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Research article

Investigation of hemeroby degree of vegetation in urban transport areas: the case of İzmit (Kocaeli)

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Abstract

One of today's main problems is the destruction of the ecosystems by human influence. In conjunction with the industrialization, increasing population and the number of factories has a negative impact on the natural vegetation of biotopes. To measure the intensity of this destruction, universally recognised hemeroby scale is used. İzmit, which is also an industrialized town and was reborn from its ashes after a major earthquake in 1999 has similar ecosystem problems. This study's primary aims are; (1) Identifying the biotope in İzmit's terrestrial (=railway and highway) transportation areas, (2) Comparing with the transportation areas of Anatolian side of İstanbul in A2 region, (3) Examining the causes of differences, (4) Additionally, revealing the floral structure of the city in transportation areas. According to the results of the study, the biotope type distributed in the terrestrial transportation areas of the city of İzmit is compared to the biotope type of the terrestrial transportation areas in the Anatolian side of Istanbul in A2 region. The causes of the differences observed are examined and the flora of the transportation areas of the city was revealed. According to our results, it's understood that these biotope types have different hemeroby degrees. Obtained results were compared with the results of similar studies from cities in Turkey as well as some European cities and the observed differences were evaluated. Additionally, flora of transportation areas of the city has been broadly revealed. Also, suggestions were made on the ecological basis of the city in the future, about the measures to be taken to protect the existing flora and the sustainability of the developing biotopes.

Keywords: *İzmit; urban; hemeroby; transportation areas; ecology; roads*

1. Introduction

Kocaeli, is an important city with numerous ships calling at its' harbours, smoking factory chimneys, rapidly increasing population where the distribution of goods were mainly made by sea and roads. Thus, the city showed a heterogeneous urban development. Turkey is the 18th most populous country in the World and Kocaeli is Turkey's 10th most populous city whereas it is ranked 1st as the most industrialized port city in Turkey. However, it shows both the positive and negative aspects of industrialization (Basaran et al., 2020; Governorship, 2020).

It is located in North western Turkey between 40°-41°N latitudes and 29°-31°E longitudes. Kocaeli is situated at the east end of Marmara Sea and Marmara Region. To the South it's neighbouring the İzmit Bay and to the North Black Sea coast with steep slopes (Fig. 1). Its neighbouring cities are Sakarya to the east, İstanbul to the West and Bursa and Yalova to the South (Mapsworld, 2020; Municipality, 2020).

Kocaeli has a population of 1.953.035 living within an area of 3.505,27 km^2. Population density is 588 people/km^2. 30^o East longitude is considered as local time reference for Turkey. İzmit is the central district of Kocaeli province out of 12 total districts. İzmit's population is 363.416 living within an area of 480 km^2. The population proportion of İzmit to the population of Kocaeli province is 1/5.25 which means that there is a dense (clustering) urbanization in İzmit (Municipality, 2020; Nufusu, 2020).

The city named as Bithynia in ancient period (1200-800 BC) and was also known as Astakoz (712-711 BC), Olibia (326-

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279 BC, Nicomedia (named after king of Bithnia; Nicomedes) (280-94 BC), İznikomid, İznikmid (Ottoman), İzmid, İzmit, Kocaeli (1924-Today) respectively throughout the history (Erken, 2015; Municipality, 2020).

İzmit, like a phoenix reborn from its ashes managed great comebacks after mega earthquakes and city-wide devastating fires (24 August 358, December 362, 17 August 1999 earthquake). The plague of 1592 halted all the transportation activities in the city for over 6 months. The city will surely get over the Covid-19, 2020 pandemic like it did before. During the course of the pandemic, İzmit continued its transportation activities both in the sea and land routes. The social and commercial life started to get revived after the construction of Haydarpaşa-Ankara railroad in 1873 (Beyhan, 2007; Municipality, 2020).

Fig. 1. Study area İzmit's location within Kocaeli province.

When the landforms are considered, the highest point of Samanlı Mountains is Keltepe (Kartepe) with its height reaching 1601 metres. Other important mountains in the province are Dikmen Mountain (1387 m), Naldöken Mountain (1125 m), Naz Mountain (917 m) and Çene Mountain (646m). The prominent plains are the flatlands between İzmit city and Sapanca Lake, along with Dilovası. The parts of Kocaeli peninsula, which is a peneplain, within the borders of the province are composed of wavy flatlands (Semerci, 2003).

Some of the waters originating from the provincial lands flow into the Black Sea whereas some of them flows into the Sea of Marmara. Since the mountain ridges extending into Kocaeli Peninsula are closer to the Sea of Marmara, the rivers flowing into the Black Sea are longer (Beyhan, 2007).

The distribution of total land assets according to soil groups and consequently land use capability, top three spots are lime-free Brown forest soils (70.56%), rendzina soils (15.89%) and alluvial soils (4.65%) (Beyhan, 2007; Severoglu et al., 2011).

Kocaeli is a transition zone between Mediterranean climate with little rainfall and Oceanic climate. It's rainy in summer with high temperatures. Mean temperature of İzmit is around 14.4 ºC (30-year average). Rain can be seen in all months throughout the year in Kocaeli but January and December are generally rainy months. The precipitation regime type is W.A.S.S. (winter, autumn, spring, summer). The precipitation type falls into the category of Central Low Rainfall Mediterranean Precipitation Regime (Köppen and Geiger, 1954; Akman, 1990).

The mean temperature during the vegetation period in Kocaeli province (March 15-December 15) is 17.02 °C as seen in Table 1. Total mean rainfall of Kocaeli province is 62.25mm/year 35.74% of which falls during winter. Months with the most fruitful rains are December and January. 14.72% of the entire year's rainfall happens during the summer period. July and August have the least rainfalls with 9.1%. Spring precipitation is 22.08% whereas during the fall this increases to 27.44%. Snowfall is also but rarely seen.

