Evaluation of plant species in home gardens: A case study of Batumi city (Adjara)

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Abstract: The home vegetation features in urban landscapes play an important role as indicators of urban biodiversity potential. They are also ornamental resources in the context of landscape appreciation for the human environment. This study gives information about existing plant species that have already been determined and evaluated according to plant characteristics (aesthetic & visual, functional, socio-cultural and ecological) in the gardens of detached houses and housing estates in home areas in the city centre of Batumi. Therefore, this paper provides quantitative information on the distribution of plant species in the urban residential landscape areas of Batumi city (Adjara). This study covers a total of 100 home gardens. The home gardens are mainly based on 4 different types which are traditional housing, detached housing, villa, and apartment blocks-housing estates. The results showed that there were 147 species from 61 different families in these home gardens. There are more exotic species in residential gardens. Furthermore, the richness of species and diversity are positively related to new urban development areas.

However, it was clearly determined that the vegetation structure has a tendency towards ornamental purposes, which is different from detached housing gardens and villa gardens where fruit and other benefiting species are available.

Keywords: Floral and landscape assessment, Home garden vegetation, Urban biodiversity, Batumi (Adjara)

Konut bahçelerindeki bitki türlerinin değerlendirilmesi: Batum (Acara) kent merkezi örneği

Özet: Konut bahçelerinde kullanılan bitki türleri kent peyzajında belirleyici rol aradenin biyoçeşitlilik potansiyelinde önemli bir yer tutar. Bunun yanında peyzaj kalitesi arttırılmak adına dekoratif bir kaynak sağlar. Bu çalışma, Batum kent merkezindeki konut bahçelerinde kullanılan bitkiler hakkında da nicel bilgiler vermektedir. Çalışma alanında toplam 100 konut bahçesi araştırma yapılmıştır. Bu konut bahçeleri yerel evler, özel konulatar, villalar ve apartman bahçelerinde olmak üzere 4 farklı tipi kategorisinde ele almıştır. Araştırmanın konut bahçelerinde 61 farklı familya aitt 147 bitki türine rastlanmıştır. Araştırmanın konut bahçelerinde, özellikle fazla egzotik bitki türine rastlanmıştır. Özellikle tür çeşitliliğinin fazlalığı ve farklılığı yeni yerleşim yerlerinde daha çok göz çarpmaktadır. Bu nedenle, çalışmadan net olarak görülmektedir ki yerleşim merkezindeki siso bitkilerinin kullanımı villa ve özel konulatarla yerin yer meyve ve diğer fayda getiren türlerle bırakmaktadır.

Anahtar kelimeler: Flora ve peyzaj değerlendirme, Konut bahçesi bitkileri, Kentsel biyoçeşitlilik, Batum (Acara)

I. Introduction

In recent years, there has been an increasing interest in examining the role of gardens (Mazumdar and Mazumdar, 2012). Home gardens occur in regions with either high or low population densities and are often located in proximity to human dwellings, often delimited from their surroundings by hedges, fences or other barriers. The gardens are markedly different from the surrounding landscape. The gardens are markedly different from the surrounding landscape (Guarino and Hoogendijk, 2004; Galluzzi et al., 2010; Agbogidi and Adolor, 2013).

Home gardens, whether in rural or urban areas, are characterized by a structural complexity and multifunctionality, which brings different benefits to ecosystems and people (Galluzzi et al., 2010). Gardens are powerful settings for human life, transcending time, place, and culture (Gross and Lane, 2007; Kiesling and Manning, 2010), as well as the connection between gardening and psychological well-being (Kaplan, 1973; Francis and Hester, 1990; Kaplan and Kaplan, 1990; Kuo and Taylor, 2004). Contact with and access to nature has potential benefits for both physical and mental health (Frumkin, 2003), which helps reduce effects of disease (Ulrich, 1984), reduces stress in children (Wells and Evans, 2003) increases cognitive functioning (Shibata and Suzuki, 2002), contains memory, of past landscapes, trees and plants (Bhatti and Church, 2001; Thompson, 2005), childhood play and hideaway spaces (Cooper, 1992; Francis, 1995), material artefacts, such as gazebos, furniture, tools, and social interaction and formation of significant relationships with friends, parents (Bhatti and Church, 2001).

