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THE IMPACT ON ENVIRONMENTAL SUSTAINABILITY OF CATERING FACILITIES FOR TOURISTS

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Abstract
Catering facilities have a significant impact on the environmental sustainability of any destination. While travelling, people waste more food, eat more and prefer environmentally less sustainable products. This unsustainable behaviour is spatially conditioned: tourists move almost exclusively within a small part of a destination (the so-called limited area) where only a limited number of catering facilities are located. These businesses are therefore the key drivers of the environmental sustainability. The main objectives of this paper are to investigate the size of the limited area, number of catering options spatially accessible to tourists and finally to assess the environmental vulnerability of 38 European destinations associated with the limited area tourists usually visit and with the number of catering facilities that are accessible for tourists. Based on the spatial analysis considering the location of catering facilities, geo-located photographs and Airbnb listings, the limited area was calculated, and four indicators were implemented to assess the environmental vulnerability. The results showed that tourists move in only 4.4 km^2 (3.3% of a city administrative boundary). In this area, millions of tourists have access to 685 catering facilities. In terms of spatial conditionality of food consumption, Venice, Amsterdam, and Florence are among the most environmentally vulnerable destinations. Furthermore, Venice and Florence also lack the environmental potential as a strong majority of catering facilities is located within their limited areas. On the contrary, Geneva and Thessaloniki were assessed as the least environmentally vulnerable destinations in our sample. Paris is the destination with the highest environmental potential, as 84% of its catering businesses are located beyond the borders of the limited area.

Key words
Catering facilities, environmental impacts, environmental overtourism, limited area, spatial analysis, tourism.

INTRODUCTION

Europe has long been a major tourist region: In 2019, the year before the pandemic began, exactly 744 million (51%) of international tourists visited this region. Between 2010 and 2019, arrivals increased by a staggering 250 million

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(UNWTO, 2020). However, the rapid growth has caused an extreme spatiotemporal concentration of tourists in European cities, where 44% of all global international arrivals are concentrated (WTTC, 2019). While the pandemic has significantly reduced tourism, past experience with global tourism development (UNWTO, 2018) and regional analyses related to tourism downturns, e.g., after terrorist attacks (Pizam & Smith, 2000), show that the sector is resilient to crises. Despite the new tourism challenges associated with COVID-19 that may affect post-covid tourism development, such as travel fear (Zheng et al., 2021), it is likely that tourism issues will again take centre stage in the near future.

Due to the increased accessibility of cities through low-cost airlines and short-term rentals, the increasing importance of social networks and the growth of the global (urban) population, overtourism can occur in popular destinations (Capocchi et al., 2019; Dodds & Butler, 2019). Excessive concentrations of tourists can degrade the quality of life for residents in many ways. According to Lochman and Vágner (2021), existing research on overtourism has focused primarily on social impacts. On the contrary, less attention is paid to "environmental overtourism", which refers to a situation where the deterioration of the quality of life of residents (and tourists) occurs due to environmental causes, e.g. deterioration of residents' health caused by air pollution (presence of cruise ships) or the degradation of soil caused by concentration of heavy metals emitted by transport means. In this respect, this article deals with the consequences of the overconcentration of tourists in popular urban destinations in Europe, the world's most popular tourist region, that take place beyond the immediate territory of a destination: the environmental impacts of food consumption (production), which include deforestation, soil pollution, greenhouse gas production, etc.

As stressed by Gössling et al. (2011), one of the main drivers of environmental sustainability of a destination are catering facilities, whose offer influences the eating habits of tourists and therefore the level of environmental damage. Agriculture is one of the key contributors to climate change. The blame lies primarily with livestock production, which generally has higher environmental demands (Steinfeld et al., 2006). As Gössling et al. (2011) further argue, the area of a tourist destination is largely limited and there is only a limited number of catering facilities. Theoretically, if catering facilities with access to the tourism market offered only environmentally less sustainable food, the sustainability of a destination and the quality of life of residents would be significantly at risk. This paper addresses the so-called limited area of a destination and the environmental vulnerability associated with food consumption at a more concrete level.

The results will contribute to understanding of the nature of overexploitation of natural resources in a destination and can also provide background for relevant policymakers. The assessment of environmental vulnerability based on the limited area of a destination can be a guide for the formulation of environmental

regulations aimed at reducing the environmental impacts of tourism: catering facilities located in the limited area are geographically advantaged because they have access to crowds of tourists who are almost exclusively dependent on their menus. Geographical conditionality ensures high demand for food and gives stakeholders the opportunity to influence the environmental sustainability of a destination through the food on offer.

