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Special Issue 2.2022

Mobile phone data for exploring spatio-temporal transformations in contemporary territories

TeMA

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Published by

Laboratory of Land Use Mobility and Environment
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples "Federico II"

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Editor-in-chief: Rocco Papa
print ISSN 1970-9889 | online ISSN 1970-9870
Licence: Cancelleria del Tribunale di Napoli, n° 6 of 29/01/2008

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Special Issue 2.2022

MOBILE PHONE DATA FOR EXPLORING SPATIO-TEMPORAL TRANSFORMATIONS IN CONTEMPORARY

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TeMA Special Issue 2 (2022) 57-71
print ISSN 1970-9889, e-ISSN 1970-9870
DOI: 10.6092/1970-9870/8914

Received 3rd February 2022, Accepted 9th November 2022, Available online November 30th 2022

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www.tema.unina.it

Permanent and seasonal human presence in the coastal settlements of Lecce

An analysis using mobile phone tracking data

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Abstract

This paper presents the first results of analyses carried out using mobile phone data on human presence (residents, commuters, visitors) in the coastal territory of Lecce (Italy). The aim of the research, conducted in the framework of the DASTU Project 'Department of Excellence on Fragile Territories' in collaboration with the Municipality of Lecce, is to provide precise feedback on the actual use of a coastal territory which is mostly inhabited temporarily, marked by unauthorised building, and threatened by various environmental and climate risks. Starting with an acknowledgement of the limits that traditional census and registry data have in detecting the use of territories characterised by seasonal use and informality, the paper analyses the variations in anthropic presence over multiple years and the incidence of permanent residents. The analyses were carried out using mobile positioning data extracted from the TIM Data Visual Insight (DVI) platform and refer to the period between September 2019 and September 2020. The results show evident heterogeneity among the different coastal settlements. In particular, there are substantial differences between the southern *marine* (San Cataldo, Torre Veneri, Frigole, Montegrappa) and northern ones (Torre Chianca, Spiaggiabella, Torre Rinalda), where the former show a greater presence of stable residents and a less pronounced seasonal fluctuation. These differences are fundamental for urban planning policies to determine in which areas the retreat of the building from the coast could cause more difficulties and inconveniences.

Keywords

Coastal settlement; Second homes; Unauthorised construction; Human presence; Seasonality.

How to cite item in APA format

Curci, F., Kërçuku, A., Zanfi, F., Novak, C. (2022). Permanent and seasonal human presence in the coastal settlements of Lecce. *Tema. Journal of Land Use, Mobility and Environment*, 57-71. <http://dx.doi.org/10.6092/1970-9870/8914>

1. Introduction

This paper aims to analyse the seasonal fluctuations of human presence in the coastal settlements (*marine*) of Lecce and to evaluate the specific contribution of mobile phone data compared to census data. This analysis can importantly support public policies to evaluate the actual use of the housing stock to delimit areas with greater exposure to environmental risks or underutilization phenomena. The way these data can help local authorities and land-use policies to promote retreat or regeneration strategies along the coast is also discussed. The *marine* of Lecce are characterized by unauthorized building and other informal practices in the use of the littoral.¹ This case is not sufficiently known in the literature, thus much of the information reported in this paper is the result of fieldwork activities carried out by the authors between 2018 and 2022 in dialogue with the municipal administration and local actors.

The paper is structured in 5 paragraphs. Since the study area has very peculiar weaknesses, before proceeding with a more methodological and statistical treatment, the Paragraph 1 provides a synthetic and qualitative portrait of the area under study, also from a landscape point of view, and tries to explain its main frailty. Paragraph 2 provides a general framework of the observed phenomenon in Southern Italy. Paragraph 3 introduces the potential and criticalities of mobile phone data in the analysis of human presence.² Paragraph 4 presents and discusses the analysis of mobile phone data carried out for the *marine* of Lecce. In the concluding section (Paragraph 5), we summarise and raise further questions that may be addressed in the future.

2. A fragile territory, and difficult to interpret: the *Marine* of Lecce

The coastal settlements of the Municipality of Lecce (Apulia Region, Italy) consist mainly of second homes. They encompass seven coastal hamlets known as *marine*³, distributed along a 22-km-long stretch of the Adriatic coast with shallow, sandy beaches.

In terms of urban morphology, the *marine* are non-homogeneous settlements. This is also true of their relationship with the main roads, historical evolution, and distance from the urban centre of Lecce. Moreover, along the same stretch of coast, we also find protected natural areas, agricultural areas, military areas, wetlands, water basins, and a variety of hydraulic infrastructure. These bear witness to the enormous efforts made since the beginning of the twentieth century to reclaim land for agricultural use through the construction of reservoirs, canals, irrigation systems, and water pumps.

However, a contrasting and common phenomenon found in the *marine* is the construction of unauthorised structures. The roots of this practice are found in the informal constructions that initially developed thanks to the infrastructure and land grid created by reclamation works that — particularly in the 1970s and 1980s — became a sort of guide for unauthorised plots (Fig.1).

Besides the dualism of legality and illegality, there is also another dualism of natural and artificial elements. These contrasts constantly deteriorate the area with evident effects on coastal erosion (Fig.2), the dismantling of dune systems, hydrogeological instability, and the formation of sinkholes.⁴

Recent years have seen an intensification in the processes of sea intrusion, rising water tables, the return of marshes, and the reappearance of ancient coastal lakes. On the one hand, all this has contributed to increased

¹ Articles dedicated to the theme of the urban waterfront have often been published in this journal (Giovinazzi & Moretti, 2009; Pirlone & Erriu, 2016), while the theme of informal coastal settlements has rarely been dealt with.

