Infilling practices and environmental impacts on domestic gardens: Phase II
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### Appendices

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1. Introduction

This research is a part of the wider project “Green space issues and the Metropolitan City 1990-2012” in the Helsinki Metropolitan Region Urban Research Program (KatuMetro) 2010-2014. The main focus of this work is on infilling practices and their environmental impacts on private domestic gardens in low-density residential areas of Helsinki Metropolitan Area. This work is a continuation to the pilot study done in 2011.

1.1. Structure of the report and research questions

The report consists of three main sections. In the first part of the report, infilling practices and housing policies of the cities in the Helsinki Metropolitan Area are introduced as a background for the infill development occurring in the established residential areas. In the second part, the infill development of the case study residential area - Ylästö in Vantaa - is investigated by using Geographic Information System (GIS) based mapping methods, aerial photographs and other maps. The main goal is to quantify the change of the garden land areas due to the infilling during 1998-2009. The results of the mapping work are presented and compared with the results achieved from the pilot case study area of Paloheinä in Helsinki. In the third part of the report the environmental impacts of infilling on the private gardens are briefly discussed. This research aims to generate baseline information about the garden resource and to increase the awareness of the potential environmental and biodiversity benefits that private gardens provide in urban environments.

The research questions are:

1. What policies have Helsinki and Vantaa had and continue to have regarding infilling practices, particularly in low-density housing areas?
2. What has actually happened to the garden and yard area during the infill process? How much of the garden and yard areas are lost due to the plot subdivisions in the Ylästö case study area during 1998-2009?
3. What kind of environmental impacts does the infill process have on private gardens?
1.2. Private domestic gardens

Residential areas are a major component of a city, and in Finland much of these areas are comprised of low-rise housing areas with detached and semi-detached houses. At present, there are over 67 000 detached/semi-detached houses with associated gardens and yards in the Helsinki Metropolitan Area (Table 1). The considerable potential of these private green spaces in providing ecosystem services for the residents and supporting urban biodiversity should be acknowledged in the city planning.

**Table 1.** The number of residential buildings in the Helsinki Metropolitan Area (31.12.2011)\(^1\).

<table>
<thead>
<tr>
<th></th>
<th>Detached and semi-detached houses</th>
<th>Attached and row houses</th>
<th>Blocks of flats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helsinki</td>
<td>19680</td>
<td>4150</td>
<td>10036</td>
</tr>
<tr>
<td>Espoo</td>
<td>25601</td>
<td>3640</td>
<td>2626</td>
</tr>
<tr>
<td>Vantaa</td>
<td>20705</td>
<td>2798</td>
<td>2240</td>
</tr>
<tr>
<td>Kauniainen</td>
<td>1053</td>
<td>143</td>
<td>94</td>
</tr>
<tr>
<td>Helsinki Metropolitan Area</td>
<td>67039</td>
<td>10731</td>
<td>14996</td>
</tr>
</tbody>
</table>

Gardens fulfill multiple roles in the urban areas as they are valuable for people and wildlife\(^2\). They are unique and heterogeneous environments, where the management choices of individual gardeners play a very important role, particularly when considering the possibilities of these habitats to enhance urban biodiversity. In the previous phase of this research project, it was discovered that there was no information available on the extent of domestic gardens in the Helsinki Metropolitan Area. The cities do not monitor the state of private green areas - such as domestic gardens - and thus, there are no detailed registers or statistics from these areas. In addition, there is a considerable lack of ecological research done in private garden environments\(^3\).

However, increasing attention is being given to the urban garden environments in many

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\(^1\) Helsingin seudun aluesarjat 2012  
\(^2\) Smith et al 2011; see e.g. reviews: Goddard et al. 2010; Cameron et al. 2012  
\(^3\) Ojala 2011
European cities and the research done in the UK, in particular, highlights the potential of these habitats in supporting urban wildlife\(^4\). Gardens are considered to be important for certain species\(^5\), for example due to the land-use changes in wider countryside. In the previous phase of this study it was discovered that private gardens of Espoo may provide habitats even for strictly protected species such as flying squirrels and certain bat species\(^6\), indicating that the biodiversity potential of these habitats should be investigated more in detail also in the Helsinki Metropolitan Area.

Private gardens cannot replace natural habitats, but they can complement them and provide resources (e.g., foraging and nesting sites) that benefit urban fauna\(^7\). Especially highly mobile species such as birds and flying insects are most likely users of the garden environments. However, private gardens can also have unwanted impacts on biodiversity, as they may, for instance, provide sources for harmful invasive species\(^8\).

1.3. Urban growth challenges in the Helsinki Metropolitan Area

Today, Helsinki Metropolitan Area is a growing region with slightly over one million inhabitants, accounting for one fifth of the Finland’s population\(^9\). Besides Helsinki, the Helsinki Metropolitan Area includes the cities of Vantaa, Espoo, and Kauniainen. In addition, the Helsinki Metropolitan Area forms the heart of the larger Helsinki Region, which consists of 14 municipalities in total\(^10\). The concentration of the Finnish population to this region is expected to continue also in the future: it is projected to host approximately 1.8 million residents in 2050\(^11\).