According to the Turkish State Meteorological Service observation records of Kocaeli province, the monthly average relative humidity is at its lowest in June with 66.2% and highest in January with 75.8% and the annual mean relative humidity of Kocaeli province is 71.7%, number of mean yearly foggy days is 17.1, the annual average number of days with snow is 17.2, mean number of days with hailstorms is 0.8, mean number of days with frost is 14.1, annual average number of days with thunderstorms is 21 and the maximum snow cover thickness is 74 mm (Meteorology, 2020).

According to the Tubives (Turkish Plants Data Service) 2020 records, there are 344 taxa in Kocaeli province. Our province however, sees 950 species and subspecies spread across the province. 11.75% of these taxa belongs to *Asteraceae*, 8.94% to *Fabaceae*, 7.76% to *Poaceae*, 5.93% to *Lamiaceae*, 3.77% to *Scrophulariaceae*, and 3.77% to *Rosaceae* (Beyhan, 2007).

The number of vascular plants in Europe is 12500 and 28% of these plants are endemics. Turkey is one of the richest countries in terms of flora with 9996 plant species belonging to 1320 genus and 167 families. The diverse flora of Kocaeli was studied by many researchers. Evaluation of plants spreading in Kocaeli in terms of endemics and danger classes (Ozen and Acemi, 2011), Flora of Hereke, Kocaeli (Kose and Ozen, 2017) are two of these studies. Also numerous studies were carried out in urban and countrysides (Yarci and Ozcelik, 2002; Yarci et al., 2007; Altay et al., 2010a, 2010b; Osma et al., 2010; Severoglu et al., 2011; Eskin et al., 2012). Also, there are similar studies both in Turkey and Europe. Altay et al., (2015) studied railroads between Haydarpaşa and Gebze can be cited as an example. Similar studies in Europe were also carried out in North Germany (Brandes, 1984), Trento-Italy (Brandes, 2003a) and Strasburg-France (Brandes, 2003b).

Table 1
Temperature and precipitation values of Kocaeli province (Meteorology, 2020).

	January	February	March	April	May	June	July	August	September	October	November	December
Mean Temp. (°C)	5.8	6.2	8	12.5	17.5	21.5	23.4	23.3	19.9	15.8	11.9	8.2
Min. Temp. (°C)	2.7	2.9	4.1	7.7	11.9	15.6	17.9	18	14.6	1.4	8	4.9
Max. Temp. (°C)	8.9	9.6	12.	17.4	22.6	26.9	28.9	28.7	25.3	20.2	15.8	11.5
Precipitation (mm)	90	69	65	53	47	42	31	37	54	70	81	108

Fig. 2. İstanbul-Adapazarı 2019 up-to-date routes of Turkish State Railways (TCDD, 2020).

Table 2
Hemeroby Scale (Jalas, 1955; Sukopp, 1976; Kowarik, 1988; Kowarik, 1990).

Hemeroby Step	Location /Vegetation
HO ahemerob	Practically non-existent in Europe (High mountains at the very most)
H1 oligohemerob	Flat or tall but dense forest without any affects. Swamps, rock and seaside vegetation.
H2 oligomesohemerob	Extensive, water-free wetlands. Areas with fever woody plants, some wet meadows.
H3 mesohemerob	Commonly used forests, undisturbed secondary forests, grasslands of anthropogenic regions, traditionally used meadows.
H4 mesoßeuhemerob	Culture woods comprising single tree species (eg.; memorial forests). Secondary forests, ruderalized dry meadows with sparse vegetation cover.
H5 ß-euhemerob	Young forests, dense grasslands and meadows, ruderal high shrubs vegetation's strongly ruderalized dry meadows in anthropogenic regions.
H6 ß-eu a-euhemerob	Traditional segetal vegetation comprising single tree species, trampled lawns, ruderal meadows.
H7 a-euhemerob	Fields and gardens worked intensely.
H8 a-eu polyhemerob	Field vegetations treated strongly with pesticides (eg; corn fields), ruderal primary vegetation, and trampled grasses.
H9 polyhemerob	Pioneer vegetation in railroads, garbage and slag dump sites, salt-spread roads

The expected hemeroby degree near railroads and land roads is H9 polyhemerob.

2. Materials and methods

This study was carried out in 2002-2006 vegetation period with plants collected from near İzmit's railroads and roads. Identifications and evaluations were made with known botanical methods according to Davis 1965-1985 and Davis et al., 1988.

Mapping was done according to Kunick (1987). Identification and classification studies of dried plant samples were carried out in MUFE (Marmara University, Faculty of Science and Arts Herbarium in Istanbul-Turkey) using "Flora of Turkey and the East Aegean Islands" with its supplements (Davis, 1965-1985; Davis et al., 1988; Guner et al., 2000). The flora is listed alphabetically by family, genus and species and given in Appendix.

Anthropocentrism (Angeles, 1981); the understanding that everything serves humanity, is dominant in societies raised with a human-centric environmental awareness. For this reason, as long as we continue exploiting the nature, environmental damage by the hands of humans will continue to increase. In our study, the degree of destruction caused by human effects in land transportation areas was evaluated according to the hemeroby scale (Jalas, 1955; Sukopp, 1976; Kowarik, 1988; Kowarik, 1990). Mapping works were carried out for the taxa located within 3 meters of transportation areas in İzmit (Kunnick, 1987).

2.1. Studying biotypes of terrestrial transportation areas in İzmit

Roads assume an important role in physical structure of cities by providing movement of people and any type of transportation used by people. Today, roads along with limited open and green areas, build up the breathing spaces in the city (Sayar, 1998). We will classify and examine the biotopes that we determined within İzmit as "Terrestrial Transportation Areas" as "railroads" and "motorways".