² For all more specific references relating to mobile phone data, please refer also to the other article of this thematic issue.

³ We have decided not to translate the Italian noun *marina* (pl: *marine*) — seaside settlements — because there is no perfectly corresponding English term.

⁴ Sinkholes are cracks in the limestone floor which, in the coastal area of Lecce, are lapped by a very shallow water table.

hydrogeological risks, especially in the autumn and winter months. On the other hand, it has taken large portions of fertile soil away from agriculture.



(a)

(b)

Fig.1 Lecce. Spontaneous settlements of holiday homes in Torre Chianca (a), and Spiaggiabella (b)



(a)

(b)

Fig.2 Spiaggiabella (Lecce). Buildings on the shoreline (a) and disruptions to beach accessibility (b)

The legacy of land reclamation, an engineering commitment to dominating the landscape and making it valuable and healthy, has mainly been lost: the canals are clogged, the water scoops are inactive, houses have replaced the fields, and the *Xylella* bacterium is transforming the Salento landscape of olive groves into something that cannot yet be foreseen.



(a)

(b)

Fig.3 Lecce. Dunes (a) and wetlands (b) that claim their natural space

These complex, problematic phenomena are accompanied by threats due to climate change, especially from rising sea levels. On a low coastline, where land reclamation and illegal construction have taken away the natural space of water and sand (inhibiting the natural dynamics of dune movement and water flow) (Fig.3), the expected rise in average sea level leads to a radical rethinking of the relationship between artificial elements and nature and a necessary process of adaptation to climate change.

The settlements, mainly built in a short time and with poor construction quality caused by the use of cement made of sand from the dunes, the absence of sewage systems, and building on top of marshy, unstable land have been in a critical — if not terminal — phase in their life cycle for at least a decade. Many are in a state of decay while others are abandoned (Fig.4).



Fig.4 Alternation of abandoned vacant lots (a) and holiday homes with serious hydraulic problems due to rising water tables (b)

Some quantitative elements are helpful for outlining the extent of the phenomenon of unauthorised building and the precariousness — even legal precariousness — of the built heritage.

The preliminary document for the new urban plan of Lecce, dating back to the early 2000s, found that the entire coast of Lecce⁵ had a housing stock of more than 3,500 dwellings for a few hundred resident inhabitants. The maximum number of visitors during the summer season was estimated at about 30,000, of which just under half were campsites (Coletta, 2010, p. 288).

The building stock has been subject to various building amnesties, most often without receiving a legal status from the public administration. This means that thousands of buildings wait in a sort of legal limbo, adding to unauthorised buildings for which amnesty has never been requested and the many enclosures of buildings that have never been started or finished. To provide a measure of the phenomenon of unauthorised building in the *marine* of Lecce (San Cataldo, Frigole, Torre Chianca, Spiaggiabella, Torre Rinalda), we refer to data from the Sogea Report (Centro Studi Sogea, 2016)⁶ and an initial mapping — still in progress — launched in 2017 by the municipal offices.⁷ Considering only the *marine*, the documents show that under the three laws on building amnesty of 1985, 1994, and 2003, there are about 1400 pending applications under Law 47/85, about 130 under Law 724/94, and about 30 under Law 326/03.⁸ This legal precariousness also affects building maintenance, which is scarce or at least very differentiated (between regular and irregular buildings), and the building market, where supply exceeds demand.

⁵ Until 15 May 2012, Casalabate, which now belongs to the municipalities of Squinzano and Trepuzzi, was also part of the Municipality of Lecce.

⁶ In the municipality of Lecce, 19,850 requests for building amnesty were presented. About 14,000 (70%) were submitted pursuant to Law 47/85. A total of 6,450 are still waiting to be processed.

⁷ The authors were allowed access by virtue of an agreement signed in 2018 between the Department of Architecture and Urban Studies of the Politecnico di Milano and the Municipality of Lecce.

⁸ These numbers appear small in relation to the total (see note 8) if we do not consider that requests for building amnesty in the *marine* are almost exclusively related to 'total' abuses.

If we look beyond the houses and their relationship with open space, semantic poverty emerges due to the continuous repetition of fences and gates (all different but all similar), the alternation of spontaneous buildings, open spaces and abandoned walls, and an even lower quality of public space. The narrow and unpaved streets are often the result of allotments designed to maximise land use and are only compliant with the civil code. Except for San Cataldo, the squares, gardens, car parks, and seafronts are inadequate because they were created with limited investment and poor materials.

In this context, polarised between intensive summer use and winter abandonment, between illegal and regular housing, nature reclaiming its spaces and derelicts defacing it, it is challenging to investigate population dynamics and interweave demographic data with the different spatial characteristics of the settlements. Thus, innovative data and methods can help outline possible policies, direct the allocation of public investments, and organise policies for withdrawal from the coast in time and space.

2. The *Marine* of Lecce as part of a larger phenomenon: emerging issues in Southern Italy

The *marine* of Lecce exemplify the complexity encountered today in illegal coastal settlements. As various surveys have shown in recent years, many of these settlements based on unauthorised construction are increasingly affected by dynamics of decline and value loss inherent both in low building quality and premature landscape degradation (Zanfi, 2013; Curci et al., 2017). Here, two different dynamics intertwine.