A growing population has applied – and continues to apply - great pressures on the city planning and housing production. In the Helsinki Region, the most intense period of urban growth has

\(^{4}\) Goddard et al. 2010; Smith et al. 2011
\(^{5}\) e.g., hedgehog (Doncaster 1994), house sparrow (Chamberlain et al. 2007), common frog (Carrier & Beebee 2003)
\(^{6}\) Ojala 2011
\(^{7}\) e.g. Goddard et al. 2010; Henning & Ghazoul 2012
\(^{8}\) Marco et al. 2008; Seppälä 2011; Ministry of Agriculture and Forestry 2012: e.g. hogweeds (jättiputket), japanese rose (kurtturuusu) and spanish slug (espanjansiruetana) have been declared particularly harmful invasive alien species in Finland.
\(^{9}\) Statistics Finland 2012; City of Kauniainen 2012
\(^{10}\) City Of Helsinki Urban Facts 2009
\(^{11}\) HSL 2011
occurred since the Second World War. For example, during 1980-2005 the densely built-up areas\textsuperscript{12} of this area has increased by 55\% and the total housing stock by 64\%\textsuperscript{13}. The municipalities of the Helsinki region have collaborated in many ways concerning land use and housing in recent decades. This cooperation is necessary, as the region’s housing supply has impacts on the economic growth of the whole area\textsuperscript{14}. One example of this collaboration is the Helsinki Region’s Program for land use, housing and transport (called MAL 2017)\textsuperscript{15}. Related to this program, a new letter of intent concerning housing and land supply was signed between the state and the local authorities of Helsinki Region municipalities in June 2012. According to this document an average of 12\,000 - 13\,000 new dwellings will be constructed in the Helsinki Region annually\textsuperscript{16}.

One of the principal challenges in the Helsinki Metropolitan Area, besides answering to the housing supply, is the consolidation of the city structure\textsuperscript{17}. The community structures within region’s cities are characterized by urban dispersion (sprawl). Even Helsinki has a dispersed urban structure and is included among the most sprawled cities in Europe, when measured in terms of residential density\textsuperscript{18}. On the other hand, the cities in the Helsinki Metropolitan Area are very green with many parks and urban forests situated between the residential areas.

National aims of consolidating urban community structure include infilling practices, where new complementary housing is situated within or close to the existing community\textsuperscript{19}. Over the past decades, and in particular from the 1990s onwards, the official planning documents of Helsinki and Vantaa, have promoted a consolidation-orientated - i.e. a densification-orientated - city structure policy\textsuperscript{20}. This planning policy is based on the idea that a more compact city structure could provide many benefits to the city and the citizens. These benefits include opportunities to

\begin{itemize}
\item Here built-up areas are densely populated areas with at least 200 inhabitants and buildings max 200 m between each other. In Finnish: YKR-taajama.
\item Strandell & Harju 2008
\item Elämänmakuista asumista Vantaalla 2009, p.7
\item MAL Neuvottelukunta 2008: Helsingin seudun Maankäytön, Asumisen ja Liikenteen toteutusohjelma 2017
\item Ministry of the Environment 2012
\item MAL Neuvottelukunta 2008
\item Kasanko et al. 2006
\item Ministry of the Environment 2009
\item Vantaa kaupunki 1992, p.16; Helsingin kaupunki 1992, p.23; Vantaa kaupunki 2007, p.7; Helsingin kaupunki 2008, p.15
\end{itemize}
optimize the use of previously developed land and infrastructure, to promote public transportation, to revitalize established residential areas\textsuperscript{21}, and at the same time provide more homes for new inhabitants. In the low-density housing areas\textsuperscript{22}, the aims of the infill development include also the protection of local services, thus maintaining or even improving the quality of these areas for the residents. In addition, infill measures have been undertaken in order to attract new residents, especially families. This would diversify the population structure of the existing areas\textsuperscript{23}.

2. Infilling practices related to low-density housing areas in Helsinki and Vantaa

In the beginning of the year 2012 Helsinki hosted about 595 000 inhabitants and Vantaa about 203 000 inhabitants\textsuperscript{24}. The current master plan of Vantaa has made provision for population of 240 000 inhabitants in Vantaa by the year 2030\textsuperscript{25}. In Helsinki, the planning process of the new master plan has started in autumn 2012. According to the latest population prognosis (its fastest growth option) the population of Helsinki will be 860 000 in 2050, which means an estimated increase of 265 000 people. This would mean a need for the construction of over 190 000 new housing units in the next 40 years\textsuperscript{26}.

In addition to the local master and the detailed plans, city strategies\textsuperscript{27} and other programmes and planning documents\textsuperscript{28} can direct the growth and development of the city, including also the complementary building of the already established housing areas. At present, the housing policy in Helsinki is governed by the Land use and Housing implementation programme\textsuperscript{29}. Similarly to

\textsuperscript{21} e.g. Rauhala 1999; Vantaan kaupunki 1992, p.17; Helsingin kaupunki 2008, p.15
\textsuperscript{22} In this report, this term refers to a housing area, which includes detached, semi-detached, attached houses; i.e. dwellings with their own yard on the ground (in Finnish: pientaloalue)
\textsuperscript{23} Vantaan kaupunki 2005
\textsuperscript{24} City of Helsinki Urban Facts 2012
\textsuperscript{25} Vantaan kaupunki 2007, p.21
\textsuperscript{26} Helsinki City Planning department 2012
\textsuperscript{28} See e.g. for Helsinki: Santaoja et al. 2008, Tuominen et al. 2008; Vantaa: Henriksson & Jääskeläinen 2006
\textsuperscript{29} Helsingin kaupunki 2008
Helsinki, the Housing programme of Vantaa (2009-2017) presents the main aims and measures concerning housing issues. According to these programmes, Helsinki will construct approximately 5,000 and Vantaa 2,000 new dwellings annually. To achieve these housing production goals, both the construction of the new housing areas and considerable densification of the existing housing areas are required.