2.1.1. Railroads

Kocaeli province has 68 km of railroads as of today (Fig. 2). The new train station building of İzmit has opened to public in 29 July 1999 and the railroads started operating on this new route since then. The railroad mainlines which used to extend at a 90° angle to the motorway and shoreline, now runs along the shoreline parallel to the motorway (Fig. 3) (Municipality, 2020).

Fig. 3. Vegetation on and around the railroad in İzmit.

In İzmit, in the area called "(Demiryolu) Hürriyet Caddesi" old rails were removed, new cobblestones were laid, making walkways for pedestrians while large trees like sycamores were carefully preserved and labelled by "High Council of Monuments" (Fig. 4) (Beyhan, 2007).

Fig. 4. Old railway route, converted to pedestrian walkways by laying cobblestones in İzmit.

In İzmit, not all biotope types that we described as "Transportation Areas" have the same degree of hemeroby. Railways, being one of the main elements of transportation areas, represents hemeroby characteristics between Polyhemerob-Metahemerob (Beyhan, 2007; Altay et al., 2015).

2.1.2. Motorways

Within the borders of Kocaeli province, there are 249 km of state motorways; 180 km of which is asphalt and 69 km surface coated. 49 km are divided roads. Additionally, there is 207 km of provincial roads. The main arteries are TEM (Trans European Motorway) and D-100 (E-5) motorway.

The most common taxa in the vegetation on roadsides and refuges are *Nerium oleander* L., *Acer pseudoplatanus* L., *Platanus orientalis* L., *Cupressus sempervirens* L., *Hordeum murinum* L., *Raphanus raphanistrum* L.

Apart from this, planted woody taxa and the regions natural taxa are seen in Transportation Areas. "Motorways; Asphalt, Transit roads" which we have evaluated within the scope of Transportation Areas, on the other hand, shows Euhemerob characteristics. When analysed descriptively, the obtained results are better than the value shown on the hemeroby scale (Beyhan, 2007).

3. Results and discussion

In our study, conducted in İzmit region, naturally occurring 80 taxa, 32 families, 64 genera (60 species, 12 subspecies, and 8 varieties) that grows spontaneously around transportation areas, were identified. Among them, 70 species are dicots and two species are monocots (Table 3 and Supplement).

Table 3
Monocot (geophytes) and dicot ratios.

	Monocots		Dicots		
Taxon	Number	%	Number	%	Total
Family	1	3.12	30	93.75	32
Genus	1	1.56	56	87.5	64
Species	2	4	69	86.25	80

There are only two monocot species here, which are *Muscari commutatum* Guss. and *Muscari parviflorum* Desf. (*Asparagaceae*, belonged to *Liliaceae* previously) and constitutes 4% of total species. Dicots on the other hand, constitute 86.25% of total species. If we rank the families according to the number of species they contain; the ranking will be as, *Asteraceae* (13 species, 16.25%), *Poaceae* (9 species, 11.25%), *Brassicaceae* (8 species, 10%), *Fabaceae* (8 species, 10%), *Plantaginaceae* (3 species, 3.75%), and *Geraniaceae* (3 species, 3.75%) (Table 4).

Table 4
Ratios of richest families found in İzmit's transportation areas.

	Genera (64)		Species (80)		
Family	**Number**	**%**	**Number**	**%**	**Sp./Genus ratio**
Asteraceae	10	15.62	13	16.25	1.3
Poaceae	7	10.93	9	11.25	1.28
Plantaginaceae	1	1.56	3	3.75	3
Brassicaceae	8	12.5	8	10	1
Fabaceae	5	7.81	8	10	1.6
Geraniaceae	2	3.12	3	3.75	1.5

As can be seen from Fig. 5, families with higher number of taxa are determined as; *Asteraceae* (16.25%), *Brassicaceae* (12.5%), *Poaceae* (11.25 %), *Fabaceae* (7.81%), *Plantaginaceae* (3.12%), and *Geraniaceae* (3.12%). These values are proportionally accurate when the general vegetation and flora composition is taken into consideration.

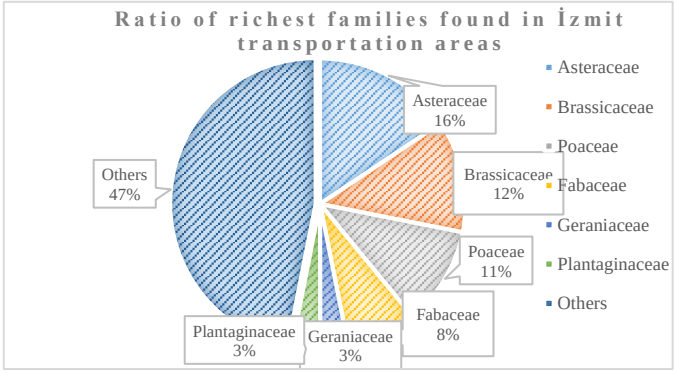

Fig. 5. Pie diagram of taxa distribution ratios of richest families in İzmit transportation areas.

Asteraceae has the highest number of species and a species/genera ratio of 1.3, whereas *Brassicaceae* has the lowest species/genus ratio of 1. This ratio is higher in other families. The ratios of other families are as follows; *Poaceae* (1.28), *Geraniaceae* (1.5), *Fabaceae* (1.6), *Plantaginaceae* (3). According to previous studies carried out in A2 region, *Asteraceae* family is the richest in terms of number of species when compared with other families (Altay et al., 2015). In one of studies regarding *Asteraceae*, Pietrzyk reported abundant *Asteraceae* species on the side of railroads and that they cause allergies (Pietrzyk et al., 2019). Another one from England studied railroad side habitats (Marshall, 2018). Borda-de-Água et al., (2017) suggested that the difference in the diversity of the species on left and right sides of the railways is due to *Asteraceae* members creating a barrier for other living things. It is kind of a transition zone since it prevents spreading (ecotone).

