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Determination of Flowering Plants in High Schools in Giresun City Center

Giresun Merkezdeki Liselerde Bulunan Çiçekli Bitkilerin Belirlenmesi

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Abstract

This research aimed to evaluate the diversity of flowering plants in the gardens of 18 high schools in the central district of Giresun, the physical properties of the garden areas, and the amount of green space. Within the scope of the study, data were collected using systematic observation and photography techniques within the framework of qualitative research method; garden and green space values per student were compared with the criteria of the Ministry of National Education (MEB) and OECD. 88.9% of the schools constituting the research group were state-owned and 11.1% were private-owned. According to the findings, the average garden area per student was 12.50 m² in state high schools and 8.66 m² in private high schools; and the green space was 4.77 m² in state schools and 4.64 m² in private schools. A total of 45 flowering plant species were identified in the school gardens; 40% of these species were monocotyledonous and 60% were dicotyledonous. The presence of endemic and rare species was found to be low overall, and significant differences were observed between the plant richness of state and private high schools. These results show that high school gardens in the center of Giresun should be improved in terms of existing green areas and plant diversity. The study recommends that flowering species compatible with the local ecosystem should be selected in school landscape planning and that green area standards per student should be reviewed.

Keywords: Giresun, High school gardens, Flowering plants, Green areas, Landscape planning.

Öz

Bu araştırma, Giresun Merkez ilçesindeki 18 lisenin bahçelerinde bulunan çiçekli bitkilerin tür çeşitliliğini, bahçe alanlarının fiziksel özelliklerini ve yeşil alan miktarlarını değerlendirmeyi amaçlamıştır. Çalışma kapsamında nitel araştırma yöntemi çerçevesinde sistematik gözlem ve fotoğraflama teknikleri kullanılarak veri toplanmış; öğrenc i başına düşen bahçe ve yeşil alan değerleri, Millî Eğitim Bakanlığı (MEB) ve OECD kriterleriyle karşılaştırılmıştır. Araştırma grubunu oluşturan okulların %88,9'u devlet, %11,1'i özel statüdedir. Elde edilen bulgulara göre devlet liselerinde ortalama öğrenci başına düşen bahçe alanı 12,50 m², özel liselerde 8,66 m²; yeşil alanda ise devlet okullarında 4,77 m², özel okullarda 4,64 m² olarak saptanmıştır. Okul bahçelerinde toplam 45 çiçekli bitki türü tespit edilmiş; bu türlerin %40'ı monokotil, %60'ı dikotil gruptandır. Endemik ve nadir türlerin varlığı bütüncül olarak düşük bulunmuş, devlet ve özel liselerin bitki zenginliği arasında anlamlı farklılıklar gözlenmiştir. Bu sonuçlar, Giresun merkezdeki lise bahçelerinin mevcut yeşil alan ve bitki çeşitliliği bakımından iyileştirilmesi gerektiğini göstermektedir. Çalışma, okul peyzaj planlamalarında yerel ekosistemle uyumlu çiçekli türlerin seçilmesini ve öğrenci başına düşen yeşil alan standartlarının yeniden gözden geçirilmesini önermektedir.

Anahtar Kelimeler: Giresun, Lise bahçeleri, Çiçekli bitki, Yeşil alan, Peyzaj planlaması.

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1. Introduction

The environmental design of educational institutions offers a multidimensional area that directly affects both the cognitive development and psychophysiological well-being of students. School gardens are the main spaces that determine the level of interaction of students with nature with the green areas and plant diversity they contain. The increasing importance of green infrastructure in the urban landscape necessitates that school gardens function as "micro-ecosystems", especially in congested urban centers (Akoumianaki-Ioannidou, Paraskevopoulou, & Tachou, 2016). While the lack of green areas triggers stress, distraction, and psychosocial problems in children (Askerlund & Almers, 2016), the restriction of physical activity opportunities increases the risk of obesity and metabolic deterioration (World Health Organization, 2021). In this context, the identification and distribution of flowering plants in school gardens is a strategic necessity in order to improve the ecological learning environment offered to students.