Recently, the housing production in Helsinki and Vantaa has focused on building blocks of flats due to the high demand of efficient housing. However, according to the current housing programmes, there is a need for a diverse housing production that includes, for instance, detached houses designed especially for the dense urban areas. In Vantaa, about 25% of the total housing stock consists of dwellings in detached/semi-detached houses, whereas in Helsinki these dwellings are about 8% of the total housing stock. Yet the total acreage of low-density housing areas – e.g. with detached and semi-detached houses - equals that of the high-density housing areas with blocks of flats even within the city of Helsinki.

Living in a suburban type of residential environment with single-family houses has been, and still is, highly valued in Finland. Indeed, according to the recent survey on residential environments - Residents’ Barometer 2010 – the most preferred housing type was a detached house. The majority of the respondents (55%) hoped to live in a single-family house. Especially families with children valued such houses. The most important criteria for the preferred residential area was its peacefulness, but also the opportunity to have an own yard was ranked high among the respondents.

Both Helsinki and Vantaa aim to provide the residents also with the most desired forms of housing types. Especially in Helsinki, the existing housing stock consists mainly of small

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30 Elämänmakuista asumista Vantaalla 2009
31 e.g. Östersundom in Helsinki and Marja-Vantaa in Vantaa
32 e.g. Siivola 2011
33 Statistical Yearbook of Helsinki 2011, p.31; Vantaan kaupungin tilastollinen vuosikirja 2011, p.46
34 See the special designed detached house type “Helsinki” in http://www.uutahelsinkia.fi/asumaan/helsinki-pientalo
35 Uudenmaan liiton tietopalvelu 2012
36 Tuominen et al. 2008
37 Strandell 2011
apartments and there is a considerable lack of large family-dwellings\textsuperscript{38}. In order to increase the number of small-scaled dwellings\textsuperscript{39} the cities have, on one hand, searched for new housing areas, and on the other hand, promoted the infill development of already established areas. The infill development of existing low-density housing areas in Helsinki and Vantaa can occur, for example, through\textsuperscript{40}:  

A) Expanding the residential area by zoning new housing plots  
B) Allowing the owners to subdivide plots with unused permitted building volume  
C) Allowing more permitted building volume  
   a. to the individual plot’s owner, or  
   b. to the whole residential area.

In practice, the infill process is guided by the local master and the detailed plans of the city. In Helsinki, especially during the 1970s, certain existing detached house areas were directed to a more compact form by detailed planning. The detailed plans allowed, for instance, the construction of row houses and attached houses to these areas. This resulted in changes in the forms of these detached house areas\textsuperscript{41}. Vantaa had also set a goal for achieving higher housing density rates in existing detached house areas in the 1970s. At first, the justification for the infill development was the opportunity to get sufficient number of residents and dwellings to these areas for the economic building of municipal infrastructure such as water and sewage networks. A well-functioning infrastructure was an important precondition for the planned growth of these areas\textsuperscript{42}.

In the 1990s, the master plan of Helsinki pointed out the residential areas that could be compacted more and those that still had maintained the original architectural and aesthetic

\textsuperscript{38} Statistical Yearbook of Helsinki 2011, p. 28  
\textsuperscript{39} i.e. detached and semi-detached houses and attached houses  
\textsuperscript{40} Tuominen et al. 2008, p.18; Kukkonen et al. 2000, pp.18,58; Elämänmakuista asumista Vantaalla 2009, p.19  
\textsuperscript{41} Helsingin kaupunki 1992, map 2  
\textsuperscript{42} Hirvonen 2005, p.89
values. The current master plans of Helsinki and Vantaa also point out certain housing areas based on their special historical, cultural and landscape values and direct the intensive infill developments elsewhere.

In general, the infill development of the low-density housing areas is a gradual process and it occurs mainly by the plot subdivisions. The detailed plan and its regulations form the basis for the plot subdivision. The detailed plan informs, among other things, the permitted building volume and possibly the building area of the plot. The subdivision possibilities depend on, for instance, the amount of unused building right, the location of the existing dwelling, and the general landscape features of the site (e.g., the type of the soil). As the initiative to plot division comes from the plot owner, the extent and the timing of this development may be uncertain from the city’s point of view. Recently, it has been estimated that up to 20,000 new detached houses could be built on the private lands with unused building right in Helsinki Metropolitan Area. The municipalities can encourage the development of the empty residential plots, for instance, by raising the real estate tax of these undeveloped sites. At present, the possible range of this tax is 1.0-3.0 %. Currently in Helsinki, the rate of it is 1.8 % and in Vantaa somewhat higher, 2.5 %.

