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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 alarak kentin biyoçeşitlilik potansiyelinde önemli bir yer tutar. Bunun yanında peyzaj kalitesini arttırmak adına dekoratif bir kaynak sağlar. Bu çalışma, Batum kent merkezinde ki mevcut bitki türlerinin estetik, görsel, fonksiyonel, sosyo-kültürel, ve ekolojik değerlerini göz önüne alarak özel konut bahçeleri, siteler ve yerleşim yerlerinde yapılmıştır. Bunun yanında Batum kent merkezindeki konut bahçelerinde kullanılan bitkiler hakkında da nicel bilgiler vermektedir. Çalışma alanında toplam 100 konut bahçesinde araştırma yapılmıştır. Bu konut bahçeleri yerel evler, özel konutlar, villalar ve apartman bahçelerinde olmak üzere 4 farklı konut tipi kategorisinde ele alınmıştır. Araştırma yapılan konut bahçelerinde 61 farklı familyaya ait 147 bitki türüne rastlanmıştır. Araştırma yapılan konut bahçelerinde, oldukça fazla egzotik bitki türüne rastlanılmıştır. Özellikle tür çeşitliliğinin fazlalığı ve farklılığı yeni yerleşim yerlerinde daha çok göze çarpmaktadır. Bunun dışında, çalışmada net olarak görülmektedir ki yerleşim merkezindeki süs bitkilerinin kullanımı villa ve özel konutlarda yerini yer yer meyve ve diğer fayda getiren türlere bırakmaktadır.
Anahtar kelimeler: Flora ve peyzaj değerlendirmesi, Konut bahçesi bitkileri, Kentsel biyoçeşitlilik, Batum (Acara)

1. 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 recovery after surgery (Ulrich, 1984), reduces stress in children (Wells and Evans, 2003) increases cognitive functioning (Shibata and Suzuki, 2002), containers of 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

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(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 Baillie, 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 (Galluzzi et al., 2010).

Homegardens have besides the vertical structurethe 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), inventorization 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 residence 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 km^2 (Pepping, 2012). It represents a crossroads of geographical-genetic elements characteristic to the Mediterranean, Iran-Turkish and northern hemispheric ancient flora. This landscape geo-botanical zone is comprised of wetlands, unique lakes and marshes, various types of mountainous steppes, mountainous xerophyte shrublands, dry and mesophillous 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 sub-tropic plains to the sub-alpine and alpine landscapes of Atchara-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 (Bondyrev et al., 2008).

The region is divided into three floristic provinces Euxine, Armeno-Iranian, and Caucasian. The Euxine 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).

Figure 1. Study area

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 Batuni 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. Resindence 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)