Urban and countryside home gardens contribute to the functioning and sustainability of the urban ecosystem.
(Engels, 2001), providing benefits such as pollination, a shelter for micro- and macro-fauna and allowing gene-flow between plant populations in and out of the garden. The increasingly important role of urban ecosystem, which is no longer connected to home gardens, contributes to improving air quality, reducing CO2 emissions and temperatures and, providing citizens with livelihood opportunities as well as social, income and recreational activities (Van Veenhuizen, 2006; Viljoen et al., 2009). Vegetation plays a key role in urban environments by providing food, breeding sites and shelter for animals and plants, and also by modifying the microclimate (Dickman, 1987). Home gardens’ specific relevance for conservation purposes resides in their capacity to represent biodiversity at multiple (Hodgkin, 2001)

Improving urban environments for biodiversity will not only be beneficial to human individuals and communities inhabiting those areas, but will also be advantageous for biological conservation. In developed regions where intensive use of the wider landscapes, particularly through agriculture, has resulted in the decline of the population of species, therefore urban areas are becoming increasingly important for sustaining regional abundance (Beebee, 1997; Gregory and Baille, 1998; Mason, 2000; Bland et al., 2004; Peach et al., 2004).

Studies carried out in various countries demonstrate that high levels of plant genetic diversity, especially in terms of traditional crop varieties and landraces, are preserved in home gardens, providing services such as pollination, refuge for micro- and macro-fauna, home gardens are important social and cultural spaces where knowledge related to agricultural practices is conveyed and allowing for plant-to-plant populations inside and out of the garden (Gullazzi et al., 2010).

Homegardens have besides the vertical structurthe closest mimics of natural forests in their structure and homegardens also have distinct horizontal structure which together help in the efficient utilization of water, light and space, and support diverse wildlife species besides meeting various social and basic needs of families. Homegardens are important in situ conservation sites and in accordance with the Convention of Biological Diversity Article 7-8 and 10(c), inventorytization of such areas can help in the identification and conservation of biodiversity while assessing the sustainability of the system. In order to understand the structure and function of homegardens, it is necessary to analyse both socio-economic and biophysical aspects of these systems (Fernandes and Nair, 1986; Kumar et al., 1994; Santhakumar et al., 1996; Mendez et al., 2001; Das and Das, 2005).

Species diversity in a homegarden can range from less than five to more than 100 (Mendez et al., 2001), and therefore can be important islands of diverse plants. Yet systematic study tends to suffer from low sample sizes (i.e., few homegardens sampled), or limited taxonomic treatment (e.g., surveying only trees), so the capacity of homegardens to contribute to biodiversity conservation in Batumi (Adjara) remains understudied.

This study contributes to the knowledge on biodiversity in cities focusing on the species in the city of Batumi (Adjara). The present paper explores the relationship between resilience types, distance to the city centre and plant species diversity. In this context, ornamental woody species in the selected settlement forms were analyzed. In addition to this article, this article provides a base for further scientific studies in the region.

2. Materials and methods

2.1. Study area

Batumi is a city located on the coast of the Black Sea. It is located in the southwest of Georgia. Georgia borders Russia in the north, Azerbaijan-Armenia in the south, Turkey in the southwest, and the Black Sea in the west (Figure 1). Batumi is the capital of the autonomous republic of Adjara and has approximately 130,000 inhabitants. The city of Batumi covers approximately 19 km² (Pepping, 2012). It represents a crossroads of geographical-genetic elements characteristic to the Mediterranean, Iran-Turkish and northern hemispheric ancient flora. This landscape geobotanical zone is comprised of wetlands, unique lakes and marshes, various types of mountainous steppes, mountainous xerophyte shublands, dry and mesophilous meadows and relict remnants of forests once common in Javakheti upland (Akhalkatsi et al., 2009). In this region also, an abrupt transition takes place from the humid subtropic plains to the sub-alpine and alpine landscapes of Achara-Trialeti range, the south slope of the East Caucasus and climate dividing the Gombori range (with slightly developed sub-alpine landscapes), and rising above plains surrounding (Bondyreva et al., 2008).

