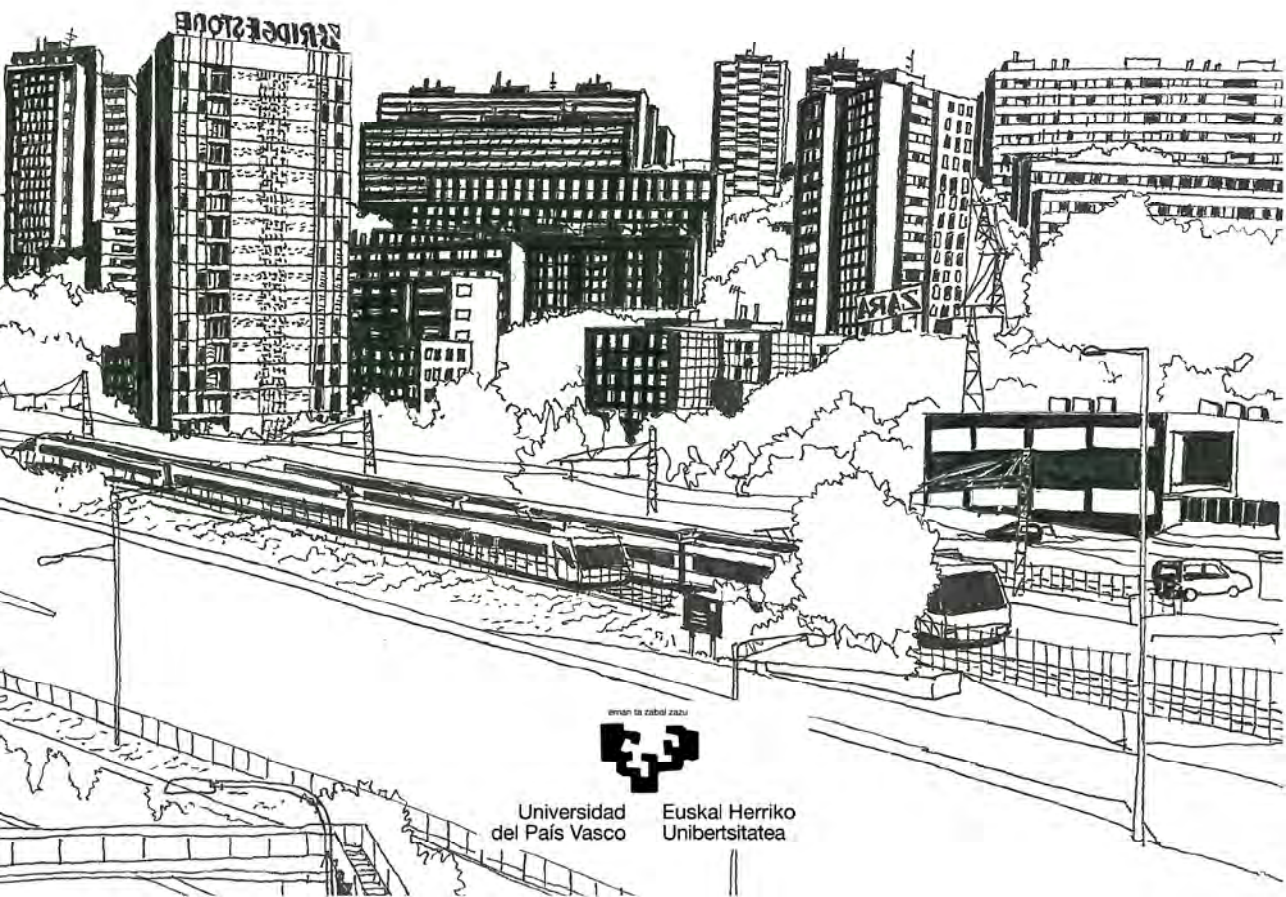
I International Research Seminar
in Urban Processes and Natural Morphologies

7-8 September, 2017
Donostia / San Sebastián, Spain



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Universidad del País Vasco
Euskal Herriko Unibertsitatea

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Madalen González-Bereziartua and Izaskun Aseguinolaza Braga (Editors)

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International Research Seminar in Urban Processes and Natural Morphologies

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INTRODUCTION

FOREWORD

It was among Dr. Maider Uriarte-Idiazabal´s wishes to organize a seminar like the present one. Therefore, her family would like to acknowledge the effort made by the organizers of the seminar, Dr. Madalen González-Bereziartua and Prof. Sören Schöbel, as well as the University of the Basque Country (UPV/EHU) and the Summer Courses Foundation. The family is also thankful to Leire Milikua, Anartz Ormaza and the UEU for editing her thesis and publishing it as a book.

And finally, we appreciate the efforts made by the key speakers Prof. Prominski, Prof. Campkin and Prof. Vicenzotti to take part in the seminar. We, the family, are non-experts on the field of urban planning and landscape. But we would like to remember that Maider's work was based on new approaches, parameters and methodologies for understanding and rethink urban fringes. The central element of her approach was the Landscape Perspective tool. This tool is structured in a four dimensional model of landscape construction. The first dimension refers to the Idea that represents the understanding of land in connection with a purpose or intention of transformation. The second one, contains a Representation of landscape, which is derived from the direct association between a Landscape Perspective and its communication. The third one looks upon the Agencies that promote or act in Landscape. And finally, the tool studies the Elements or the effected transformation. The Landscape Perspective tool interprets landscape in two ways: first speculating with its character by formulating different approaches, and also/second by structuring an inquiry on its character through interpretive dimensions. This would be Maider's main academic heritage.

Among her future goals were, the implementation of the Landscape Tool in an academic context or in a regional planning framework, and, as said above, organizing a seminar like this one.

Let these goals and hopes become true in shapes that Maider liked!!

Maider Uriarte's family

HITZAURREA

Maider Uriarte Idiazabalen azken helburuetako bat izan zen eskuartean duguna bezalako kongresu bat antolatzea. Honebestez, bere familiakook eskerrak eman nahi genizkieke Madalen González-Bereziartua doktoreari eta Sören Schöbel irakasleari kongresua antolatzeagatik. Halaber, eskerrak eman nahi genizkieke Euskal Herriko Unibertsitateari (UPV/EHU) eta Uda Ikastaroen Fundazioari, kongresua egiteko jarritako erraztasunengatik. Martin Prominski, Ben Campkin eta Vera Vicenzotti irakasleek hizlari moduan eginiko ahalegina ere nabarmendu behar dugu. Azkenik, familiakook gure eskerra azaldu nahi genieke Leire Milikua, Anartz Ormaza eta UEUri, Maiderren tesia editatu eta liburu moduan argitaratzeagatik.

Nahiz eta Maiderren familia hirigintza eta paisaiagintza arloetan arrotz samarrak izan, gogorarazi nahiko genuke Maiderren ikerketa hiri-bazterreko paisaien izaeraren interpretazioari buruzko lan bat izan zela. Ikerketaren emaitza nagusia konstruktibismoa oinarri duen interpretazio-tresna baten egituraketa da: paisaia-ikuspegi deritzon tresna, hain zuzen. Tresna honek lau dimentsio ditu. Lehen dimentsioa ideia da; ideiaren bitartez, lurralde batekiko jarrera eta jarduera bat definitzen da. Bigarrenik, paisaiaren irudikapena dugu. Autoreek edo agenteek duten lurralde-ulermenaren edo paisaia-ikuspegiaren ideia irudikatu egiten dute egitasmo bat aurrera eramateko, edo estetika nahiz komunikazio eta zabaltze helburuak direla eta. Hirugarrenik, agentzia dugu, lurraldearen eraldaketak eta balioak naturalizatu beharrean, paisaia-ikuspegiaren bitartez horiek testuinguru sozial, ekonomiko, kultural eta politikoan jartzeko modua alegia. Eta, azkenik, elementuak ageri dira; paisaiaren ideiak, helburu ezberdinen arabera, elementu batzuk proposatuko eta diseinatuko ditu lurraldearen analisiaren arabera aukeratutako tokian kokatzeko.

Maiderren etorkizuneko helburuen artean, paisaia-ikuspegiaren tresna maila akademikoan zein lurralde-antolaketa praktikoan erabiltzea zen; eta, arestian esan bezala, honelako kongresu bat antolatzea. Maiderren helburu horiek betetzea nahi genuke.

Maider Uriarteren senideak

INTRODUCCIÓN

Uno de los objetivos de Maider Uriarte-Idiazabal era organizar un seminario como el que nos ocupa. En ese sentido, la familia agradece el esfuerzo realizado por la doctora Madalen González-Bereziartua y el Profesor Doctor Sören Schöbel, así como a la Universidad del País Vasco (UPV/EHU) y a la Fundación de los Cursos de Verano para organizar este seminario. La familia quiere agradecer también a Leire Milikua, Anartz Ormaza y la UEU por el trabajo de edición en libro de la tesis doctoral de Maider Uriarte-Idiazabal. Finalmente manifestamos nuestro agradecimiento por el esfuerzo realizado por los Profesores Prominski, Campkin y Vicenzotti, además del Profesor Schöbel, que serán los conferenciantes invitados en el Seminario.

Nosotros, la familia, no somos expertos en el campo de la planificación urbana y el paisaje. Sin embargo queremos recordar que el trabajo de Maider aportaba nuevas aproximaciones y metodologías para entender y repensar los márgenes urbanos. En síntesis, el elemento central es la herramienta denominada perspectiva del paisaje. Esta herramienta propone cuatro dimensiones para la construcción del modelo del paisaje. La primera dimensión se refiere a la idea que representa la interpretación de la tierra como algo que está sujeto a transformación. La segunda se refiere a la representación del paisaje que se deriva de la asociación directa entre la perspectiva del paisaje y su comunicación. La tercera se ocupa de las agencias que promueven o actúan sobre el paisaje. Y finalmente, la última dimensión estudia los elementos afectados por la transformación. La herramienta de la perspectiva del paisaje interpreta el paisaje desde dos puntos de vista: primero reflexionando sobre sus características y formulando diferentes aproximaciones, y segundo proponiendo líneas de investigación acerca de sus características. Esta sería la principal herencia académica de Maider.

Entre sus futuros objetivos estaba la implementación de la herramienta del paisaje en el contexto académico y/o en el marco de la planificación regional y, tal como se ha mencionado al principio, organizando seminarios como el que nos ocupa.