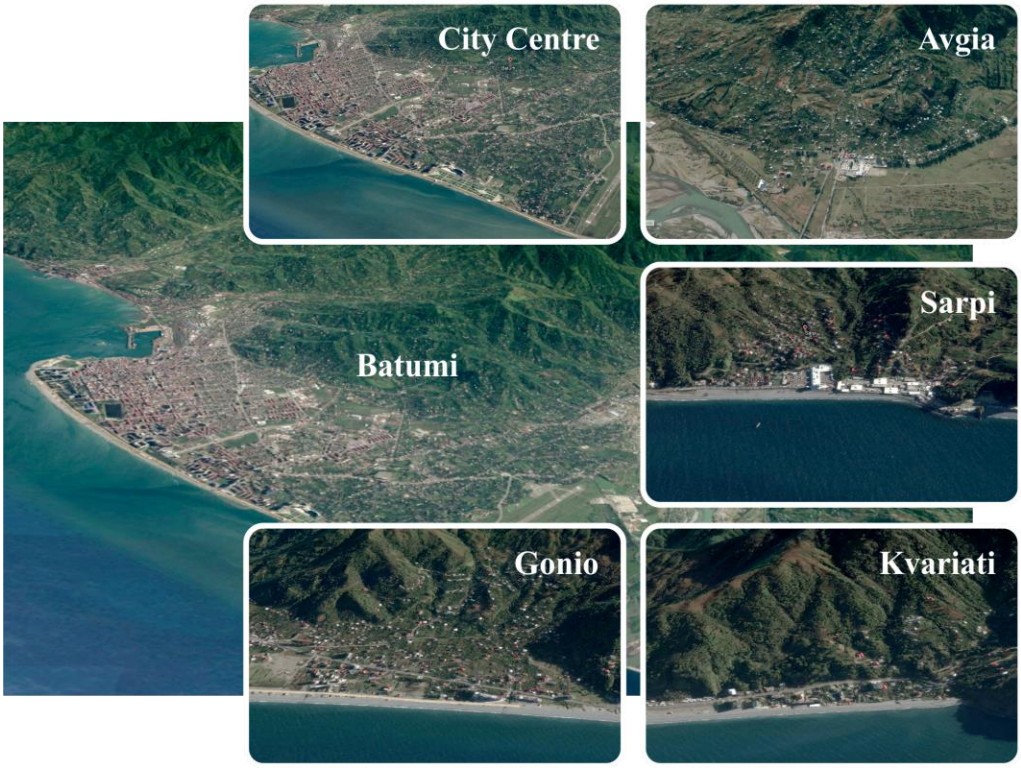

Figure 2. Field sampling regions in Batumi

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 settling. 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 in terms of place usage (front yard, side yard, back yard,) in the home garden. To detect relationship between existing plant characteristics and home types and distance from the city centre we employed Spearman's rank correlation coefficients analysis using the package SPSS 19.0 program for Windows.

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 *Camelia japonica* were determined in traditional houses. *Juniperus sabina*, *Camelia japonica*, *Citrofortunella microcarpa*, *Hibiscus rosasinensis*, *Lauracerasus officinalis*, *Pyrus communis*, *Pyrus domestica*, and *Salix alba* were encountered in detached houses. Similarly, *Camelia japonica*, *Philadelphus coronarius*, *Citrofortunella microcarpa*, *Lauracerasus officinalis*, *Sambucus nigra*, and *Rhus typhina* were mostly recorded in villas. *Fatsia japonica*, *Citrofortunella microcarpa*, *Jasminium fruticans*, *Pyrus domestica*, *Vitis sylvestris* and *Phyllostachys bambusoides* 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 rosasinensis*, *Pyrus communis*, *Pyrus domestica*, *Rhus typhina*, *Abelia grandiflora*, *Citrus reticulata*, *Fatsia japonica*, *Laurus nobilis*, *Lonicaera 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 rosasinensis*, *Tiliacordata*, *Vitis sylvestris*, *Jasminium fruticans*, *Juniperus horizontalis*, *Musa xparadisiaca*, *Phoenix canariensis*, *Pyrus communis*, *Pyrus domestica*, *Rhododenron 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.

3.1.2. Species distribution by plant families

In total, 61 plant families are represented in the city of Batumi (Figure 4). The families with the highest number of taxa were Rosaceae (24 taxa), Cupressaceae (10 taxa), Caprifoliaceae (5 taxa), Oleaceae (5 taxa), Aceraceae (5 taxa) and Agavaceae (4 taxa).