On the one hand, we recognise more marked filter-down dynamics affecting the lowest-quality segments of the building stock, and consequent repopulation processes of former second homes by immigrant and poorer resident populations, with instances of marginalisation and concentration of social unease. Such is the case of settlements along the Domitia state road north of Naples, the south-eastern Sicilian coast, the areas of Rosarno and Crotonese in Calabria, upper Apulia, and the province of Latina south of Rome (Fucile & Di Figlia, 2017; Miano, 2017).

On the other hand, we are witnessing the takeover of a variegated population of individuals with limited economic capital who are expressing more permanent residential demands. They are permanently re-inhabiting a residential heritage based on tourism which is currently in decline since it is more accessible than the residential heritage of urban markets from which they are expelled, cases of which have occurred near various capitals of the centre-south such as Bari, Gela, Taranto, Caserta, and Latina (Curci, 2012; Curci et al., 2017). Both phenomena must deal with the scarcity of all types of equipment and services which are rarely present in the settlements in question, and with the consequences of climate change, which in many cases expose the assets of former second homes to substantial risks tied in particular to coastal erosion and rising sea levels.

Therefore, the central question that these places raise today not only relates to the complex management of outstanding amnesty practices and building assets that have lost much of their value (which in some cases have such a low value that paying building taxes related to the amnesty is no longer convenient). The question also concerns how to politically channel this complex and urgent building amnesty process and the selective reuse of the building stock in light of the emerging dynamics of repopulation of some segments of decayed heritage — raising delicate social issues — and in light of climate change — which raises equally complex matters of public safety.

3. The use of mobile phone data in understanding informal coastal settlements: its potential and critical issues

Mobile phone data or mobile positioning data (MPD) offer essential information on temporary populations and non-systematic mobility, which can support and increase the efficiency of urban and mobility policies (Pucci,

2013). Due to the high pervasiveness of cellular phones in society, MPD have been mainly used to quantify the volume of tourist flows, analyse tourist behaviours, verify the reliability of the official data collected through hotel/accommodation surveys, support the production of official tourism statistics (Grassini & Dugheri, 2021). They have also been used to analyse mobility practices within some informal settlements and reveal slum dynamics that are usually impossible to grasp with official statistics (Wesolowski, 2012).

Informal coastal settlements, especially those with no hotels but only vacation homes, are excellent contexts for exploiting MPD. Their predominantly 'illegal' nature — from an urban planning point of view — and their use for *proximity tourism* (Diaz Soria & Lurdes Coit, 2013) makes the analysis of both residential and tourist practices challenging. Therefore, demographic representation based on census and registry data is insufficient. Such data are not always effective and reliable in detecting the resident population in contexts of unauthorised second homes. This is also due to the tendency of homeowners to circumvent taxation and regulations, which makes data from institutional sources less reliable. MPD can be beneficial in coastal contexts with a strongly seasonal use and marked by unauthorised construction, not only for testing the effectiveness of census and registry data but primarily for providing new analytical elements supported by greater spatial and temporal detail.

On the one hand, the data obtained from mobile phone users and activities, suitably anonymised by the operators putting them on the market, make it possible to overcome the 'latency' of data collection, a typical characteristic of data from traditional sources, and exploit the widespread mass distribution of mobile phones. Therefore, these types of data will be increasingly used to analyse and interpret people's presence and movements (Pucci et al., 2015).

On the other hand, these types of data are never truly complete. They contain a certain level of uncertainty, since each operator's users represent a particular population sample. Moreover, they cannot be considered 'neutral' as they are the output of algorithms and calculation processes highly dependent on selective choices made upstream by the operators themselves (Gillespie et al., 2014). For these reasons, it is essential to compare and integrate MPD with other data from official sources when possible, if only to verify their reliability and effectiveness. The opposite is also true, however, as phone data allow us to understand where census data are incomplete, stimulating their integration and 'correction'.

Regarding two aspects in particular, MPD may allow us to formulate innovative reflections on the case study in question.

- a. **Seasonality/Residency.** Compared to census data, telephone data allow for a greater temporal frequency in detecting behaviours related to residential mobility, especially concerning tourist-recreational mobility. The sub-municipal scale reveals the actual uses of the area. It is free of administrative, fiscal, and legal aspects, enabling reading and interpretation of even short-term de facto residency and informal tourist practices, which are difficult to trace in other ways. Furthermore, MPD allows behaviours to be monitored throughout the summer season to understand the trend in a more extended time while also allowing for targeted inter-weekly and inter-seasonal comparisons, between the high and low beach seasons and between ordinary weekdays and holidays. This will enable us to analyse the growth (May–June) and decay (September–October) curves of residents and attendance in the high beach season. These data can also be crossed with other fiscal and administrative information owned by the Municipality of Lecce to perform quality checks on the coverage and significance of the data;
- b. **Environmental risks/Demolitions.** In the fragile environment described in Paragraph 1, anthropogenic presence still plays an important role. It is essential to ask whether there is a correlation between the rate of residency and environmental risks. The use of MPD makes it possible to strengthen or create new evidence with public value, also confirming some hypotheses that have not yet been proven or only partially demonstrated. The propulsive dynamics of unplanned building development have weakened significantly compared to the 1970s and 1980s. It is necessary to think about what to do with a building stock that is

increasingly characterised by abandonment and underuse. Amnesty policies and planning activities that provide essential services and infrastructure have often treated the coastal territory uniformly, regardless of the recreational character of the settlements. The hypothesis underlying this text is that the differences are substantial and require differentiated plans and projects, particularly strategies to lighten the anthropic pressure, starting with removal of the most impactful and most risk-prone building components. It is clear that along the 22 km of Lecce coast, it will be impossible to indiscriminately demolish all the buildings closest to the beach or those in dangerous areas. Still, MPD can help produce evidence and arguments that facilitate demolition policies. In this sense, MPD can provide valid arguments supporting difficult public decisions such as those relating to the demolition of buildings that cannot be condoned.

