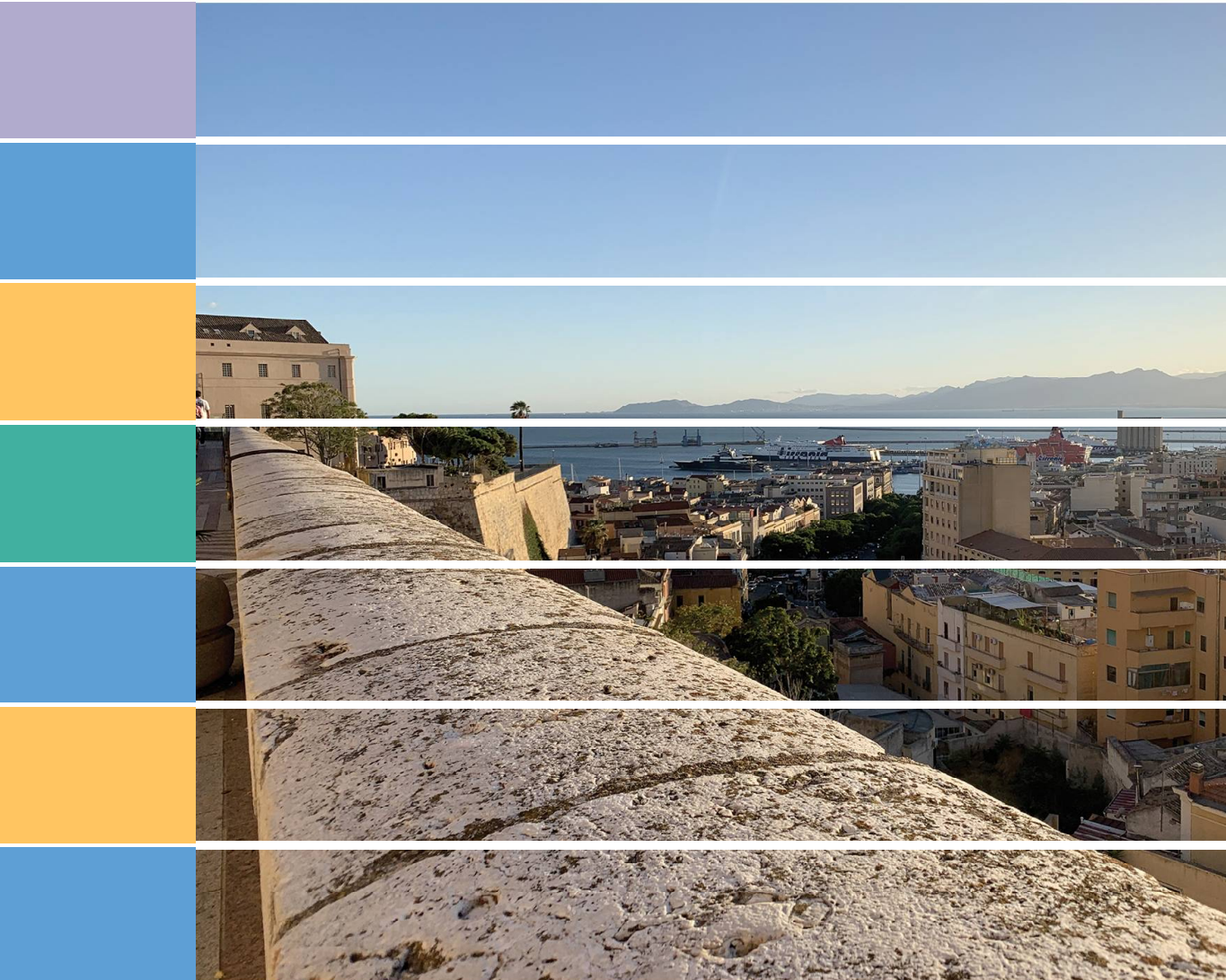


Carmela Gargiulo Corrado Zoppi
Editors

Planning, Nature and Ecosystem Services



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Scuola Politecnica e delle Scienze di Base

Smart City, Urban Planning for a Sustainable Future

5



Carmela Gargiulo Corrado Zoppi
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Planning, Nature and Ecosystem Services

INPUT aCAdeMy 2019
Conference proceedings

Federico II Open Access University Press



Planning, nature and ecosystem services / editors Carmela Gargiulo, Corrado Zoppi - Napoli: FedOAPress. 2019 - (Smart City, Urban Planning for a Sustainable Future. 5).