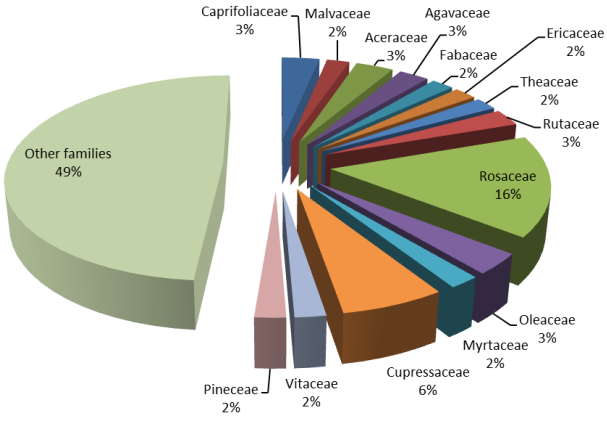

Figure 4. Distribution of the species by families

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

Plant species	Family	Residence type[a]				Distance[b]		
		Type1 (30)[c]	Type2 (35)	Type3 (15)	Type4 (20)	D1 10-15 km	D2 5-10 km	D3 0-5 km
Abelia grandiflora	Caprifoliaceae	55.2	26.4	59.0	52.0	77.4	74.2	62.5
Biota orientalis	Cupressaceae	23.1	26.0	31.8	55.3	31.2	82.6	34.0
Camelia japonica	Theaceae	74.2	70.2	92.0	21.2	39.0	49.4	29.9
Citrofortunella microcarpa	Rutaceae	74.2	70.2	86.9	85.8	39.0	66.0	34.0
Citrus limon	Rutaceae	39.0	38.0	64.4	53.1	54.0	72.8	74.2
Citrus reticulata	Rutaceae	96.6	41.6	42.4	53.1	77.4	60.0	74.2
Fatsia japonica	Araliaceae	47.4	26.4	42.4	89.1	77.4	98.0	62.5
Hedera helix	Araliaceae	53.1	42.9	64.4	66.0	33.8	46.8	86.9
Hibiscus rosasinensis	Malvaceae	59.8	70.2	59.8	9.8	79.2	92.2	20.8
Hosta spp.	Liliaceae	36.8	26.0	42.4	25.6	31.2	81.9	86.9
İlex colchica	Aquifoliaceae	36.8	26.4	42.4	55.3	31.2	35.1	64.8
Jasminiumfruticans	Oleaceae	87.4	39.6	71.1	88.4	240	81.9	64.8
Juglansregia	Juglandaceae	28.6	36.4	49.5	660	23.6	35.1	62.5
Juniperushorizontalis	Cupressaceae	26.5	260	59.0	55.3	46.0	92.2	41.3
Juniperussabina	Cupressaceae	41.6	89.1	59.4	35.4	79.2	52.8	55.2
Kerria japonica	Rosaceae	26.5	26.0	18.4	21.2	21.2	7.8	62.5
Lauracerasus officinalis	Rosaceae	55.2	62.4	85.8	70.0	54.0	31.2	62.5
Laurusnobilis	Lauraceae	39.0	59.8	59.0	51.6	77.4	72.0	26.0
Lonicaeratatarica	Caprifoliaceae	26.5	51.6	51.6	55.3	77.4	68.9	55.2
Musa x paradisiaca	Musaceae	74.2	29.7	27.3	53.1	33.8	82.6	86.9
Nerium oleander	Apocynaceae	53.1	57.2	49.5	33.8	77.4	720	20.2
Pelargonium domesticum	Geraniaceae	55.2	32.2	79.2	70.0	77.4	44.2	86.9
Philadelphuscoronarius	Saxifragaceae	53.1	51.6	92.0	53.1	77.4	52.8	42.4
Phoenix canariensis	Palmae	29.7	32.2	59.0	55.3	42.9	92.2	62.5
Phyllostachysbambusoides	Gramineae	26.5	20.7	59.8	79.2	21.2	44.2	26.0
Prunusceracifera"atropurpurea"	Rosaceae	39.0	32.2	79.2	35.4	42.9	52.8	20.8
Pyruscaucasica	Rosaceae	32.2	62.4	49.5	54.6	79.2	82.6	62.5
Pyrusdomestica	Rosaceae	96.6	62.4	49.5	86.0	79.2	82.6	62.5
Quercuspontica	Fagaceae	25.6	42.4	71.1	23.0	77.4	68.9	23.6
Rhododenronponticum	Ericaceae	47.4	29.7	51.6	79.2	31.2	98.0	41.3
Rhustyphina	Anacardiaceae	62.4	36.4	79.2	20.8	79.2	66.0	34.0
Robiniapseudoacacia	Papilionaceae	50.6	26.4	23.4	42.4	77.4	31.2	62.5
Rosa spp.	Rosaceae	89.1	21.0	59.8	55.3	21.7	60.0	46.8
Rubusfruticosus	Rosaceae	89.1	41.6	51.6	52.0	26.0	29.9	55.2
Salix alba	Salicaceae	66.0	62.4	71.1	25.6	24.7	49.4	46.8
Sambucusnigra	Adoxaceae	39.0	33.2	85.8	59.8	20.8	98.0	41.3
Syringa vulgaris	Oleaceae	36.8	32.2	49.5	35.4	31.2	72.0	39.0
Tiliacordata	Tiliaceae	74.2	38.0	42.4	21.2	23.4	92.2	86.9
Vitissylvestris	Vitaceae	36.0	29.9	44.2	82.8	28.6	82.6	55.2
Washingtoniarobusta	Palmae	47.4	28.6	49.5	23.0	21.0	72.0	86.9