OBJECTIVES

The main objective of this paper is to calculate the limited area of a destination and the options that tourists have for catering and, on this basis, assess the environmental vulnerability of 38 European urban destination. The assessment is based on the concentration of tourism, the limited spatial behaviour of tourists and the spatial distribution of catering facilities. In general, the following research questions were set:

(1) How large is the limited area of a destination in which tourists are usually concentrated?
(2) How many catering opportunities tourists have?
(3) What is the level of environmental vulnerability associated with the spatial behaviour of tourists and the spatial dispersion of catering facilities?

THEORETICAL FRAMEWORK

Consumption behaviour of tourists and its impact on the environment

Based on a literature review, the paper first discusses the relevance of the research of the limited area in the context of food consumption: the focus is on the different consumption behaviour of tourists and the different environmental impacts of food that is in high demand. The literature review concludes with a discussion of relevant articles describing the limited tourist movement in a destination.

The first important aspect of differential behaviour is the preference for certain types of food: especially meat-based dishes, as demonstrated in different geographical and cultural contexts, Tibet (Li et al., 2019) and the USA (Wang et al., 2020). Further, the research from the US shows that the consumption of dairy products when travelling increases, while the consumption of vegetables and fruit decreases. Seafood consumption increases slightly, probably mainly in the context of sun-and-sea destinations (Santos et al., 2020). Gössling (2001), who compared the diets of residents and tourists in Tanzania, found that the dietary composition of tourists contained significantly more meat (12.9 percent compared to 0.6 percent) and fish and seafood (19.3 percent compared to 11.0 percent). The environmental impacts of catering is also stimulated by the fact that the average diet of tourists contains approximately 0.5 kg more food per day (Gössling & Peeters, 2015).

Eating habits that differ from everyday life are associated with, among other things, a higher frequency of visits to fine dining restaurants (Wang et al., 2020), which generally conditions a higher consumption of fatty foods and, conversely, lower carbohydrate intake (Yue et al., 2017). A multidimensional relationship to diet during travel can be observed in a group of healthy eaters. Chang (2017) argues that a specific group of healthy-eating tourists change their eating habits when travelling because the novelty motive is a key aspect for them.

Higher consumption of meat and dairy products contributes significantly to climate change. As demonstrated by Poore and Nemecek (2018): if the median is considered, the production of 1 kg of bovine meat produces approximately 16 times more kg CO^2eq than rice, which is the most emission-intensive primary plant food. However, the difference is lower for other types of meat. For example, for lamb and mutton compared to rice it is 11 times, for bovine meat (dairy herd) it is 9 times, crustaceans (farmed) it is 4 times, pork is almost 3 times, and chicken 2 times more demanding food in this respect. The higher environmental impact (including water use, land-use and biodiversity loss) of meat and dairy products, and thus of an omnivorous diet, and the lower negative environmental impact of a plant-based diet are confirmed by other studies (Alexander et al., 2015; Alexander et al., 2016; Stoll-Kleemann & Schmidt, 2017; Yue et al., 2017; Vanham, et al., 2018; Chai et al., 2019; Wilson et al., 2019; Harris et al., 2020; Lonnie & Johnstone, 2020). However, there may be exceptions where a vegan dieter has a higher ecological footprint compared to an omnivore (Rosi et al., 2017).

The pressure of tourists' diet on land-use can be illustrated by empirical research from Lhasa (Li et al., 2020). A study from a Tibetan town showed that between 2013 and 2015, arable land requirements increased by 7,833 hectares due to tourist demand, primarily as a result of higher tourist numbers and secondarily due to dietary pattern effect. To meet tourist demand, a total of 22,209 hectares had to be secured in 2015, of which 18,618 (84 per cent) were for livestock production.

Different attitudes towards eating at a destination may be related to the motive for travelling (Quan & Wang, 2004). Gastronomy has become one of the main interests of tourists and a factor determining their satisfaction, as well as the intention to return (McKercher et al., 2008; UNWTO, 2017; Stone et al., 2019). The increased interest in local food has even given rise to a so-called food tourism, which Hall and Sharples (2003, p. 10) define as:

"visitation to primary and secondary food producers, food festivals, restaurants and specific locations for which food tasting and/or experiencing the attributes of specialist food production region are the primary motivating factor for travel". The importance of food in tourism is also confirmed by Xue and Zhang (2020): tourists are willing to spend more money in restaurants compared to residents. Travelling for food to a different cultural environment, and therefore eating unfamiliar food,

is an inevitable cause of different diets and higher dependence of tourists on catering facilities compared to everyday life.