The region is divided into three floristic provinces Euexine, Armeno-Iranian, and Caucasian. The Euexine province is located in the extreme western part of this region on the Adjara Imereti range (Ketskhoveli, 1959; Akhalkatsi et al., 2009). A humid subtropical mountainous climate with cold winters and mild summers is characteristic to the transient climatic zone located south-west of the Adjara-Trialeti Mountain System and Turkey-Georgia border. The mean annual precipitation in the transitional climate region is approximately 508-654 mm at the Georgian-Turkish border. The majority of the precipitation falls between April and October, with May and June being considered the months with most rainfall (82 mm/month and 88 mm/month, accordingly). The driest months of the year in these parts are December (32 mm/month) and January (30 mm/month) (Akhalkatsi et al., 2009). It is probably fair to say that Batumi has become one of the most attractive places on the Black Sea coast. With a subtropical climate and a location on the shores of the Black Sea, Adjara was well known in the Soviet Union as a holiday paradise for prominent leaders and a key area for growing crops such as tea, tobacco, and citrus. As for agriculture, Adjara used to be one of the main producers of citrus fruits, tea, nuts and tobacco in the Soviet Union. Accordingly, a high number of food processing factories were constructed in Adjara which are currently producing very little or out of use. Currently, the main source of income for the rural population is subsistence-type agriculture in small land plots and cattle farming (Frederiksen, 2012).
2.2. Floristic analysis and field sampling

The present research provided floristic information that form urban plant species of the home gardens in the city of Batumi. A botanical inventory was conducted in the homegardens of 100 randomly selected sample households across five regions in Batumi (Figure 2) from Batumi city centre, Avgia, Kvariati, Gonio and Sarpi districts from the study site.

Except the city center, there are scattered settlements due to the topographical structure. All the sample spaces are selected from the home areas in the city. Selection of households was based on home types. Sample spaces are selected at random from home garden located in a home area surveyed. The location and altitude of each sample household was recorded by a global positioning system (GPS). A botanical inventory was conducted twice in each selected homegarden. Thus, the seasonal variation in floristics and structure was assessed.

To gather information about plant materials field survey forms were employed. These forms, which will be the basis of the analyses to be conducted later on, contained information such as housing type, name of each plant material, number of these materials, places of use and properties of usage in the landscape and purpose. Measurements, site observations, photographs and sample collection were performed and taken during the field studies. Within the sample sites, all woody tree, shrub, ground cover, vine plant species were recorded for the 2014–2015 period. Habitats were first sampled in the spring, then marked and resampled in summer in order to record the presence of the communities that segregate their phenological peak.

All species present in each sampled homegarden were identified and recorded by the botanical name, or by local name that was later confirmed from the Artvin Coruh University forest faculty Herbarium if the botanical name was not immediately known. All individuals of trees and shrubs were counted and recorded except the individuals in hedgerows. Plant species distribution was designated by a phase of general analyses, and then one of the most common plant species in private gardens was evaluated according to residence types (Figure 3) and their distance to the city centre. Residence types and distance from the city centre as follows;

Residence type:
- Type1: Traditional housing
- Type2: Detached housing
- Type3: Villa
- Type4: Apartment blocks and housing estates

Distance from the city centre:
- Distance1: 10–15 km (D1 - Kvariati and Sarpi home areas)
- Distance2: 5–10 km (D2 - Avgia and Gonio home areas)
- Distance3: 0–5 km (D3 - City centre)
Figure 3. Examples of residence types in the study area

Research, we assessed plant species for landscape preferences in different residence types. Evaluation was done according to characteristics of species. The species were categorized on the basis of the features of aesthetic (flowering, fruiting, leaves and calligraphic effect, trunk-shoot, habits, texture) and functionality (fruit benefiting, barrier, wall covering, direction, screening, accent, shade, wildlife, hedge) dimensions.

2.3. Data analysis

Each species recorded was classified by family. Mean diversity and occurrence values of the plant species were calculated for each home setting. Various indices have been used to measure diversity within an assessed point. These diversity indices were used to assess species diversity based on the floristic data. Each species recorded were classified according to the type of housing they were found. The species richness was described as the number of species encountered in each sample site. For the quantification of species occurrence, frequency values are given. Each species recorded were detected according to the type of housing they were distribution of the evergreen and deciduous plant species. Each species recorded were detected according to distance of places to the city centre, plant species show differences among the areas. Hibiscus rosa-sinensis, Pyrus communis, Pyrus domestica, Rhus typhina, Abelia grandiflora, Citrus reticulata, Fatsia japonica, Laurus nobilis, Lonicaeae tatarica, Nerium oleander, Pelargonium domesticum, Philadelphus coronarius and Robinia pseudoacacia were determined frequently in housing in the city centre. Species that were found within a residential area of 5-10 km distance to the city centre were: Biota orientalis, Fatsia japonica, Hibiscus rosa-sinensis, Tilia cordata, Vitis sylvestris, Jasminium fruticans, Juniperus horizontalis, Musa xparadisiaca, Phoenix canariensis, Pyrus communis, Pyrus domestica, Rhododendron ponticum, Sambucus nigra, and Hosta sp. Similarly, Washingtonia robusta, Hosta spp., Musa xparadisiaca, Pelargonium domesticum, Tilia cordata and Hedera helix were mostly recorded in a residential area 10-15 km distance to the city centre.