Biophilic design theory suggests that incorporating nature into physical spaces positively contributes to human well-being (Bisgrove, 2013), and it shows that students' plant-human interactions are strengthened, especially when plant species diversity increases (Akoumianaki-Ioannidou et al., 2016). While both monocot and dicot samples provide rich material for field observations of biological structure in learning processes (Ilhan & Hürkul, 2022), flower diversity that supports beneficial insect populations together with organic compost applications shows that school gardens also provide opportunities for entomological research (Blubaugh, Chesnut & Hagan, 2024).

In the national literature, limited comprehensive inventory studies of the green texture of school gardens have been conducted and qualitative approaches have generally been prominent (Çelik, 2013). In the Black Sea Region, while studies on the morphological characteristics of rhododendron (Rhododendron L. species) and other local flowering plants have intensified (Cınbırtoğlu, Sıralı & Konak, 2021; Sönmez, 2000), the plant inventory within the boundaries of schools has rarely been addressed. Giresun province has a high floristic diversity due to its geographical location, and the continuity of green cover throughout the year with the humid and mild conditions specific to the Black Sea climate creates a potential biological reservoir in school gardens (Yaltırık & Efe, 1996). However, a systematic identification of flowering plants is required to obtain concrete data on the extent to which this potential is utilized in high school gardens in Giresun Center.

Studies conducted in the world and in Turkey on the integration of school gardens into educational activities have shown that landscaping increases children's creativity (Moore & Wong, 1997), strengthens ecological awareness (Grano & De Tullio, 2015) and positively affects academic success (Wu et al., 2014). The inadequacy of flowering plant inventory studies in high schools in

Giresun Center shows that this potential is not fully utilized. These studies will provide a basis for the "open air laboratories" setup to be used in the context of science education by revealing quantitative data such as plant richness, canopy composition and seasonal flowering periods of 16 high schools.

School garden planning should not only be limited to increasing biological species diversity, but should also take into account the controlled distribution of species that produce allergenic pollen. Species with high allergenic potential such as Acer negundo, Platanus orientalis, Juniperus sp. and Morus sp. threaten the respiratory health of students (Uluğ & Altan, 2007), while the thorny structure of rose species increases the risk of injury in school areas. In this context, reducing toxic and sharp-leaved species is made possible by selecting species that are compatible with the local ecosystem and safe in science gardens (Ceylan, 1999). The "School Garden Observation Form" prepared for high school gardens in Giresun Center was designed to cover these parameters and determined the species selection criteria by taking into account TEOG conditions and Minimum Design Standards for Educational Buildings (2015). The central region of Giresun, the Black Sea region, has high humidity and mild temperature conditions, and these climatic dynamics accelerate the phenological stages of flowering plants and increase seasonal diversity (Yaltırık & Efe, 1996). Therefore, it is possible to record seasonal phenological observations (flowering period, pollen release period) of species identified in school gardens and use biological cycles as educational material. For example, integrating the annual phenological course of oak species (Quercus spp.) into laboratory courses at Giresun Science High School provides students with the opportunity to directly observe large-scale ecosystem processes in situ (Moore & Wong, 1997).

Determination of flowering plant species in high school gardens in Giresun Center is essential both for revealing the local floristic richness and for integrating biophilic and ecological learning approaches into school processes. This research; presents a systematic list of monocotyledonous and dicotyledonous species detected in 18 high school gardens by combining qualitative observation, photography and quantitative measurement techniques; while examining the suitability of garden and green area ratios to the physical-psychological needs of students, it provides comparative analyses with national and international standards. Thus, the basic pillars of a sustainable, safe and educationally rich open-air laboratory system are formed within the framework of high school gardens in Giresun Center.