Another important aspect of tourists' differential consumption is food waste, which is approximately 1.7 higher than in the at-home scenario; the importance of on-trip waste is even more significant compared to away-from-home but non-tourism food consumption (Wang et al., 2018; Li et al., 2019). In the case of the Bahamas resort, food waste accounted for 36% of the total solid waste generation (Sealey & Smith, 2014). The consequences are not only in the nature of overproduction and unused energy and water resources, but also emissions formed during food decomposition (Saer et al., 2013). Unsustainable consumption habits of tourists are considered as one of the key causes of food waste production; this aspect is relevant in the context of buffets (Filimonau & De Coteau, 2019) and all-inclusive packages (Li & Wang, 2020). Gössling et al. (2011) argue that buffets, beyond their tendency to leave higher amounts of leftovers, encourage tourists to eat more than normal.

Limited spatial behaviour of tourists

The environmental impact of food consumption in tourism is conditioned by the limited area of a destination, in which tourists have access to only a limited number of catering facilities.

This fact makes these facilities key actors in the environmental sustainability (Gössling et al., 2011). Gössling et al. (2011) argue that in order to ensure the environmental sustainability, it is essential that catering facilities located in an area intensively visited by tourists adhere to food management that focuses not only on limiting the supply of specific foods (imported beef), but also on the way food is prepared (using renewable energy or not using aluminium foil).

Urban destinations (or urban tourism) are typically characterised by short stays, usually no longer than two days in the case of the most popular destinations. For smaller, lesser-known cities, stays tend to be in units of hours (Ashworth & Page, 2011). The lower length of stay in cities is partly due to the attraction of business travellers (Gössling & Hall, 2018). The limited time for movement in a destination then implies a low level of dispersion of tourists and the inability of tourists to reach the entire territory of a destination (Mazanec, 1997).

The spatial behaviour of tourists is highly concentrated, usually taking place in (historic) city centres and in the vicinity of popular tourist attractions that have tourist infrastructure. Suburban zones, on the other hand, are rarely visited, as confirmed from European context (Kádár, 2014; García-Palomares et al., 2015; Kotus et al., 2015; Karayazi et al., 2021) but also from different geographical settings (Vu et al., 2015; Khan et al., 2020; He et al., 2021). Yun et al. (2018) further argue that tourists just pass through residential zones without lingering for long periods,

staying primarily in commercial areas. The spatial concentration of tourists, and hence the demand for food, is enhanced by the way tourists move around: to visit the various attractions of a city, tourists choose the shortest possible route. The transfer between attractions is used to stop at a restaurant (Modsching et al., 2008). Also, tourists seek out restaurants near tourist attractions (Zee et al., 2020).

In the case of Prague, according to Lochman (2021), restaurants near tourist attractions primarily offer meat dishes containing pork and beef. In addition, the menu structure nudges customers to choose meat-based dishes, as meatless dishes were not recommended by the restaurant staff, had their own section (which meat eaters overlook), and were localized to the end of the menu. Also, the environmental impact of each dish was not disclosed on the menu, which might persuade more environmentally conscious individuals to order the dish with the lowest ecological footprint (Visschers & Siegrist, 2015).

In some cases, tourists have been distracted to some extent by the accommodation platform Airbnb (Ki & Lee, 2019; La et al., 2021). However, the dispersion of tourists is not so significant, the dominant listings are concentrated near popular tourist attractions and the city centre (Quattrone et al., 2018; Jiao & Bai, 2020).

DATA AND METHODS

The investigation was carried out on a sample of 38 European cities (Table 1), which are mostly located in Western and Southern Europe, the most important and developed regions in the world in terms of tourism.

The calculation of the limited area of a destination

A database of 14.1 million geotagged photographs from Flickr created by Mousselly-Sergieh et al. (2014) was used. The database is spatially representative, despite the fact that it contains only publicly available photographs. The photographs predictably cover mainly Western Europe and the USA, which supports the relevance of the data selection. Moreover, the coordinates of the Flickr photographs are relatively accurate in an urban environment, with a deviation of no more than 15 metres (Mor & Dalyot, 2020). Finally, geolocated photographs are commonly used to analyse the spatial behaviour of tourists (e.g., Kádár, 2014; Yang et al., 2017; Li et al., 2018) although geographic findings can be affected by high user selectivity (Park et al., 2020). There is no distinction between tourists and residents in the data, as the various techniques for determining tourists and residents are not entirely accurate and reliable (Vaziri et al., 2019).