[a]Residence types (Type1—Traditional housing, Type2—Detached housing, Type3—Villa, Type4—Apartment blocks and housing estates).
[b] Distance from the city centre (D1—10-15 km, D2—5-10 km, D3—0-5 km).
[c] Number of sampled sites is given in parenthesis.

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 building 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).

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 decidous 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 villa and apartment-housing estate gardens, decidous 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 liliiflora, Prunus ceracifera "atropurpurea", Spirea vanhouttei, Jasminum fruticans, Wisteria sinensis, Forsythia x* and species such as *Citrus limonum, Citrus reticulata, Citrus sinensis, Diospyros kaki, Eriobotrya japonica, Ficus carica, Vitis vinifera, Punica granatum, Rubus platyphyllos* 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.

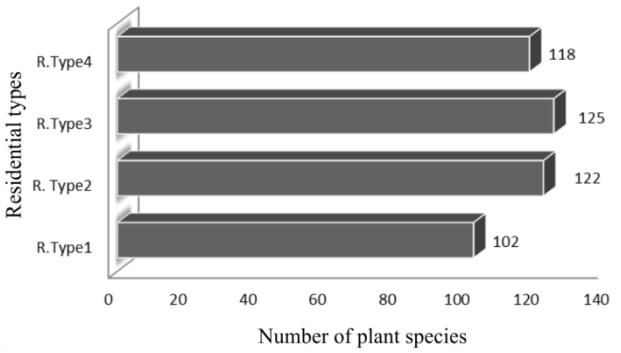

Figure 5. Number of plant species according to housing types

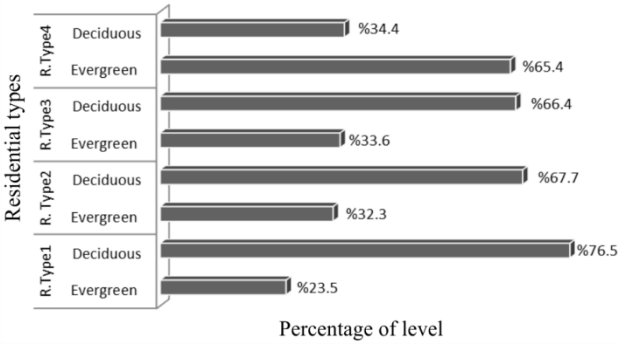

Figure 7. Distribution of evergreen and deciduous species according to housing types

Figure 6. Number of plant species according to distance to the city centre

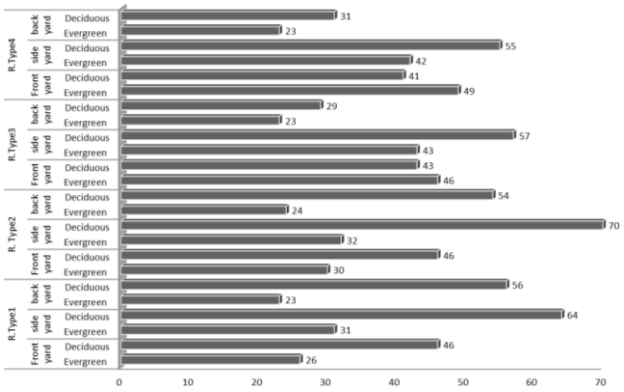

Figure 8. The number of plant species in terms of place of usage and distribution of evergreen/deciduous plant species

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.

