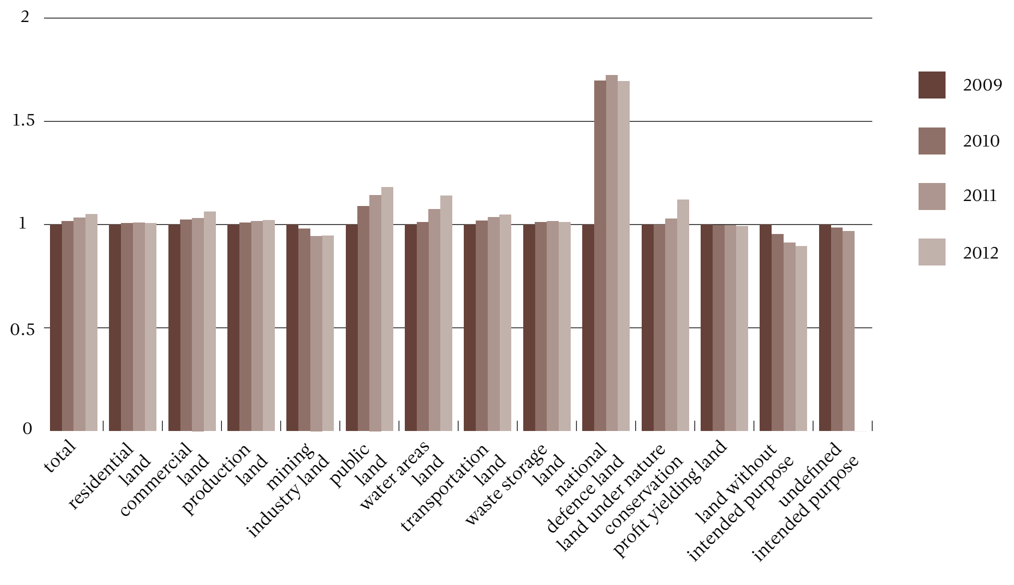


Figure 6.4. Relative change in land use in Estonia in 2009–2012.

6.1.3 Distribution of the protection status of land areas by counties (dataset EELIS)

Table 6.4 illustrates the territorial distribution of protected areas by counties as of the end of the summer of 2013. More than one sixth of the Estonian mainland territory is under protection (NATURA, ecological reserves and bird protection areas, local conservation areas and their limited management zones and protection zones of single objects). A significant part of the Estonian territory is under double or multiple protection. However, the share of reserves under strict protection is very small (79.6 km^2 or less than 0.2%). More than a quarter of the Estonian territorial sea constitutes a protected marine area. These areas are relatively new protected areas without established spatial distribution where the probability of conflicts is bigger. The areas of large lakes (Lake Peipsi and Lake Võrtsjärv) are also under protection. The changes in these areas are marginal compared to 2011. The share of areas under protection has increased most in the sea area; half of counties have not seen any changes and in the rest the changes remain within or slightly above one tenth of a percent.

At the same time the differences between counties are quite significant. Besides, nature conservation restrictions apply to some areas (such as key biotopes) but in terms of surface area they are marginal.

By comparing the share of protected areas in Table 6.4 with the share of cadastral units with the intended purpose "land under nature conservation" (Table 6.3), we can see that the difference is more than fourfold. National parks with large territories, nature conservation areas as well as the NATURA nature and bird protection areas, large parts of which have another intended purpose, are recorded as protected areas in the EELIS database. This means that the share of areas the intended purpose of which is "land under nature conservation" (4% of the mainland) reflects better the areas intended mainly for nature conservation. Table 6.4 shows the share of areas to which certain nature protection restrictions apply.

Table 6.4. Share of protected areas in the territories of counties (%) (Data: EELIS; Land Board)

	Põlva	Jõgeva	Järva	LääneViru	Viljandi	Võru	Ida-Viru	Harju	Tartu	Saare	Rapla	Valga	Pärnu	Hiiu	Lääne
%	8,0	11,0	12,9	13,7	15,0	15,5	16,8	17,9	17,9	18,2	18,5	19,0	22,9	23,1	31,0

	mainland	sea areas	large lakes	water areas (average)*
%	17,45	26,84	40,70	27,87

* In the Strategic Environmental Assessment Report attached to the National Spatial Plan large lakes are included in the sea areas. Therefore, we have included the weighted average areas of sea areas and lakes for comparison.

6.2 Urban ecology and creating a biologically diverse city

For many people a city is the only place where they are exposed to nature and wildlife. Researchers argue that the quality of these contacts largely determines people's attitudes towards nature and nature conservation. People's well being depends on the buffering capacity and resilience of urban nature. As urban ecosystems degrade, some people move to the country in search of nature, while others become even more estranged from nature. 69% of Estonians and as much as 80% of Europeans live in cities. These figures explain why studying cities as ecosystems is gathering pace across the world.