In addition, data containing the location of Airbnb listings available on the InsideAirbnb (2021) website was used to calculate the limited area. The data contains the most up-to-date version as of 25 June 2021. The reason for the

Tab. 1 Investigated cities and their administrative territories

City	Administrative territory [km^2]	City	Administrative territory [km^2]
Amsterdam	220	Madrid	604
Antwerp	521	Malaga	395
Athens	39	Manchester	116
Barcelona	102	Milan	182
Bergamo	40	Munich	312
Berlin	892	Naples	118
Bologna	141	Oslo	480
Bordeaux	577	Paris	105
Brussels	33	Porto	41
Copenhagen	102	Prague	496
Dublin	118	Riga	304
Edinburg	273	Rome	1,287
Florence	102	Sevilla	141
Geneva	18	Stockholm	215
Ghent	158	Thessaloniki	18
Girona	39	Valencia	136
Lisbon	85	Venice	174
London	1,595	Vienna	415
Lyon	48	Zurich	92

Source: Own elaboration

inclusion of Airbnb-related data is that the accommodation platform has pushed for a slight distraction of tourists towards the residential zones. The data therefore includes places where tourists move not only during the day but also in the evening (Salas-Olmedo, et al., 2018). The limited area was calculated through the number of reviews left. The location of hotels and motels were also considered, but there is no database that includes the number of tourists staying in each hotel. Additionally, it was confirmed that prominent hotels are located in the city centre close to the most popular tourist attractions (Li et al., 2015).

The limited area was calculated through a grid: the administrative boundaries of each city were divided into square grids with side lengths of 100, 200, 300, 400 and 500 meters. Different grid sizes were adopted to avoid the significant loss of information to which this method is susceptible (Borusso, 2008). In each quadrant, the number of photographs captured, and the number of reviews left were counted. Separately for both groups, Hot Spot Analysis (Getis-Ord Gi) with inverse distance was calculated to identify significant spatial clusters of geolocated

photos and Airbnb facilities with high numbers of reviews. Both clusters with a 99% significance level were merged in the next step to create a continuous area representing the limited area. In order to provide a more suitable output, the polygon boundaries were generalized.

The concentration of catering facilities

The number of facilities in the limited area was extracted from Open Street Map (OSM). The dataset is updated daily: in the context of this work, the dataset was downloaded on 25 June 2021 and is generally no more than one day old (Open Street Map, 2021). For the purpose of this research, only the following types were extracted: bakery, cafe, fast food, food court, pub, and restaurant. OSM was used due to its reliability, as shown by the research of Balducci (2021) using Italian museums as an example. The Italian OSM dataset proved to be comprehensive, containing 86% of the official number of museums. A higher proportion of official museums was present especially in large cities. Some gaps in the data are more likely to be rather in rural area.

The final data for the spatial analysis therefore consists of the following three layers: photographs, catering facilities and Airbnb listings (Figure 1). The spatial analysis was processed in the ESRI (2019) software.

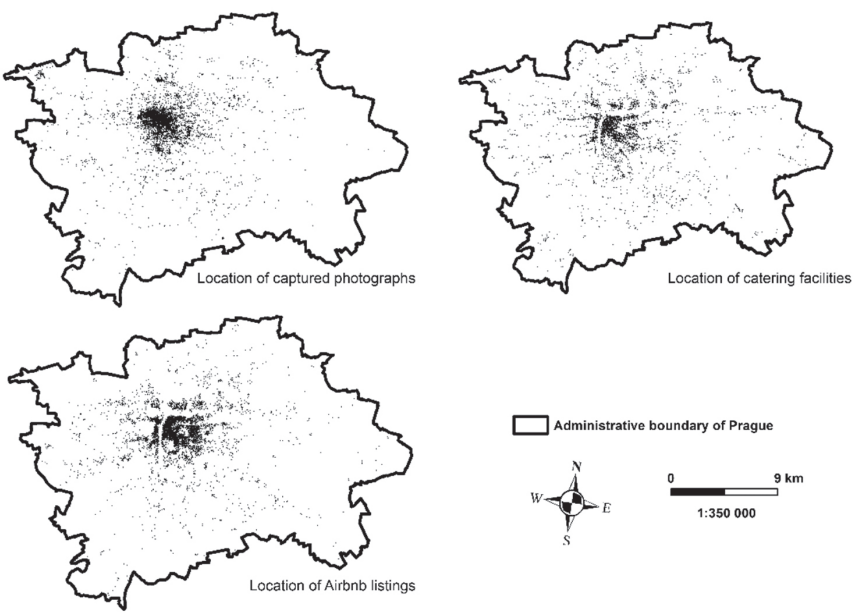

Fig. 1 The location of captured photographs, catering facilities and Airbnb listings
Source: Mousselly-Sergieh et al. (2014); ArcČR Praha (2016); InsideAirbnb (2021); Open Street Map (2021); own elaboration in ESRI (2019)