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43 Helsingin kaupunki 1992, map 2  
44 Helsingin kaupunki 2003, p.179; Vantaan kaupunki 2007, p.57  
45 e.g. Vantaan kaupunki 2005  
46 Orvo Valtonen, City Survey Department of Vantaa (personal communication)  
47 Saarinen 2011  
48 e.g. Elämänmakuista asumista Vantaalla 2009, p. 11  
49 Silfverberg 2012; Verohallinto 2012, in Finnish rakentamattoman maan kiinteistövero (cf. general real estate tax, yleinen kiinteistövero, 0.8 % in Helsinki and 1.0 % in Vantaa)
3. Case study: Garden and yard area mapping

3.1. Study area selection

In this research, a residential area from Vantaa was selected as a case study area in order to measure the changes to the garden and yard areas resulting from the infill development. The case study area within the city district Ylästö was selected in cooperation with the Environmental Center of Vantaa for the following reasons. Firstly, Ylästö has a central location in Vantaa, and its detached house areas have a potential to be as an important green corridor area close to extensive green areas including also one nature conservation area. Secondly, it was possible to get the maps needed from the City Survey Department of Vantaa, as the aerial photograph (ortophoto) and the cadastral boundary map from this area were available in the digital form as early as the year 1998. Finally, it is interesting to compare the infill development occurred in Ylästö residential area to the development in the pilot case study area of Paloheinä in Helsinki: both areas had official goals to achieve a more compact form in the 1970s by the cities, but the results from these infill processes are very different in the present townscapes of the case study areas.

Because of the limited time of this research period, only the garden and yard areas of Ylästö residential area were mapped. However, from the Paloheinä area there is information available about the housing and planning history, including also the data from the occurred plot divisions.

3.2. Ylästö as a case study area

The city district Ylästö is located in the southern part of Vantaa and it follows the border of the city of Helsinki (Figure 1). The housing stock of the district consists of detached and semi-detached houses, as only about 3 % of the total housing stock are other kind of residential
buildings\textsuperscript{50}. Because the official city district area of Ylästö is large (8.7 km\textsuperscript{2}), a smaller district within it – hereafter called Ylästö4A – was chosen for the more detailed analysis (Figure 1).

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{map}
\caption{The city district Ylästö is located in the southern part of Vantaa. A smaller district, the case study area Ylästö4A, is situated within this area (Base map data from http://kartta.hel.fi/avoindata/).}
\end{figure}

This area is covered mainly by the local detailed plan called Ylästö4A (see Appendix 1), which has total acreage of 147 ha. Within Ylästö4A, the zoned residential area covers approximately 44 hectares. This is only about 30\% of the total zoning area, because extensive green areas (e.g.

\textsuperscript{50} Helsingin ympäristötilasto 2012
forests and fields) are also included within this detailed plan. Ylästö4A is bounded on the south by the road Ylästöntie and on the east by the stream Krakanoja. In the northern part of Ylästö4A is situated the nature conservation area Blåbärkärrsbergen (Appendix 1).

3.3. Measuring the changes in the garden and yard areas

Since there is no existing detailed register containing the information on the garden and yard sizes of the residential areas in the Helsinki Metropolitan Area, the basis of this work was a research on the aerial photographs (Figure 2).

**Figure 2.** The garden and yard areas measured from 389 plots in total: 115 plots in 1998 (in blue) and from 274 in 2009 (in yellow). The aerial photograph shown here is from the year 1998 (Source: City Survey Department, City of Vantaa).
The garden and yard areas of Ylästö4A were mapped from the aerial photographs taken in 1998 and 2009 by manual digitizing using Geographic Information System (GIS) techniques. The software MapInfo Professional 10.0 was used in the analysis. In the mapping, the base of the analysis was an aerial photograph implemented with a cadastral boundary map - showing the plot boundaries. The plot boundary maps and the aerial photographs were provided by the City Survey Department of Vantaa.

The coverage of garden and yard areas was measured from the residential plots with detached, semi-detached and attached houses. Garden and yard land (hereafter called garden land) refers to the vegetated land within the boundary of an existing property.

3.4. Mapping results

Overall, the garden land development in the Ylästö4A area has been twofold. On one hand, new gardens were created to this area as a result of the housing development and on the other hand, garden and yard areas were lost through infill development on the existing garden lands.

3.4.1. Total change in the garden areas

In 1998, the Ylästö4A area had 115 residential plots and the total amount of garden land within these plots was 18.0 hectares. As a result of the housing development and the plot divisions that had occurred in old plots, there were in total 274 plots in 2009 with 21.5 hectares of garden land within them (see Table 2). In 1998 the garden land represented approximately 72 % of the total area used for the housing, and in 2009 50 % (Table 2). Thus, new gardens were created to this area from the previously unbuilt land such as former field or forest areas. However, they were in general smaller in size than the ones already established in 1998. In addition, the needed infrastructure (e.g. roads) for the new housing reduced the size of the existing garden and yard areas in some locations.
Table 2. Results from the garden and yard area mapping in Ylästö

<table>
<thead>
<tr>
<th>Ylästö4A case study area</th>
<th>1998</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area zoned for housing in the detailed plans (ha)</td>
<td>44</td>
<td>46,3*</td>
</tr>
<tr>
<td>Area used for housing (estimate, ha)</td>
<td>25</td>
<td>43</td>
</tr>
<tr>
<td>Total garden and yard area (ha)</td>
<td>18,0</td>
<td>21,5</td>
</tr>
<tr>
<td>Range of garden and yard areas in plots (m²)</td>
<td>290 - 10810</td>
<td>34 - 5383</td>
</tr>
<tr>
<td>Number of residential plots</td>
<td>115</td>
<td>274</td>
</tr>
</tbody>
</table>

* an increase of 2,3 ha zoned to housing through the amendments to the original detailed plan

3.4.2. Garden area loss resulting in plot subdivisions

Since 1998 there have been 37 plot divisions in the Ylästö4A area. The plots have been divided into 2-5 smaller parts, resulting 56 new plots by the year 2009 (Table 3). In total, approximately 3.4 hectares of the previous garden land has been lost as a result of these plot divisions during 1998-2009. This is, overall, a 39 % reduction to the situation in 1998 and equals to a land size of seven football fields.