3. Results

3.1. Floral assessment

3.1.1. Frequency of ornamental species

A total of 147 ornamental plants were recorded in the 100 sample sites of the city of Batumi. According to residence types, some differences were recorded in the use of plant species. As seen in Table 1, Pyrus domestica, Citrus reticulata, Rosa spp., Rubus fruticosus, Jasminium fruticans, Tilia cordata, Citrofortunella microcarpa and Camellia japonica were determined in traditional houses. Juniperus sabina, Camellia japonica, Citrofortunella microcarpa, Hibiscus rosa-sinensis, Lauraceae officinalis, Pyrus communis, Pyrus domestica, and Salix alba were encountered in detached houses. Similarly, Camellia japonica, Philadelphus coronarius, Citrofortunella microcarpa, Lauraceae officinalis, Sambucus nigra, and Rhus typhina were mostly recorded in villas. Fatsia japonica, Citrofortunella microcarpa, Jasminium fruticans, Pyrus domestica, Vitis sylvestris and Phillostachys bammusoides are some of the most preferred species in the context of apartment blocks-housing estates and villas. According to distance of places to the city centre, plant species show differences among the areas. Hibiscus rosa-sinensis, Pyrus communis, Pyrus domestica, Rhus typhina, Abelia grandiflora, Citrus reticulata, Fatsia japonica, Laurus nobilis, Lonicaeae tatarica, Nerium oleander, Pelargonium domesticum, Philadelphus coronarius and Robinia pseudoacacia were determined frequently in housing in the city centre. Species that were found within a residential area of 5-10 km distance to the city centre were: Biota orientalis, Fatsia japonica, Hibiscus rosa-sinensis, Tilia cordata, Vitis sylvestris, Jasminium fruticans, Juniperus horizontalis, Musa xparadisiaca, Phoenix canariensis, Pyrus communis, Pyrus domestica, Rhododendron ponticum, Sambucus nigra, and Hosta sp. Similarly, Washingtonia robusta, Hosta spp., Musa xparadisiaca, Pelargonium domesticum, Tilia cordata and Hedera helix were mostly recorded in a residential area 10-15 km distance to the city centre.

Figure 4. Distribution of the species by families
Moreover, distribution of plant species was evaluated according to residence type. It was observed that the number of plant species is 102 in traditional residential gardens, 122 in detached house gardens, 125 in villa gardens, and 118 in housing estate and apartment buildings gardens (Figure 5). We categorized places according to distance to city centre, these are; D3 covering an area of 0-5 km to city centre with 101 species, D2 (5-10 km) with 144 species, and D1 (10-15 km) with 126 species (Figure 6). As can be seen in the Figure 5, more plant species were recorded in villa gardens (Type3) and in detached house gardens (Type2). We can see in the Figure 6, more plant species in D2 (5-10km) home gardens, which is located in the residential areas.

Distribution of the evergreen and deciduous plant species in terms of housing types is shown in the Figure 7. Here, the most common species in Type1, Type 2 and Types3 are deciduous, while the most common species in Type 4 are evergreen species (Figure 7).

### Table 1. Frequency of the species recorded in different residence types and distance from the city centre (only those of above 20% were given)