The calculation of the environmental vulnerability (index) of a destination

Based on spatial data, three following indicators were incorporated into the calculation of the environmental vulnerability index of a destination:

- Tourism concentration rate (the share of the limited area in the administrative area of a destination): the first indicator shows to what extent is the spatial dispersion of tourists limited in a destination. We consider destinations with lower dispersion to be environmentally more vulnerable as the consumption is highly spatially limited.
- Tourism intensity rate (number of photographs per square kilometre of the limited area): The second indicator refers to the stage of development of tourism. Destinations with higher intensity face a higher number of tourists, higher level of food consumption and, therefore, are more environmentally more vulnerable.
- Catering facilities availability rate (number of photos per one catering facility): the last indicator dealing with the environmental vulnerability shows how many catering opportunities tourists have in a destination. Destinations with a high rate are environmentally more vulnerable as the offer of catering facilities may not correspond with their regular diets due to fact that number of tourists significantly exceeds the number of catering facilities.

Additionally, we developed another indicator which do not enter the calculation of the environmental vulnerability: Environmental potential rate (share of catering facilities outside the limited area). Destinations with a higher proportion of catering facilities outside the limited area may be less environmentally vulnerable if tourists disperse beyond the current limited area borders. This indicator was not used for the calculation of the environmental vulnerability but serves as an additional environmental characteristic of a city.

The final size of the limited area, number of photographs and catering facilities, entering into the calculation of indicators, represents the average value calculated from all five grids. The value of each of the first three indicators was normalized so that the values for each city ranged between 0 (least vulnerable) and 1 (most vulnerable). The final Environmental vulnerability index is the average of all three indicators. Finally, the Environmental potential rate was assigned for each city.

RESULTS AND DISCUSSION

The spatial analysis showed that urban destinations are significantly spatially limited; tourists move exclusively in a negligible part of a city in relation to the administrative city territory (Figure 2).

Fig. 2 An example of the limited area of Prague (500 meters grid)
Source: ARCČR (2016), own elaboration in ESRI (2019)

On average, tourists in popular European urban destinations move within 7.1 km^2 (median 4.4), or 3.4% (median 3.3) of the administrative city territory. The standard deviation, which indicates how far the values deviate from the mean, is 8.2 km^2 (1.5%). A standard deviation higher than the mean value indicates the

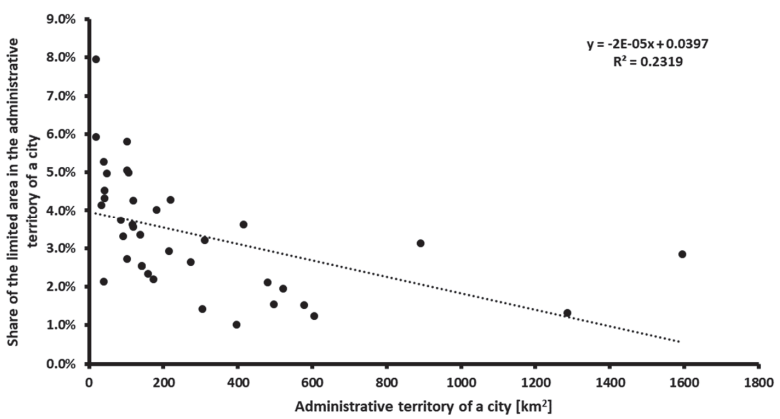

Fig. 3 The relationship between administrative territory and the share of the limited area in the administrative territory of a city
Source: own elaboration

occurrence of outliers. The size of the limited area varies between 0.8 km^2 (Girona) and 45.4 km^2 (London) and its share of the city administrative area range between 1.0% (Malaga) and 7.9% (Geneva).

Tourists visiting a given city have, on average, access to 991 catering facilities with a standard deviation of 812. It should also be noted that the median is significantly lower, at only 685. As large cities are represented in the sample, which may have an extreme number of catering facilities, the median value is considered more relevant and representative. The range of the number of catering facilities is between 164 (Girona) and 3,722 (London).