With regard to the topic and the case in question, a unique possibility was provided by the DASTU Project 'Department of Excellence on Fragile Territories' through the creation of a 'custom scenario' centred precisely on the *marine* of Lecce. We were able to acquire specific passive mobile positioning data accessible through the TIM Data Visual Insight (DVI) platform and referring to September 2019–September 2020.

Given the apparent advantages and potential described above, there is always a need to deepen detection methods to understand the practical reliability of TIM data, even in territories where there is not a dense distribution of telephone antennas (this is also true of the *marine* of Lecce). In addition, it is necessary to deepen the data synthesis and aggregation methods, conduct qualitative analysis, and discuss the results. Among the main limitations of the data purchased by DASTU and made available through the TIM DVI platform, we point out: the impossibility of building time series with data before 2019; the impossibility of making comparisons with other similar settlements, mainly due to the high costs of the data and service offered by TIM, which does not facilitate the start of more custom scenarios on similar territories; the under-representation of some social groups (in particular people under 18 and foreigners); and the impossibility of extracting data in grid or vector formats to process them independently in the GIS environment. Despite these limitations, we have conducted various analyses described in the next section.

4. Data analysis and statistical comparison

Since the registry data provided by ISTAT⁹ refer to either the entire municipal territory or the ACEs¹⁰, we opted for an analysis that would relate and compare the MPD with census data. With regard to the data from ISTAT, census data are the only data that reach the sub-municipal scale and rely on a large number of variables referring to the resident population and housing. Accordingly, at our request, the 'custom scenario' built ad hoc by TIM was based on specific aggregates of census tracts (2011 Census) that would trace, albeit with some approximation, the different *marine* of Lecce with the addition of those located in the municipalities of Trepuzzi and Squinzano, which were part of the Municipality of Lecce until 2012.

The first type of analysis is based on comparing summer and winter seasons in the same year. We selected two specific dates to perform the data extraction: Saturday, 1 February 2020, and Saturday, 1 August 2020. This first assessment aimed to analyse the change in resident population as classified by TIM through its resident population detection algorithm. The 'cell' of residence is calculated starting from the telephone 'events' made by the user in the 30 days before the observation, in particular in the first four days of the week (Monday, Tuesday, Wednesday, and Thursday), from 00:00 to 06:00 and from 22:00 to 24:00, and on Fridays from 00:00 to 06:00. With this type of data, we estimated the actual number of 'residents' in the *marine* of Lecce in the middle of the summer period. We ascertained that the southernmost *marine* in Lecce (San Cataldo, Torre Veneri, Frigole, Montegrappa, Torre Chianca) have more winter residents in absolute terms. The

⁹ The analyses conducted so far have not yet been able to draw on the registry data owned by the Municipality of Lecce.

¹⁰ ACE's (Census Areas) are large clusters of census tracts with 13,000 to 18,000 inhabitants.

settlements located further north (Spiaggiabella, Torre Rinalda, and also Casalabate), on the other hand, acquire a permanent population in August while remaining less 'permanent' in relative terms compared to the southern *marine* (Fig.5). In general, we see a doubling of the resident population between February and August. This is a notable increase even if it is not as striking as that of some seaside resorts in Salento that are very attractive from a touristic standpoint. Otranto and Porto Cesareo come to mind in particular, which are populated in the summer by tens of thousands of vacationers compared to a municipal population of about 6,000 residents.

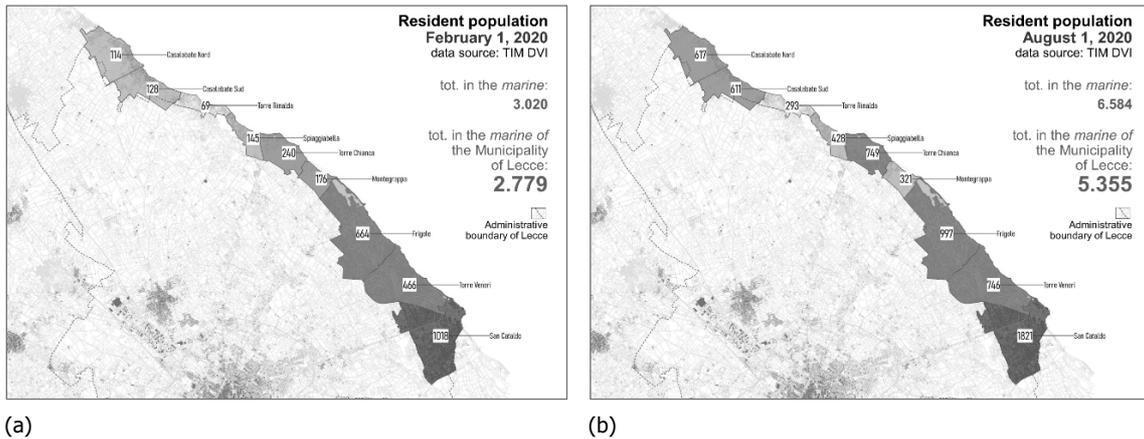


Fig.5 Resident population (average) detected through mobile phone data on (a) Saturday, 1 February 2020, and (b) Saturday, 1 August 2020. The chromatic gradient is based on "natural breaks" classification

In particular, we concentrated on the following dynamics.