Web link:

<http://www.tema.unina.it/index.php/tema/Monographs>

ISBN: 978-88-6887-054-6

DOI: 10.6093/978-88-6887-054-6

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Centro di Ateneo per le Biblioteche "Roberto Pettorino"

Piazza Bellini 59-60 - 80138 Napoli, Italy

<http://www.fedoapress.unina.it>

Published in Italy

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Cover and graphic project: TeMALab

This book collects the papers presented at INPUT aCAdeMy 2019, a special edition of the INPUT Conference hosted by the Department of Civil and Environmental Engineering, and Architecture (DICAAR) of the University of Cagliari.

INPUT aCAdeMy Conference will focus on contemporary planning issues with particular attention to ecosystem services, green and blue infrastructure and governance and management of Natura 2000 sites and coastal marine areas.

INPUT aCAdeMy 2019 is organized within the GIREPAM Project (Integrated Management of Ecological Networks through Parks and Marine Areas), co-funded by the European Regional Development Fund (ERDF) in relation to the 2014-2020 Interreg Italy – France (Maritime) Programme.

INPUT aCAdeMy 2019 is supported by Società Italiana degli Urbanisti (SIU, the Italian Society of Spatial Planners), Istituto Nazionale di Urbanistica (INU, the Italian National Institute of Urban Planning), UrbIng Ricerca Scientifica (the Association of Spatial Planning Scholars of the Italian Schools of Engineering) and Ordine degli Ingegneri di Cagliari (OIC, Professional Association of Engineers of Cagliari).

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This book is the most recent scientific contribution of the "Smart City, Urban Planning for a Sustainable Future" Book Series, dedicated to the collection of research e-books, published by FedOAPress - Federico II Open Access University Press. The volume contains the scientific contributions presented at the INPUT aCademy 2019 Conference. In detail, this publication, including 92 papers grouped in 11 sessions, for a total of 1056 pages, has been edited by some members of the Editorial Staff of "TeMA Journal", here listed in alphabetical order:

- Rosaria Battarra;
- Gerardo Carpentieri;
- Federica Gaglione;
- Carmen Guida;
- Rosa Morosini;
- Floriana Zucaro.

The most heartfelt thanks go to these young and more experienced colleagues for the hard work done in these months. A final word of thanks goes to Professor Roberto Delle Donne, Director of the CAB - Center for Libraries "Roberto Pettorino" of the University of Naples Federico II, for his active availability and the constant support also shown in this last publication.

Rocco Papa

Editor of the Smart City, Urban Planning for a Sustainable Future" Book Series
Published by FedOAPress - Federico II Open Access University Press

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SMART CITY GOVERNANCE FOR CHILD-FRIENDLY CITIES

IMPACTS OF GREEN AND BLUE
INFRASTRUCTURES ON CHILDREN'S
INDEPENDENT ACTIVITIES

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How to cite item in APA format:

Annunziata, A., & Garau, C. (2019). Smart City Governance for Child-Friendly Cities. Impacts of Green and Blue Infrastructures on Children's Independent Activities. In C. Gargiulo & C. Zoppi (Eds.), *Planning, nature and ecosystem services* (pp. 524-538). Naples: FedOAPress. ISBN: 978-88-6887-054-6, doi: 10.6093/978-88-6887-054.6

ABSTRACT

The research investigates the features of blue/green infrastructure integrated in the built environment that affect children's independent mobility and outdoor activities. Independent activities, including mobility, spatial appropriation, imaginative play and cooperative and social activities, are instrumental to children's physical, cognitive, emotional and social development. Building on previous research, the paper introduces the notion of meaningful usefulness to signify the potential of public open spaces to enable multiple purposeful, valued activities. The research aims to structure a synthetic index of usefulness and the Practices of children in open urban spaces (POCUS), an assessment tool which addresses the potential of public open spaces incorporating blue/green infrastructure to enable children's functional, recreational and social activities.

This research fills a void in the literature, by addressing two issues: i) the complex pattern of activities by means of which children engage with the material and social environment; ii) the social impact of affordances incorporated in blue/green infrastructure, in terms of children's well-being, agency and right to the city. The assessment tool and its embodied methodological framework support the design of trans-scalar mosaics of natural spaces, integrating hydrological function, biodiversity, and usable, safe, stimulating public spaces. Consequently, this research contributes to governance processes within the smart city paradigm, by supporting policies and urban planning practices which increase inclusivity and hyper-diversity within sustainable communities.

KEYWORDS

Usefulness; Blue/Green Infrastructure; Agency; Outdoor Independent Activities

1 INTRODUCTION

This paper analyzes how material, spatial, functional and social conditions of green and blue infrastructures integrated in the built environment affect children's propensity to engage in outdoor independent activities. The research aims to structure a synthetic index and the Practices Of Children in public Urban Spaces (POCUS), an audit tool which assesses the potential of public spaces incorporating Green and blue infrastructures to promote inclusion and healthy lifestyles by accommodating children's functional, optional/recreational and social activities. This potential is encompassed in the concept of meaningful usefulness, which is described in the subsequent sections.