Table 3. The plot subdivisions during 1998-2009

<table>
<thead>
<tr>
<th>Ylästö4A case study area/ Plot subdivisions</th>
<th>1998</th>
<th>2009</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of plots</td>
<td>37</td>
<td>93</td>
<td>+56</td>
</tr>
<tr>
<td>Total garden and yard area (ha)</td>
<td>8,64</td>
<td>5,28</td>
<td>-3,36</td>
</tr>
<tr>
<td>Range of the garden and yard areas in the plots (m²)</td>
<td>760 - 10810</td>
<td>34 - 5383</td>
<td></td>
</tr>
</tbody>
</table>
When the existing plots are divided, the remaining gardens and newly created garden lands are naturally smaller in size and the habitats within them are more fragmented. The infill developments can have different environmental and ecological consequences, and these are discussed more in detail in the section 4.

3.5. Mapping limitations

There were a few problems related to the mapping of the garden areas. There was a limit to the details visible in aerial photographs, and especially the resolution of the aerial image from the year 1998 was not very good. This caused some inaccuracy defining the boundaries of the garden land. For example, sometimes small built structures and paved surfaces could not be identified and they were recorded as garden land. In some areas shadows were also problematic as they obscured the gardens.

3.6. Comparing the infill development of Ylästö and Paloheinä

In the 1970s, both the residential case areas, Ylästö in Vantaa and Paloheinä in Helsinki, were seen as suitable sites for the infill development by the growing cities. However, in the present townscapes of these areas the compaction processes are quite different. The main reasons for this are the differences in the areas’ housing and planning histories, and particularly in their detailed planning regulations considering the housing types allowed for these areas.

3.6.1. Housing histories

Ylästö residential area has grown gradually from a small village area to a modern housing area. It consists today mainly of detached and semi-detached dwellings with diverse appearances. Paloheinä represents an example from a special, but in Finland a common type of detached house
area. Paloheinä was constructed relatively quickly after the Second World War for housing war veterans and Finnish immigrants who had lost their homes. The construction of these residential areas, so-called veteran’s housing areas, was guided initially by various type drawings produced by the Settlement Committee of Agricultural Societies. Usually, the same kind of building type was used in the whole area, thus forming locally a very harmonious townscape.

In 1947, the land area of Paloheinä was purchased from the city of Helsinki by the state. A total of 541 sites were drawn to the Paloheinä area, and the building of the houses started quickly. The plots were spacious, typically ranging in 1000-2000 m² in area. In addition, there were 40 larger sites with the acreage of 3000-9000 m², and people living on them had a duty to farm the land for private use. The houses of Paloheinä were originally so-called type-planned houses (in Finnish rintamamiestaloja). They could be constructed entirely from wood, which was an important benefit during the period when other construction materials were scarce. In general, these detached houses were relatively small, usually one and a half storey high with saddle roof. Their gardens were spacious and they were planned for small-scaled food production.

Ylästö, on the other hand, has a long housing history as it has been inhabited already from the 15th century. The old historical road from Turku to Viipuri (King’s road, or now locally called Ylästöntie) goes through the area. Ylästö has been rural environment and there are, for example, old village-like areas and small farms still existing with many cultural and historical values. Thus, the housing development of Ylästö area has been more gradual and mosaic-like as the residents have been selling their lands at very different times.

3.6.2. Planning histories

In both case study areas, the detailed planning process involved also local residents. In Paloheinä, before the detailed plan was drawn up, the residents’ opinions about the most suitable housing types for the infill development were investigated by the city officials. The majority of residents

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51 Suikkari et al. 2008
52 Sädevirta et al. 2003
53 Haimi 2010, p.79
54 Suikkari et al. 2008
55 e.g. Karisto 2003
56 Vantaa alueittain 2010, p.111
(77%) preferred detached houses, semi-detached houses and row houses to blocks of flats. This survey result, among other things, influenced the detailed plan. Consequently, the basis for the infill development was decided to be a small-scaled housing production57. In Ylästö, the planning process involved besides the residents also city planners other than architects (e.g. environmental planners and engineers) and cooperation was done between different city departments58.

In Paloheinä, the local detailed plan came into force 1972 and it included the whole residential area. In this plan, the plot density rate (eₜ), which expresses the permitted building volume relative to the surface area of the plot, was raised from 0.2 to 0.3. The detailed plan allowed the construction of row houses and attached houses to the area. Of particular notice is the planning notation (1/400), which allows for each full 400 m² plot area a building to be constructed. This was different from the general decision made in Vantaa in the 1970s to consider 800 m² as the minimum plot size59. After the Paloheinä’s detailed plan came into force, the sales of the plots begun. Many of the original type-planned houses were replaced with row houses, resulting also the loss of the previous gardens60. After the year 1972 there has been over 250 plot divisions: usually the plot was divided into two or sometimes into three separate parts61. In general, the plot division rate has been greater in Paloheinä (about 6.4 subdivisions per year) than in Ylästö (about 3.4 subdivisions per year).