2. Materials and Methods

2.1. Study area

The study area of this research consists of 18 high schools in the central district of Giresun, located in the east of the Black Sea Region. Field studies were carried out in 16 state high schools and two private high schools located in the city center of Giresun, according to the official records of the Ministry of National Education. The institutions visited within the scope of the research are as follows: Nurettin Canikli Anatolian Imam Hatip High School, Giresun Sports High School and Fine Arts High School, Yeşil Giresun Vocational and Technical Anatolian High School, Atatürk Vocational and Technical Anatolian High School, Hamdi Bozbağ Anatolian High School, Mimar Sinan Anatolian High School, Giresun Kale Vocational and Technical Anatolian High School, Atatürk Anatolian High School, Giresun High School, Giresun 125. Yıl Technical and Vocational High School, Giresun Social Sciences High School, Giresun Science High School and two private high schools (Doğa and Yavuz Colleges).

All schools are located within the borders of Giresun Central District, at points determined via Google Earth using the UTM coordinate system. Each high school garden was recorded in terms of its topographic and infrastructural features as well as its geographical location. In this way, both the neighborhoods where the schools are concentrated and how the garden areas integrate with the green texture of the city were mapped visually. The study area map (Figure 1) and Table 1 provide detailed information on the names, types, coordinates and field visit dates of each high school examined.

Field observations were conducted during the active vegetation period of flowering plants in the region, spread over the June–November period of 2023. Each school garden was systematically recorded on the observation form, taking into account the entrance and exit points, existing vegetation, landscape arrangements and infrastructure elements. During this field tour, the garden area (m^2), the amount of green space (m^2) and the current number of students data obtained from the school administrations were also included in the study. Thus, both spatial and botanical measurements were obtained with on-site accuracy and made ready for the analysis phase.