- *Percentage change in resident population between Saturday, 1 February 2020, and Saturday, 1 August 2020.* The more significant seasonality of the northern *marine* compared to the southern ones is noted. To confirm this, we were able to ascertain that the percentage change in residents, calculated using MPD, is negatively correlated (-0.8) with the occupancy rate of the houses, an indicator that can be obtained from the 2011 census data (surveys from 9 October) (Fig.6b). The winter-summer variability, that is, the intermittent nature of these settlements, is more substantial where there is a larger number of second homes (Fig.6a).

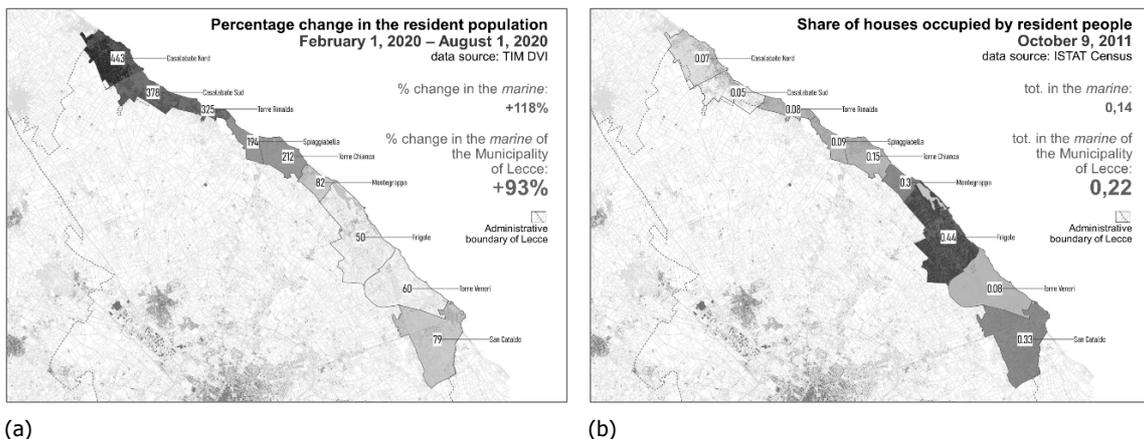


Fig.6 Percentage change in resident population between Saturday, 1 February 2020, and Saturday, 1 August 2020. The map shows the absolute increase for each area of observation (our processing of TIM DVI data); and (b) share of houses occupied by residents on Wednesday, 9 October 2011. The chromatic gradient is based on "natural breaks" classification

- *Spurious comparison of resident population on Wednesday, 9 October 2019 (TIM DVI data) and on Wednesday, 9 October 2011 (ISTAT Census).* In this case, we opted for a 'spurious' comparison since census data were compared to MPD (Fig.7). Although the data cannot be compared appropriately, this

analysis, based on the same day of the year and of the week, is useful to verify some anomalies and/or divergencies as well as to test the general distribution of the resident population within the different *marine*. In this case, it is interesting to note that in Torre Veneri, the MPD also classifies the personnel present in the military base as a 'resident' population, which was not registered by ISTAT. This only apparent anomaly actually constitutes proof of the validity of the data and a confirmation of the two different types of surveys.

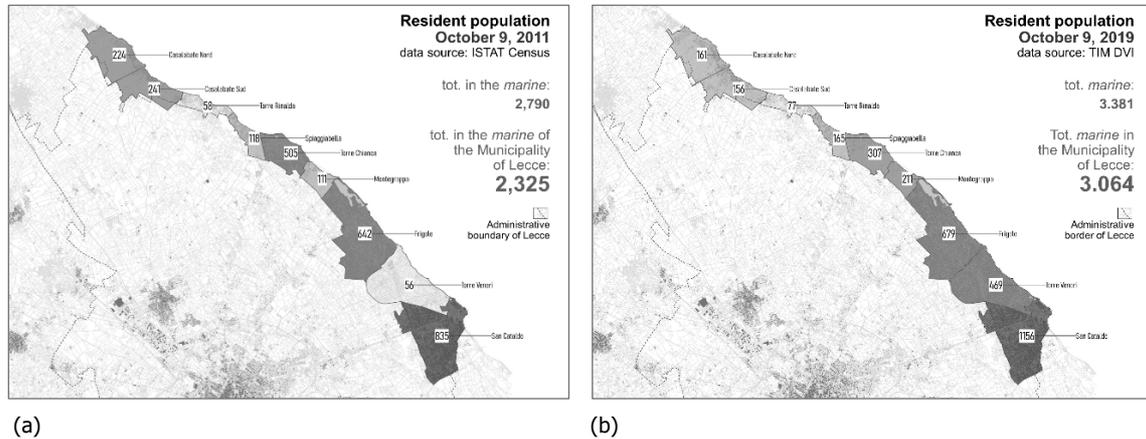


Fig.7 Resident population detected (a) through the national census on Wednesday, 9 October 2011, and (b) through mobile phone data on Wednesday, 9 October 2019. The chromatic gradient is based on "natural breaks" classification