The drawing of the detailed plan of Ylästö (Ylästö 4A) started in 1992. It was based on the partial local master plan which came into force 1976 and on the housing production plan approved by the City council in 1989. In the partial local master plan of Ylästö the stated objective was to enable more efficient land use in the area, and to get sufficient number of residents to justify various services. However, in the detailed plan of Ylästö4A, the plot density rate (eₜ) is generally only 0.15-0.25. In town planning, the stated goals of the detailed plan were e.g. 1) to preserve the original detached house identity of the area, 2) to maintain the green corridors between nature areas and 3) to expand the housing area on the lands owned by the city.

57 Helsingin kaupunki 1971
58 Vantaan kaupunki 1998
59 Kukkonen et al. 2000
60 Haimi 2010 p. 91
61 Counted from the Cadastral boundary map of Helsinki GIS Service 2011
Therefore, the area efficiency remained slightly lower than targets stated\textsuperscript{62}. However, in order to achieve the stated population growth goals, there was a considerable need to expand the existing housing area.

It is stated in the Ylästö4A detailed plan that every house should have a defined yard area. In addition, the housing block areas may have a planning notation concerning the planting of trees and shrubs, i.e. in some locations the plots have a certain area that should have trees and shrubs within it. The houses can be linked together with small warehouses, for example, but the overall detached house identity should be maintained in the area\textsuperscript{63}.

3.6.3. Conclusions

It seems that there were very different objectives concerning the townscape in the two case areas: In Paloheinä the infill was considered so important that the rather dramatic change of the original character of the area was accepted with row house construction, whereas in Ylästö the identity of the area with detached and semi-detached houses was preserved. Especially in Paloheinä, the detailed plan didn’t have any plan regulations for the protection of the cultural history values of the area, and for this reason, the intensive infill densification was possible. However, in both residential areas, the planning process involved also the local residents and their opinions were taken into account in the preparation of the detailed plans.

In Ylästö, there was more unbuilt space available, so the growth pressure of the area could be still directed outwards from the established housing area. Although the detailed plan was a compromise between different goals, the preservation of green corridors between the nature areas and creating a sufficient buffer zone adjacent to the nature conservation area were considered important. Consequently, these connections and green areas were taken into account in the zoning. However, this infill development has caused generally a loss of garden habitats,

\textsuperscript{62} Vantaan kaupunki 1998
\textsuperscript{63} Vantaan kaupunki 1998
both when garden lands were built upon in the older parts of the housing area and when the
gardens associated with the new houses were smaller in size.

4. Environmental consequences of the infill process

In urban land use planning, intensification of the existing housing areas can be seen as a part of
the sustainable community planning, because a more coherent urban structure provides many
clear benefits to the city (e.g. economic savings)\textsuperscript{64}. However, intensive infilling can have harmful
environmental and ecological impacts, especially when green areas – such as parks and gardens -
are developed\textsuperscript{65}. The ecological functions provided by these green areas depend on their
configuration and internal composition\textsuperscript{66}. The loss of green areas negatively affects many
ecosystem processes, for example, the amount and internal make-up of these areas are important
determinants of local climate regulation, stormwater retention, and carbon storage and
sequestration\textsuperscript{67}. For instance, the research done in five UK cities showed that more densely
urbanized areas had smaller habitat patch sizes, greater predicted run-off and higher predicted
maximum temperatures, indicating a weakened ecosystem quality\textsuperscript{68}.

Because of the complementary building, the proportion of vegetated land decreases and the
amount of hard surfacing – such as paths, patios and parking areas – may increase in the garden
areas of residential areas\textsuperscript{69}. This can cause, for instance, potentially more local flooding
incidents\textsuperscript{70} as the vegetated land cover increases water infiltration into the soil and reduces
surface flows, which cause flooding\textsuperscript{71}. The increase of paved surfaces can affect also the local
microclimate by increasing sealed (i.e. “non-evapotranspiring”) surfaces\textsuperscript{72}. However, more

\textsuperscript{64} See e.g. Henriksson & Jääskeläinen 2006, p. 11
\textsuperscript{65} Pauleit et al. 2005, Yli-Pelkonen 2011
\textsuperscript{66} Smith et al. 2005
\textsuperscript{67} Pauleit & Breuste 2011
\textsuperscript{68} Tratalos et al. 2007
\textsuperscript{69} Smith et al. 2011
\textsuperscript{70} See e.g. Perry & Nawaz 2008
\textsuperscript{71} Whitford et al. 2001
\textsuperscript{72} Pauleit et al. 2005
research is needed to quantify the extent to which gardens contribute to localized air cooling. Similarly, the role of the vegetation as pollutant and noise absorbers should be studied more in detail in domestic garden environments\textsuperscript{73}.