Table 2. Frequency values by plant characteristics in all 147 species of residential landscapes of Batumi city

Plant characteristics	Preferred species number	Frequency (%)	Plant characteristics	Preferred species number	Frequency (%)
Aesthetic– visual characteristics			Functional characteristics		
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
Habits	-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 housings, 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.

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 germenica, 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 exists 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 distances from the city centre in a residential area were *Biota orientalis, Fatsia japonica, Hibiscus rosa sinensis, Tilia cordata, Vitis sylvestris, Jasminium fruticans, Juniperus horizontalis, Musa x paradisiaca, Phoenix canariensis, Pyrus communis, Pyrus domestica, Rhododenron 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; Galluzzi 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 centre. 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 plants 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 (Trewhella 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.

Referecences

Acar, C., Acar, H., Eroğlu, E., 2007. Evaluation of ornamental plant resources to urban biodiversity and cultural changing: A case study of residential landscapes in Trabzon city (Turkey). Building and Environment, 42(1): 218-229.

Agbogidi, O.M., Adolor, E.B., 2013. Home gardens in the maintenance of biological diversity. Applied Scientific Reports. 1(1): 19-25.

Akhalkatsi, M., Maxted, N., Mosulishvili, M., Kimeridze, M., Maisaia, I., 2009. Recovery, Conservation, and Sustainable Use of Georgia's Agricultural diversity".Conservation and sustainable use of crop wild relatives in Samtskhe-Javakheti Georgian Society of Nature Explorers "Orchis" Biological Farming Association "Elkana". GEF/UNDP Project Final Report, Tbilisi, Georgia.

Beebee, T.J.C., 1997. Changes in dewpond numbers and amphibian diversity over 20 years on chalk downland in Sussex, England. Biological Conservation, 81: 215–219.

Bland, R.L., Tully, J., Greenwood, J.J.D., 2004. Birds breeding in British gardens: an underestimated population? Bird Study, 51: 96–106.

Bhatti, M., Church, A., 2001. Cultivating natures: Home and gardens in late modernity. Sociology, 35: 365–383.

Bondyrev, I.V., Tavartkiladze, A.M., Seperteladze, Z.K., Tsereteli, E.D., 2008. Anthropogenic Transformation of the South Caucasus Natural Ambiente. Pologaf, Tbilisi, 476.

Bryant, M.M., 2006. Urban landscape conservation and the role of ecological greenways at local and metropolitan scales. Landscape and Urban Planning, 76(1): 23-44.

Calvet-Mir, L., Gómez-Baggethun, E., Reyes-García, V., 2012. Beyond food production: Ecosystem services provided by home gardens. A case study in Vall Fosca, Catalan Pyrenees, Northeastern Spain. Ecological Economics, 74: 153-160.

Clarke, L., W., Li, L., Jenerette, G.D., Yu, Z., 2014. Drivers of plant biodiversity and ecosystem service production in home gardens across the Beijing Municipality of China. Urban Ecosystems, 17(3), 741-760.

Cooper, M.C., 1992. Environmental memories. I. Altman, S.M. Low (Eds.), Place attachment, Plenum, New York, 87–112.

Das, T., Das, A.K., 2005. Inventorying plant biodiversity in homegardens: A case study in barak valley, Assam, North East India. Current Science-Bangalore-, 89(1): 155.

Dickman, C.R., 1987. Habitat fragmentation and vertebrate species richness in an urban environment. Journal of Applied Ecology, 24(2): 337-351.