Esperemos que estos objetivos y deseos se hagan realidad de la manera que le hubiera gustado a Maider.

La familia de Maider Uriarte

I. URBANISM AND LANDSCAPE IN MOUNTAINOUS AREAS

LANDSCAPE STRUCTURES IN THE ALPINE RHINE VALLEY
Their significance and contribution to the qualification of urban sprawl

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ABSTRACT

This paper is based on the assumption that the existing landscape structures allow the qualification of a settlement development in the urban sprawl of the Alpine Rhine Valley. For this, the characteristic landscape structures have to be treated as an integral part of the valley landscape both on a regional and urban planning level (Bormann et al., 2005).

This approach is based on an integral and complementary spatial qualities analysis of landscape and settlement areas (Corboz, 2001). For this aim, qualitative and context-related methods of analysis are used (Schöbel 2003, Kort-Krieger et al., 2006).

That overlays it with its historical and current characteristics of the valley-landscape and puts it into a context that pertains to its social and historical change of function and meaning. This allows to derive correlations and to identify potentials. What is common to the sub-areas is the existence of landscape structures, each of which accommodates different or multiple functions (Prominski, 2004).

In a second step, the opening proposition is verified for its validity, i.e. densification and extension are tested on the basis of pre-defined criteria in specific investigation areas of the Alpine Rhine Valley. The aim of this is to develop an understanding where it is necessary to apply strategic, negotiation or conceptual countermeasures if specific qualities and functions are to be preserved.

Key words: landscape, landscape urbanism, qualification, urban sprawl, spatial development.

LABURPENA

Artikulu honen oinarrizko premisa da Alpeetako Rhin haraneko paisaia-egituren bitartez kalifika daitekeela haraneko hiri-hedapenean den finkamendu-garapena. Horretarako, paisaiaren berezko egiturak haraneko paisaiaren zatitzat hartu behar dira, nola hiri-arloko hala eskualde-arloko antolamenduari dagokionez (Bormann eta al., 2005).

Ikuspegi horrek paisaiaren eta kokaguneen espazio-ezaugarri funtsezko eta osagarrien azterketa du oinarri (Corboz, 2001). Horretarako, azterketa-metodo kualitatiboak eta testuinguruari buruzkoak erabili dira (Schöbel, 2003; Kort-Krieger et al., 2006).

Hori eginda, haran-paisaiaren ezaugarri historiko eta gaur egungoen gainetik jarri du eskualde hau, funtzioari eta esanahiari lotutako aldaketa sozial eta historikoaren zati den testuinguruan ezarrita. Horri esker, korrelazioak atera eta ahalmenak identifika daitezke. Azpizona guztiek ezaugarri berbera dute, paisaia-egiturak dituzte, hain zuzen ere, eta horietako bakoitzak askotariko funtzioak edo funtzio ugari ditu (Prominski, 2004).

Bigarren fasean, hasierako premisa baliozkoa den egiaztatu da; adibidez, dentsifikazioa eta zabalkuntza egiaztatu dira, Alpeetako Rhin haranari buruzko ikerketa-arlo berezietan aurrez zehaztutako irizpideetan oinarrituta. Helburua da ulertzea non den beharrezkoa erantzun estrategikoak, kontzeptualak edo negoziazio-arlokoak ezartzea, ezaugarri eta funtzio espezifikoak babestu nahi badira.

Gako hitzak: paisaia, paisaia-urbanismoa, kalifikazioa, hiri-hedapena, espazio-garapena.

RESUMEN

Este artículo se basa en la premisa de que las estructuras del paisaje existentes permiten calificar un desarrollo de asentamiento en la expansión urbana del valle del Rin alpino. Para ello las estructuras características del paisaje se han de tratar como parte integrante del paisaje del valle al nivel de la ordenación tanto urbana como de la región (Bormann et al., 2005).

Este enfoque se basa en un análisis de cualidades espaciales esenciales y complementarias del paisaje y las zonas de asentamientos (Corboz, 2001). Para ello se han empleado métodos de análisis cualitativos y relativos al contexto (Schöbel, 2003; Kort-Krieger et al., 2006).

Esto lo superpone a sus características históricas y actuales del valle-paisaje y lo pone en un contexto que pertenece a su cambio social e histórico de función y significado. Gracias a esto se pueden extraer correlaciones e identificar potenciales. Lo que es común a las subzonas es

la existencia de estructuras de paisaje, cada una de las cuales alberga diferentes o múltiples funciones (Prominski, 2004).

En una segunda fase, se comprueba la validez de la premisa inicial; por ejemplo, se prueban la densificación y la extensión sobre la base de criterios predefinidos en áreas de investigación específicas del valle del Rin alpino. El objetivo es entender dónde es necesario aplicar respuestas estratégicas, conceptuales o de negociación si se desean preservar cualidades y funciones específicas.

Palabras clave: paisaje, urbanismo de paisaje, calificación, expansión urbana, desarrollo espacial.

1. INTRODUCTION

All over Europe an intense debate about the topic urban sprawl –"Zwischenstadt" (Sieverts, 1997)– occurs in every thinkable appearance. Whether it is sururban space in between more than one city-center, acres covering suburbia spreading over wide landscapes or longitudinal valley landscapes naturally bordered by steep mountain slopes. All these types of urban sprawl appear as dispersal growth of fragmented monofunctional settlements incoherently lying apart, bordered and divided by lines of infrastructure, rests of agriculture and all kinds of fallow areas. In difference to compact urban areas the interchange and interference of complex social systems takes place only at certain points and at certain time. Many sectors inside the settlement as well as in the surrounding open spaces are used monofunctional and by uniform groups. Recently increases the intention for upgrading these new settlement areas.

Previous perceptions show this complex of problems in growing settlements always under the aspects of losing landscape. To strike a new path in the debate of urban sprawl –"Zwischenstadt"– it seems necessary, to disconnect progressing growth of disperse settlements with the loss of landscape, which obstructs the view for the interrelationship of both structures.

2. CENTRAL QUESTIONS OF RESEARCH AND METHODOLOGY

This research project acts on the assumption, that existing landscape structures allow the improvement of the settlement development in the urban sprawl of the Alpine Rhine Valley. For this, the characteristic landscape structures have to be considered as an integral part of the valley landscape.

With the help of landscape structures urban sprawl in valley landscapes can upgrade settlement areas today and in future. Landscape structures form a stable spatial framework that can be employed on a flexible basis for the network of relationships in the valley landscape. The focus was placed on the following questions:

- What is the role of landscape structures for creating and supporting various degrees of publicness and the quality of the user experience in general and in the various settlement areas in particular? What specific characteristics are relevant in this respect?

- How can these landscape structures be maintained in the long term at the regional and urban planning levels with regard to development decisions and specific structural measures?

Answering these questions presupposed a concept of landscape in which settlement and the landscape space are not distinct but are seen as mutually defining and interwoven components of a certain quality.

This research is based on the assumption that landscape is dynamically linked with its specific spatial and social contexts and with its genesis (Corboz, 2001). Like sediments, changes and their development over time are deposited in the territory and are to be seen as embedded in their respective social contexts. Certain relics outlast their time and can also be used and adapted in a subsequent period, which confers new meaning on them in a new societal context. These processes are not finished but point to possible future uses and interpretations. Landscape is generally seen as a combined product of natural and human processes, and a creation of possibilities. The answer to such challenges with unpredictable, process-related and relational circumstances is complex conceptualization (Prominski, 2004).

The treatment of a valley landscape in this way and distillation of lead landscape structures from the characteristic interaction of their individual components presupposes a qualitative method of analysis capable of logically and demonstrably revealing structures for use on a variable basis (Schöbel, 2003; Kort-Krieger et. al, 2006).

Such an analysis will be capable of breaking down the physical space, regardless of all political and administrative borders, into its topographical and morphological constituents, overlaying them with its historical and present character in terms of vegetation structures, water body structures, road networks and settlements (historical and current themed maps) and relating them to changes in social use and importance in order to derive the relevant relationships.

On the one hand, the objective is to understand the dynamic genesis of this valley landscape and on the other, to identify spatial patterns and distinctions in which landscape structures and structural elements assumed a significance other than the significance they had before. That makes it possible to find landscape structures that have already survived several shifts in relevance. In a variety of ways, such robust structures could assume new functions and meanings in the overall context for the future, too.

The search perspective is targeted at multifunctional landscape structures that are relevant for new construction projects and the enhancement of existing areas of settlement on a scale of 1:25 000 and 1:1000.

This approach is capable of revealing the potential for current requirements and the scope for future developments as a landscape structure of regional significance on a scale of 1:25 000. At the same time, existing construction projects are investigated on the basis of the regional landscape structures found with regard to their potential for further development in combination with the qualities of those landscape structures. That is done with the help of predefined criteria, including the following: orientation, e.g. along roads and paths; functional and visual organisation of the settlement structure; social functions such as the quality of

the user experience in private, semi-public and public sectors; creation of or support for gradations of publicness; ability to experience visual contacts; availability or absence of changing perspectives and spatial depth.

That makes it possible to deliver transparent proof of permanent spatial qualities in the district and equally to identify points of departure in those cases where such qualities no longer exist.

As appropriate research area fits the Alpine Rhine Valley very well, because it is dominated by pronounced transformations of the landscape through anthropogenic activity.

3. SHORT DESCRIPTION OF THE ALPINE RHINE VALLEY

The Alpine Rhine Valley is a north-south trending longitudinal Alpine valley. The river of the same name that gives the valley its character flows north into Lake Constance. In the area of the Swiss-Liechtenstein border the valley bottom is between three and four kilometres wide.

The steep mountain slopes that rise up on both sides of the gravel terraces impose topographical limits on the area available for settlement. The point at which the angle of slope finally prevents settlement is indicated in the field by the tree cover and rock outcrops and on the map by the tightly packed contour lines.

As a north-south axis linking southern Germany with the Mediterranean regions to the south of the main Alpine chain, the Alpine Rhine Valley has been an important trade and transit route since time immemorial. That is reflected in a continuous history of settlement from the Stone Age to the Roman period and up to the modern day (Historischer Verein für das Fürstentum Liechtenstein, 2015).

For many centuries, only those areas were used for human settlement that were not threatened by the flood waters of the Rhine and its tributaries. They mainly comprised the transitional zone between the foot of the slopes and the valley flat plus flood-free elevations on the floor of the valley.