After infill development, the abundance and diversity of vegetation may decrease, which results in the loss of suitable wildlife habitats. Gardens may also vary widely in the provision of features that may promote wildlife\textsuperscript{74}. Larger gardens tend to have more variety in the types of microhabitats that they provide for wildlife (e.g., trees, shrubs and other vegetation) than smaller gardens\textsuperscript{75}. At the scale of housing areas, it seems likely that residential blocks associated with large gardens will have greater habitat and vegetation diversity – and hence also greater overall species diversity - than similarly large residential blocks with smaller gardens\textsuperscript{76}.

The abundance and cover of trees has been shown to be an especially important habitat element for insect and bird species richness in gardens\textsuperscript{77}. In Finland, it is estimated that broadleaved trees have generally more biodiversity benefits than conifers. For example, goat willow (\textit{Salix caprea, raita}) and bird cherry (\textit{Prunus padus, tuomi}) are promoted as very beneficial trees for early pollinators such as bumble bees and butterflies – also in private garden environments\textsuperscript{78}. In smaller gardens, planting of fruit trees or shrubs (such as roses\textsuperscript{79} and lilacs) is a good option: they are also useful for many species, as they provide foraging sites and cover\textsuperscript{80}. Despite the frequent absence of native plants, the garden floras may show high levels of floristic diversity\textsuperscript{81}. Indeed, domestic gardens may provide a continuous supply of nectar and pollen, which different beneficial pollinators can utilize during the growing season\textsuperscript{82}.

\textsuperscript{73} Cameron et al. 2012
\textsuperscript{74} e.g. Gaston et al. 2005
\textsuperscript{75} Smith et al. 2005; Smith et al. 2011
\textsuperscript{76} e.g. Smith et al. 2011
\textsuperscript{77} Smith et al. 2006a; Daniels & Kirckpatrick 2006
\textsuperscript{78} Cajander 2010 p.34,42
\textsuperscript{79} Other species than japanese rose \textit{Rosa rugosa} , see Ministry of Agriculture and Forestry 2012
\textsuperscript{80} Cajander 2010 p.61, Mikkola et al. 2005 p.175
\textsuperscript{81} Smith et al. 2006b
\textsuperscript{82} e.g. Fussel & Corbet 1992; Henning & Ghazoul 2012
5. Summary and recommendations

In the Helsinki Metropolitan Area, growing urban population applies a great pressure on the housing production: besides developing new housing areas, the densification of established low-density housing areas has been considered necessary by the cities since 1970s. In addition to the cities’ master and detailed plans, the city specific strategies and housing programmes guide the infill development. In Helsinki and Vantaa, the infill development can occur, for example, through expanding the residential area by zoning new plots adjacent to the existing area or allowing the plot subdivisions within the area. However, because of the private ownership of the land in many old detached house areas, the densification process is uncertain from the city’s point of view. One way to encourage the development of empty residential plots is to raise the real estate tax of the undeveloped sites.

Until now, information on the extent of private gardens in the Helsinki Metropolitan Area was lacking. This study provided pilot methods for quantifying the effect of infill development on garden lands in the residential area. The mapping results of this and previous research showed that private gardens constitute an important part of the area used for housing in the investigated case study areas. In order to examine the scale of changes to the garden areas due infill development, the extent of garden lands were measured in Ylästö area (44 ha) in Vantaa. The change in the garden land cover was quantified by comparing aerial photographs taken in 1998 and 2009. Overall, the residential area of Ylästö has expanded considerably during the study period. Thus, the total garden land area has increased by 3.5 hectares because of the construction of new detached houses with gardens. However, in 1998 the garden land represented 72 % of the land used for housing and in 2009 only 50 %. New plots had smaller gardens, and the new infrastructure (e.g. roads) reduced the size of the gardens in some locations. In addition, the plot subdivisions that occurred in the old plots reduced the amount of garden land. Due to this infill development, a total of 3.4 ha garden land was lost (a 39 % reduction to the situation in 1998). It was discovered that the planning and housing histories are very important when considering the infill development of certain housing area.
Although Ylästö now has more gardens, the quality and composition of these gardens may differ considerably from the original gardens. However, this study investigated only the general change to the garden land, and in future it would be beneficial to map also the different garden structures and vegetation elements (e.g. paved surfaces, trees, shrubs) more in detail. Other studies have shown, for instance, that the amount of hard surfacing - such as patios, paths, and parking spaces - may increase due to the development. This can cause, for instance, potentially more local flooding and changes in local microclimate regulation. When the existing plots are divided, the remaining gardens and newly created garden lands are naturally smaller in size and the habitats within them are more fragmented. After development, the proportion of vegetated land decreases, resulting in a loss of wildlife habitat.

Overall, private gardens are unique habitats, where the management choices and preferences of individual owners play a very important role, particularly when considering the possibilities of these environments to support urban biodiversity. Local authorities can exercise only very limited control over gardens. Therefore, in order to maximize the garden land potential for urban biodiversity, it is essential to engage the garden owners themselves\textsuperscript{83}. An important goal for future work would be to raise the awareness of the environmental and ecological values of urban private gardens – both as an individual habitat patch and as a part of the wider green space resource. Furthermore, it would be beneficial to encourage the residents to actively share their local ecological knowledge for environmental planning purposes. Hence, closer collaboration between urban planners, ecologists, residential associations and individual gardeners is needed.

\textsuperscript{83} Smith et al. 2011
Recommendations

More research should be conducted on the extent of private gardens in Helsinki Metropolitan Area. Baseline information is needed on the extent and distribution of private gardens. This could be used for monitoring long-term change of urban green space, taking into account both regional and local levels.