6.2.1 Urban ecology as science

Urban ecology is the scientific study of the relations and links between city dwellers and urban nature. Urban ecology is a recent field of study that became established as a separate subdiscipline in the 1970s and 1980s pf the last century. In Europe, urban ecology as a science was born in the universities of West and East Germany, which started to study urban vegetation. Urban ecology research groups were also created elsewhere in the world. Often the trigger was a local environmental problem that needed to be solved, be it the control of introduced species, reduction of air or water pollution, management of excessive rainwater or the urban heat island effect caused by a highly heat-absorbing artificial environment.

In a few decades, urban ecology became an interdisciplinary science. Researchers and experts in the field of urban ecology deal with very diverse issues that combine natural sciences, economy, social and cultural sciences, health care and psychology, engineering science and many other sciences and fields of activity. Irrespective of the object and field of research, the practical output of urban ecology is pretty much the same — to gain new knowledge about the functioning of urban ecosystems in order to create a comfortable living environment for both people and biota.

Classical research objects of urban ecologists are urban flora and fauna. Researchers work to establish how indigenous and introduced species adjust to life in a city, withstand and recover from the impact of stress factors. In many parts of the world, researchers study the behaviour and ecology of urbanised foxes, badgers, wild boar and other urbanised wildlife populations in order to reduce conflict between animals and people.

Normally, green spaces and biodiversity are distributed unevenly in cities and they are scarce rather than excessive. However, the abundance of species in many cities has been preserved, either as a result of conscious action or in spite of human activity. Many research groups study the historic, cultural and socio-economic reasons of why there is an abundance of indigenous species and greenery in some cities, while in others green spaces are distributed unevenly or are missing altogether. Do affluent parts of a city have more bird species because there are more gardens, or less because manicured lawns are not a suitable habitat and feeding ground for animals? The results of such studies differ from country to country as well as from city to city but they help to develop landscaping methods that are appropriate for certain regions.

6.2.2 Development of urban ecology

The rapid economic development of the 20th century facilitated the development of urban ecology as a science. After the Second World War, when the economy of many European countries developed very rapidly, environmental legislation was weak and environmental requirements for activities polluting air, water and soil were either inadequate or absent. The number of city-dwellers grew, as did the pollution levels in cities. Therefore, cities in western Europe began to pay more attention to urban vegetation and sought ways to increase the area of green spaces in order to reduce the levels of pollution. Namely, many Austrian and German cities developed guidelines and legislation in the 1970s and 1980s in order to create green roofs to mitigate the issues related to rainwater and air pollution. Today, Germany is considered a world leader in green roof industry with an estimated 10% of the rooftops in Germany 'greened' and 10 km^2 of green roofs being added each year.

Urban nature has become the centre of focus in both Europe and elsewhere in the world, thanks to more stringent nature conservation legislation and international agreements on the protection of biodiversity. The ratification of the Convention on Biological Diversity has led to an increased interest in studying and protecting urban biota. Almost all cities have areas of biodiversity that may be of international importance, not just local significance. For example, Cape Town in South Africa is unique amongst world cities for its high concentration of endemic plant and animal species. There are examples from closer to home, too. Plant and animal species of European conservation concern that are protected by EU directives are found in all Estonian towns and cities. Tallinn is a nesting site for 20–24 endangered bird species of European conservation concern listed in Annex I to the Bird Directive — many nature conservation areas pale in comparison with that number (Table 6.5).

Nowadays, the development of urban ecology is facilitated by increasing awareness and appreciation of ecosystem services, i.e. the benefits people obtain from ecosystems. It is estimated that two thirds of the world's population will be living in cities by the middle of this century. Without major changes in the principles of city planning, urban ecosystems will not be able to offer these benefits to all people. This means that the well-being of people and the quality of life will deteriorate.

Dozens of voluminous scientific works have proven that people have a natural need to be in an environment that is green and biologically diverse. A biologically diverse and green urban environment with various plants and animals improve people's mood and health, offers opportunities for exercising and vitalises business activities. Also, we cannot disregard the ecosystem services that protect human health and property against adverse weather and environmental conditions. Because people's well-being partially depends on the surrounding biodiversity, the status of biodiversity is considered to be one of the most important indicators of the quality of life in cities.

Urban vegetation offers various benefits. It

- is a source of horticultural and forestry products;
- decreases air pollution;
- decreases noise levels;
- cools urban air;
- helps to manage floods;
- absorbs greenhouse gases;
- improves water quality;
- creates habitats;
- is aesthetical;
- improves people's health and provides opportunities for recreational activities;
- increases the value of real property;
- increases the energy efficiency of buildings.

Table 6.5. Wildlife species in Tallinn in 1980–2013 (according to M. Uustal)

Group of wildlife		Number of species	Share in total species in Estonia	including number of species under protection
1.	Ground beetle (Carabidae)	164	59%	
2.	Apionidae	49	72%	
3.	Odonata	37	65%	3
4.	Bumblebees (Bombus)	20	62%	13
5.	Butterflies	72	60%	3
6.	Moths	566	26%	2
7.	Amphibians	6	54%	6
8.	Reptiles	5	100%	5
9.	Birds (total)	248	65%	94
	incl. breeding birds	149	66%	48
10.	Mammals (total)	44	66%	12
	incl. bats	10	83%	9
	incl. other mammals	34	64%	3
	Total number of species	1211		138

6.2.3 Shaping biota and creating artificial habitats

Natural areas in cities have two somewhat contrasting functions. On the one hand, they serve as habitats for numerous species, some of them even under protection; on the other hand, green spaces must be open to the public and provide opportunities for walking, recreational activities and sports to as many people as possible. A number of scientific studies focus on finding balance between these two functions so that both wildlife and people could benefit from their existence.