— *Comparison of population density between Saturday, 1 February 2020, and Saturday, 1 August 2020.* The densest areas in winter are San Cataldo (127 inhabitants per sq. km) and Montegrappa (116 inhabitants per sq. km) (Fig.8a). However, if we consider the population density in summer, the densest *marine* are Spiaggiabella (281 inhabitants per sq. km) and Torre Chianca (254 inhabitants per sq. km) (Fig.8b). These areas have fewer resident services and more unstable conditions due to coastal erosion and wetlands, with frequent events related to hydrogeological instability. The population density of San Cataldo, which remains high even in winter, shows that it is the most planned and infrastructure-equipped *marina* in Lecce (with both a water and sewage network). San Cataldo has the lowest seasonal fluctuations, together with the more rural *marine* of Montegrappa and Frigole. Here, despite some obvious changes that have occurred in the past fifty years, the structure of an 'agricultural village' (*borgo rurale*) remains thanks to some essential services for permanent residents, including a nursery school that is still active today. It is the only school in the *marine* of Lecce;

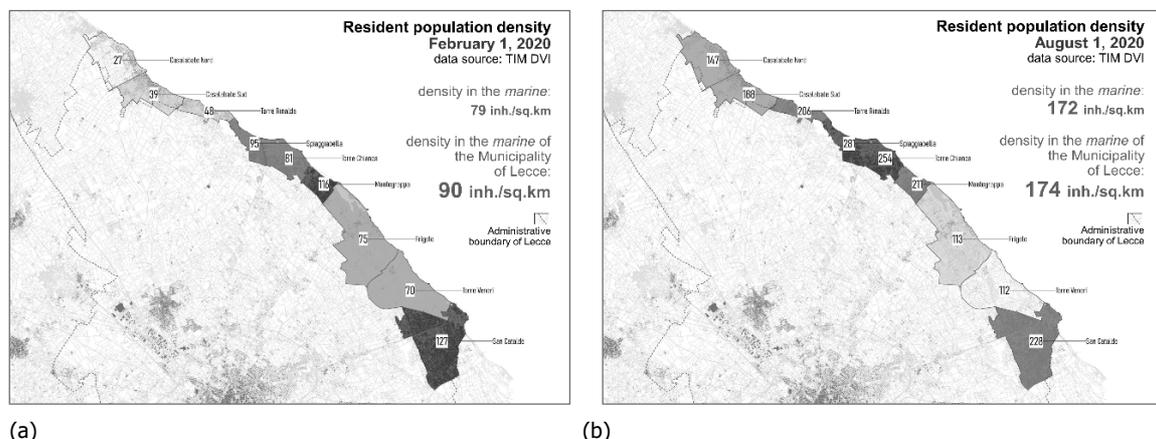


Fig.8 Resident population density (a) on Saturday, 1 February 2020, and (b) on Saturday, 1 August 2020. The chromatic gradient is based on "natural breaks" classification

- *Ratio between resident and present population between Saturday, 1 February 2020, and Saturday, 1 August 2020.* In this case, the goal was to build a simple statistical index that would allow us to read the propensity of each *marina* for residential use. Again, the southern *marina* prove to have a better ratio between residents and commuters/visitors, i.e. with less intermittent human presence (Fig.9). In particular, Frigole stands out with a higher index than all other *marina*, both in summer (0.55) and in winter (0.88), surpassing San Cataldo;

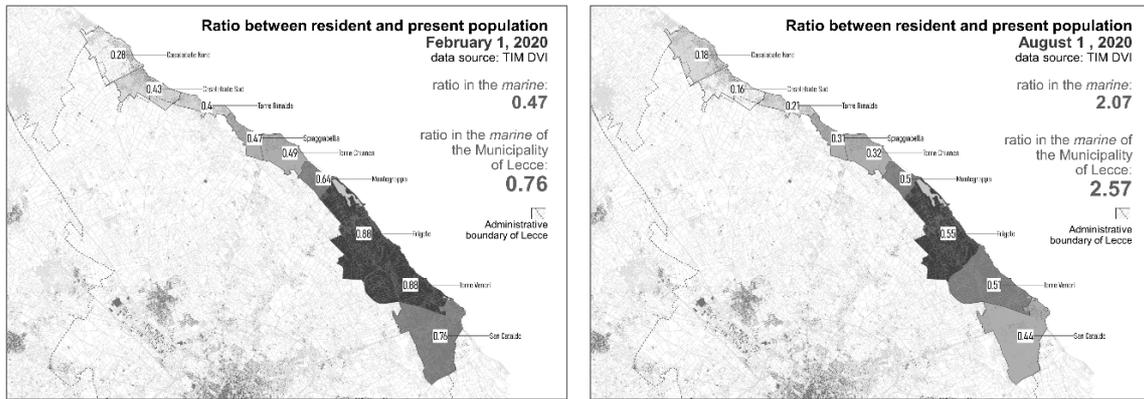


Fig.9 Ratio between resident and present population (a) on Saturday, 1 February 2020, and (b) on Saturday, 1 August 2020. The chromatic gradient is based on "natural breaks" classification