Gössling et al. (2011) argue that food management, which was conceptualised in their work, should be a solution to enhance the environmental sustainability of a destination. This specific way of managing the business is characterised by the inclusion of vegetarian dishes in menus, the reduction of beef, or the non-use of aluminium foil. Although the limited area of a destination is an important aspect of food management introduction, it has not yet been quantified and elaborated in order to explore which catering facilities should implement this specific style of management. The menus of catering facilities in the limited area of Prague were investigated by Lochman (2021): he argues that most of the dishes offered near the most popular attractions (the limited area) are animal-based, which includes pork and beef. Vegetarian and vegan restaurants have significantly less access to tourist attractions compared to common restaurants. It can be considered that they are located outside the limited area. One of the conclusions of this paper is that support for businesses with environmentally sustainable offerings or generally lower environmental impacts (adopted food management) should be encouraged. In fact, a change in diet in the context of the rise of food tourism is also urged by Hall (2020). Another example that illustrates the environmental impacts of catering of tourists is the investigation in Lhasa (Li et al., 2020), which revealed that in just three years, the development of tourism (and changing dietary habits) necessitated the expansion of a potential 7,833 hectares of arable land.

The importance of catering facilities in a destination will increase in the future due to the influence of gastronomic tourism. Gastronomy is proving to be one of the factors at least supporting destination selection and at the same time increasing the likelihood of repeat stays in the destination (Kivela & Crotts, 2005; Karim & Chi, 2010; Sánchez-Canizares & López-Guzmán, 2012). We believe that the proposed investigation can serve relevant policymakers who can influence the implementation of similar measures through their decisions.

Regarding the environmental vulnerability index, for each indicator, the selected destinations were divided into three groups that refers to the level of the environmental vulnerability (Table 2). The division is based on the average and standard deviation of the values. In order words, depending on the particular indicator, cities above or under standard deviation are assessed as either

environmentally more vulnerable (highlighted in dark grey in the table) or least vulnerable (light grey). Cities whose value is within the standard deviation are considered to have average environmental vulnerability (not highlighted). The calculation of standard deviation does not include outliers because the calculation is significantly influenced by them (in case of significant outliers, the standard deviation can be greater than or nearly equal to the mean).

Tab. 2 The environmental vulnerability and the environmental potential rate

	Tourism concentration rate	Tourism intensity rate	Catering facilities availability rate	Environmental vulnerability index	Environmental potential rate
Amsterdam	4.3% (0.53)	10,950 (1.00)	15.0 (0.28)	0.60	43.3%
Antwerp	2.0% (0.86)	1,479 (0.09)	7.0 (0.08)	0.35	55.8%
Athens	5.3% (0.39)	1,932 (0.14)	9.0 (0.13)	0.22	75.8%
Barcelona	5.8% (0.31)	2,569 (0.20)	23.3 (0.48)	0.33	67.3%
Bergamo	4.3% (0.52)	2,021 (0.15)	3.8 (0.00)	0.22	51.3%
Berlin	3.1% (0.70)	1,860 (0.13)	11.9 (0.20)	0.34	68.3%
Bologna	2.5% (0.78)	1,623 (0.11)	13.3 (0.23)	0.37	51.0%
Bordeaux	1.5% (0.93)	6,715 (0.60)	5.3 (0.04)	0.52	50.9%
Brussels	4.1% (0.55)	1,018 (0.05)	14.3 (0.26)	0.29	58.5%
Copenhagen	5.0% (0.42)	1,224 (0.07)	8.2 (0.11)	0.20	65.7%
Dublin	4.3% (0.53)	1,069 (0.06)	24.1 (0.50)	0.36	61.0%
Edinburg	2.6% (0.77)	2,746 (0.22)	17.3 (0.33)	0.44	45.6%
Florence	2.7% (0.75)	5,387 (0.47)	21.5 (0.44)	0.55	45.7%
Geneva	7.9% (0.00)	1,710 (0.12)	12.2 (0.21)	0.11	70.3%
Ghent	2.3% (0.81)	4,736 (0.41)	6.7 (0.07)	0.43	53.7%
Girona	2.1% (0.84)	498 (0.00)	9.4 (0.14)	0.33	59.4%
Lisbon	3.7% (0.61)	2,436 (0.19)	15.2 (0.28)	0.36	67.8%
London	2.8% (0.74)	764 (0.03)	40.4 (0.90)	0.56	70.8%
Lyon	5.0% (0.43)	3,049 (0.24)	5.5 (0.04)	0.24	67.6%
Madrid	1.2% (0.97)	516 (0.00)	17.4 (0.33)	0.43	66.8%
Malaga	1.0% (1.00)	2,795 (0.22)	9.1 (0.13)	0.45	48.4%
Manchester	3.6% (0.63)	2,391 (0.18)	18.5 (0.36)	0.39	46.3%
Milan	4.0% (0.57)	1,291 (0.08)	14.8 (0.27)	0.31	70.4%
Munich	3.2% (0.69)	4,008 (0.34)	12.0 (0.20)	0.41	73.9%
Naples	3.6% (0.63)	4,600 (0.39)	9.6 (0.14)	0.39	44.7%
Oslo	2.1% (0.84)	1,774 (0.12)	15.4 (0.29)	0.42	39.8%