It was not until the 19th and 20th centuries that additions to the infrastructure and flood control measures permitted the valley area to be shaped according to human needs and thus permanently modified.

In the 18th century, overexploitation of the forests in the catchments of the Rhine and its tributaries led to an increase in the bedload in the river with higher peak flood levels and increased sediment deposits. The widely meandering river eventually filled with gravel bars, leading to waterlogged soils in the valley bottom and problems with floodwater discharge (Historisch-heimatkundliche Vereinigung des Bezirks Werdenberg, 1990).

The river regulation measures implemented between 1832 and 1918 in the area of the border between Switzerland and Liechtenstein gave the valley its most dominant man-made structure and led to the construction of a series of other drainage structures, including the Werdenberg and Rhine Valley Canals on the Swiss side of the border and the Liechtenstein Canal on the other side as the biggest inland structures (Broggi, 2009). Other measures included drainage of the flood-free valley space with the help of countless drainage ditches and underground pipes.

From Landquart to the confluence with the River Ill north of Liechtenstein, Rhine regulation took the form of a levee system. In narrow sections of the valley, i.e. two to four kilometres wide, the engineering works are designed to create a river channel with a uniform width of 120 m, with banks in the form of flood protection embankments. The crown of the levee is between three and ten metres higher than the surrounding land. Within the regulated river channel, the formation of continuously shifting gravel banks is possible to a degree, and they make a strong contribution to the character of this section of the river. Construction of the canals parallel to the river was accompanied by the construction of an extensive drainage system and related measures.

Gravel removal from the Rhine, with its high bedloads, carried out between 1953 and 1973 resulted in a lowered river bed. That was done to provide additional flood protection for the right-hand bank following the disastrous failure of the embankment at Schaan in 1927. The measure also had the effect of lowering the groundwater level in the whole of the valley.

The geometrical patterns of the drainage system on the left and right banks of the Rhine created a new landscape, which has been decisive since then for the character of the whole valley space, with west-east running windbreaks and rows of trees along the ditches and canals playing a dominant role.

During the war years, extensive felling was performed in the valley's riverine forests. That deprived the fertile soil and the crops planted there of protection from the strong winds and soon had negative repercussions on agriculture. To compensate for these disadvantages, the Liechtenstein government in Vaduz initiated a shelter belt project. The objective was to create 10 m wide shelter belts extending across the valley at 500 m intervals. From 1949 onwards, several local authorities in Liechtenstein started implementing the plan, with the main focus on plantations in the Gampriner and Schaaner Riet. Further additions and improvements were made starting in 1968.

The course of the surface drains has basically remained unchanged. In recent years, revitalisation measures have been taken in certain areas to upgrade the drains and make them more accessible, for example in Vaduz and Buchs.

As a result of past drainage programmes, the floor of the valley now has a carefully calculated artificial network of canals and streams which have no direct contact with the surface waters

Fig. 1: Drainage plan “Mayer from1841” for the valley flat in the Swiss Rhine Valley at Buchs. (Werdenberger Jahrbuch, 1990)

Fig. 2: The windbreaks today and the finely compartmentalised landscape they create in the Liechtenstein Unterland. (Catarina Proidl)

Fig. 3: Aerial photo looking north in the direction of flow of the River Rhine. (Catarina Proidl)

of the Rhine. The bed of the Rhine now remains more or less constant as the bedload is trapped at the run-of-river power plants in the upper reaches. A new (artificial) equilibrium between gravel deposition and transport in the engineered river channel has established itself since the 1970s. The artificial lowering of the river bed has removed the risk of flooding along the Rhine. The levees are considered to be of adequate height relative to the river bed to withstand flooding over the next 300 years.

Successive measures taken to drain the gravel terraces have increased the area of land suitable for agriculture. Whereas the areas close to the Rhine were originally too wet for intensive agriculture, the amelioration measures taken now permit crops to be planted up to the Rhine embankment. The resulting geometrical layout of the land also offers ideal conditions for modern, i.e. mechanised, working methods. As in the case of Switzerland, the food shortages experienced in Liechtenstein in the First World War generated considerable pressure to achieve self-sufficiency in agriculture (Merki, 2007; Quaderer-Vogt, 2014).

The landscape as we see it today is accordingly the product of a combination of natural processes and artificial measures and structures. As these two forces are effective over long periods of time, their traces are visible like sediment in the landscape of the Alpine Rhine Valley (Corboz, 2001).

The lowering of the groundwater level in the valley not only brought an increase in the area of land suitable for agriculture; it also created potential building land in flood-free locations in the whole of the valley space up to the Rhine embankment. As a result, by 1943, the conditions had been established in the Alpine Rhine Valley for the form of settlement for which, 54 years later, Tom Sieverts was to use the term “Zwischenstadt” or “in-between city” (Sieverts, 1997).

Today’s conflicts of interests in the Alpine Rhine Valley can be better understood with the help of some key data that reflect the dynamic pace of development in the region, which can also be witnessed –albeit to a lesser degree– in the neighbouring districts of Switzerland and Austria (Vorarlberg).

The Principality of Liechtenstein occupies a total area of 160 km^2. Of that total, the designated area of settlement amounts to 16 km^2. Today about 37 600 people live in this area of settlement, which supports 36 700 jobs. More than half of the workforce (19 600 people) are commuters from the neighbouring regions.

With construction activity remaining at a high level in spite of the financial crisis, growing demands are now being voiced for a higher standard and better integration of land use planning and increased housing densities.

4. REGIONALLY SIGNIFICANT LANDSCAPE STRUCTURES

In the context of dynamically expanding settlement areas in longitudinal Alpine valleys, landscape structures have multiple functions. In such loosely built-up areas, it is the landscape structures that define the spaces and provide orientation rather than the buildings, which are too low and too far apart to do so.

In addition, as the number of buildings increases within such a valley landscape, the landscape structures also assume more and more social functions in the outdoors. These two points form the focus of this paper.

Vegetation structures, either alone or in combination with buildings, building uses and the topography of the surroundings, can create or strengthen various public spaces. Through specific configurations, gradations of private and semi-private outdoor spaces on the one hand and public spaces on the other can be and are created and organised in a meaningful way. Landscape structures are accordingly a combination of functional networks and areas and the effect in spatial terms of topography and vegetation at the regional, urban planning and local levels of scale. They are where physical characteristics are overlaid with the actual and potential demands of modern society. In their totality, landscape structures have a multi-functionality, which reacts to the specific environment (landscape-related and settlement-related).

5. THE VADUZ-TRIESEN AREA OF STUDY

This area on the right bank of the Alpine Rhine Valley constitutes the narrow valley floor of two Liechtenstein municipalities. Settlement activity is largely concentrated along the interface between the alluvial fans of the mountain torrents and the gravel terrace of the Rhine as far as the flood protection embankment, which is also the visual limit of the land to the west. In recent years, the continuous increase in building activity in the valley in the form of residential buildings has been accompanied by the creation of grouped islands of commercial and industrial buildings in areas of the valley flat that are no longer at risk of flooding. The Rhine has visibly shaped the level valley floor as far as the slopes rising up to the east. Following the river regulation measures carried out on the Alpine Rhine at the end of the 19th century, the valley floor was mostly characterised by dominant lines. Long after the construction of the levees and successive measures taken to drain the valley floor, that is still apparent today in the form of regional linear structures (former outer bank of the Rhine –break in slope, courses of streams, canals and embankments–).

In spite of the increase in construction activity along the main road, these linear landscape structures create a fabric connecting the areas of settlement and agricultural land. In their interaction with the immediate surroundings, they have undergone a transformation in keeping with the context and assumed other functions in the process. There is considerable potential for improvements to be made for further additions to the settled areas or housing densification

on the basis of these structures. That is described in the following with reference to the former outer bank of the Rhine (Landeszentrale politische Bildung Baden-Württemberg, 2011).

The easternmost line in the Triesen area is the striking break in slope with its specific vegetation and road infrastructure on what was once the outer bank of the Rhine. It extends from south to north as far as the territory of Vaduz and is modified by the alluvial cone of the Spania Rüfe. The tight combination of narrow road, varying height of offset and variations in the width and accessibility of the adjoining outer areas creates a mosaic composed of contiguous areas of disparate character.

5.1 Urban planning qualities of the landscape structure formed by the outer bank of the Rhine in its surroundings

A striking feature of the pronounced break in slope in Triesen with its links with the surroundings areas is the variation in height in the offset, namely between one metre and a whole storey. The edge is accompanied over almost its full length by a path or access road. In some areas it is overlaid by the lower, steeply convex section of the Triesenberg-Triesen landslide, which is indicated by the steepness at An der Halda and the steep adjoining slope. Over its full length, this structural line provides a varied connection between the public path or road and private open spaces adjoining the surrounding buildings, with the degree of privacy a function of the difference in height. Confined spaces contained by walls and buildings are to be found here (An der Halda) as well as open, semi-private areas within the fabric of road, slope and car parks outside restaurants and office buildings (Kappileweg pedestrian access). Here solitary trees and groups of trees have an important function in defining spaces and providing privacy, so that people enjoy being there and communication is encouraged. At the same time, the crowns of the trees create the desired distance to private gardens and houses. Along the break in slope, the combination of these structural elements and the adjoining terrain gives rise to areas of varying size with trees and bushes that reinforce this character in the vegetation period. And there are repeated vantage points offering views over the buildings in the valley bottom and the surrounding countryside as far as the horizon in Switzerland. The break in slope is also intersected by a multitude of paths, ramps and steps, which provide good links between the main axis and the surrounding areas of settlement.

These links can support the positive effects of the difference in height between the public road and private outdoor areas where the latter are small and accessible from the road. As the difference in height increases, so does the degree of privacy. Communication along the line of the road and in wider front lawn areas is supported as long as the distances and heights between the entrances, longitudinal paths and semi-private areas are not excessive. Car drivers using the access road on this section of the break in slope are encouraged to reduce their speed by the alternation of narrow and wider sections and confined and open spaces along straight and curved passages of the break in slope.