This paper introduces the notion of children's independent activities (CIAs). Outdoor independent activities include independent mobility and the complex of practices producing the meaningful engagement with the material environment: exploration, occupation and transformation of spaces, intra-active play, structured group activities, imaginative and creative games (Annunziata & Garau, 2018; Garau et al., 2018). The planning and design of multifunctional trans-scalar networks, serving biodiversity, water safety and quality, landscape and heritage, biodiversity, local food production, while promoting inclusivity emerges as a crucial element in the construction of governance practices within the smart city paradigm (Chawla, 2015; Tjallingii, 2015). The latter implies in fact investments in human and social capital and traditional (transport) and modern (ICT) infrastructure that support sustainable economic development and a high quality of life, with a wise management of natural resources, through participatory action and engagement (Caragliu, 2009). This research focuses on the built environment and on urban blue/green infrastructure for two intertwined reasons: i) coherence with the authors' existing research on walkability, children's mobility, and child-friendly cities; ii) and the emergence of built environments as the main milieu of children's development. UNICEF (2012) observes that more than 1 billion children live in urban settings around the world and in the next future, following the global trends toward urbanization, the majority of world's children will grow-up in towns and cities. This research deals with a subject little discussed in the literature on the blue/green infrastructure and on walkability and livability of public spaces. In fact, the influence of BGI (Blue and Green Infrastructure) on children's spatial practices investigates in this research a specific aspect of social benefits provided by BGIs. These benefits are, for instance, the correlation of early nature experiences and the development of human nature connections, which in turn affect the possibility of the "trans-generational establishment of sustainable futures" (Giusti et al., 2018). Moreover, this research emphasizes the complex patterns of activities by focusing on outdoor independent activities instead of solely on physical activity or mobility

The proposed POCUS audit tool incorporates qualitative street audit and quantitative GIS-based indicators for measuring microscale features specific to single spaces as well as indicators referred to meso- and macro-scale contextual factors. Moreover, the audit tool is integrated into an open and adaptable methodological framework which accounts for the dependence of perceptions and use patterns on socio-demographic individual factors and on contextual socio-economic and cultural factors. This methodology is applied to a central area in Cagliari, Italy.

Starting from these assumptions, this paper begins by defining the urban blue/green infrastructure and by analyzing the literature review on the availability of natural settings and public open spaces for children's independent mobility and physical activity. Then, a methodological framework for assessing the practicability of spaces incorporating the urban blue/green infrastructure, is presented. In the subsequent section a case study, a central area in Cagliari (Italy) is described. Finally, results of the study are exposed, by identifying the level of meaningful usefulness, of the selected public open spaces and individuating critical aspects to be confronted. The paper concludes by considering the validity of results of the case study analysis and exploring the limitation of the proposed model as well its relevance for other similar contexts.

2 LITERATURE REVIEW ON CHILDREN'S INDEPENDENT ACTIVITIES WITHIN THE URBAN BLUE/GREEN INFRASTRUCTURE

Urban blue and Green infrastructures (Urban BGI) are here defined as an interconnected network of natural areas and other open spaces that contributes to people's wellbeing and to the balance between city and nature by providing ecological, economic and social benefits, including water purification, retention and drainage, bio-diversity, local food production, recreation and identity building (Armour et al., 2014; Boyd & Banzhaf, 2007; Millennium Ecosystem Assessment - MEA, 2005).

This paper focuses on the social benefit dimension of urban green/blue infrastructure, in terms of its effect on children's well-being, agency and right to the city. This impact can be better understood by referring to the notions of affordance and capability. Affordances can be defined as the functional, emotional and social properties of a space incorporating opportunities and restrictions that affect users' active interaction with the environment. Affordances can be potential, perceived, utilized and shaped. A potential affordance can be actualized, thus utilized or shaped, only if it is available for children to use (Gibson, 1979, Jamme et al., 2018; Kytta, 2003).

The notion of affordance is instrumental to investigate the spatial, material, social and functional attributes of urban blue/green infrastructures that affect the use and the conceptual value of public open spaces and, thus, their potential to enable meaningful activities. According to Min and Lee (2006) spaces that enable meaningful psychological experiences are identified by children as places; a place is defined as a setting imbued with psychological, behavioral, and symbolic meanings.