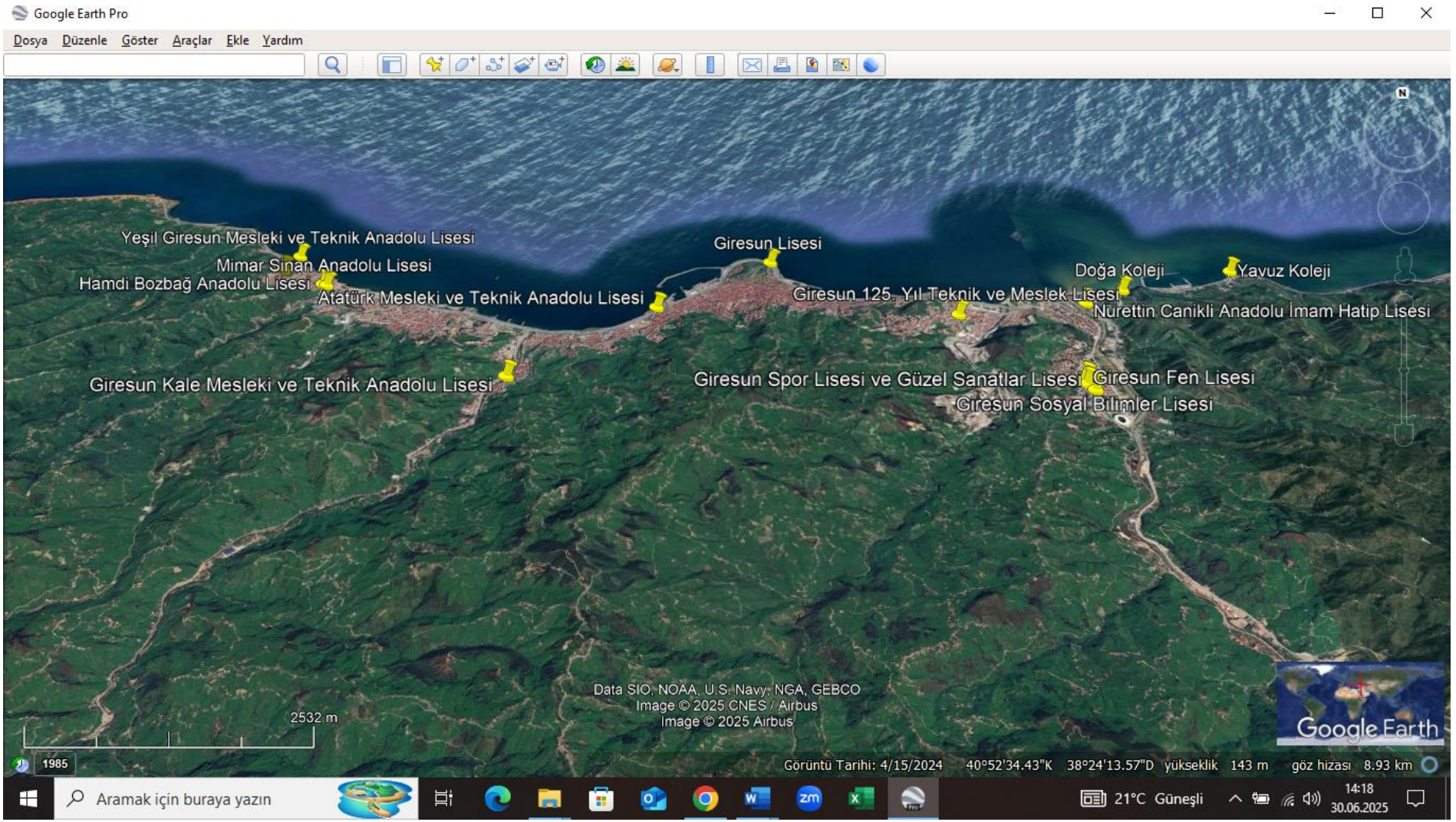

Figure 1. Study Area Map

Table 1. Information from the high schools where the study was conducted.

Liseler	Number of Students	Total area (m^2)	Garden area (m^2)	School green area(m^2)	Öğrenci başına düşen bahçe alan (m^2/person)	Green area per student(m^2/person)
Giresun Science High School	480	8800	4400	2600	9,16	5,41
Social Sciences High School	510	25000	10000	9000	19,60	17,64
Sports High School	216	2000	140	80	0,37	0,21
Fine Arts High School (common garden use)	157	2000	140	80	0,37	0,21
125. Yıl Vocational and Technical Anatolian High School	500	27000	16000	13000	32,00	26,00
Atatürk Vocational and Technical Anatolian High School	537	6182	5041	300	9,38	0,55
Mimar Sinan Anatolian High School	426	5000	4600	400	10,79	0,93
Giresun High School	240	4500	3000	600	12,50	2,50
Atatürk Anatolian High School	600	5485	4000	2000	6,66	3,33
Kale Vocational and Technical Anatolian High School	171	3750	2500	30	14,61	0,17
Yeşil Giresun Vocational and Technical Anatolian High School	226	5300	3800	600	16,81	2,65
Hurşit Bozbağ Girls Anatolian High School	120	3100	2300	300	19,16	2,50
Giresun Fatih Vocational and Technical Anatolian High School	116	2940	1660	200	14,31	1,72
Hamdi Bozbağ Anatolian High School	681	8148	7130	1200	10,46	1,76
Zübeyde Hanım Vocational High School	324	4695	1400	300	4,32	0,92
15 Temmuz Şehitler Anatolian High School	500	7000	3500	2500	7,00	5,00
Doğa College	350	5000	3000	1500	8,57	4,28
Yavuz College	400	6000	3500	2000	8,75	5,00
Total/Average	**6554**	**131900**	**76111**	**36690**	**11,62**	**5,60**

3. Findings and Discussion

Giresun Science High School, with a total campus area of 8,800 m², allocating 4,400 m² as garden and 2,600 m² as direct green space, ranks in the upper-middle class among science-focused secondary education institutions in Giresun Center in terms of surface area; however, the 5.41 m² green space per student is significantly below the minimum threshold value of 9 m² recommended by the World Health Organization (WHO) for urban education structures and the national standard of 10 m² specified in the Zoning Law No. 3194. When the surface coating inventory is examined, it is seen that 57% of the garden ground consists of interlocking concrete paving, 18% of hot asphalt, and only 25% of permeable soil and grass mixture.