Pavlova and Tonkov (2005) mention that *Asteraceae* family is observed at a high rate in central Europe. This proves the success of the family in dispersal and survival. Yarci et al., (2007) recorded a similar distribution when he studied the vegetation of historical areas and buildings in Edirne. According to Davis, (1965-2000) *Asteraceae* family demonstrates success at similar levels all around Turkey.

When we examine the table, *Brassicaceae* family seems to be very rich in İzmit compared to other locations. The reason

may be that our study comprises both railroads and motorways whereas other studies comprise railroads. Also, *Andrzeiowskia cardaminifolia* (DC.) Prantl., which is a very rare plant, was also detected in transportation areas. This taxon was normally registered in grids A2, A5, A6, C3 in İstanbul, Antalya and Samsun, and can be seen in Russia, Greece and W. Syria (Beyhan, 2007).

Table 5
Comparing percentages of richest families in İzmit with studies from Haydarpaşa-Gebze (Altay et al., 2015) and European cities. References: Northern Germany (Brandes, 1984), Trento-Italy (Brandes, 2003a), Strasburg-France (Brandes, 2003b).

Family	Haydarpaşa -Gebze	İzmit	Germany	Italy	France
Asteraceae	14.37	**16.25**	17.07	14.86	18.42
Poaceae	10.34	**11.25**	15.85	16.21	12.28
Brassicaceae	4.02	**10**	4.87	4.05	3.50
Fabaceae	12.64	**10**	1.21	5.40	3.50

Consequently, natural vegetation is desired to be kept under control by the use of herbicides near roads. However, if herbicides are used uncontrollably, they may cause damage to natural vegetation and we must protect our ecological treasures.

Highways, land roads and railroads act as ecological corridors. They form synthetic corridors. Bushy plants are tested to be helpful and successful in preventing events such as landslides and floods (Shi et al., 2018). Extensive use of concrete structures should be prevented, the natural vegetation should be preserved and allowed to spread. Thus, undesired events such as floods and landslides in cities can be reduced. Sides of highways and railroads can also assume the role of forming a green belt encompassing the city (Altay et al., 2015).

In order to create a solution here, younger generations should let go the human centric (Anthropocentrism) approach (Angeles, 1981) and start serving for the revitalization of the nature. The course of Covid-19 the humanity is enduring will likely help us understand the importance of balance in the nature. The consciousness for environmental protection, reduced consumption, reusing and recycling; and acknowledging the nature and developing empathy for nature should be popularized.

The future of humanity is entrusted to a sustainable environment, not an environment with all of its resources dried and drained.

Appendix

List of Flora (Taxa found in İzmit terrestrial transportation areas)

APIACEAE
Tordylium apulum L.

APOCYNACEAE
Nerium oleander L.

LILIACEAE
Muscari commutatum Guss. G.
Muscari parviflorum Desf.

ASTERACEAE
Bellis perennis L.
Calendula arvensis L. Th.
Circium creticum (Lam.) d'Urv. subsp. *creticum* H. E. Medit.
Cichorium inthybus L. Ch. E. Medit.
Crepis aurea (L.) Cass. subsp. *olympica* (C. Koch.) Lamond
Crepis armena DC.
Crepis reuterana Boiss. subsp. *reuterana*
Doronicum orientale Hoffm.
Pulicaria dysenterica (L.) Bernh.
Senecio taraxacifolius (Bieb.) DC. var. *taraxacifolius*
Senecio vulgaris L. Th.
Sonchus arvensis L. subsp. *uliginosus* (Bieb.)Beg.
Taraxacum officinale Wiggers Ch.

BETULACEAE
Carpinus betulus L.

BRASSICACEAE
Arabidopsis thaliana (L.) Heynhold
Arabis brachycarpa Rupr.
Capsella bursa- pastoris (L.) Medik. Th. Cos.
Calepina irregularis (Asso) Thellung
Cardaria draba (L.) Desv. subsp. *chalepensis* (L.) O.E.Schultz
Andrzeiowskia cardaminifolia (DC.) Prantl.
Neslia apiculata Fisch. Th. Wid.
Raphanus raphanistrum L.

BORAGINACEAE
Anchusa arvensis (L.) Bieb. subsp. *orientalis* (L.) Nordh
Echium plantagineum L.

CARYOPHYLLACEAE
Moenchia mantica (L.) Bartl. subsp. *mantica*
Stellaria media (L.) Vill. subsp. *pallida* (Dumort.) Aschers. & Graebn.
Cerastium glomeratum Thuill Th. Cos.

CONVOLVULACEAE
Convolvulus arvensis L. H. Cos.

CUCURBITACEAE
Ecballium elaterium (L.) A. Rich. H, Medit.

EUPHORBIACEAE
Euphorbia helioscopia L. Th.
Euphorbia exigua L. var. *retusa* L.
Euphorbia lathyris L.

FABACEAE
Hymenocarpus circinnatus (L) Savi.
Robinia pseudacacia L.
Trifolium stellatum L. var. *stellatum*
Trifolium striatum L.
Trifolium bocconei Savi
Medicago polymorpha L. var. *vulgari*s (Benth.) Shinners
Medicago marina L.
Vicia sativa L. var. *sativa*

GERANIACEAE
Geranium rotundifolium L.
Geranium lanuginosum Lam.
Erodium malacoides (L.) L'Herit.

HIPPOCASTANACEAE (SAPINDACEAE)
Aesculus hippocastanum L.