The concept of capability is here introduced as a structural category for describing the ways in which the meaningful engagement with natural settings affects children's well-being and development. Capabilities refer to valuable states of being or conditions that a person can access (Sen, 1993). For children, the foundational capability is the "capability to develop". Chawla (2015) reconceptualizes positive effects of children's engagement with natural settings through the capability approach. Therefore, building on findings from research by Nussbaum (2011), Chawla identifies ten central capabilities associated with children's access to nature, including: life; bodily health; bodily integrity; affiliation; practical reason, play; senses, imagination, and thought; emotions; connection to nature and other species; control over one's environment. Building on these premises the notion of meaningful usefulness of a setting can be defined as the product of its spatial, material, functional and social properties incorporating opportunities for children's independent mobility and functional, recreational and social activities.

Furthermore, the existing literature on Children's experience of public spaces emphasizes the relevance of natural settings, including green areas, parks, nature/conservation areas, woods, wastelands, vacant lots, river banks, as destination spaces, threshold spaces, or transition spaces supporting children's independent activities socialization and community life, (Furieux & Manaugh, 2018; Witten et al. 2017).

Availability, accessibility, proximity to other important places and sense of territoriality emerge as fundamental characters of these surfaces, for determining the conceptual and use value of a natural setting. In particular, the configuration of natural settings, as loose, available spaces is identified as a correlate of children's recreational and social practices by Garau et al., (2018); Jamme et al., (2018); Kyttä et al., (2018) and Min and Lee (2006), underline the relevance of size and morphological regularity as conditions that increase the openness of a loose space to diverse recreational and social practices.

Privacy and sense of territoriality are negatively associated to adults' control of the public space. Spatial control is exercised through authority constraints, interferences, and physical manicuring of the landscape: these practices communicate adults' ownership and result in a constraint on children's opportunities to dwell with open public spaces. Witten et al. (2017) underline that the identification of a setting as a place is profoundly conditioned by its affective

atmosphere, which results from the combination of material, social and symbolic stimuli. The concepts of Eyes on the street and “broken window” refer to the nexus between built environment factors and social milieu attributes, which constitute the ecology of children’s experience of the public space (Jamme et al., 2018). The former refers to the spontaneous surveillance of public spaces determined by the density of outdoor activities and the latter to the presence of signs of neglect and abandonment affecting the perception of social fragilities. Natural settings and elements are also related to improved conditions of comfort and well-being, resulting from the control of micro-climatic conditions and from the emotional affordances incorporated in natural elements and settings (Jamme et al., 2018; Min and Lee 2006). The minimal geometry designed by variations in the morphology of surfaces (Slopes, steps, terraces, level changes) incorporates potential functional affordances for different informal or structured recreational and social activities, according to Min and Lee (2006). Vegetation, grass, dirt surfaces, water features, loose elements, (earth, water, stones, grass, and branches) pieces of furniture incorporate affordances for creative and imaginative play, including exploration, manipulation and construction (Chawla, 2015; Pyyry, 2017) observes that the manipulation, experimentation and appropriation of spatial elements and loose objects, can result in intra-active play and can generate a meaningful, affectual engagement with a specific setting. The singular experience of enchantment can emerge from this profound involvement.

Finally, natural elements, affect the conspicuousness of the public space by reinforcing its complexity, human scale and imageability.

3 METHODOLOGY

The POCUS audit tool is based on a review of existing assessment procedures for the analysis of the quality of urban public spaces. In particular, the review of urban quality assessment tool is focused on audit tools, (Pedestrian Environment Data Scan [PEDS]; Environmental Assessment of Public Recreation Spaces [EAPRS], Public Open Space Desktop Auditing Tool [POSDAT], QQuality INdex of Parks for Youth [QUINPY], (Mygind et al., 2016; Rigolon & Németh, 2018; Saelens et al. 2006); and questionnaires (Neighbourhood Environment Walkability Survey [NEWS]; Garau, 2013; Rosenberg et al., 2009;).

The POCUS tool is structured as an audit tool based on publicly available, secondary data, and including quantitative and qualitative indicators related to micro-scale site-specific variables and on macro-scale contextual factors. Indicators related to micro-scale features account for the functional, social and emotional affordances incorporated in the spatial organization of individual natural settings. Context-related Indicators assess land use patterns and density of the surrounding environment, as well as the spatial continuity of the blue/green