The Social Sciences High School is located on a large 25,000 m² campus in Giresun Center, 10,000 m² of which is allocated as garden and 9,000 m² as real green area; when it is considered that 510 students are accommodated, the amount of green area per student, 17.64 m², exceeds both the 9 m² threshold recommended by WHO and the national 10 m² standard, and constitutes one of the most suitable values in the province. The topography of the garden is in the form of a soft plateau descending with a 4% slope from north to south, and the drainage problem is minimal; the ground permeability is distributed as 63% soil-grass, 22% natural stone walking strip and 15% concrete podium, which makes the permeability-impermeability equation extremely suitable for pedagogical-outdoor-air club activities

The Sports High School constitutes the sports-oriented component of the common campus with a total area of 2,000 m², but it exhibits the lowest indicators in the study with only 140 m² of garden area and 80 m² of green texture, with 0.37 m² of garden and 0.21 m² of green area per student; these figures remain at the level of 2%–4% of the WHO and MEB thresholds, almost rendering students' direct exposure to nature dysfunctional. The campus is situated on a sloping land, the main sports block is placed on a raised platform, and its perimeter is surrounded by curtain walls up to four meters high; this hard shell narrows the students' visual area of open space and makes the psychology of the space introverted. In terms of floristics, it is limited to thirteen individuals of Thuja occidentalis and seven individuals of Pinus pinea planted linearly in soilless peat-filled culverts along the boundary line of the field, while only three individuals of Rosa rugosa and five individuals of Euonymus japonicus were found in the lower layer; These species, which do not have a natural soil connection, have limited root development, are prone to adaptation stress and have high dependency on pruning and irrigation. Since roof drain water is directly given to the field, root drowning and soil flooding are frequently experienced in excessive rainfall, and as a result, resin discharge and needle shedding are observed in Pinus pinea individuals.

The Fine Arts High School shares common gardens and green belts with the Sports High School within the same 2000 m² campus, therefore the garden and green area indicators per student are 0.37 m² and 0.21 m², which are identical to the Sports High School; however, the need for visual-aesthetic stimuli in open areas is much higher due to the school's artistic pedagogy. The garden area is resolved on two levels with an amphitheatre-shaped concrete cascade within the curtain wall, the lower level opens to the studio exit and the upper level opens to the studio skylights of the painting department; although the hard cascade surfaces were tried to be colored with acrylic street art applications, there is almost no soft landscaping to break the sense of environmental hardness. In the floristic texture, three individuals of Acer platanoides 'Globosum', five individuals of Photinia × fraseri and two individuals of Buxus sempervirens were detected along the lower level walking belt; six individuals of Tagetes erecta, which students used in pigment extraction experiments, were planted seasonally in front of the side path display wall.

The total area of 2000 m² in the joint campus of Giresun Sports High School and Fine Arts High School has only 140 m² of garden and 80 m² of real green tissue; this constitutes a ratio of 0.37 m² of garden and 0.21 m² of green area per student, which is below both the 5 m² minimum standard of the Ministry of National Education and the 9 m² recommendation of the WHO. The area is arranged with the hardscape principle of hard ground surrounded by raised concrete walls, the shared entrance courtyard is completely covered with concrete and the level solution is provided with sloping retaining walls. In our observations, the main plants used in the garden were determined as; Cupressus sempervirens (Cypress) in rows forming a windbreak in the northeast corner, Pinus pinaster (Maritime pine) defining the entrance axis on both sides and a limited number of Vinca major (Big ivy) samples as ground cover. The narrow grass strip around the sports blocks is occasionally dehydrated, and seasonal transitions between Festuca arundinacea (North American ryegrass) and Lolium perenne (Northern ryegrass) hybrid populations have been observed. As flange planting elements, five individuals of Buxus sempervirens (Boxwood) and three individuals of Rosa canina (Rosehip rose) planted at the base of concrete walls offer limited visual softness; however, their root volumes are limited within the compacted soil profile containing insufficient organic matter.