Fig. 4: Landscape structure of the former outer bank of the Rhine in Triesen, Kappileweg. (Catarina Proidl)

Fig. 5: Alternation of private gardens, front lawns and the public road along the landscape structure formed by the former outer bank of the Rhine in Triesen, An der Halda. (Catarina Proidl)

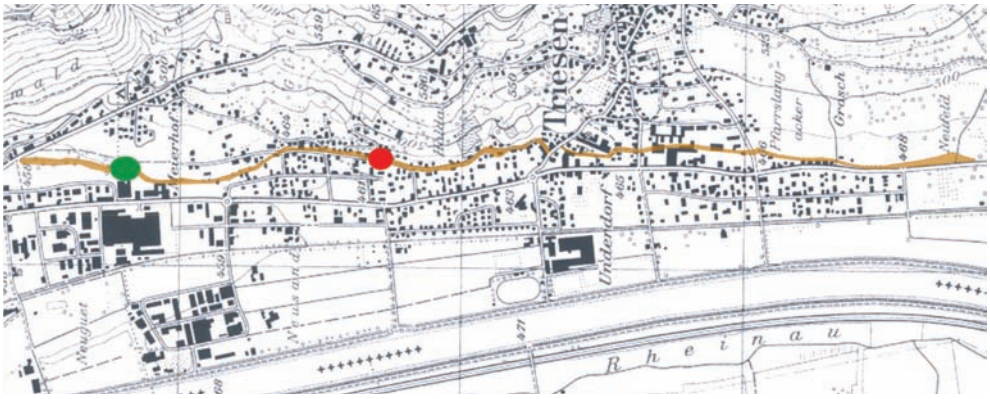

Fig. 6: Map showing the location of the examples discussed relative to the landscape structure formed by the former outer bank of the Rhine in Triesen. (SWISS-TOPO 25, modified by Catarina Proidl)
Green: break in slope integrated in the settlement structure
Red: former outer bank of the Rhine levelled for construction of the public road

Fig. 7: Terraced apartment building on the levelled road (Haldenstrasse) in Triesen. (Catarina Proidl)

Fig. 8: Location of the terraced apartment building within the settlement area. (ABI-Vermessung FL, modified by Catarina Proidl)

Fig. 9: This group of residential buildings makes use of the potential of the landscape structure formed by the former outer bank of the Rhine; Triesen. (Catarina Proidl)

Fig. 10: Location of the residential buildings within the settlement area (ABI-Vermessung FL, modified by Catarina Proidl)

5.2 Under what conditions can use be made of these qualities for new construction projects and when can it not?

Two examples of multi-unit residential buildings will serve to illustrate how these qualities and potentials can be utilised.

In the case of a terraced apartment building, the structures on this section of the former outer bank of the Rhine and levelling of the road space have led to structural impoverishment. That also reduces the creative potential for use of the road space in this area. The parking spaces in front of the ground-level garages make the road appear disproportionately wide. The steeply rising residential building, which is built into the slope, has no private external spaces at the level of the street. Cars parked along the public road and the refuse containers do not encourage people to come together and communicate. Without parked vehicles, the whole street seems too wide. That cannot even be mitigated by the small-crowned trees planted in a row on one side of the street. The result is that car drivers automatically drive faster. The wider space potentially available for children to play in the road is more dangerous than the narrow sections.

The second example involves three stand-alone buildings (multi-storey residential buildings) with an external space concept that includes integration of the public footpath following the line of the former outer bank of the Rhine at the lower limit of the grounds. The external space comprises private garden plots adjoining the building for the ground floor units and communal outdoor areas, which also include children's play areas at a certain distance from the gardens. These areas are on a level about two metres above the public footpath, from which the terraced margin is separated by a slope with wild shrubbery. There is no direct line of sight between the footpath and the private gardens in this area; it is only restored further along the path. That gives the external spaces the necessary degree of privacy. Visual contact and communication with both the communal play areas and the footpath are possible –and desirable– from the edge of the grounds at the top of the slope. Three solitary trees standing on the upper break in slope of the former outer bank of the Rhine function as a visual filter to the windows of the office buildings opposite and adjoining car parking spaces. They also create a sense of space and offer shade for the communal play areas of the apartments.

In spite of the considerable volume of living space created, it was possible to locate the buildings on the plot and the entrance to the basement car park in such a way that the higher-level landscape structure was preserved in visual and functional terms over its full length. At the margin of the plot there is a driveway integrated into the terrace, which merges with the vegetation-covered break in slope. The plants were selected to match the character of the trees and bushes growing in the adjoining sections of the former outer bank of the Rhine and thus reinforce the visual impact of the line as a whole.

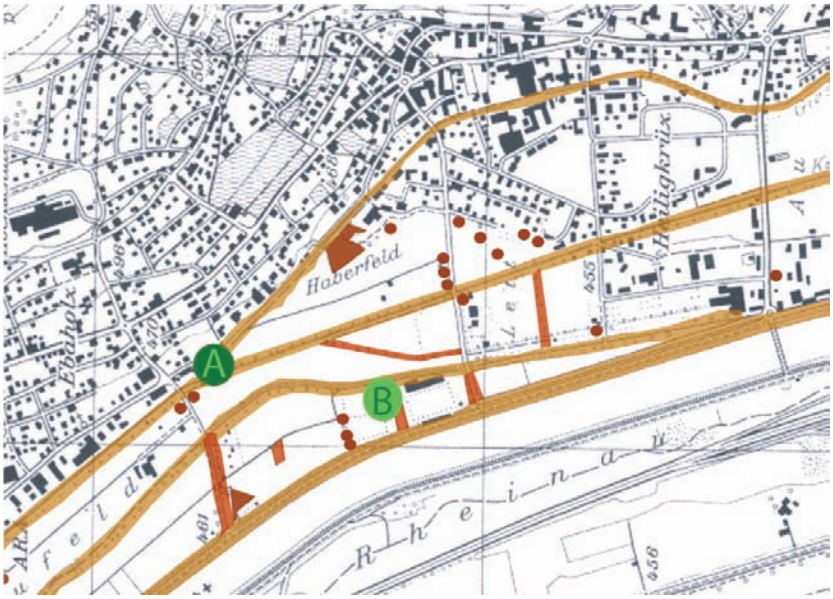

Fig. 11: Location of positive exaples “A” and “B” within the settlement area of Vaduz. (SWISS-TOPO 25, modified by Catarina Proidl)

Fig. 12: Sequence from public recreational area to private gardens of the residential row housing within the settlement area of northern Vaduz “A”, view northward. (Catarina Proidl)

Fig. 13: Location of the residential row housing within the settlement area of northern Vaduz (ABI-Vermessung FL, modified by Catarina Proidl)

Fig. 14: Public sporting area of Vaduz “B” implemented into the grid of existing landscape structures of former and current embankmentstructures, view southward. (Catarina Proidl)

Fig. 15: Location of public sporting area of Vaduz implemented into the grid of existing landscape structures of former and current embankmentstructures. (ABI-Vermessung FL, modified by Catarina Proidl)

In this case the landscape structure comprising the former outer bank of the Rhine plus footpath, with all its qualities and potentials, was utilised for a new construction project and effectively preserved.

Two more examples should show, how the longitudinal landscape structures in the valley flat of the Vaduz area are able to support functionality of public and private open spaces, reduce expected conflicts at the borders and increase opportunities for utilisation. The example “A” uses the existing landscape structure break in slope for a good integration of private gardens edging to a public recreational area along pathways and a small river. The example “B” shows how various the existing grid of landscape structures far the settlement can be adapted for sport fields and children’s play, without losing the connecting function on the top of the embankments.

In a similar way, the beak in slope was used in a northern part of Vaduz in connection with new row housing. Where not only a public pathway, a recreationally used public water canal could remain at the settlement edge as well. In about 2 m above the footpath private gardens are situated between the houses and the pathway. The private gardens are protected with a loose filter of plants from views of far reached parts of the recreational area. Persons moving directly along the gardens at the pathway are not able to get sight contact with the private spaces due to topography. Existing public recreational areas along footpaths could be divided with the natural shift of 2 m height and filters of plants from private row house gardens. The continuous public footpath system could be preserved and the break in slope is still readable in the built-up area-landscape.

The Example “B” shows the sports ground of the Vaduz area aside the settlement and close to the River Rhine. The football arena, the training fields and other sports fields are inserted into the preshaped valley flat by the current flood protecting bank of the River Rhine, the former protection bank and windbreak plantations. This landscape compartment offers natural tree shadow at its edges for audience and playing children at the edges of the modified eastern embankment. The steep slopes of the flood protecting bank allow to insert the grandstand. Paths for pedestrians, cyclists and roller-scater on top of the banks provide permanent the connection between the village and the “event area” aside the settlement for various groups. Grandparents with children use them as well as sportive cyclists or groups of teenagers. Because of the proximity to the settlement and good network of footpaths there is no effort to reach these aims in everyday life and on weekends.

6. CONCLUSIONS FOR URBAN PLANNING

New property development projects in the valley flat should be managed with due regard for the recognised qualities of the landscape structures described and their interaction at the regional level (space creation, space structuring, lead function) and subsequently at the urban planning level (interaction with building structures and their use, creation of and support for degrees of publicness).

Structural analysis reveals a system that is oriented on spatial qualities and potentials –from the regional to the local level of scale–. Planning with a focus on form and structure using components of the landscape can become spatial reality where the role and significance of the regional landscape structures are recognised on a smaller level of scale at the same time and integrated in the development and upgrade process.

At the cross-municipal-border level, regional landscape structures can offer a development framework, which can be used to generate district-based qualities in combination with the built environment and organised in proven sequences. Landscape structures can be deliberately reinforced with the help of local construction measures so that they remain the natural component of an urban valley landscape.

7. URBAN PLANNING WITH LANDSCAPE – UTILISING REGIONALLY RELEVANT LANDSCAPE STRUCTURES FOR CONSTRUCTION PROJECTS

One of the key findings is the fact that landscape structures are present in the specific context of the valley landscape of the Alpine Rhine Valley as a combination of functional networks/ areas and the spatial interaction of topography and vegetation. One and the same landscape structure can make different contributions at the regional, urban planning and local levels to upgrading the urban landscape in the Alpine Rhine Valley –depending on its location and function in the overall context–.

Whatever their differences in spatial character and shape (e.g. linear landscape structures in the valley space), landscape structures involve interaction in terms of form and function, which shows them to be a superordinate element at the regional level.