- *Ratio between residents and houses between Saturday, 1 February 2020, and Saturday, 1 August 2020.* In this comparison, we have again resorted to a spurious approach by building an index based on mobile phone tracking (number of residents, 2020) and a variable from the national census (number of houses, 2011). Assuming an insubstantial change in the number of homes between 2011 and 2020, the calculated index makes it possible to read the occupancy status of residential properties, highlighting the locations with the most significant underuse of the housing stock (Fig. 10). In addition to a higher rate of occupancy, among the southern *marina* (with Frigole standing out both in summer and in winter, followed by Montegrappa and San Cataldo), the anomaly of Torre Veneri emerges once again due to the presence of the military base: the high number of residents (according to MPD) does not correspond to a proportional number of houses;

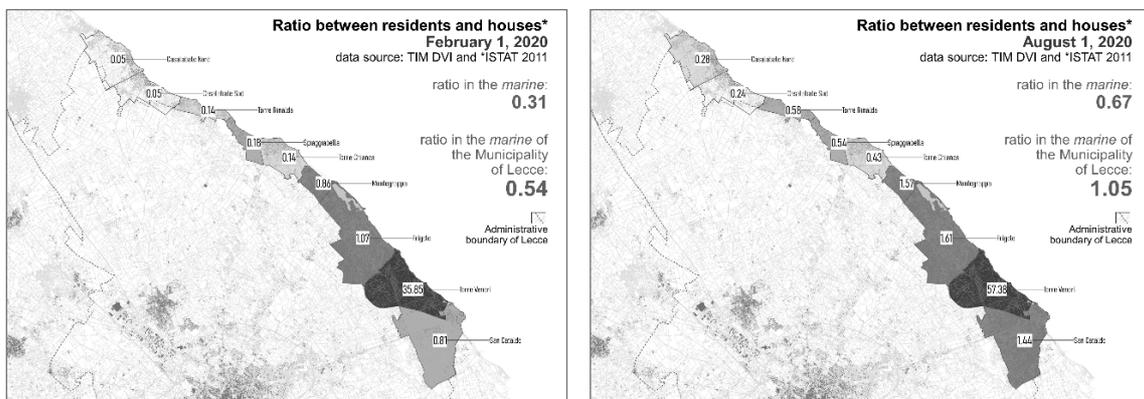


Fig.10 Ratio between residents and houses (a) on Saturday, 1 February 2020, and (b) on Saturday, 1 August 2020. The chromatic gradient is based on "natural breaks" classification

- *Percentage of male residents on 9 October 2011 (ISTAT Census) and on 1 February 2020 (TIM DVI data).* The analyses show that a greater male presence is correlated with underuse of the housing stock

<i>marina</i>	Δ presences		Δ residents		Δ visitors	
	(from South to North)	all	all	intra-regional	extra-regional	foreign
San Cataldo		+199 (+11%)	+216 (+16%)	+40 (+19%)	+10 (+22%)	-50 (-44%)
Torre Veneri		+127 (+18%)	-21 (-4%)	+135 (+175%)	+18 (+174%)	-7 (-49%)
Frigole		+262 (+29%)	+35 (+5%)	+170 (+223%)	+37 (+313%)	+11 (+32%)
Montegrappa		+97 (+31%)	=	-3 (-19%)	-5 (-51%)	+8 (19%)
Torre Chianca		+258 (+45%)	+136 (+31%)	+56 (+160%)	+8 (+20%)	+59 (160%)
Spiaggiabella		+109 (+32%)	+79 (+36%)	+34 (+139%)	+6 (+31%)	+21 (94%)
Torre Rinalda		+101 (+49%)	+88 (+79%)	+40 (+252%)	+6 (+49%)	+7 (43%)
Casalabate So.		+198 (+53%)	+173 (+78%)	+73 (+202%)	-6 (-26%)	+1 (+3%)
Casalabate No.		+235 (+48%)	+183 (+66%)	+90 (+149%)	+6 (+17%)	-12 (-18%)
tot. <i>marine</i> (all)		+1585 (+28%)	+888 (+22%)	+635 (+116%)	+80 (+40%)	+40 (+10%)
tot. <i>marine</i> (Lecce)		+1152 (+24%)	+532 (+15%)	+472 (+104%)	+80 (+55%)	+50 (+18%)

Tab.1 Absolute and percentage change of the daily averages (calculated on an hourly basis) of presences, residents and visitors in the *marina* of Lecce between Monday, 23 September 2019, and Monday, 21 September 2020

Finally, in addition to the statistical comparisons referring to the *marina* as a whole, we conducted some in-depth analyses, particularly on the Spiaggiabella area (Fig.12), to understand whether there are local differences in the human presence between summer and winter that have a relationship with the environmental risks present in the area. The maps developed show a more widespread presence throughout Spiaggiabella in summer, even in areas with a high susceptibility to flooding and soil instability. This greater diffusion of the presence of people in summer — in some ways indifferent to the environmental criticalities in the area — could be justified by the lower danger compared to the winter period. In fact, adverse events, particularly floods, are more frequent during autumn and winter. The concentration of people in the drier and less risky areas in winter would seem to bear witness to a greater awareness of the existing risks of people who live and frequent these territories even in colder months.