networks and their connection with the networks of pedestrian paths and public transportation. The combination of site-specific and contextual factors reflects the fact that the meaningful usefulness of a place is determined both by its inherent attributes and by its endowed conditions (Blecic et al., 2015; Jabbari et al., 2018; Moura et al., 2017). The POCUS audit tool is incorporated into an adaptable methodological framework, structured as a 5 stages process. This includes: i) selection and characterization of the case studies; ii) selection of natural settings correlates of children's CIAs and definition of their relative importance through a comprehensive literature review and a session of stakeholders. The latter is based on the phenomenological approach and the saturation principle and is structured as a workshop of urban explorations involving 42 children – 18 girls and 24 boys – aged 5 to 13 years. A more detailed description is in Annunziata and Garau (2018); iii) selection of indicators and sub-indicators representative of natural environment correlates of children outdoor activities. Indicators are defined building on available audit tools (Mygind et al., 2016; Saelens et al., 2006; Rigolon & Németh, 2018) and respond to criteria of objectivity, relevance, measurability and reproducibility, validity, representativeness, comparability over time and understanding; iv) the definition of thresholds values and/or of value functions for the normalization of measurements for the selected qualitative and quantitative indicators; v) data collection, indicators evaluation and aggregation of results. The audit incorporates 19 indicators; six refer to accessibility related factors, twelve indicators refer to factors of the public space incorporating functional, social and contextual affordances and one refers to aspects related to children's participation in governance processes (tab.1). The range of values for each indicator is established according to the findings from the literature review and the session of stakeholders. It considers the relevance, quantity, variety, gradient and size of the affordances incorporated in the related environmental features.

The sum of the partial scores assigned for each indicator determines a global score, ranging from 0 to 100, which corresponds to the value of an Index of usefulness of specific public open spaces (I_{UIPOS}) defined by a score, ranging from 0 to 100. The subsequent stage is the determination of a continuity factor (f) of the blue/green network. The latter measures the level of connection of natural settings and is determined as the ratio of the aggregate size of the public open spaces contiguously connected in the largest continuous subnetwork and the total surface area of the public open spaces considered in the area of study. In the final stage the values of the I_{UIPOS} Indexes of specific public open spaces are weighted according to the surface area, aggregated and multiplied for the continuity factor (f).

Categories	Indicators	Score
Factors related to functional affordances		0-33
Spatial	Variety of settings	0-10
Material	Enabling materials for imaginative play	0-15
	Presence of amenities/equipment	0-8
Factors related to emotional/contextual affordances		0-45
Material	Water features	0-3
	Number of trees	0-3
	Bio-diversity	0-2
	Microclimatic conditions	0-6
	Imageability	0-7
	Location of lights	0-5
	Social	Natural control of the POS
	Signs of neglect (broken window)	0-4
	Sense of privacy/territoriality	0-8
	Commitment	Participation in planning/design/ management
Accessibility		0-22
Spatial connection	Connection to mass transit	0-4
	Connection to pedestrian facilities	0-4
	Connection to bicycle facilities	0-2
	Barrier effect	0-4
Functional contextual	Availability of local destinations	0-4
	Residential density	0-4

Tab. 1 Indicators included in the POCUS tool

The result is a synthetic index of usefulness of urban blue/green infrastructures within a pre-determined area (I_{BGI}). The I_{BGI} index is thus representative of individual open spaces and of the connectivity of the blue/green networks. Data are retrieved from the Sardinia Regional Informative Territorial Service, the Municipal Cagliari informative territorial service, the Open Street Map platform, internet-based street level imagery services (Google Street View), and territorial imagery services (Google Maps, Google Earth, Bing Maps), and are validated through direct observations during on-site surveys. In the subsequent paragraphs, the authors illustrate the case study of Cagliari and the application of the POCUS tool.

3.1 PRESENTATION OF THE CASE STUDY

Cagliari emerged as an optimal case study, because of its rich tradition of policies and projects developed to promote children's rights related to accessibility and participation (Annunziata & Garau, 2018). The study focused on a central urban area of Cagliari, that includes part of the historic and consolidated districts of Stampace, Castello, Sant'Alenixedda, Is Mirrionis (Fig. 1).