Where they are eliminated, the development areas involved suffer structural impoverishment in terms of form and function that is apparent at the local level. The logical connection with the specific location and its surroundings is frequently replaced by a much lamented sameness and anonymity.

Construction techniques and styles that make use of the regional context of the landscape at the levels of design and implementation in the case of small-scale construction projects can also “build” the existing qualities and thus strengthen the overall context even in cases of high building densities and modern architecture.

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CHARBON, MON AMOUR
Extraction Urbanism in the Powder River Basin, Wyoming

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ABSTRACT

Wyoming's recent economic and urban development is based on its natural morphology. The mountainous state is the home of the Powder River Basin; a topographical drainage and geologic structure estimated to be one of the biggest coal reserves in the world. Traces of extraction sites are evident over the surface of this immense, vast, mountain territory. Beyond this technological "habitation", human habitation is observed, as well. The formation of America's Energy Capital, Gillette, is going hand in hand with fossil fuel extraction.

The paper is accompanied by a unique set of representations. The preliminary goal of these observations is to "make things public", things that might not be visible otherwise: Urbanization patterns over the decades, artificial morphologies as a result of coal apparatuses, underground fossil fuel beds as shown in a geological section.

Through the use of various means, such as text and graphic representation as a political tool, this paper is questioning vis a vis urbanization processes and geographical morphologies. How did the latter perform as a dynamic catalyst that shaped urban development? What is the relationship between coal extraction and urban development in the mountainous area of the Powder River Basin? How might the unique condition of Gillette's urbanization paradigm provide knowledge and experience for planners, designers, and scientists when the future of alpine urbanized territories in the age of the Anthropocene is discussed?

Key words: Rocky Mountains, Wyoming urbanization, landscapes of energy, Anthropocene, coal urbanism.

1 Fulbright Fellow, Onassis Foundation Scholar.

LABURPENA

Wyoming-ek (Estatu Batuak) azken garaian izan duen hiri- eta ekonomia-garapenak bere morfologia naturalean du jatorria. Estatu menditsu horretan, Powder ibaiaren arroa dago, egitura geologiko eta drainatze topografikoko egitura dena. Adituen ustez, mundu osoko ikatz-erreserbarik handienetako bat da. Lurralde menditsu itzel horren azalean, erauzketa-guneen aztarnak daude. "Okupazio" teknologiko horrez gain, giza okupazioa ere nabarmena da. Estatu Batuetako hiriburu energetikoa –Gillette– erregai fosilen erauzketarekin batera eratu zen.

Artikuluari irudikapen-sail paregabea atxiki zaio. Behaketa hauen aurretiazko helburua da bestela ezkutuan geratuko liratekeen gauzak ezagutzera ematea, hala nola hainbat hamarkadatan izandako urbanizazio-patroiak, ikatza erauzteko ekipoak erabiltzearen ondoriozko morfologia artifizialak, eta sekzio geologiko batean agertzen diren erregai fosileko lurrazpiko geruzak.

Hainbat baliabide erabiliz, hala nola testua eta irudikapen grafikoak tresna politiko gisa erabiliz, artikulu honek urbanizazio-prozesuak eta morfologia geografikoak zalantzan jartzen ditu. Zein eratan izan dira horiek hiri-garapena osatzeko katalizatzaile dinamikoak? Zer lotura dago Powder ibaiaren arroko gune menditsuko ikatz-erauzketaren eta hiri-garapenaren artean? Zer modutan izan liteke Gilletteren urbanizazio-paradigmaren aparteko egoera jakintza- eta esperientzia-iturri hirigile, diseinatzaile eta zientzialarientzat Antropozenoaren aroan urbanizatutako lurralde menditsuen etorkizunari buruzko eztabaidan?

Gako hitzak: Mendi Harritsuak, Wyomingeko urbanizazioa, energia-paisaiak, Antropozenoa, ikatzaren urbanismoa.

RESUMEN

El reciente desarrollo urbano y económico de Wyoming (Estados Unidos) se debe a su morfología natural. Este montañoso estado alberga la cuenca del río Powder, una estructura geológica y de drenaje topográfico que se calcula que es una de las mayores reservas de carbón de todo el mundo. En la superficie de este inmenso, vasto territorio montañoso se observan huellas de puntos de extracción. Más allá de esta "ocupación" tecnológica, también se observa ocupación humana. La formación de la capital energética de Estados Unidos, Gillette, se produce en paralelo con la extracción de combustibles fósiles.

El artículo va acompañado de una serie única de representaciones. El objetivo preliminar de estas observaciones es dar a conocer cosas que de otra manera no serían visibles: Patrones de urbanización a lo largo de decenios, morfologías artificiales como resultado del uso de

equipos para el carbón, capas subterráneas de combustible fósil que aparecen en una sección geológica.

A través del uso de varios medios, como texto y representaciones gráficas como herramienta política, este artículo cuestiona los procesos de urbanización y las morfologías geográficas. ¿Cómo han actuado estas últimas de catalizador dinámico para conformar el desarrollo urbano? ¿Cuál es la relación entre la extracción de carbón y el desarrollo urbano en la zona montañosa de la cuenca del río Powder? ¿Cómo podría la situación excepcional del paradigma de urbanización de Gillette proporcionar conocimientos y experiencia a urbanistas, diseñadores y científicos en el debate sobre el futuro de los territorios montañosos urbanizados en la era del Antropoceno?

Palabras clave: Montañas Rocosas, urbanización de Wyoming, paisajes de energía, Antropoceno, urbanismo del carbón.

1. FOR THE LOVE OF COAL: A SHORT INTRODUCTION

Wyoming's last 50-year economic development is based on the extraction of coal. The alpine state is home of the topographical drainage and geologic structure named after Powder River –the Powder River Basin–. The basin is estimated to be one of the biggest coal reserves in the world. Major coal operations did not take place before the 1970s, although smaller scale mines existed since the beginning of the 20th century. Traces of extraction sites are evident over the surface of this immense, vast, mountain territory. Beyond this technological "habitation,' human habitation is observed as well. The formation of the city of Gillette is going hand in hand with fossil fuel extraction. In the 2002 published, well read geography textbook "Across this Land – A Regional Geography of the United States and Canada," John C. Hudson describing the Powder River Basin Coal is mentioning:

> There are no grubby "coal towns' in Wyoming, nor are the ugly scars of strip mining as visible, because of environmental regulations requiring restoration of the land surface following mining. For the next century and more, the production of electricity in the United States will depend on Powder River Basin coal.

Many things have changed since the above statement. Recent studies are showing that the coal deposits might not be as large as initially predicted, and coal companies are considering the possible shutdown of a series of mines in the Powder River Basin. Furthermore, the recent layoff of a significant amount of workers from the coal industry predicts a rather optimistic future for the surrounding towns, including the biggest one, Gillette.

This paper is questioning vis a vis the relationship between urbanism and coal extraction. How did the latter perform as a dynamic catalyst that shaped urban development? What is the relationship between coal extraction patterns and patterns of urbanization in an isolated content such as the Powder River Basin?

This research question is answered by the analysis of the Basin and the history of Gillette as two distinct events that correlate, overlap and merge, into one common chapter towards the end of the paper. This research study concludes re-questioning regarding the future of this love story –within the contemporary context– and what we, as designers, should do both in the dimension of the landform as well as in the urban form.

Divided into four chapters, the first one is analyzing the geological formation of Powder River Basin, a territory of extraction. Understanding mining as a historical gesture that played a catalytic role in the formation of the identity of the American West, the second and the third chapters analyze the history of Gillette and its relationship with fossil fuel extraction. The paper concludes with the last part, the conclusion and the questions and theses that came out from the research.

The accompanied representations are following the story narrated in the paper: one for this introduction, two for each of the core chapters and a set of maps and aerial images constructing a new kind of Atlas of the Powder River Basin, for the conclusion chapter. The preliminary goal of the representations produced is to “make things public” –things that might not be visible otherwise–, such as the coal beds of the Powder River Basin’s upper surface as shown in a geological section, the footprints of Gillette’s urbanization through the past 100 years and how the sequence of these patterns dramatically changes during the years of the coalboom or the earth patterns produced as a result of coal apparatuses.

2. THE POWDER RIVER BASIN

The Powder River Basin is a geologic structural basin stretching between the northeastern part of Wyoming and southeastern Montana. The former is the home of around three-quarters of the territory. Wyoming’s economy is built upon coal extraction. The existence of coal was known since the beginning of 20th century, although for a series of reasons, coal has been widely capitalized only since the 1970s. The basin is often characterized as the power engine of America –and not wrongfully–. The coal extracted from the reserves of the Powder River Basin produce more than 40% of America’s total production. It is the primary source of coal supply for a significant number of U.S. power plants, especially in the Midwest and the North West States of the country creating around one tenth of the national’s total electricity. (Rottenberg, 2003: 259) In comparison with the Eastern coal reserves of the Appalachian coal fields where the average deposit is a few feet thick, Powder River Basin’s coal beds are “as big as eight-story office buildings” (Considine, 2013: 514). It is worth mentioning that those big coal deposits of coal accumulate the top of the basin’s surface. According to studies, equally large deposits are placed underground, although their extraction would be extremely costly. Currently, the majority of mining operations take place on the surface of the basin. This process of surface mining has created large scale open pit mines. As mentioned at the Wild Earth Guardians’ 2009 report that follows the US Bureau of Land Management, the largest coal producer in the Powder River Basin, the North Antelope/Rochelle Mine covers an area of 14 342 acres (around 22 sq mi), out of which 6 200 are actively mined. (Nichols, 2009). According to the fact sheets of Peabody Energy, the mine is one of the largest in the US. Hence, the Powder River Basin, not only deposits one of the bigger coal reserves but has also homes some of the larger surface mines across the globe.

According to the Clyde Bergeman Power Group survey, Powder River Basin’s coal properties, including pore structure, moisture retention capacity and high amounts of oxygen, chemically bonded to the coal itself make it competitive and readily salable. Since recently, almost all coal extracted from the mines of the basin was shipped to coal-fired power plants by rail. Ostlind mentions that is estimated that around 14% of America’s greenhouse gas emissions result from power plants that burn coal extracted from the Powder River Basin.