LAMIACEAE
Lamium amplexicaule L. T. Euro.- Sib.

LINACEAE
Linum austriacum L. subsp. *austriacum*

MALVACEAE
Malva sylvestris L. H.

MORACEAE
Ficus carica L. subsp. *carica* Ph, wid.
Morus alba L.

MYRTACEAE
Myrtus communis L. subsp. *communis*

OLEACEAE
Ligustrum vulgare L. Ph, Euro.- Sib.
Phillyrea latifolia L. Ph, Medit.

OXALIDACEAE
Oxalis articulata Savigny

PAPAVERACEAE
Papaver macrostomum Boiss. & Huet.ex Boiss.

PLANTAGINACEAE
Veronica hederifolia L.
Veronica pectinata L. var. *pectinata*
Veronica polita Fries.

PLATANACEAE
Platanus orientalis L.

POACEAE
Hordeum murinum L. subsp. *leporinum* (Link) Arc. var. *simulans* Bowden
Hordeum distichon L.
Hordeum vulgare L.
Bromus diandrus Roth.
Agrostis stolonifera L.
Alopecurus vaginatus (Willd.) Boiss.
Lolium perenne L.
Melica ciliata L. subsp. *magnolii* (Gren & Godr) Husnot.
Phleum echinatum Host.

PORTULACACEAE
Portulaca oleracea L.

RANUNCULACEAE
Ranunculus marginatus d'Urv. var. *marginatus*

ROSACEAE
Rubus sanctus Schreber.

RUBIACEAE
Galium tricornutum Dandy

SALICACEAE
Salix babylonica L.

SOLANACEAE
Solanum nigrum L.

URTICACEAE
Urtica dioica L.

VITACEAE
Vitis vinifera L.

Abbreviations: Ph=phanerophytes; Ch=chamaephytes; H=hemicryptophytes; Th=therophytes; G=geophytes; Euro.-Sib.=Euro-Siberian; Ir.-Tur.=Irano-Turanian; Medit.=Mediterranean; E. Medit.=East Mediterranean; cos.=cosmopolitan; wid.=widespread

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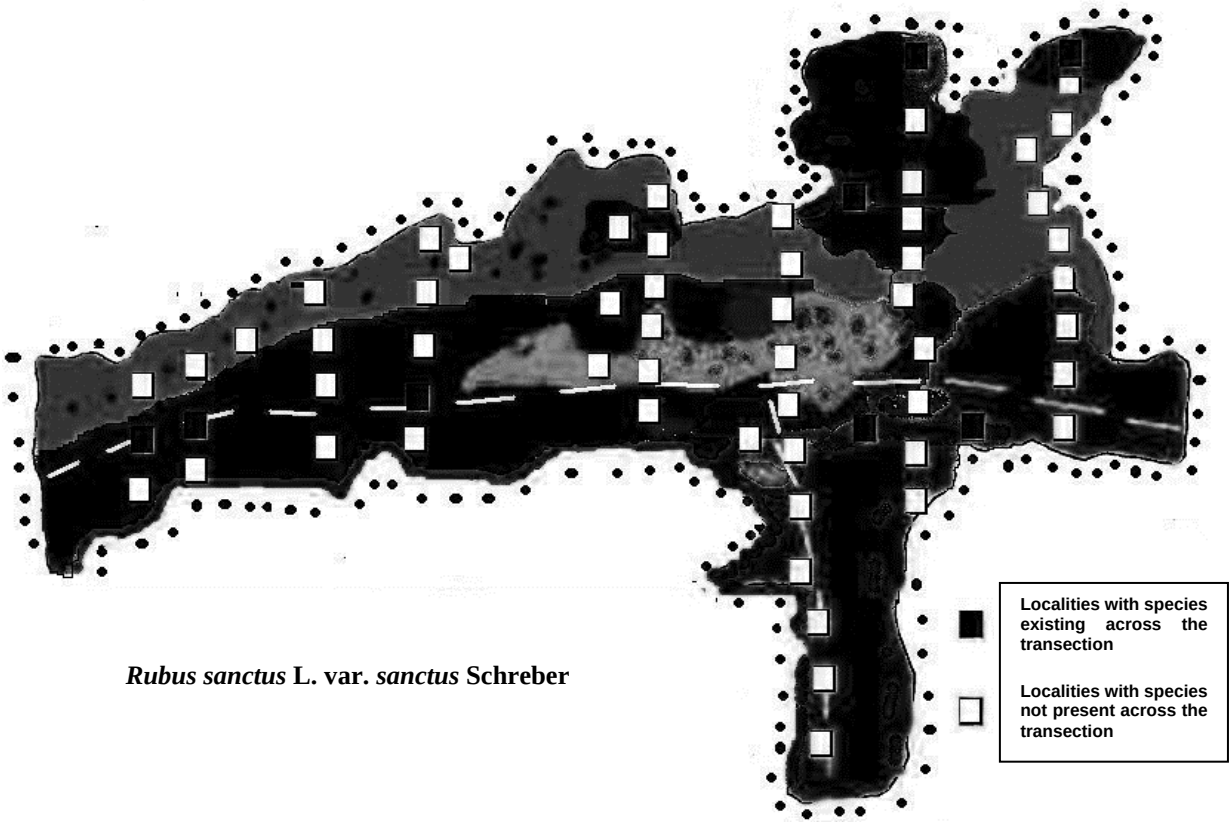
Supplementary

Display of taxa on the map, that are common on transects.

Suppl. Fig. 1. Distribution of *Platanus orientalis* L. in İzmit

Suppl. Fig. 2. *Platanus orientalis* L.