	Tourism concentration rate	Tourism intensity rate	Catering facilities availability rate	Environmental vulnerability index	Environmental potential rate
Paris	5.0% (0.43)	2,295 (0.17)	29.7 (0.64)	0.41	84.4%
Porto	4.5% (0.49)	2,015 (0.15)	8.3 (0.11)	0.25	51.9%
Prague	1.5% (0.92)	492 (0.00)	9.6 (0.14)	0.36	61.5%
Riga	1.4% (0.94)	6,411 (0.57)	5.6 (0.04)	0.52	57.1%
Rome	1.3% (0.96)	2,756 (0.22)	27.5 (0.58)	0.59	60.5%
Sevilla	2.5% (0.78)	3,127 (0.25)	14.4 (0.26)	0.43	51.0%
Stockholm	2.9% (0.73)	2,025 (0.15)	12.8 (0.22)	0.36	68.6%
Thessaloniki	5.9% (0.29)	1,026 (0.05)	5.6 (0.04)	0.13	72.7%
Valencia	3.3% (0.66)	1,819 (0.13)	23.4 (0.48)	0.42	62.6%
Venice	2.2% (0.83)	1,748 (0.12)	44.3 (1.00)	0.65	37.8%
Vienna	3.6% (0.63)	790 (0.03)	8.1 (0.11)	0.25	62.3%
Zurich	3.3% (0.67)	3,303 (0.27)	8.7 (0.12)	0.35	70.3%
Mean	**3.2% (0.68)**	**2,140 (0.16)**	**13.2 (0.23)**	**0.37**	**59.5%**
Standard deviation (STD)	**1.3% (0.19)**	**1,212 (0.12)**	**6.6 (0.16)**	**0.12**	**11.2%**
Mean + STD	**4.6% (0.87)**	**3,352 (0.27)**	**19.8 (0.39)**	**0.49**	**70.7%**
Mean - STD	**1.9% (0.49)**	**928 (0.04)**	**6.5 (0.07)**	**0.25**	**48.3%**

Source: Own elaboration

Note: Considering the actual bias of the calculation, means and standard deviations were calculated without outliers identified by boxplot (e.g., Geneva in the case of Tourism concentration rate) to provide more representative findings.

Among the most environmentally vulnerable destinations belong destinations that are usually associated with overtourism issues: Venice and Amsterdam. In addition, both cities have below-average environmental potential as a significant majority of catering facilities are located in the limited area. In case of Venice, the high environmental vulnerability is primarily caused by the small number of catering facilities with respect to the total number of photos in the limited area. Amsterdam primarily deals with the intensity of tourism (number of photographs per square kilometre). Another vulnerable destination with low potential is Florence. Even though London one of the most vulnerable destinations, it has a high potential as 71% of catering establishments are located outside the limited area. If a sufficient number of tourists disperse towards the clusters of catering facilities outside the limited area, the destination may be less vulnerable.

The least environmentally vulnerable destination is Geneva. The main reason is the Tourism concentration rate: compared to other destinations, tourism in this city is much more dispersed: tourism covers almost 8% of the administrative area, which is 2.4times more than the average value. Thessaloniki has almost the same value of the Environmental vulnerability index, it differs by only two hundredths. Moreover, Thessaloniki has a significant potential as 73% of catering facilities are located outside of the limited area.