Even though the coal extracted from the basin have a huge contribution to climate change, it also brings enormous amounts of capital and development to the surrounding area. Since

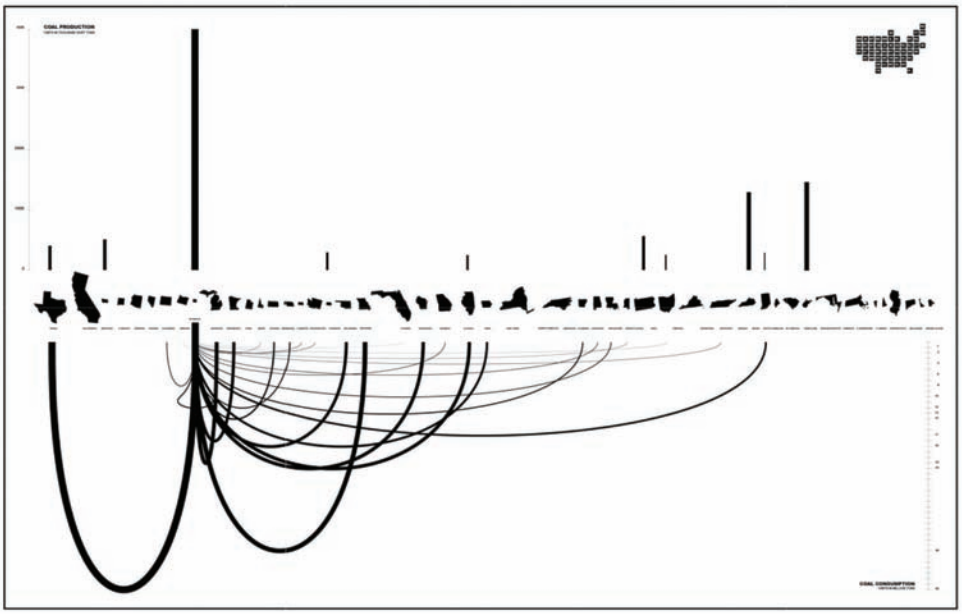

Fig. 1: Relationships of coal. An arrangement of states by size, scaled according to their population density; on coal production, on bottom coal consumption. Thickness of the lines symbolize the tendency, in terms of coal consumption, between Wyoming and the rest of the U.S. States. (Angelos Siampakoulis)

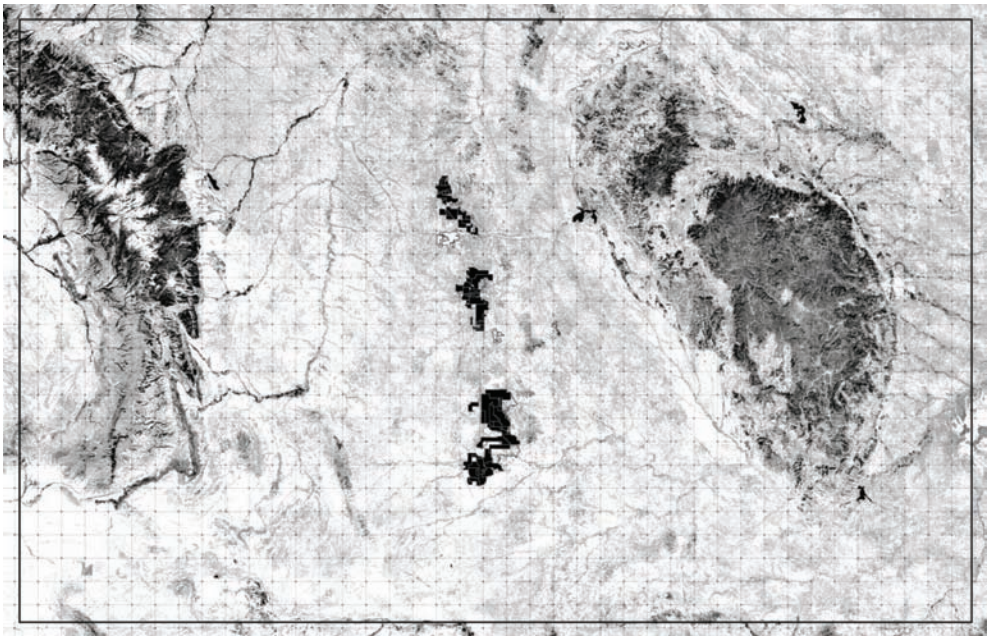

Fig. 2: A map of the Powder River Basin. A map showing the plateau of the Basin surrounded by the Rocky Mountains. In the middle the traces of extraction as well as the current footprint of Gillette. (Angelos Siampakoulis)

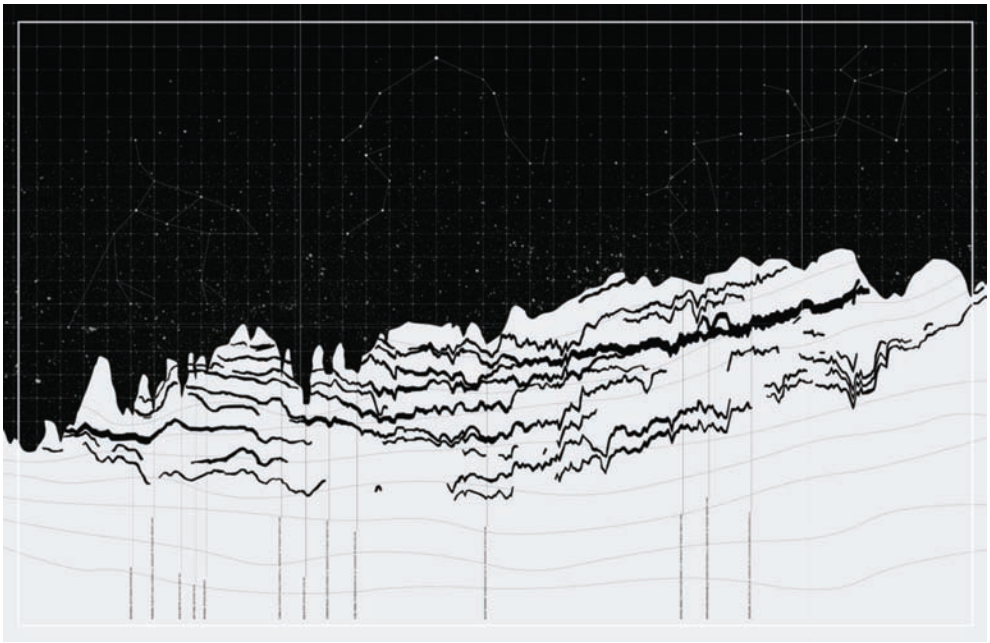

Fig. 3: Section of PRB with coal deposits. Geological section from North to South of the Powder River Basin, showing the amount of coal existing in the underground. Coal beds are on black; locations of mines and their names are also noted. We observe the extent amount of soil removed from the mines around the city of Gillette (here on the left part of the section), as they are the oldest ones. (Angelos Siampakoulis)

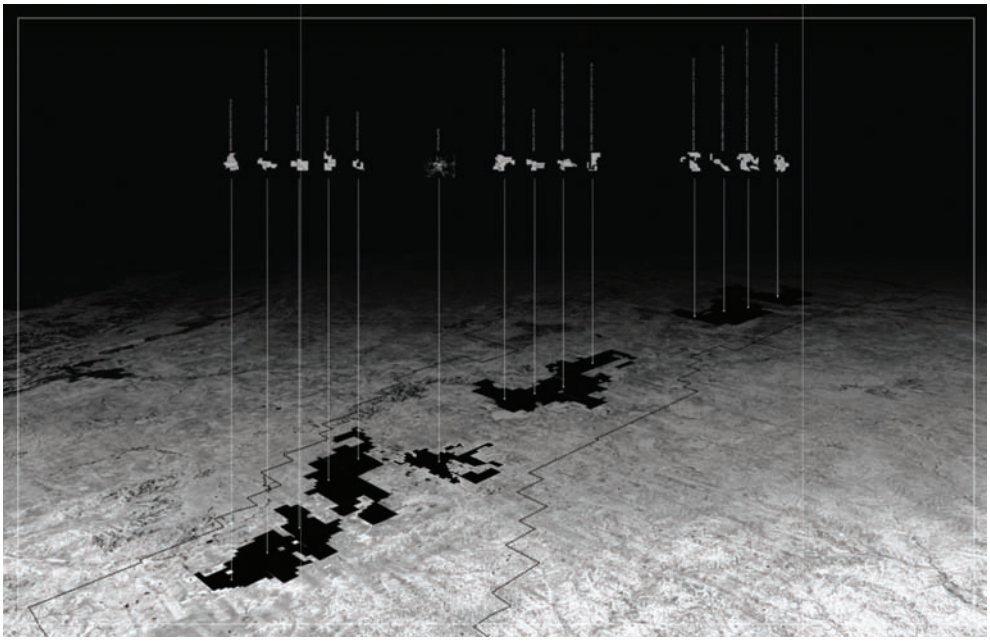

Fig. 4: Bird's view of the Powder River Basin's Mines. Representation that aims to work as a comparative mean illustrating the scale and design differences between the the form of the urban outline of Gillette and the minds around the city. (Angelos Siampakoulis)

coal boom in the decades of 1960s and 1970s the basin has been populated with mines, pits and creeks, bringing new physical inhabitants to the area, the cities around and more specifically, Gillette. It's urban growth (but not birth) is related to this boom. This urban story and its relationship to coal will be the subject of the next two parts of this paper.

3. GILLETTE, WYOMING

Gillette is a small, isolated town, located within the Powder River Basin, serving as the country seat of Campbell, Wyoming. Originally, Gillette is neither a company town nor a mining town. The city was not created because of coal either designed by a coal mining company to home miners. On the other hand, following the terminology of the Historians of the Frontier Era, Gillette is characterized as a "Railroad Town". Although, one should not forget that the town of Gillette is an urban product of coal "booms and busts" –as Eve Blau would say–. But, in that case, Gillette experienced only one coal boom, during the 1970s that contributed to its current condition.