Engels, J., 2001. Home gardens- A genetic resource perspective. In: Watson J.W, Eyzaguirre P.B. eds. Proceedings of the second international home garden workshop. Biodiversity International, Rome, Italy, pp. 3-9.

Erduran, F., Kabaş, S., 2010. Investigation of balanced, functional and esthetic plantation principles in the ecological conditions of parks: Exemplary case of Çanakkale Halk Bahçesi. Ecology, 19(74): 190-199.

Fernandes, E.C.M., Nair, P.K.R., 1986. An evaluation of the structure and function of tropical homegardens. Agric. Syst., 21: 279–310.

Francis, M., Hester R., 1990. The meaning of gardens, MIT Press, Cambridge.

Francis, M., 1995. Childhood's garden: Memory and meaning of gardens. Children's Environment, 12(2): 183–191.

Frederiksen, M.D., 2012. Insecurity and Suspicion in the Wake of Urban Development Projects in Batumi, Ajara. Caucasus Analytical Digest.

Frison, E.A., Cherfas, J., Hodgkin, T., 2011. Agricultural biodiversity is essential for a sustainable improvement in food and nutrition security. Sustainability, 3(1): 238-253.

Frumkin, H., 2003. Healthy places: exploring the evidence. American Journal of Public health. 93(9): 1451-1456.

Galluzzi, G., Eyzaguirre, P., Negri, V., 2010. Home gardens: neglected hotspots of agro-biodiversity and cultural diversity. Biodiversity and Conservation 19(13): 3635-3654.

Gregory, R.D., Baillie, S.R., 1998. Large-scale habitat use of some declining British birds. Journal of Applied Ecology, 35: 785–799.

Gross, H., Lane, N., 2007. Landscapes of the lifespan: Exploring accounts of own gardens and gardening. Journal of Environmental Psychology, 27: 225–241.

Guarino L, Hoogendijk, M. 2004. Micro Environments. In: Eyzaguirre, P. and Linares, O. eds. Home Gardens and Agro-Biodiversity. Smithsonian Books, Washington, pp. 31-40.

Hodgkin, T., 2001. Home gardens and the maintenance of genetic diversity. In: Watson, J.W. and Eyzaguirre, P.B. (Eds.), Proceeding of the second International Home Garden Workshop, Biodiversity International, Rome, Italy, 14-18.

Jaganmohan M., Vailshery L. S., Gopal D., Nagendra H., 2012. Plant diversity and distribution in urban domestic gardens and apartments in Bangalore, India, Urban Ecosystems, Volume 15, Issue 4, 911-925.

Kabir, M., Webb, E.L., 2008. Can homegardens conserve biodiversity in Bangladesh? Biotropica, 40(1): 95-103.

Kaplan, R., 1973. Some psychological benefits of gardening. Environment and Behavior, 5:145–16.

Kaplan, R., Kaplan, S., 1990. The restorative experience: The healing power of nearby nature. The meaning of gardens, MIT Press, Cambridge, MA, pp. 238–243

Kendal, D., Williams, K., Williams, N., 2012. Plant traits link people's plant preferences to the composition of their gardens. Landscape and Urban Planning, 105(1): 34-42.

Ketskhoveli, N., 1959. Vegetation of Georgia. Acad. Scien. Georgia, Tbilisi.

Kiesling, F.M., Manning, C.M., 2010. How green is your thumb? Environmental gardening and identity and ecological gardening practices. Journal of Environmental Psychology, 30: 315–327.

Kumar, B.M., George, S.J., Chinnamani, S., 1994. Diversity, structure and standing stock of wood in the homegardens of Kerala in Peninsular India. Agrofor. Syst., 25: 243–262.

Kuo, F.E., Taylor, A.F., 2004. A potential natural treatment for attention deficit-hyperactivity disorder: Evidence from a national study. American Journal of Public Health, 94: 1580–1586.