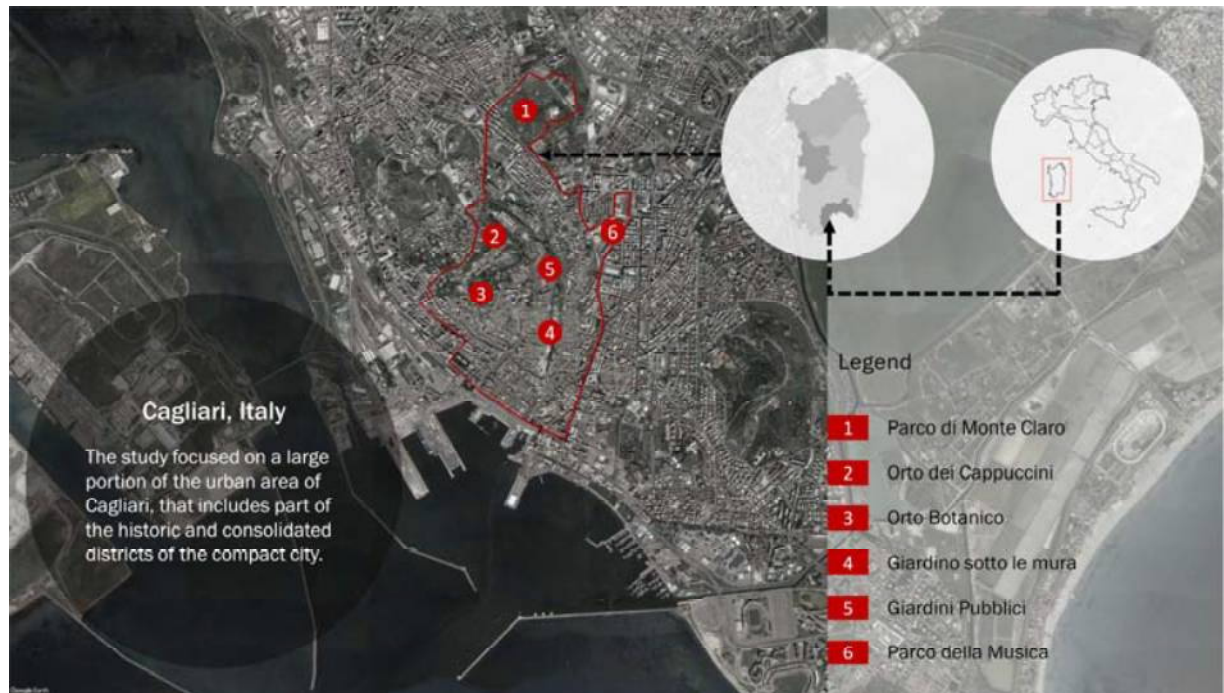


Fig.1. Representation of Public open spaces analyzed via the POCUS tool

The analysis focuses on a form of open space: the urban park. This refers to a man-made space, whose organization and management depends on a geometric rationality and on the use of "contrary energy" (Clement, 2005); yet, these spaces are considered as potential components of a trans-scalar, continuous mosaic of green spaces. The public open spaces individuated for the application of the POCUS tool are: Monte Claro, Giardino sotto le Mura, Giardini Pubblici, Orto dei Cappuccini, Orto Botanico, Parco della Musica. These spaces are selected according to 3 criteria: centrality within the public debate; significance as context of practices and activities of diverse groups of users; relevance as potential components of a continuous green/blue network across the compact city. The findings from the application of the Audit tool are discussed in the subsequent section.

4 FINDINGS AND DISCUSSIONS

The application of the proposed methodological framework demonstrates the potential of the POCUS audit tool for understanding and evaluating the opportunities for children's

independent activities, incorporated in the spatial, material, social characters of public open spaces.

The results, described in Tab. 2 and in Fig. 2, show that the values of the Index of usefulness of individual spaces (I_{UIPOS}) ranging from 59 to 73, on a 100 units scale and a value of 38 (on 100 units scale) for the synthetic Index of the quality of urban blue/green infrastructure incorporating public open spaces (I_{BGI}).

PUBLIC OPEN SPACES	I_{UIPOS}	Surface (m ²)	Average (\bar{I}_{UIPOS}) ($\sum I_{UIPOS} * A$) / ($\sum A$)	f (Area_connected subnetwork/ $\sum A$)	I_{BGI} ($\bar{I}_{UIPOS} * f$)
Parco di Monte Claro	73/100	224617	-	-	-
Orto dei Cappuccini	65/100	29673	-	-	-
Orto Botanico	62/100	65492	-	-	-
Giardino sotto le Mura	56/100	11337	-	-	-
Giardini Pubblici	69/100	32856	-	-	-
Parco della Musica	69/100	48376	-	-	-
Urban BGI (Area of study)	-	412351	69/100	0,54	38/100