As already mentioned, archaeological findings show that humans –together with coal– were always present in the wider area of the Powder River Basin. West of the present-day Gillette was a small tent town known as Donkey Town from which it would emerge today's city of Gillette, in the 1890s. Edward Gillette is acknowledged as the founder of the city. An engineer and surveyor, he was in charge of surveying the area around the tent town while he was working for the Chicago, Burlington and Quincy Railroad company, in 1892. Wyoming was officially admitted to the Union in 1890. Therefore, during that period there was an increasing interest to connect the newly reclaimed west part of the country with the Midwest and East states. Edward Gillette contributed to the construction of a sufficient railroad route and the company named the newly founded nearby town in his honor. The owners of the land, Lincoln Land and Livestock Company, assigned the first plan of the city, and soon after the completion of the railroad in July of 1891, they started selling the lots to individuals. Gillette was officially incorporated as a city in 1892; Herbert A. Alden was the first mayor.

In its first decade, young Gillette was nothing more than someone would expect. Building upon a typical Western community the new town was serving passengers who were traveling to the West. Ranchers and cowboys were the new inhabitants of the city trying to make a new living across this new and unknown land. The Homestand Act, already existing from 1862 gave the right to citizens of the age of 21 or head of household "to file as many as 160 acres of unappropriated public lands". Agriculture was the most important and consistent industry in the town of Gillette, at least during that initial period of development. During this decade, cattle and sheep production, together with farming of wheat, barley, oats, hay and corn flourished in nearby newly founded ranches. Additionally, individual citizens set up businesses to host, feed and entertain the travelers. Barns, stables, blacksmiths were co-existing with hotels, pensions, eateries, bars and brothels catering travelers and visitors. Indeed, the existence of the new railroad crucially helped the new city in its first steps.

Burlington route circulated capital and people across this new Western frontier of which Gillette was a part. The first school appeared in 1891 and the first Baptist and Catholic churches around 1901 and 1903, respectfully. Electric supply, telephone infrastructure and banking services made their appearance in the first decade of the 1900s. Apart from travelers, tourists made their appearance at the same time. The Black & Yellow trail, a new highway extension connected Gillette with Yellowstone in the 1912 and brought even more visitors to the town. The economic prosperity of the first three decades, until the 1930s, helped Gillette grow both in population as well as in size. In 1910 the population of the newly founded town was only 448 people while in 1930 it increased to 1340 and 2177 by 1940. This population growth forced the city to expand its plan to host the newcomers. South and north of the historic part of the old town, the Sunnyside and the Northside Additions, respectfully, were built; The Bivens Addition expanded the city to the East.

Development was slowed down during the Great Depression of the 1930s and the years of the second World War. Population also dropped. The implementation of the Civilian Conservation Corps camps, also known as the CCC, a public work relief program, operated in Gillette from 1933 through 1938 and helped the population sustain a certain level, without leaving people flock away from this small isolated town in the middle of nowhere. During that period, around 200 worked at the camp for a total of more than 758 000 hours. Their primary task was to put off underground fires that were burning for an unknown period of time and they were considered hazardous for the underground hide precious coal deposits. The young men also removed millions of tons of coal and overburden. The CCC camp was also supporting the local economy of the town as supplies were provided by the city businesses. It remained open until 1942 when it was closed and dismantled. Its existence helped the city not to loose a bigger portion of its population.

In contrast to other major mining towns of Mountain West's frontier period, such as Central City in Colorado and others, Gillette was born as a railroad town, not a mining town. Its fundamental role, on a regional scale, was to function as a transportation hub. Coal of course was and still is, present. Peerless mine, at the east of Gillette, was operating by 1918 with underground coal mined since 1909. (Hein, 2013) Hein on the same article provides us with critical information vis-à-vis early mining as well as the techniques the miners were using during the frontier era to extract coal from the ground.

With the use of fresnos –earth scrapers drawn by two- or four-horse teams– Peerless operated from approximately 1918 to 1925, producing 20,464 tons of coal in all. In 1923, near the Peerless Mine, the Wyodak Company began developing surface operations in the same coal seam. In 1925, Wyodak produced 33,579 tons of coal. Wyodak, purchased by the Black Hills Corporation on Nov. 1, 1956, is considered to be the oldest continually operated coal mine in the United States, according to the Wyodak company website.

With the end of the Second World War, a new era will rise for the city of Gillette. The discovery of oil will trigger a series of events that will lead to the coal boom of the 1960s and the 1970s.

Fig. 5: Coal Taxonomy. A taxonomy of the major mines of the basin as well as the interior subdivision of properties and mine boundaries expressing contemporary coal apparatuses within the energy industry of coal. (Angelos Siampakoulis)

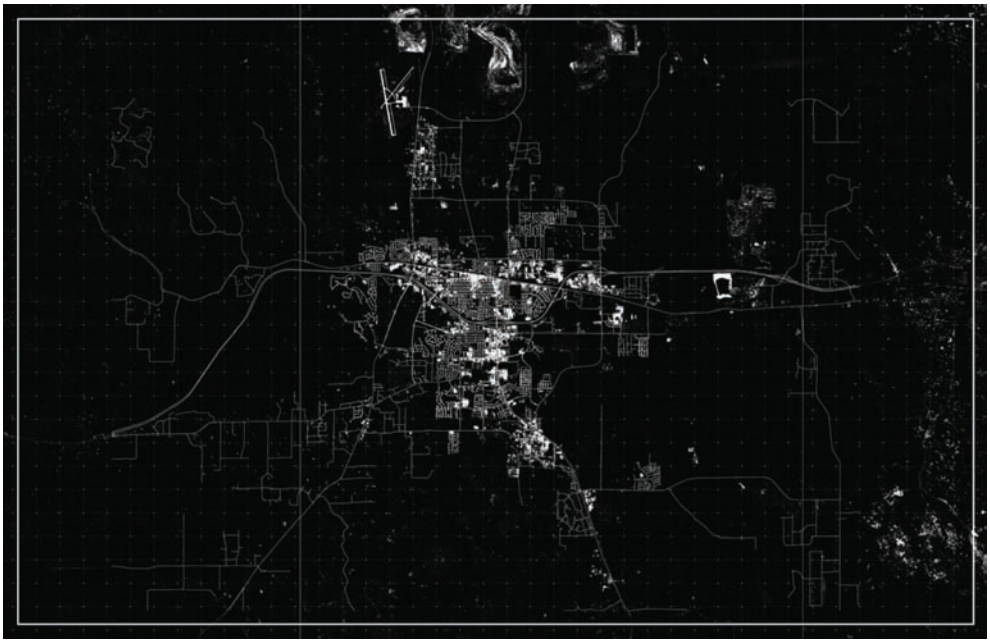

Fig. 6: Cartographic representation of the city of Gillette. Contemporary situation of the urban footprint of the Gillette. (Angelos Siampakoulis)

The first major, but not that successful oil boom will precede during the decades of 1950s and 1960s. Both booms, most importantly the coal boom though, will play a catalytic role in the development of the city and will lead the Powder River Basin to become the power engine of America and Gillette, the energy capital.

4. THE GILLETTE SYNDROME: COAL BOOM AND THE FORMATION OF THE CONTEMPORARY CITY

Phycologist El Dean Kohrs invented the term “Gillette Syndrome” to describe the social disruption that might appear in a community from the rapid population growth (Kohrs, 1974). The term refers to the “boom development” that took place on Gillette during the decades of the 1960s and 1970s. The term is relevant to boomtowns that face rapid growth due to nearby natural resource extraction.

During the first years of the 1950s, oil made its appearance in the broader area of the town of Gillette and the Powder River Basin. The first commercial discovery of oil in the Campbell County was recorded in 1948 even though oil explorations were going through since the beginning of the decade. Despite the fact that coal is the major fossil fuel extracted from the Basin, from now on coal together with oil will go hand by hand, with the former having the most dominant position. Oil though will contribute to the first, major boom, preparing the way for coal during the 1970s. Major Energy companies will claim the land during these years.

Together with Gillette, in the north Part of the Powder River Basin, a small town will also be created, in the South to serve as a company town for workers at the surrounded mines. Wright is designed from the begining as a mining town as a result of the boom years. Compared to Gillette, Wright is a planned community studied by the Atlantic Richfield Company (ARCO) in order to house workers of the Black Thunder Coal Mine. Issues such as housing, zoning, recreation spaces, water and sewer were extremely studied. Gillette’s current size also took place during the boom years.

In Gillette, the population of the city was more than doubled from 1965 to 1970, from 5861 to 12 957. This change is also reflected in the demographic scale as according to records, in the 1960 around 11% was employed in the coal mining industry while in 1970 the same percentage was 27,5. In the later years of this coal boom the average age of the city was transformed as well. Young adults were moving to the town to fill in jobs in the coal industry but also in the oil drilling. The average age was 28 in the 1980s. In addition, it is described that in boom times students dropped out of school in order to accept works in the mines that would give them back from $30 to $50 per hour. As mentioned by Phil Rogers in his New History of Wyoming, Chapter 19, “Boom ans Bust Again: Wyoming in the 1970s” on Rebecca Hein’s Campel County’s History online analysis “Many Wyomingites became prosperous during (boom) years but there were contradictions of prosperity”. In the same article it is described that “Older residents, living on Social Security or other fixed income, watched property prices spiral upward […] with […] rising assessments […] Small business operators, accustomed

to hire employees at the minimum wage, suddenly faced competition for laborers from much better paying mines [...] Town councils were overwhelmed with demands for water and sewer taps for housing developments". Indeed, the stress not only in infrastructure but also in social institutions and the current inhabitants of the city during the period of the coal boom was insignificant for the standards of Gillette back at the beginning of the 1970s.

Despite the huge amount of capital and urban development that coal extraction has brought into the city of Gillette over the past 40 years the future is not predicted that bright. This economic development continuously grew until the financial crisis of 2008. Since then coal production started slowing down, coal prices dropped and recent layoffs are making the population of the city to drop.