In order to ensure sufficient ecosystem services and biota that is as rich in species as possible, shaping biota is becoming increasingly common across the world. The need for shaping biota arises from the fact that the number of suitable habitats is limited in the urban environment. Moreover, the number of such habitats is falling because no new equivalent habitats emerge by themselves. Therefore, habitats have to be created to ensure the continuation of indispensable services provided by animals (or pollinating insects) and plant communities (e.g. in areas that absorb stormwater).

Two different approaches are applied to shaping biota. The first is to create, develop and improve new artificial habitats, the second is to improve the quality of the existing habitats and communities. Artificial habitats are, for example, green and pebble rooftops, sustainable storm water systems and flower lawns as well as nesting and roosting boxes, that are being developed by hundreds of researchers, engineers and biologists throughout the world. These measures are described in detail below because all of them have proven to be a success and are worth implementing in our cities.

A green roof is a roof of a building that is partially or completely covered with vegetation and a growing medium, planted over a waterproofing membrane. Green roofs have many advantages over conventional roofs. Vegetation acts as a sponge, absorbing rainwater, letting it seep gently into the ground and reducing the risk of flooding that occurs due to extreme rainfall. A green roof also regulates temperature inside the building, helps save on heating and cooling costs, absorbs pollutants from urban air and muffles noise on streets and inside buildings. The plants growing on rooftops serve as feeding grounds and habitats for insects which, in turn, are hunted by birds. Pebble roofs are built to provide safe nesting sites for terns and seagulls that have lost their habitats on the coast and to prevent their chicks from overheating on hot rooftops.

A sustainable stormwater system comprises green rooftops, water collection facilities (barrels, pools), permeable soil, ditches, ponds, absorption areas and wetlands. A sustainable stormwater system mimics natural wetland communities that help to absorb or evaporate rainwater or to direct it to natural water bodies or to the sewerage infrastructure. A sustainable stormwater system reduces the pressure on the existing sewage infrastructure and wastewater treatment plants in areas susceptible to excess water and flooding. Urban water bodies help to regulate air temperature and naturally make the area more attractive to both people and biota.

A flower lawn is a colourful flowering meadow-type community created by sowing wildflower seed mixes or from local vegetation. Wildflower seed mixes consist of the seeds of plants that are a food source for animals and insects attracted by nectar, seeds and other parts of plants as well as by prey animals. Besides being used to increase biodiversity, flower lawns are used in the parts of Western European cities that have bad reputation, on wastelands and in former industrial areas because they are extremely aesthetical.

Nesting boxes for different bird species and roosting boxes for bats are simple measures the importance and impact of which tends to be overlooked. The uses of nesting boxes are extended by innovative products that last longer and are more durable than those made of wood boards. These nesting boxes that are made of the mixture of sawdust and concrete can even be used as building blocks.

Six suggestions for increasing biodiversity in Estonian cities

- Install nesting boxes for different bird species
- Reduce mowed areas and the number of mowing events
- Plant trees, shrubs and herbaceous plants that produce nectar and pollen from early spring to late autumn
- Plant shrubs and create hedges
- Leave fallen trees on the ground to decompose
- Plant more creepers

Improving the quality of urban habitats

Each city has urban habitats and biota of different value and no new habitats need to be created. Often it is sufficient to change the principles of maintaining landscaping in green spaces, industrial and residential areas and to plant vegetation that offers added value to wildlife (hiding places or food). Creating shrubberies and hedges and leaving fallen trees on the ground are critical components of increasing biodiversity.

Estonian towns and cities are quite rich in species but there are no precise data to prove that. More detailed overviews have been prepared for the biota in Tallinn and Tartu which, like some other towns, can boast areas and habitats of species of European importance, not to mention more common species. For example, former military areas (Paljassaare and Astangu in Tallinn as well as Raadi in Tartu) that were closed to the public for decades have very diverse wildlife and plant communities.

Our knowledge of the benefits of urban nature, relations between humans and urban biota and the functioning of cities as ecosystems and their differences from rural areas have improved greatly over a very short time. However, urban ecology is a new and rapidly developing field of science — many links and interactions are still unclear and remain to be explored.

It is important to remember that biodiversity does not only embrace protected species. What is more important in an urban environment are common sparrows, hedgehogs and other animals who are a joy to watch when they expectedly or unexpectedly emerge from their hiding places. In order to keep them in the city and providing ecosystem services we must create habitats and natural feeding grounds for them. The protection of urban wildlife starts from our own front door.