Tab. 2 Values of the Indexes of usefulness for the selected POS

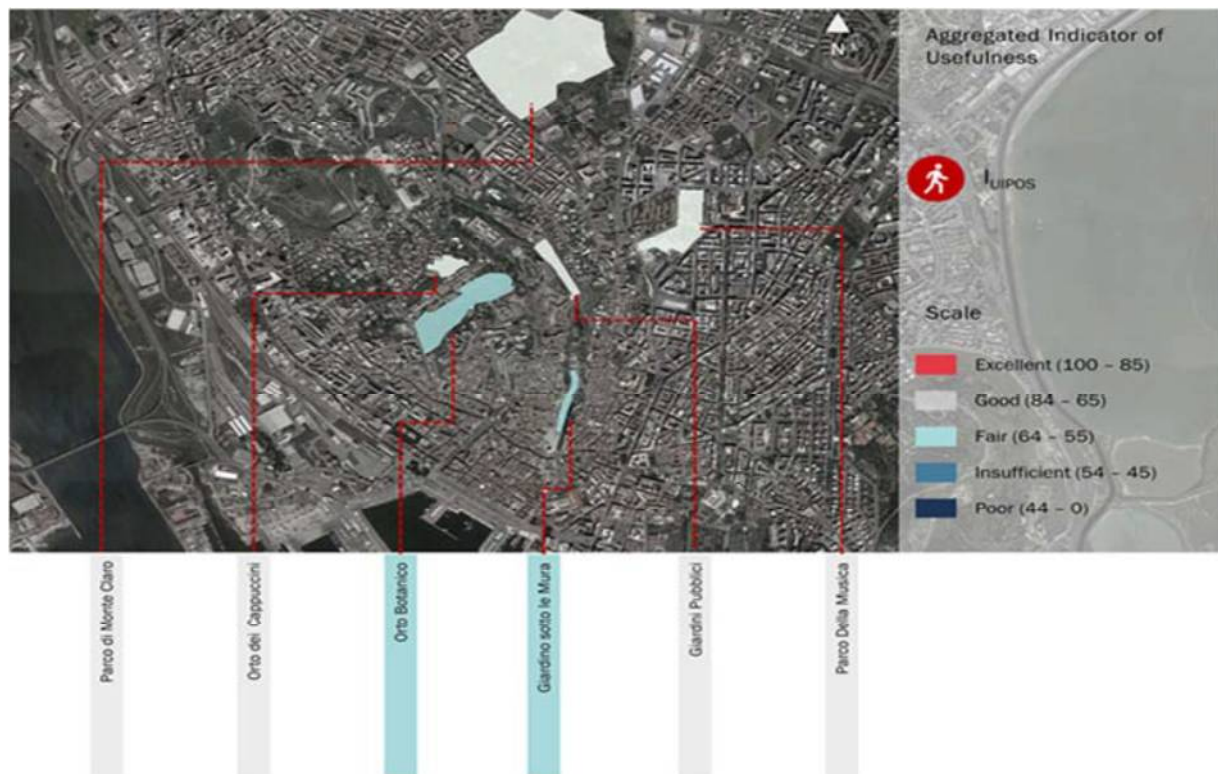


Fig.2. Representation of performance levels related to the indicator of usefulness I_{UIPOS}

The results are determined by the divergence, in terms of utility among the material and spatial conditions of public open spaces related to the dimension of functional affordances, the social and environmental properties related to the dimension of contextual affordances, including the issues of safety, privacy and territoriality and the dimension of spatial properties related to the accessibility of public spaces.

Therefore, the biotic component of the selected public spaces and the morphology of surfaces determine a significant variety of spatial and microclimatic conditions and the availability of different settings and enabling materials (Witten et al., 2017). These spatial and material properties incorporate functional affordances for meaningful activities and experiences and are thus fundamental correlates of the meaningful usefulness of a space (tab. 3).

PUBLIC OPEN SPACES	Functional factors (Settings + enabling materials + equipment) - Imageability - Social factors (Constraints + broken window + eyes on the POS)	Spatial Connection (to pedestrian facilities + Bicycle facilities + mass transport+ Barrier effect)	Available local destinations
Monte Claro	30/33 - 6/7 - 14/16	5/14	3/4
Orto dei Cappuccini	27/33 - 7/7 - 10/16	6/14	4/4
Orto Botanico	22/33 - 7/7 - 07/16	5/14	4/4
Giardino sotto le Mura	21/33 - 7/7 - 10/16	6/14	4/4
Giardini Pubblici	25/33 - 7/7 - 12/16	5/14	4/4
Parco della Musica	25/33 - 7/7 - 12/16	6/14	4/4

Tab. 3 Relevance, in terms of Usefulness of a set of material, functional, spatial and social features of the selected POS

As for the contextual affordances affecting the dimension of safety, comfort, privacy and territoriality, a fundamental issue is the conflict among children's need for spatial appropriation and adults' interferences and constraints. In particular, the analysis reveals different forms of adults' control on public open spaces: specialization, competition among adults' practices and children's activities, coupling constraints, and the manicuring of space. These constraints affect children's sense of privacy and territoriality by limiting their possibility to spontaneously engage with spaces, their access to natural settings and by communicating adults' ownership of the public space (Chawla, 2015; Min & Lee, 2006; Pyyry, 2017). A general positive situation is observed regarding the conditions related to concepts of "eyes on the street" and "the broken window".