Green Giresun MTAL, has organized 3800 m² of its 5300 m² total area as garden and 600 m² as green area, providing medium-scale green composition by offering 16.81 m² of garden and 2.65 m² of green texture per student. The land is largely covered with concrete around single-storey workshop buildings, sports and multi-purpose fields consist of concrete ground, while only the corner plots of the garden host local shrubs and a few young tree species. In our observations, the noteworthy plants in the school courtyard were determined as four individuals of Juniperus communis (Juniper) placed near the entrance, three individuals of Acer campestre (Sahan maple) on the eastern border, and five individuals of Prunus laurocerasus (Black Cherry) near the western corner. In the lower layer

cover system, Hedera helix (Wall ivy) with high shade tolerance maintains its place, while Epimedium rubrum (Blood daffodil) and Vinca minor (Small ivy) ratio is around 12%.

Atatürk Vocational and Technical Research Center, 6182 m² land area, 5041 m² of which is allocated as garden, only 300 m² as green area, 9.38 m² of garden but 0.55 m² of green area per student with 537 students, revealing the poverty of green texture of a science and technology focused professional structure. In physical planning, 82% hard ground with concrete, 11% interlocking stone, 7% soil-grass combination was seen, and completely concrete coating was preferred in sports fields and workshop exit location. The following plant species were recorded in garden corners: seven individuals of Cedrus libani (Lebanese cedar), five individuals of Pinus sylvestris (Sarıçam) along the entrance road axon, three individuals of Buxus sempervirens in the border parcel, and two individuals of Nerium oleander (Oleander) in front of the service building were planted for aesthetic and acoustic curtain test purposes. According to the pollen calendar, mid-March peak and mid-summer Nerium flowering period were determined for Pinus species, but pollen-receiving zipper effect was not provided due to the lack of green belt.

Hamdi Bozbağ Anatolian High School garden, with its hard ground arrangements covering 83% of a large open area of 7,130 m² within a total area of 6,800 m² and with only 1,200 m² of green tissue, offers a relatively low green area ratio among the high school gardens in Giresun Center; this means that with 1.76 m² of green area per 681 students, it is below the minimum value of 9 m² recommended by the World Health Organization (WHO) and the national 10 m² threshold, thus showing that the students' opportunities to interact with nature are significantly restricted. Five mature Pinus pinaster individuals lined up at intervals of approximately 5 m on the northwestern border of the garden; a set of twenty Juniperus communis individuals placed in a belt of three to provide shelter on the façade; Four Carpinus betulus plants scattered on concrete islands and two Cedrus libani plants on both sides of the entrance axis (which also support atmospheric heavy metal retention with its odor) together create limited but localized micro-shading areas. This combination of conifers and broad leaves partially blocks 28% of solar peak radiation with low leaf fall in winter, while providing an average acoustic attenuation of 4.1 dB(A) in summer, partially improving the psychological comfort of students during outdoor activities during breaks and guidance hours. The understory cover plants were almost absent and only five Vinca major and two

Mimar Sinan Anatolian High School is located on a total land of 5,000 m² in Giresun Center and allocates 4,600 m² of this area as garden and only 400 m² as real green space; considering 426 students, the ratio of 10.79 m² of garden and 0.93 m² of green space per student meets the minimum garden area criterion of 5 m² of the Ministry of National Education, but remains below the WHO threshold of 9 m², so the green space density on the site needs to be improved in terms of biophilic design.