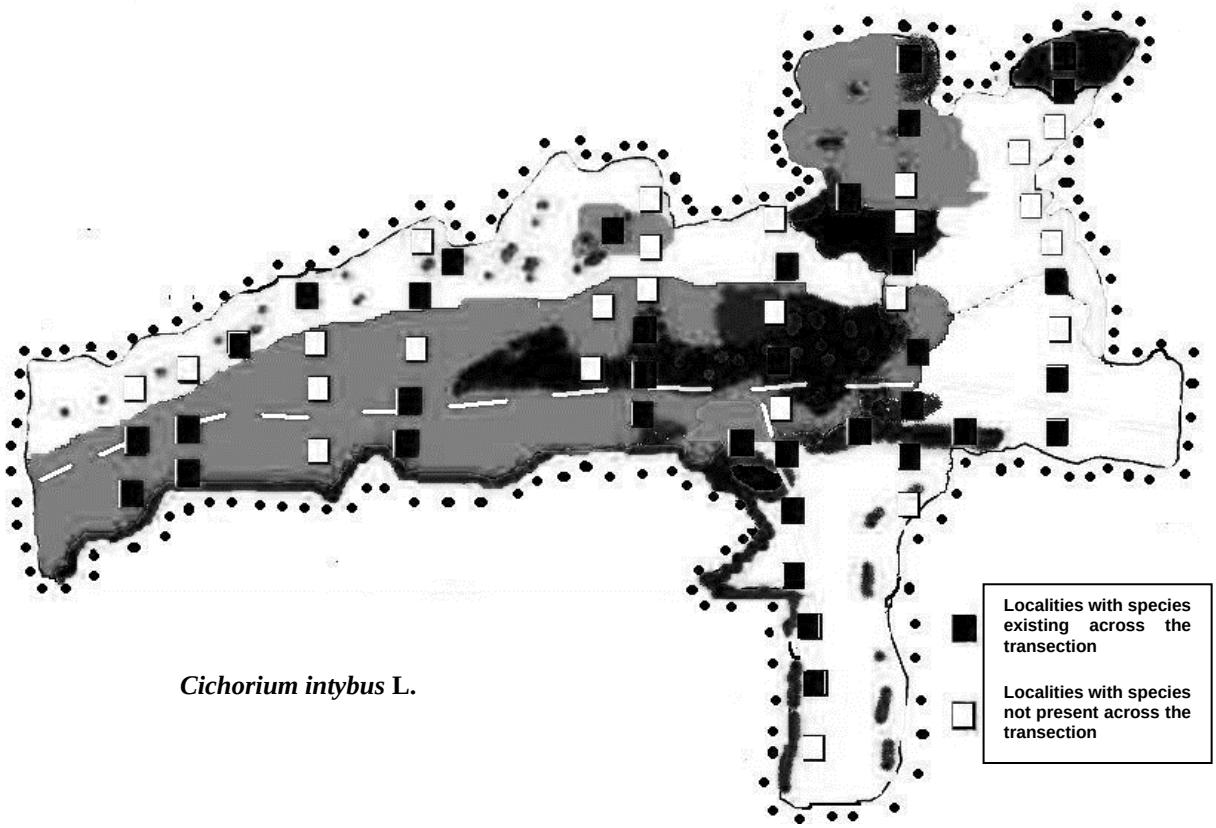


Suppl. Fig. 3. Distribution of *Rubus sanctus* L. var. *sanctus* Schreber in İzmit

Suppl. Fig. 4. *Rubus sanctus* L. var. *sanctus*

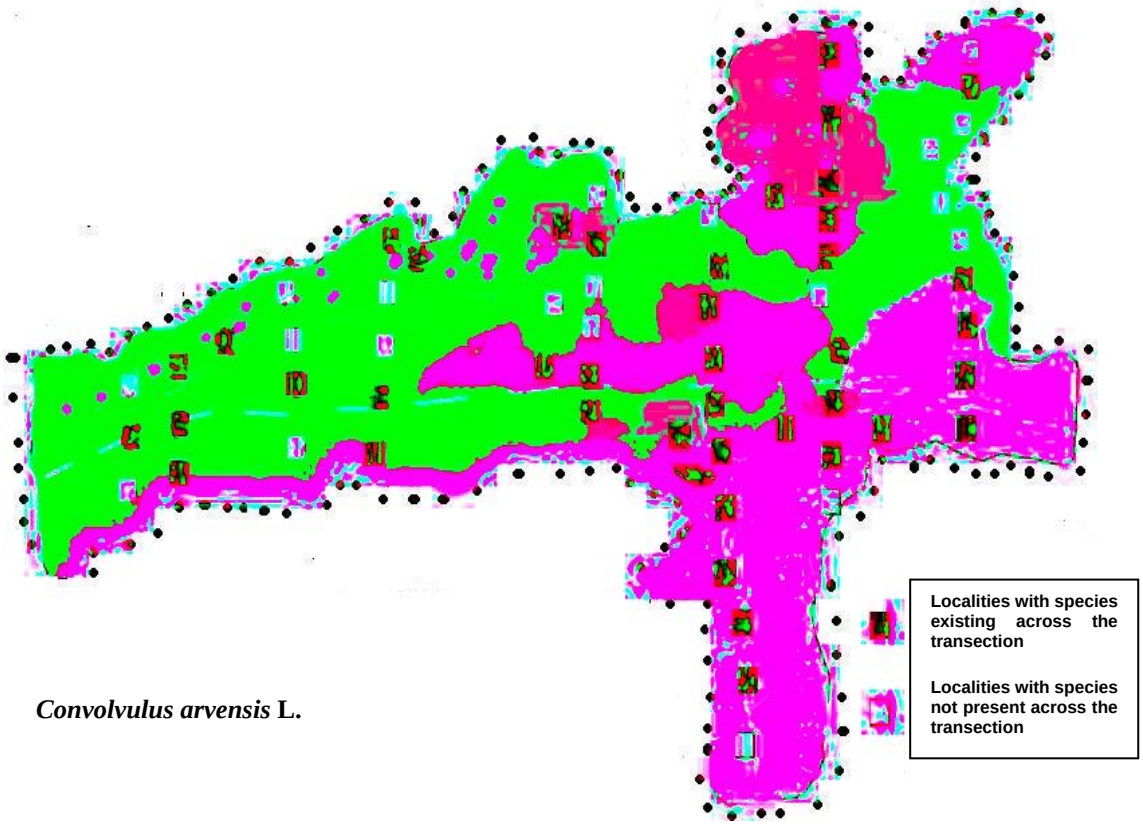
Suppl. Fig. 5. Distribution of *Hordeum murinum* L. subsp. *leoporinum* (Link.) Arc. var. *simulans* Bowden in İzmit