These notions refer to the environmental stimuli determined by the built environment – social milieu nexus and associated with safety perceptions. The properties considered representative of the built-social nexus include condition of surfaces, furniture and vegetation, cleanliness,

presence of services and of intergenerational activities. Conspicuousness, or the potential of a space to produce a structured, useful and meaningful image, is observed to be a distinctive positive condition of the selected POS: it results from the complexity and human scale incorporated in the vegetal structures as well as from the singularity of landscape elements, pieces of art, spatial elements, buildings and architectural follies. A positive element, in terms of usefulness, is represented by the variety of primary and secondary functions and services, located within a walking distance from the selected spaces. Nevertheless, the opportunities for meaningful purposive recreational and social activities are not supported by the conditions of inadequate spatial connection among public open spaces and other meaningful places, thus resulting in lesser opportunities for children to frequently and independently access to and engage with the selected spaces. These conditions are determined by the discontinuity of the system of natural settings and public open spaces and by the configurational and compositional characters of the networks of pedestrian and bicycle facilities, including continuity, slope, inadequate dimension and conditions of separation/distinction of the pedestrian space, poor maintenance and barrier effect. Finally, it is observed the lack of participatory and co-creation process involving children and the wider community in the planning, project and management of public spaces. This results in a limitation of children's control on their environment (Chawla, 2015).

5 CONCLUSIONS

This paper describes an open, adaptable, methodological framework, for evaluating the potential of urban blue/green infrastructure to increase the meaningful usefulness, for children, of public spaces. Building on a comprehensive review of the literature on children's experience of natural settings, the POCUS audit tool fills a void in the research on the assessment of public open spaces and of urban blue green infrastructures. The proposed theoretical and methodological framework emphasize the meaningful usefulness of public open spaces as a central component of the social dimension of ecosystem services provided by the Urban Blue Green Infrastructure, underlining the relevance of childhood nature experiences, as an issue concerning both the integral development of children and the establishment of Human nature connections. Additionally, this research operationalizes the concept of affordance in terms of an auditing tool for investigating, evaluating and describing public spaces. The application to a case study reveals the potential of the POCUS audit tool to support timesaving and thorough analysis of the capacity of specific public open spaces and of the blue/green networks within a pre-specified area to enable children's independent activities. The limitations observed concern the validation of the results and the determination of the weight of each indicator, which is expressed in the scale, or potential score, associated

to each of them, and which constitutes a fraction of the total score equal to the value of the IUIPOS Index.

In fact, several inquiries including Garau et al. (2018), Moura et al. (2017), emphasize the correlation between children's propensity to engage in outdoor activities and cultural constructs, contextual socio-economic factors and individual socio-demographic characteristics. Consequently, future stages of the research will be aimed at addressing two fundamental aspects: i) establishing procedures for weighting natural environment attributes and the related indicators, according to children's individual purposes and cultural and socio-demographic characteristics ; ii) defining a validation procedure, based on direct observations or on home based and on site surveys, for comparing the outcomes of the analysis with actual levels of outdoor activities and with children's perceptions of spaces.

The POCUS tool contributes to the monitoring and assessment of the quality of the public space by supporting three actions: i) the comparison of the quality of individual public open spaces, in terms of their usefulness; ii) a synthetic description of the capacity of the urban blue/green networks to support inclusivity and social processes by enabling children's practices; iii) the understanding of criticalities to be addressed in order to increase the meaningful usefulness of public open spaces integrating urban blue/green infrastructures.

Consequently, the POCUS tool relevantly contributes to the implementation of governance processes within the smart city paradigm by supporting planning actions which promote children's access natural spaces and consolidate inclusion and equality within sustainable communities.

AUTHOR CONTRIBUTIONS

This paper is the result of the joint work of the authors. 'Methodology', and 'Findings and discussions' were written jointly by the authors. Chiara Garau wrote the 'Introduction', and 'Conclusions'. Alfonso Annunziata wrote the 'Literature review on children's independent activities within the urban blue/green infrastructure'.

6 ACKNOWLEDGEMENTS

This study was supported by the MIUR (Ministry of Education, Universities and Research [Italy]) through a project entitled *Governing the smart city: a governance-centred approach to Smart urbanism - GHOST* (Project code: RBSI14FDPF; CUP Code: F22I15000070008), financed with the SIR (Scientific Independence of Young Researchers) programme. We authorize the MIUR to reproduce and distribute reprints for Governmental purposes, notwithstanding any copyright notations thereon. Any opinions, findings and conclusions or

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This study was also supported by the project “Healthy Cities and Smart Territories,” founded by the Foundation of Sardinia and Autonomous Region of Sardinia (Fondazione di Sardegna—Convenzione triennale tra la Fondazione di Sardegna e gli Atenei Sardi Regione Sardegna 2016).

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