| Plant species      | Family            | Type1 (30) | Type2 (35) | Type3 (15) | Type4 (20) | Distance |
|-------------------|-------------------|------------|------------|------------|------------|----------|
|                   |                   | D1 (10-15 km) | D2 (5-10 km) | D3 (0-5 km) |
| Rubusfruticosus    | Rosaceae          | 39.0        | 72.5       | 71.1       | 72.5       |          |
| Hibiscus rosa-sinensis | Malvaceae       | 59.8        | 96.6       | 96.6       | 96.6       |          |
| Fatsia japonica    | Araliaceae        | 47.4        | 29.7       | 29.7       | 29.7       |          |
| Hedera helix       | Araliaceae        | 53.1        | 41.3       | 41.3       | 41.3       |          |
| Hosta spp.         | Liliaceae         | 36.8        | 55.2       | 55.2       | 55.2       |          |
| Ilex colchica      | Aquifoliaceae     | 36.8        | 15.6       | 15.6       | 15.6       |          |
| Jassminumfruticans | Oleaceae          | 87.4        | 72.5       | 72.5       | 72.5       |          |
| Juniperus chinensis| Cupressaceae      | 26.5        | 55.2       | 55.2       | 55.2       |          |
| Juniperus communis | Cupressaceae      | 41.6        | 49.5       | 49.5       | 49.5       |          |
| Kerria japonica    | Rosaceae          | 26.5        | 59.8       | 59.8       | 59.8       |          |
| Laurus nobilis     | Lauraceae         | 39.0        | 59.8       | 59.8       | 59.8       |          |
| Liquenaria tatarica| Caprifoliaceae    | 26.5        | 51.6       | 51.6       | 51.6       |          |
| Meconopsis betonicus| Papilionaceae    | 72.5        | 59.8       | 59.8       | 59.8       |          |
| Nerium oleander    | Apocynaceae       | 53.1        | 41.3       | 41.3       | 41.3       |          |
| Philadelphus coronarius | Saxifragaceae | 53.1        | 51.6       | 51.6       | 51.6       |          |
| Phoenix canariensis| Cactaceae         | 29.7        | 59.8       | 59.8       | 59.8       |          |
| Phylllostachys bambusoides| Gramineae | 26.5        | 79.2       | 79.2       | 79.2       |          |
| Prunus cerasifera "atropurpurea" | Rosaceae | 39.0        | 79.2       | 79.2       | 79.2       |          |
| Pyrus communis     | Rosaceae          | 32.2        | 49.5       | 49.5       | 49.5       |          |
| Pyrus domestica    | Rosaceae          | 96.6        | 49.5       | 49.5       | 49.5       |          |
| Quercus pyrenaica  | Fagaceae          | 25.6        | 71.1       | 71.1       | 71.1       |          |
| Rhododendron ponticum| Ericaceae      | 47.4        | 51.6       | 51.6       | 51.6       |          |
| Rhus aromatica     | Caprifoliaceae    | 62.4        | 79.2       | 79.2       | 79.2       |          |
| Robinia pseudoacacia| Leguminosae    | 50.6        | 42.4       | 42.4       | 42.4       |          |
| Rosa spp.          | Rosaceae          | 89.1        | 59.8       | 59.8       | 59.8       |          |
| Rubus fruticosus   | Rosaceae          | 89.1        | 51.6       | 51.6       | 51.6       |          |
| Salix alba         | Salicaceae        | 66.0        | 71.1       | 71.1       | 71.1       |          |
| Sambucus nigra    | Adoxaceae         | 39.0        | 85.8       | 85.8       | 85.8       |          |
| Syringa vulgaris   | Oleaceae          | 36.8        | 49.5       | 49.5       | 49.5       |          |
| Tilia cordata      | Tiliaceae         | 74.2        | 42.4       | 42.4       | 42.4       |          |
| Vitex vinifera     | Vitaceae          | 36.0        | 44.2       | 44.2       | 44.2       |          |
| Washingtonia robusta| Cactaceae      | 72.5        | 51.6       | 51.6       | 51.6       |          |

*Residence types (Type1—Traditional housing, Type2—Detached housing, Type3—Villa, Type4—Apartment blocks and housing estates).

*Distance from the city centre (D1—10-15 km, D2—5-10 km, D3—0-5 km).

*Number of sampled sites is given in parenthesis.