Suppl. Fig. 6. *Hordeum murinum* L. subsp. *leporinum* (Link.) Arc. var. *simulans* Bowden



Suppl. Fig. 7. Distribution of *Cichorium intybus* L. in İzmit

Suppl. Fig. 8. *Cichorium intybus* L.



Suppl. Fig. 9. Distribution of *Convolvulus arvensis* L. in İzmit

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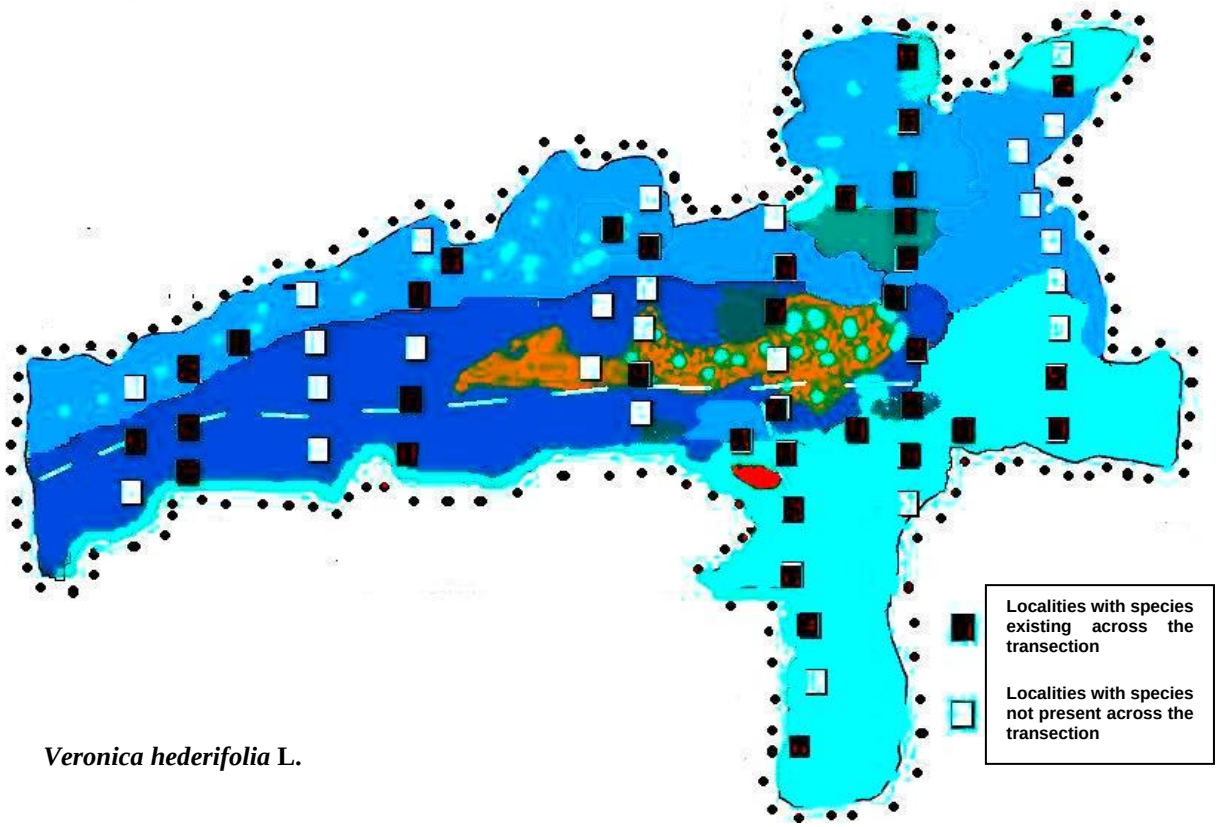
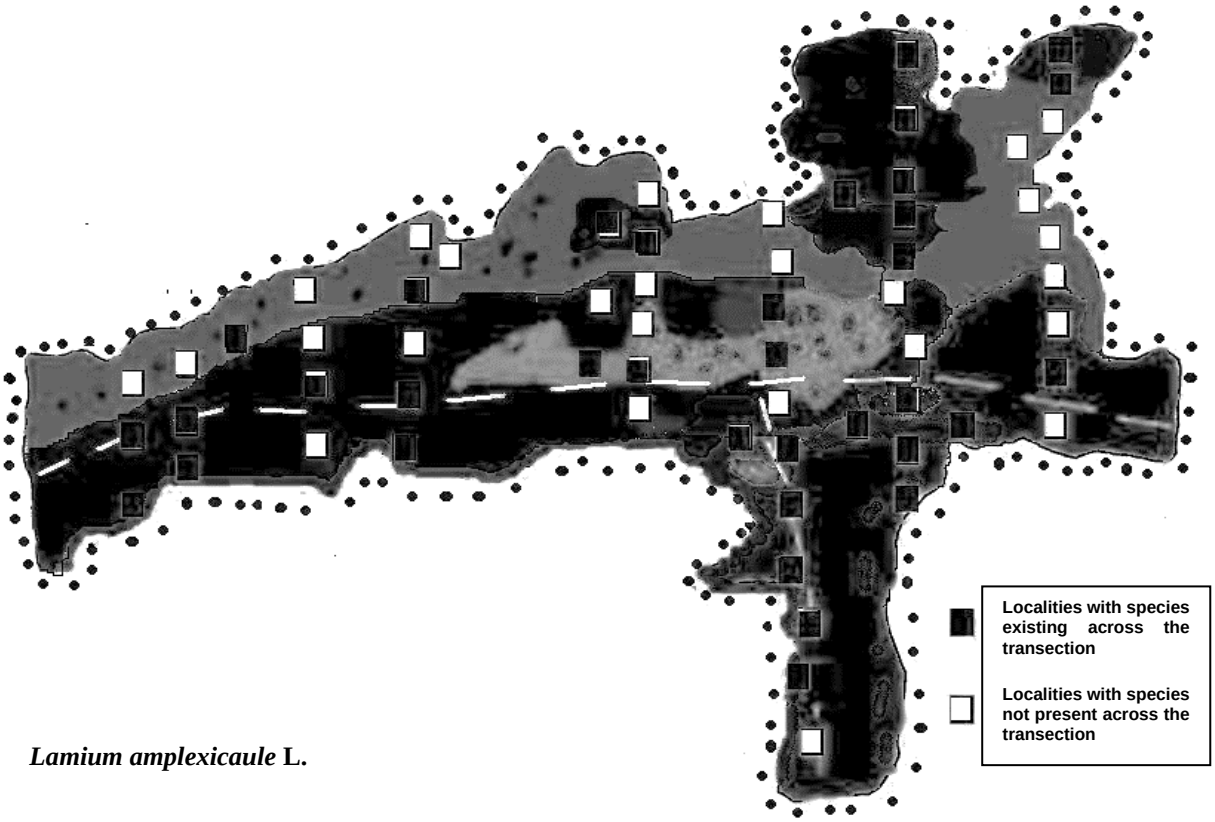
Suppl. Fig. 10. *Convolvulus arvensis* L.