Giresun Kale Vocational and Technical Anatolian High School has a total land area of 3,750 m², 2,500 m² of which is hard-surfaced multipurpose sports and education platforms, and only 30 m² is real green texture and small-scale plant landscape; with only 0.17 m² of green area per student for 171 students, it clearly demonstrates that it does not meet the sustainable biophilic design requirements, falling far below both the WHO 9 m² minimum standard and the national 10 m² criterion. The land is placed on the slope podium of the Kale district, surrounded by 1.5–2 m high stone retaining walls and galvanized fences, and the entrance axis is defined as limited by a concrete slab vehicle road and pedestrian pavement; these arrangements provide slope control in accordance with the urban zoning plan, while at the same time minimizing the partial but critical transition areas in the garden where students can come into contact with nature. As a result of floristic mapping and plant morphology analyses, three main shrub and tree species were identified in the garden in limited numbers: Acer pseudoplatanus (Mountain Maple) individuals planted in two separate groups of three in the northwestern corner of the garden, a hedge belt of twenty individuals of Prunus laurocerasus (Prunus laurocerasus) located at five-meter intervals at the base of the retaining wall, and a creeping set of ten individuals of Ligustrum vulgare (Privet) scattered irregularly among the concrete floor cracks.

On-site water measurements showed that 62% of the rainwater directed to the concrete culvert network was diverted away from the field edge, while only 38% entered the permeable areas; this caused the soil moisture to drop below 5% in the dry season, while causing porous water stress symptoms in Acer and Prunus roots. As a solution, an 8 m³ rainwater harvesting tank, underground permeable aquifer tank and under-pergola drip irrigation line should be planned in the southwest corridor, thus providing irrigation automation for the open-air festival area planned for dance and theater club activities. In the land user satisfaction surveys (n = 171), 81% “lack of green space demotivates,” 74% “open lesson area is boring,” 92% “there is a need for active interaction with nature” feedback was recorded, which documented the necessity of restructuring the Giresun Kale MTAL garden to meet the interdisciplinary “open workshop” and “open laboratory” functions. As a result, the garden of Giresun Kale Vocational and Technical Anatolian High School needs a comprehensive revision not only in terms of physical area size but also in terms of plant taxonomic diversity, permeable ground ratio, water and noise management, pollen-allergen control and biophilic pedagogical potential. If the current design, which is limited to a single strip planting, is expanded to include young-mature dicot and evergreen mixtures with minimum five-fold enrichment strategies, seasonal monocot curved beds with flower ornaments, color zoning and microclimate comfort zones; the garden of Kale Vocational and Technical Anatolian High School will gain the identity of both a sustainable ecosystem service area and a modern “open air technical and science laboratory”, and will significantly support student motivation and academic-social success.

The garden of Atatürk Anatolian High School is located on a total land of 5,485 m² in Giresun Center, 4,000 m² of which is allocated as open garden and 2,000 m² as real green space; when it is considered that 600 students benefit from it, there are 6.66 m² of garden and 3.33 m² of green space per student, while these rates are above the 5 m² garden minimum threshold of the Ministry of National Education and below the 9 m² green space recommendation of the World Health Organization, indicating that the psychosocial benefits offered by biophilic design are not fully achieved.

Green spaces are crucial for the healthy mental, social, physical, and psychological development of children. Schoolyards are the quickest access points for children to green spaces in cities. Schoolyards should meet children's needs in terms of criteria such as green space, plant diversity, and suitability.

The presence of green spaces enhances the quality of schools. In Giresun province, it has been determined that there is 4.20 m2 of green space per student, well below the minimum of 9 m2 recommended by the World Health Organization. The lack of green spaces in schools causes children to quickly become bored (Moore and Wong, 1997), is unable to relieve stress, socializes less, and reduces creativity (Özdemir and Yılmaz, 2008). Unfortunately, children who are isolated from green spaces often resort to fighting to solve their problems (Aksu, 2023). The lack of green spaces also exacerbates the noise problem, causes restlessness and stress in children, and reduces their productivity (Kalipçi, 2007).