### 3.1.3. Evaluation by use of plant species in the garden

In Figure 8, the number of plant species used in gardens is shown in terms of place usage, distribution of evergreen deciduous plant species and according to housing types. Figure 8 shows that, while deciduous plants are mainly used in all part of gardens especially in traditional and detached houses, evergreen plants are mainly used in the front part of gardens especially in apartment/housing estate gardens, deciduous plants are mainly used in side and back part of gardens especially in villa and apartment-housing estate gardens. While flowery plant species such as Laurocerasus officinalis, Magnolia liliflora, Prunus cerasifera "atropurpurea", Spirea vanhoutrii, Jasminum fruticans, Wisteria sinensis, Forsythia x and species such as Citrus limonum, Citrus reticulata, Citrus sinensis, Diospyros kaki, Eriobotrya japonica, Ficus carica, Vitis vinifera, Panica granatum, Rubus phalystrophlos and Pyrus domestica are preferred in the side and back gardens of traditional and detached houses. People who live in these kinds of houses prefer to use these plant species in the widest part of their gardens, in their side gardens and backyards, since they make a profit from these plant species.
3.2. Landscape assessment

3.2.1. Landscape preference analysis for plant species

The species were dealt with on the basis of the features of visual-aesthetic appeal and functionality was assessed based on landscape preferences used in home types. Regarding all species among the total of 100 sampled sites, the species that were mostly preferred had the visual-aesthetic characteristics including textural (49.3%), habitual (43.4%), fruiting effect (28.1%), and flowering effect (27.7%) characteristics. The functional characteristics that were mostly preferred were: an accent (39.8%), hedge (27.1%) and shade (25.5%) (Table 2).

Table 3. illustrates the relationship between plant characteristics, residence types and distance to the city centre. In this correlation analysis, significant relationship was found among the species’ plant preference use of flowering effect, fruit benefiting, considering the first 20 plants included. In total residential landscape types, the flowering effect and fruiting effect were strongly related, while leaves effect, habits, texture, wall covering, trunk-shoot, screening and wildlife parameters were negatively correlated at p<0.01 and 0.05. Distance to city centre was negatively correlated with the flowering effect, fruiting effect, calligraphic effect, fruit benefiting, wall covering, barrier and shade were strongly related while habits, texture, accent, direction and wildlife parameters at p<0.01 and 0.05. Namely, it can be clearly mentioned that the individual characteristics of planting species could be affected by residential land use.

| Plant characteristics | Preferred species number | Frequency (%) | Plant characteristics | Preferred species number | Frequency (%) |
|-----------------------|--------------------------|---------------|-----------------------|--------------------------|---------------|
| Flowering effect      | 76                       | 27.7          | Hedge                 | 74                       | 27.1          |
| Fruiting effect       | 77                       | 28.1          | Fruit benefiting      | 50                       | 18.3          |
| Leaves effect         | 75                       | 27.4          | Barrier               | 52                       | 18.9          |
| Trunk-shoot           | 35                       | 12.7          | Wall covering         | 28                       | 10.2          |
| Calligraphic effect   | 54                       | 19.7          | Direction             | 53                       | 19.3          |
| Habits                | 119                      | 43.4          | Screening             | 60                       | 21.9          |
| Texture               | 135                      | 49.3          | Accent                | 109                      | 39.8          |
|                       |                          |               | Shade                 | 70                       | 25.5          |
|                       |                          |               | Wildlife              | 63                       | 23.0          |
Table 3. Spearman’s rank correlation coefficients between plant species characteristics, residence types and distance to city centre in Batumi city (Only major 20 species in each residence type and distance from the city centre (D))

| Plant characteristics | Type1 | Type2 | Type3 | Type4 | D1 | D2 | D3 |
|-----------------------|-------|-------|-------|-------|----|----|----|
| Aesthetic-visual characteristics |       |       |       |       |    |    |    |
| Flowering effect     | 0.250* | 0.328 | 0.340* | 0.680** | 0.585** | 0.692** | 0.512** |
| Fruiting effect      | 0.626** | 0.514* | 0.534** | -0.235 | -0.289* | 0.672** | 0.580** |
| Leaves effect        | -0.131 | -0.351** | 0.376* | 0.321* | 0.366* | 0.025 | -0.06 |
| Trunk-shoot          | -0.084 | -0.093 | 0.164 | 0.254* | 0.076 | 0.246 | -0.133 |
| Calligraphic effect  | -0.131 | 0.309* | 0.139 | 0.273* | 0.378** | 0.280* | -0.175 |
| Habit                | -0.394* | -0.418** | -0.542** | -0.323* | -0.361* | -0.281* | -0.307** |
| Texture              | -0.249 | -0.483** | -0.249 | -0.275* | -0.632** | -0.337* | -0.358** |
| Functional characteristics |       |       |       |       |    |    |    |
| Hedge                | 0.474* | 0.337* | 0.167 | -0.68 | -0.617** | 0.286* | 0.527** |
| Fruit benefiting     | 0.731 | 0.529** | 0.516** | -0.158 | -0.189 | 0.648** | 0.580** |
| Barrier              | 0.366* | 0.475** | 0.369* | 0.622 | 0.280* | 0.562** | 0.366* |
| Wall covering        | 0.283* | 0.406** | 0.675** | -0.460 | -0.578** | 0.312* | 0.223 |
| Direction            | -0.329* | -0.210 | 0.052 | 0.403 | 0.212 | -0.262 | -0.243 |
| Screening            | 0.349* | 0.154 | -0.349* | -0.326 | 0.306* | 0.193 | -0.276 |
| Accent               | -0.616 | -0.442** | 0.06 | 0.273 | 0.469** | -0.274 | -0.473** |
| Shade                | 0.314* | 0.267* | -0.193 | 0.849 | 0.406** | -0.380** | 0.480** |
| Wildlife             | 0.259* | 0.067 | -0.096 | -0.185 | -0.369* | -0.219 | 0.232 |