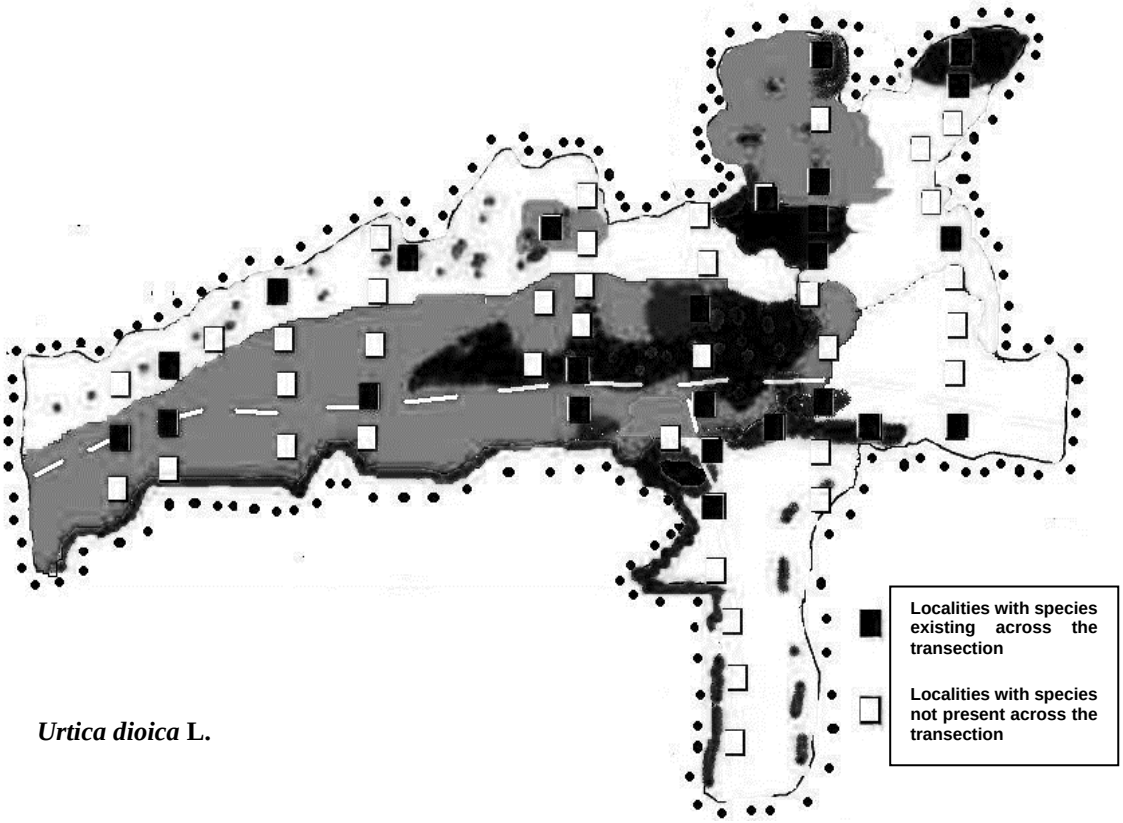
Suppl. Fig. 11. Distribution of *Veronica hederifolia* L. in İzmit

Suppl. Fig. 12. *Veronica hederifolia* L.



Suppl. Fig. 13. Distribution of *Lamium amplexicaule* L. in İzmit

Suppl. Fig. 14. *Lamium amplexicaule* L.



Suppl. Fig. 15. Distribution of *Urtica dioica* L. in İzmit

Suppl. Fig. 16. *Urtica dioica* L.