Green spaces in schools have a calming effect (Yücekaya et al., 2022) and reduce disorders such as attention deficit and hyperactivity (Kuo et al., 2004). They also contribute positively to students' academic success (Wu et al., 2014).

Green spaces in schoolyards not only positively impact the school but also the surrounding neighborhood (Vural and Yılmaz, 2018). Green spaces have a positive psychological impact and also contribute to reducing crime rates (Kuo et al., 2001). The harsh, monotonous, and barren appearance often found in schoolyards in Giresun, a province renowned for its greenery, contrasts starkly with the surrounding natural landscape. Schools encourage students to interact with their environment. In this sense, greening schools contributes positively to both the school and its surroundings, enhancing the prestige of neighborhoods.

In many developed countries, the recommended size for schoolyards is 25 m² per person (Neufert, Having a large schoolyard reduces noise and creates a positive environment (Onay, 2021). Narrow schoolyard spaces can also cause teachers and students to develop negative attitudes toward school (Karasolak, 2009). Today, children in cities, immersed in technology, spend very little time in the day, leading to various health problems, especially obesity. Schoolyards that are not large enough for physical activity contribute to obesity (WHO, 2021).

4. Conclusions and Recommendations

In all eighteen high school gardens we examined in Giresun Center, the amount of green space per student varied greatly between 0.17 m² and 17.64 m². The lowest value was recorded as Giresun Kale MTAL (%0.17 m²), the highest value was recorded as Social Sciences High School (%17.64 m²). The hard ground ratio varied between 36% and 93% in all campuses; the average permeability remained at only 27%. The soil profile analysis results measured pH between 5.8–6.5, organic matter between 0.9–3.5% and EC between 0.36–0.53 dS/m, indicating generally low soil fertility and plant root growth restriction.

A total of 112 flowering taxa were identified in the floristic inventory, 38% of which were recorded as monocots (Lilium, Iris, Tulipa, Allium, Narcissus species), 62% as dicots (mainly Tilia, Quercus, Pinus, Cupressus, Prunus, Acer, Rosa and Ligustrum species). In terms of school types, plant taxonomic composition was found to be similar between state and private high schools; however, the average green area per student in private high schools (Doğa Koleji, Yavuz Koleji) was 4.46 m², close to the average of 4.77 m² in state schools.

The most common species in the tree layer were Tilia cordata, Quercus robur, Pinus pinaster, Cupressus sempervirens and Cedrus libani, while Rosa canina, Prunus laurocerasus, Ligustrum vulgare, Buxus sempervirens were frequently found in the shrub layer. Vinca minor, Epimedium rubrum and Thymus serpyllum were prominent among ground covers. In schools that wanted to emphasize monocotyledons (Science High School, 125th Year Vocational High School, Fine Arts High School), Lilium, Iris and Narcissus species provided seasonal color continuity.

Acoustic and thermal modelling reported echo coefficients in the range of Rw ~0.52–0.58 at 1 kHz frequency and thermal comfort improvements of 5%–7% in gardens dominated by concreting, indicating that increased green belt density could provide 3–5 dB(A) more noise attenuation and 2–3 °C temperature reduction. In terms of pollen ecology, the allergenic potential of Acer, Platanus, Pinus and Prunus species has highlighted the need to support garden design with evergreen belts and pollen buffer strips.

When these integrated landscape strategies are implemented, eighteen high school gardens in Giresun Center will be transformed into a biophilic learning environment that supports both the psychological and academic performance of students and an urban green infrastructure that provides sustainable services for the local ecosystem. Thus, with a holistic landscape transformation that does not only increase the amount of green space per student but also includes water, noise, dust and pollen management, the environmental, educational and social values of Giresun high schools will be increased simultaneously.

Authors' Contributions

All authors contributed equally to the study.

Statement of Conflicts of Interest

There is no conflict of interest between the authors.

Statement of Research and Publication Ethics

Research and publication ethics were followed in the study.

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