**Correlation is significant at p<0.01 level. *Correlation is significant at the 0.01< p<0.05 level.

4. Discussion

This study is one of the first examples of researches conducted on urban home vegetation that quantitatively studies the plant species in the cities of eastern region of Adjara. This study was mainly based on 100 sample plots in residential housing, and we encountered 147 plant species in our study area. The distribution of plant species was evaluated according to residence type and it was observed that the number of plant species is 102 in traditional house gardens, 122 in detached house gardens, 125 in villa gardens, and 118 in housing estate and apartment building gardens.

Table 3. Spearman’s rank correlation coefficients between plant species characteristics, residence types and distance to city centre in Batumi city (Only major 20 species in each residence type and distance from the city centre (D))

For the case of the city of Batumi, the plant species distribution, richness and diversity patterns have been determined and their significance landscape potential-characteristics were put forward in relation to home features and distance to the city centre. In the study, the environment of detached houses and villas in Batumi city showed interesting results. One of these is the relationship between the use of plants and plant preferences. Considering the determinant plant species, it clearly appeared that these species come to the fore because of their ornamental qualities, as well as the beneficial aspects of using them. In recent years, there is a trend towards ornamental plants in home areas in Batumi city, which is based on planting with ornamental plants. However, the fact that we encountered species native to this region, such as Corylus avellana, Ficus carica, Mespilus germanica, Punica granatum and Juglans regia, illustrated their significance for urban landscape in this study. Actually, the objective of floristic surveying is to detect whether the species exist in urban biodiversity or not within the urban matrix. The study seems to be related for the example of Batumi city that, the distribution of ornamental resources is significantly related to home development. However, we need much more scientific information and researching about the ecological effects of this distribution and diversity.

According to the residence types, some differences in the use of plant species were recorded. More plant species were recorded in villa gardens (Type3) and in single-detached house gardens (Type2). We can see more plant species in D2 (5-10 km) home gardens, which are located in the residence types. According to the distance of places from the city centre plant species show differences in the study areas. Species that occurred between 5-10 km from the city centre in a residential area were Biotia orientalis, Fatsia japonica, Hibiscus rosa sinensis, Tilia cordata, Vitis sylvestris, Jasminium fruticans, Juniperus horizontalis, Musa x paradisiaca, Phoenix canariensis, Pyrus communis, Pyrus domestica, Rhododendron ponticum, Sambucus nigra and Hosta sp. Distribution of the plant species was identified in terms of housing types. The most common species in Type1, Type2 and Type3 housings types are deciduous, while the most common species in Type4 are evergreen species. It was determined that while deciduous species were preferred in Type3 residences, both evergreen and deciduous plant species were preferred in the site fields.

Findings suggest that in the example of Batumi city, plant species is significantly related to residence types and distance. The survey of current literature shows that all of the plant materials are greatly important for urban landscapes and shaping green areas (Watson and Eyzaguirre, 2002; Lubbe et al., 2010; Erduran and Kabaş, 2010; Galuzzi et al., 2010; Sarı and Acar, 2010; Frison et al., 2011; Calvet-Mir et al., 2012; Jaganmohan et al., 2012; Clarke et al., 2014). However, we need much more scientific information and research about the ecological and socio-cultural effects on diversity in the study area.