None of the selected cities have either all four indicators below the average or above the average. However, along Venice that has the highest Environmental vulnerability index, Florence is assessed as the most vulnerable destination as three out of four indicators are worse than average. The only indicator for which Florence is not classified as vulnerable is the Tourism concentration rate: the value is worse than average, but it is still within the standard deviation, so the tourism concentration has been assessed as average. On the contrary, Thessaloniki is among the least vulnerable in three indicators. The only exception is Tourism intensity rate. However, the value of this indicator (1,026) is almost the same as the lower limit of the interval of average values (928)

CONCLUSIONS

The main objective of this paper were to investigate, to what extent tourists are spatially dispersed (the so-called limited area) and how many catering options they have in a destination. Based on the introduced theoretical framework, as both aspects significantly contribute to the environmental sustainability of a destination (Gössling et al., 2011), the second objective was to assess the environmental vulnerability of the selected 38 destinations.

Our findings showed that an area of only 4.4 km^2 is exposed to tourism, representing 3.3% of the administrative area of the city (both median values; the average value amounts to 7.1 km^2 and 3.4%). The size of the limited area is moderately dependent on the overall size of the administrative area of the city: the highest spatial dispersion of tourists was primarily observed among smaller cities. In the limited area, tourists have access to 685 catering facilities (also median; the average amounts to 991 catering facilities).

Based on our developed indexes dealing with environmental vulnerability, our assessment showed that Venice (Environmental vulnerability index of 0.65), Amsterdam (0.60), and Florence (0.55) can be considered as highly vulnerable cities as their scores are significantly higher than the standard deviation of all selected cities and, in addition, they have a low environmental potential. On the contrary, Thessaloniki (0.13) and Athens (0.22) were assessed as both the least vulnerable destinations and with a high environmental potential as more than 70% of catering establishments is located beyond the borders of the limited area: if tourists would be more dispersed, their vulnerability can be even smaller.

The main significance of the paper lies in the contribution to the relevant decision-makers. Tourism activities, as well as the overexploitation of natural resources, take place only in a part of the urban destination. Decision-makers should consider the concept of the limited area when managing a destination. The significance of this work is further enhanced by the fact that, despite the environmental significance of the overconsumption of animal foods, this problem has so far not been addressed not only by political leaders (Dagevos & Voordouw, 2013), but also by the public (Stoll-Kleeman & O'riordan, 2015).

According to Gössling et al. (2020) or Sharma et al. (2021), the COVID-19 virus pandemic may provide an opportunity to shift to more sustainable tourism practices. Bertella (2020), however, argues that these appeals tend to focus on recovery strategies, overtourism and high-carbon travels. Only a scant number of works have addressed the topic of catering. Furthermore, Galvani et al. (2020) conclude that the pandemic will prompt a turnaround in people's thinking and corporate activity: new patterns of behaviour will be more in line with sustainable development principles.

The article should contribute to a shift towards environmental impact assessment. For example, within recreation ecology, a field that focuses on examining the environmental impacts of tourism, the attention of research and relevant actors has focused primarily on visible impacts in a tourist site (Monz et al., 2013). The limited attention to environmental impacts that occur outside the tourist destination and are not directly visible is reflected in the US 'Leave No Trace' initiative aimed at ensuring that tourists maintain the natural park environment as it had been before they arrived. The initiative completely ignores the background realities of outdoor tourism, which are no less environmentally serious. For example, Simon and Alagona (2013) mention that the initiative encourages tourists to purchase appropriate equipment - however, this is usually made of synthetic materials. The authors also point out that clothing was sold to promote the initiative. What are environmental benefits of buying T-shirts?

Finally, the research could further stimulate the debate on the measurement of overtourism. For the time being, overtourism is understood as a social concept whose emergence is determined through perceptions of residents - overtourism occurs when the quality of life in a destination is perceived by locals to be decreasing - but they may have no idea about the sustainability of catering facilities, the amount of food consumed and its impact on natural resources. If only food with a high environmental footprint is consumed, food is wasted or improper food preparation practices are used, "environmental overtourism", as defined by Lochman and Vágner (2021), can occur without the knowledge of residents: environmental overtourism is not so much linked to the number of tourists (as in the academic literature to date), but to the intensity of environmental impacts and their impact on the health of residents.

We consider the data used to be the most significant shortcoming. More accurate results would certainly have been obtained using geographical data of mobile operators and the exact location of catering facilities identified by field investigations. However, such data are expensive and difficult to obtain. This research attempted to present generalisable data. In cases where mobile operator data is unavailable or too expensive for local decision makers, research that takes a closer look at potential limited area computations is proposed. Research assessing the most appropriate calculation method would contribute significantly to addressing the environmental impacts of overconsumption of natural resources.

The spatial delimitation of cities is also perceived as another shortcoming. In some cases (Paris, Brussels, Manchester) a city is part of a much larger agglomeration. These circumstances may have influenced the calculation of the limited area.

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