Lindberg, J.E., Tolbert, V., RSchiller,. A., Hanowski, J., 1998. Determining biomass crop management strategies to enhance habitat value for wildlife. Poster presented at BioEnergy '98: Expanding Bioenergy Partnerships, Madison, Wisconsin .

Lubbe, S.C.S., Siebert J., Cilliers S.S., 2010. Political legacy of South Africa affects the plant diversity patterns of urban domestic gardens along a socio-economic gradient. Scientific Research and Essays, 5(19): 2900-2910.

Mason, C.F., 2000. Thrushes now largely restricted to the built environment in eastern England. Diversity and Distributions, 6: 189–194.

Mazumdar, S., Mazumdar, S., 2012. Immigrant home gardens: Places of religion, culture, ecology, and family. Landscape and Urban Planning. 105(3): 258–265.

Mendez, V.E., Lok, R., Somarriba, E., 2001. Interdisciplinary analysis of homegardens in Nicaragua: Microzonation, plant use and socioeconomic importance. Agrofor. Syst., 51: 85–96

Peach, W.J., Denny, M., Cotton, P.A., Hill, I.F., Gruar, D., Barritt, D., Impet, A., Mallord, J., 2004. Habitat selection by song thrushes in stable and declining farmland populations. Journal of Applied Ecology, 41: 275–293.

Pepping, C., 2012. Feasibility study of an artificial sandy beach at Batumi, Georgia. Doctoral dissertation, TU Delft, Delft University of Technology, Delft, Netherlands.

Santhakumar, V., 1996. On-Farm Biodiversity in Kerala. In Using Diversity (eds Sperling, L. and Loevinshon, M.), IDRC, New Delhi, pp. 22–34.

Sarı, D., Acar, C., 2010. Evaluation of plant species in urban residential landscapes based on their characteristics for landscape preferences; a sample of Trabzon city. Ekoloji, 19(74): 173-180.

Shibata, S., Suzuki, N., 2002. Effects of the foliage plant on task performance and mood. Journal of Environmental Psychology, 22: 265–272.

Ulrich, R., 1984. View through a window may influence recovery from surgery. Science, 224(4647): 224-225 Stoler.

Thompson, K., Austin, K.C., Smith, R.M., Warren, P.H., Angold, P.G., Gaston, K.J., 2003. Urban domestic gardens (I): putting small scale plants diversity in context. J. Vegetat. Sci., 14: 71–78.

Thompson, S., 2005. Digestible difference: food, ethnicity and spatial claims in the city. International Migration and Security: Opportunity and Challenges, 217-237.

Trewhella, W.J., K.M. Rodriguez-Clark, N., Corp, A. Entwistle, S.R.T. Garrett, E. Granek, K.L. Lengel, M.J. Raboude, P.F. Reason, B.J. Sewall. 2005. Environmental education as a component of multidisciplinary conservation programs: Lessons from conservation initiatives for critically endangered fruit bats in the western Indian Ocean. Conserv. Biol. 19: 75–85.

Turner, K., Lefler, L., Freedman, B., 2005. Plant communities of selected urbanized areas of Halifax, Nova Scotia, Canada. Landscape and Urban Planning, 71(2–4): 191–206.

Van Veenhuizen, R., 2006. Cities Farming for the Future: Urban Agriculture for Green and Productive Cities. Ottawa.

Viljoen, A., Bohn, K., Tomkins, M., 2009. Places for People, Places for Plants: Evolving Thoughts on Continuous Productive Urban Landscapes. Proceedings of the Second International Conference on Landscape and Urban Horticulture. Department of Agroenvironmental Science and Technology (Dista), Faculty of Agriculture, University of Bologna, Italy: 38.

Watson, J. W., Eyzaguirre, P.B., 2002. Home Gardens and in Situ Conservation of Plant Genetic Resources in Farming Systems: Proceedings of the Second International Home Gardens Workshop, Witzenhausen, Federal Republic of Germany.

Wells, N.M., Evans, G.W., 2003. Nearby nature: A buffer of life stress among rural children. Environment and Behavior, 35: 311–330.