More research should be conducted on the potential biodiversity benefits of private gardens. It is recommended that the research would be extended to also cover the possible negative impacts of gardens, in particular, the harmful invasive species. In addition, more information is needed on the role of the gardens as green corridors between nature areas.

Information gathering possibilities include:

- Species inventories. The abundance and distribution of species of particular conservation interest e.g. bats, flying squirrel, amphibians, and pollinators. Also the abundance of harmful species (e.g., particularly from gardens adjacent to nature conservation areas or other sensitive areas)
- Applying research methods that involve the local residents. For example, Espoo investigated the distribution of harmful invasive plant species by using an internet based survey
- Encouraging the residents to actively share their local ecological knowledge. Closer collaboration between urban planners, ecologists, residential associations and individual gardeners is needed.

The city can offer information on “wildlife gardening” through different means including:

- Garden campaigns, events and competitions. For example, in the UK the city of Sutton has “Sutton in Bloom” event with a category for Best Wildlife Garden
- Garden advise. For example, lists of beneficial or harmful plant species. Highlighting e.g. the importance of plant diversity and trees

Urban planners can influence the form of the future housing areas. A reasonably large share of gardens in residential areas is important for the maintenance of biodiversity and ecosystem services, and should be ensured in all land-use planning decisions.

In Germany and Sweden there is a special planning approach called Biotope Area Factor (BAF) or Green Area Factor (Vihertehokkuus). This approach is targeted at promoting the presence of vegetation in the built environment (see e.g., Kazmierczak & Carter 2010). This planning concept could be useful also in Finland when planning new housing areas. In Jyväskylä this method will be piloted in one detached house area (Jyväskylän asuntomessut 2014). One useful planning concept could also be “ecological land-use complementation”, where urban gardens are clustered adjacent to other green spaces (e.g. forest patches or crop fields) by zoning for the support of local ecosystem services and wildlife (see Colding 2007).


Jyväskylän asuntomessujen esite (Green Area Factor i.e. vihertehokkuus in Jyväskylä):
http://www2.jkl.fi/kaavakartat/asuntomessut/green_factor_esite.pdf


Pauleit, S., Ennos, R. & Golding, Y. 2005: Modeling the environmental impacts of urban land-use and land cover change – a study in Merseyside, UK. — Landscape and Urban Planning 71 (2-4): 295–310.


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7. References and glossary of terms


Pauleit, S., Ennos, R. & Golding, Y. 2005: Modeling the environmental impacts of urban land-use and land cover change – a study in Merseyside, UK. — Landscape and Urban Planning 71 (2-4): 295–310.


http://tietopalvelu.udenmaanliitto.fi/asuminen/.fi_FI/asuminen_johdanto/


The cover photograph: Anna Ojala

Glossary of terms

A more coherent urban structure
A more coherent urban structure means that new construction should mainly be located in areas that are already built through controlled expansion and relying on the existing infrastructure. Increasing coherence refers also to the location of new buildings inside already built areas by infill building, especially in low density areas (Ministry of the Environment 2009).

Block area
Area (zone) in a local detailed plan, indicated for various types of building purposes as its principal intended use.

Building ordinance
A statutory local municipal code giving guidelines for building. The building ordinance regulations may concern building sites, the size and location of buildings, a building’s suitability for its surroundings, the
method of construction, planting, fences and other constructions, management of the built environment, organization of water supply and drainage, definition of areas requiring planning, and other corresponding matters of local importance pertaining to building (COMMIN 2007).

**Building permit**
A permit required to construct or to substantially change a building. The local building control authority approves building permits (COMMIN 2007).

e = the total area of buildings in relation to land area

**Ecosystem services**
Material and immaterial benefits that people obtain from nature

**Ecological corridor**
Corridor of variety width consisting of green spaces such as forests or field-forest continuum which species can use when moving or migrating through unfavourable regions.

**Plot density**
A property of a plot accordant with a local detailed plan, illustrating the relative volume of building. Plot density is usually indicated by the **density rate**, which is a ratio of built-up or planned building volume (indicated as the permitted building volume gross floor area) on the plot area to the square area of that same plot area. (COMMIN 2007)

**Private garden**
For the purpose of this study, private (domestic) gardens are defined as the private spaces adjacent to or surrounding dwellings.

**Private land**
A land owned by a private owner, not by the state, a rural municipality or a city (COMMIN 2007)
Appendix 1: Map of the detailed plans within the Ylästö4A case study area.

The detailed plans (2-5) and one conservation area (Blåbäckärrsbergen) within the Ylästö4A case study area (1). The base map is provided by the City Survey Department of Vantaa. After the year 1989 there have been eight amendments to the detailed plans.
Appendix 2. Useful websites

A. Infilling, compacting building (in Finnish)


B. City planning (in Finnish)


- In Germany and in Sweden there is a special planning approach called “Biotope Area Factor”, i.e. BAF or “Green Area Factor”. This approach is targeted at safeguarding and enhancing the presence of vegetation in the planning areas.

  Jyväskylän asumomessujen esite (Green Area Factor i.e. vihertehokkuus in Jyväskylä): http://www2.jkl.fi/kaavakartat/asumomessut/green_factor_esite.pdf.