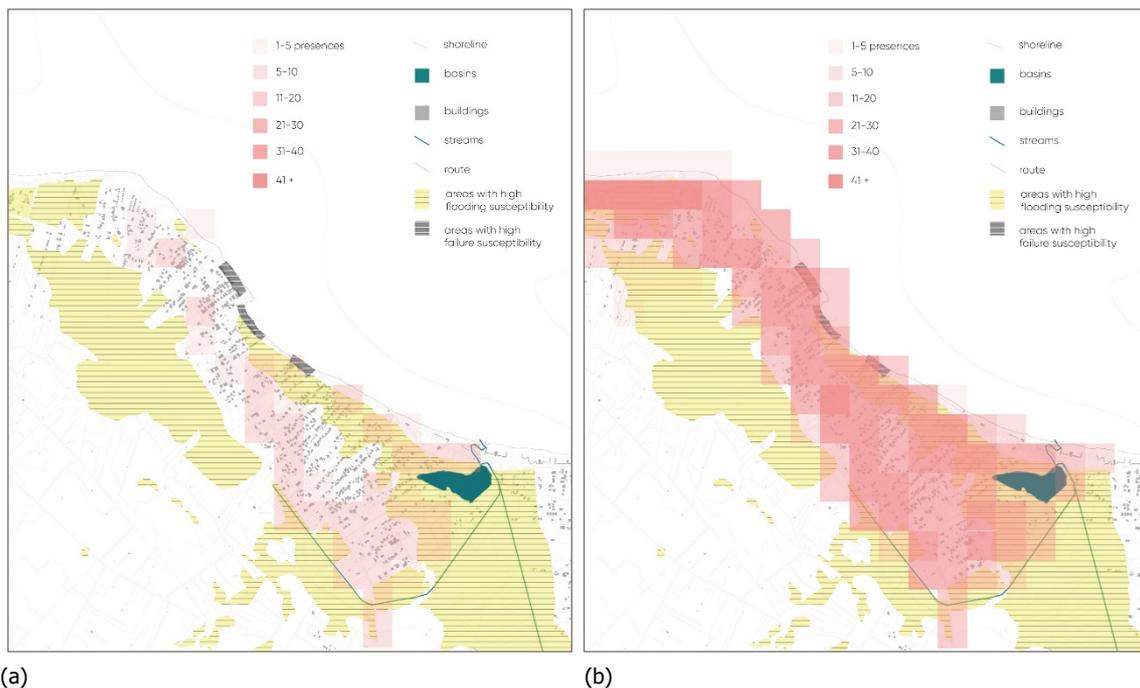


Fig.12 Detailed comparison of the presence in Spiaggiabella between (a) 1 February 2020 and (b) 1 August 2020: 150 m x 150 m cells overlapped with areas susceptible to hydrographic issues, flooding, and instability

5. Conclusion: policy and research perspectives on the use of mobile phone data for informal coastal settlements

Mobile phone data (MPD) can serve as a valuable tool for investigating concrete human presence within coastal settlements characterised by second homes and unauthorised buildings. They can integrate and fill some gaps in official statistics and help produce public evidence favouring difficult political decisions such as the order of priority of demolitions. They can also provide helpful elements for urban planning and the programming and maintenance of public works.

From this perspective, it is understood how the use of telephone data can make it possible to strengthen or create new evidence to be used in the construction of a more reasoned public discourse on these issues, also confirming some hypotheses that have not yet or only partially been demonstrated, relating to practices of restocking or new uses of the building stock, the concentration of the seasonal population around the provision of services, and conflicts between land use and environmental risk conditions. In this sense, the analysis of data related to mobile phone traffic in the *marine* of Lecce provides valid arguments in support of targeted municipal policies in terms of urban planning, taxation, and investment in public works, as well as supporting difficult public decisions, such as, for example, the targeted demolition of buildings that are incurable or at risk.

The case study of the *marine* of Lecce, in which we used TIM DVI data, shows that: there are large differences in terms of seasonality and permanence between adjacent and similar coastal settlements; census data may be effective in some areas and less effective in others; the areas with more infrastructure and less exposed to environmental risks are also the least seasonal and intermittent ones.

What has been analysed is only a part of what could be explored with MPD. First of all, with their greater spatial detail, MPD allow us to analyse the uses of the coastal space in its various hydro-geo-morphological and botanical-vegetational components: beaches, back dunes, wetlands, coastal roads, protected areas, state-owned land. Moreover, even though we have not treated this specific issue in paper, MPD may allow us to formulate innovative reflections about socio-spatial effects of COVID-19. The historical phase marked by the COVID-19 pandemic has conditioned behaviours and lifestyles both in urban and permanently inhabited territories and coastal areas with robust seasonal use. Thanks to MPD we could detect and interpret the ability of different settlements to accommodate 'anomalous' permanent housing practices in the pandemic period, comparing them with what happened previously, since changes in the use of the housing stock may anticipate more structural changes that will influence the settlement arrangement in the coming decades.

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Image Sources

Fig.1: Photo by Agim Kercuku 2022;

Fig.2: Photo by Christian Novak 2022;

Fig.3: Photo by Christian Novak 2022;

Fig.4: Photo by Christian Novak 2022;

Fig.5: Authors' elaboration on TIM DVI data;

Fig.6: Authors' elaboration on TIM DVI and ISTAT Census data;

Fig.7: Authors' elaboration on ISTAT Census and TIM DVI data;

Fig.8: Authors' elaboration on TIM DVI data;

Fig.9: Authors' elaboration on TIM DVI data;

Fig.10: Authors' elaboration on TIM DVI and ISTAT Census data;

Fig.11: Authors' elaboration on TIM DVI and ISTAT Census data;

Fig.12: Authors' elaboration on TIM DVI and Municipality of Lecce data.

Table Sources

Tab.1: Authors' elaboration on TIM DVI data.

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