According to a study conducted by Thompson et al. (2003) in the city of Sheffield, England, residence gardens were determined to contain a lot more species than other types of areas. It was determined that 33% of the garden species were natural and 67% were alien species while most of these species were of European and Asian origin. In a study conducted by Turner et al. (2005) in the city of Nova Scotia, Halifax (Canada), a total of 18 home gardens randomly selected among residential areas and 4 sample parcels from natural areas and city parks were compared. The residences were divided into 3 groups according to their ages and 6 sample residences of detached system were selected in each group. When plant species identified in the selected areas were compared, residential areas were found...
to have richer variety of plant species. The factor behind this result was shown to be the determination of non-native species in residential areas.

A recent meta-analysis of global patterns of urban biodiversity indicates a possible explanation, finding that there tends to be a preference for economically useful fruit bearing in countries with lower income levels (Kendal et al. 2012). Batumi home gardens generally use less native species. Specifically, ornamental plants are used instead of local species in home gardens in the city center. However, it is seen that ornamental plants are preferred rather than local species especially in the villas and apartment and housing estate gardens in the high density home areas. This situation reveals the need for encouraging people to use local species again. In the city of Batumi, most fructiferous species are raised especially in the gardens of old houses. There is a similar study that was conducted by Acar et al. (2007) and Sarı and Acar (2010), which examined the use of those plant species, found in residential areas, in landscaping. It was determined that plants were considered aesthetically pleasing in terms of their flowering effect, fruiting effect, habits, texture properties and it was revealed that flowering and fruiting effects of plants are preferred mostly in traditional residences. The fact that the “fruiting effect” is preferred over the “flowering effect”, especially in detached-housing, was found as a result of various habits and customs.

5. Conclusion

There is a positive correlation between both aesthetic and functional characteristics found to be prominent in the study and preference of usage according to housing types. Plants species used in the residence gardens in the research area are preferred according to their various landscaping characteristics. Particularly visual and aesthetic characteristics of plants as well as their functional properties are decisive in this regard.

Studies that were conducted on the diversity of plant species need to focus on urban areas and urban ecosystems. Thus, it will be possible to determine each city’s present species richness and local species that may adapt to these regions. Determining the properties of plants used in urban residential areas in terms of preferring them to use in landscaping may guide planting works in these areas and might allow better utilization of available local resources and richness of species.

Kabir and Webb (2007) in the city of Bangladesh, it was also reported that the floristic composition of homegardens may be similar to natural ecosystems. During the botanical inventory, the field team observed many birds, insects, and small mammals in homegardens. The diversity of wildlife in homegardens will be a reflection on the structural complexity of the vegetation (Lindberg et al. 1998). The typical homegarden in this study was dominated by trees but contained plants of all other synusae in several strata. This structure could make homegardens attractive to, and serve as important refuge for, wildlife in Batumi. Further study on the use of homegardens by wildlife, and the role of structure in wildlife use, should be undertaken to understand how to maximize the wildlife value of homegardens. The moderate level of species overlap we found across the residential areas suggests some similarity in the total array of species planted by home owners.

The plant diversity in urban landscape areas plays a role in urban nature conservation, design of cities and the determination of planning and policies (Bryant, 2006). With this in mind, the contribution of the home landscapes is considerable for developing and orientating these systems. There is an interaction gap between biophysical and socio-economic parameters. Therefore, in this study we surveyed to determine the plant diversity relations by some measures. According to this research, we need to develop plant diversity indices for shaping landscape characteristics. The biodiversity of the urban landscape is set in the urban landscape. Consequently, Plants as living materials of the landscape should be assessed not only by species and compositional determination but also by functional characteristics that contribute to the urban landscape and human life quality. Home landscapes as a part of the urban environment should be studied in urban sections to be integrative. However, it should be mentioned that this variability includes areas not within the city, but also those in a regional area.

Homegardeners need to be made aware of the status and rarity of the species they may have on their property; such awareness could result in localized efforts to conserve rare native species by promoting more widespread use. Awareness building campaigns, publications, and educational programs are methods to increase public support for using native species in homegardens (Trehwella et al. 2005).

The results of this study suggest that indeed, plant species richness of home gardens in Batumi is high. Clear scope exists to develop homegardening systems as an important strategy to conserve biodiversity outside the natural and/or protected area systems in Batumi. As the process of plant domestication and crop evolution is ongoing, homegardens in Batumi may act as refuges for native and rare plants. This is of particular interest to conservationists within the country as well as internationally.

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