5. TOWARDS AN UNKNOWN FUTURE

The current paper through the research of this case study showing the relationship between coal and urbanization gives birth to certain questions that are related to the relationship of coal extraction and design at the age of the Anthropocene. The responses to these questions might be perceived as thesis points that express the concerns of the writer (in design terms) as well as conclusions that were born during this semester's readings and representational work. Both of the following research questions have distinct character and they follow the previous separate thematically analysis of the paper; One is related to Gillette itself as a city

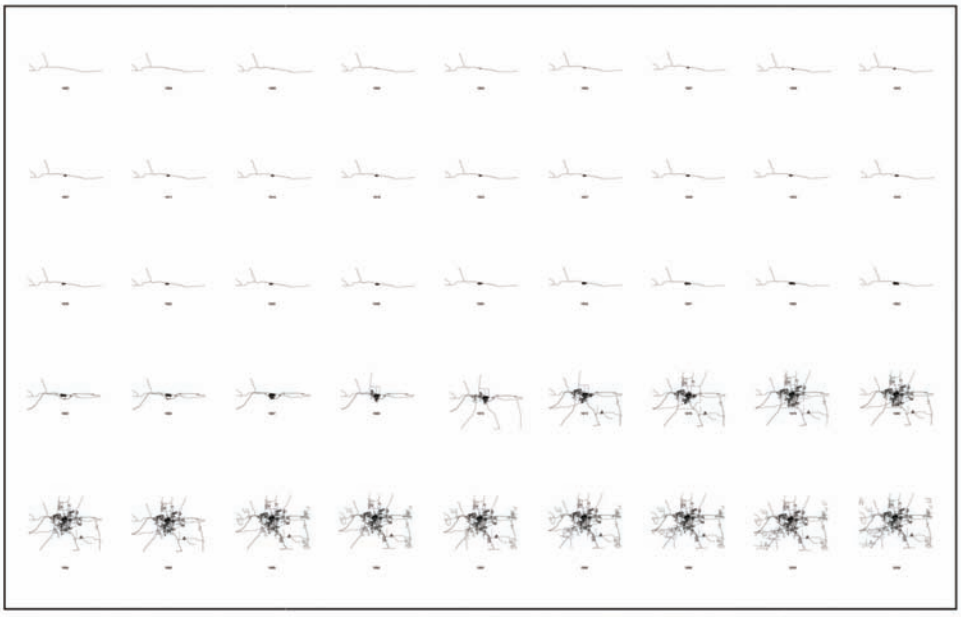

Fig. 7: Gillette Urban Form Comparative Taxonomy. A taxonomy of the evolution of the form previously represented. The railroad line, a catalyst for the birth of the city is clearly illustrated. Major development takes place during the 1960's and the 1970's, the coal boom years, contributing significantly to the change of the city. (Angelos Siampakoulis)

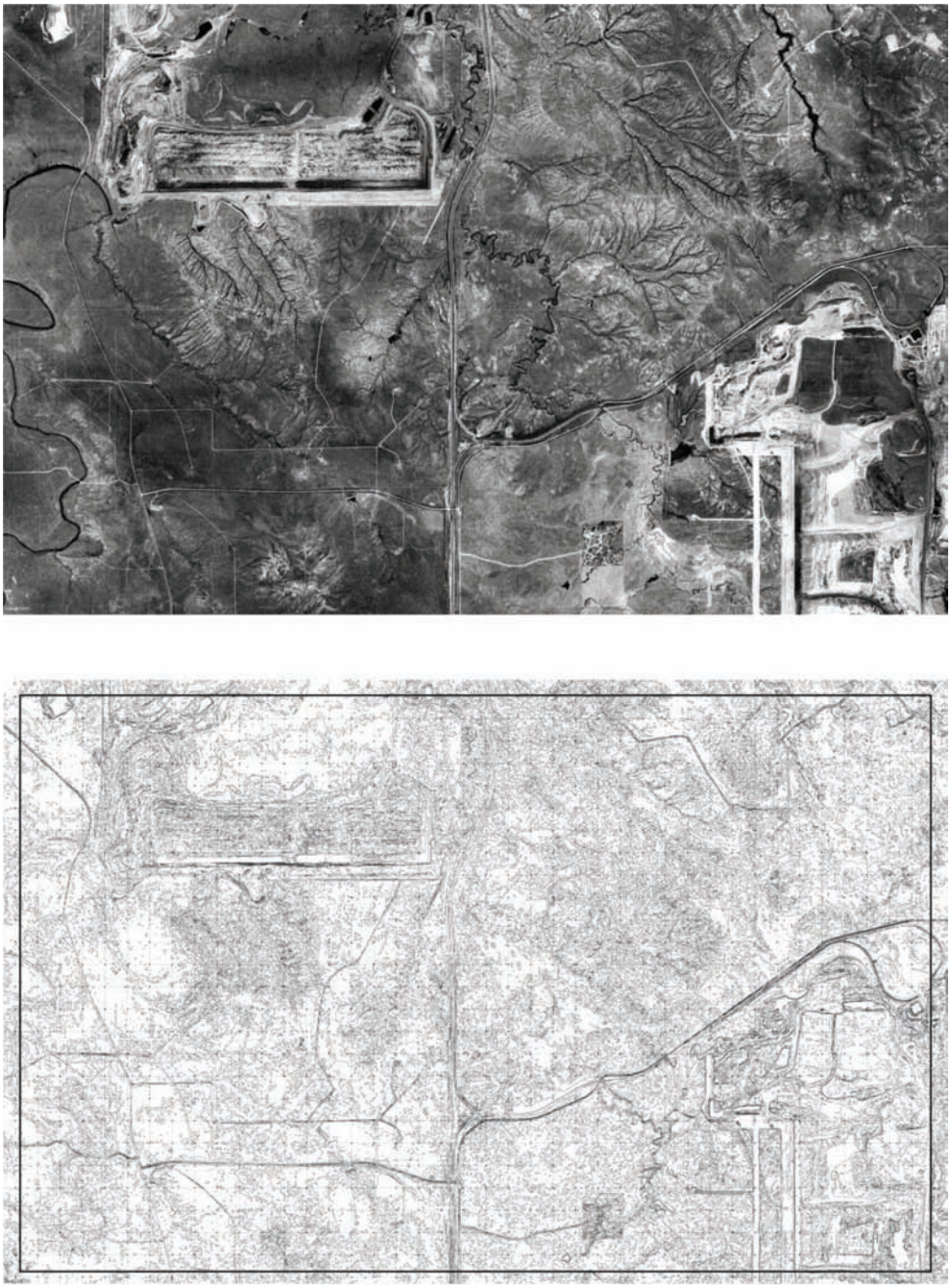

Fig. 8: A new Atlas of the Powder River Basin_The juxtaposition between the technical, technological landscape and the unattached surrounding. (Google Earth and Angelos Siampakoulis)

and the other one to the landform of this land of extraction. Both conclusion questions are connected under the broader spectrum of energy economy and coal extraction.

The first question is related to the future of the analyzed city, Gillette. How will the city develop in the future? As designers and planners, how will we have to respond to a possible future coal boom? How far is Gillette, as the "Energy Capital of America", to become a new Dubai, Kuwait or Baku, despite it's isolation in the Rocky Mountains? In the case that coal industry will not return back to its prosper years, how will we save Gillette from becoming a ghost town or a shrinking town like Detroit? From a broader spectrum, in case of a decline of the coal industry on the Powder River Basin, should we even try to save the city of Gillette, a small alpine town in the middle of nowhere?

The second question that comes out as a conclusion of this paper is related to the relationship, the juxtaposition between the technical landform and the existing one. This juxtaposition is becoming obvious in the accompanied set of representations that might work as a new Atlas of the Powder River Basin. In a post-coal era, how should we treat, as designers, the reclamation of a landform created from a mining activity of that scale? Restoration of the landscape is required by Wyoming State laws. Should this restoration take as a design opportunity the unique set and scale of the existing technical landforms that mines created? Should these traces of extraction stay obvious, both in the collective memory as well as on the Earth's Surface, as a fragment of the past? The above mentioned geographiens, literally traces on the top, thich Surface of the earth are products of the Anthropocene, product of our neoliberal processes of treating landscapes of extraction. They should not be forgoten; On the other hand their forms should be sustained, and taken advantage in a design phase –no matter the scale– as a mean to impart to the collective memory of the future generations our resourse extraction policies and their impact to the landscape.

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II. URBAN FRINGE LANDSCAPES

OPEN SPACES IN BETWEEN
Niches and Borders of Istanbul

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ABSTRACT

Nowadays, informal and historical neighborhoods of Istanbul, often run down quarters out of the public interest, are razed to the ground by government and private investors by following the model of neo-liberal capitalism policy. These urban renewal developments establish insurmountable boundaries, followed by exclusion of social and cultural groups.

Richard Sennett claims that through the creation of boundaries, urbanity, which is based on the unity of diversity and difference, dies (Sennett, 2011: 325). Underlining this theory, Detlev Ipsen declared, that the ability of different cultures and social groups living together in one city needs the arising of metacultures.

A metaculture includes parts of the dominant and particular cultures, transforming to a common culture. Considering the urban textures, Niches and Borders enable the mixture of different cultures and social groups living together and are therefore spatial origins of metacultures (Ipsen 2000: 248-259).

In Istanbul, Borders can be found in informal settlements, which let the city explode in its areal expansion throughout the last century. Due to this development, many niches appear in form of old Bosporus villages or historical quarters, which had been borders before and are still disreputable in public society since decades. In addition, the theoretical background and the assumption towards the spatial characteristics of niches and borders in Istanbul, the research analysis two neighborhoods as diverse types of borders and niches in urban fabric, public spaces and how dwellers of different cultures use open spaces and live together. Subsequently a concept for developing borders and niches is processed by using public space as a frame to encourage the forming of metacultures in contrast to the contemporary urban renewal. The concept orientates on existing informal and historical urban fabric plus the naturally given elements and textures.

Key words: niches, borders, metaculture, neighborhood, urban renewal.

LABURPENA

Gaur egun, Istanbuleko zenbait auzo informal eta historiko –interes publikoak ahaztuta gainbeheran dauden guneak dira horietako asko– gobernuak eta inbertitzaile pribatuak suntsitzen ari dira, kapitalismo neoliberalaren politika-ereduari jarraikiz. Hiri-berrikuntzako garapen horiek muga zeharkaezinak ezartzen dituzte, baita hainbat talde sozial eta kultural baztertu ere.

Richard Sennett-ek dioenez, mugen sorrera dela medio, gizalegea –aniztasuna eta desberdintasuna batzean oinarritzen dena– hil egiten da (Sennett, 2011: 325). Teoria hori azpimarratuta, Detlev Ipsen-ek aditzera eman zuen hirietan elkarrekin bizi diren kulturen eta talde sozialen trebetasunak metakulturak sortzea behar duela.

Metakulturek kultura nagusien eta partikularren zatiak bildu eta haiek kultura komun bihurtzen dituzte. Hiri-testurak aintzat hartuta, nitxoek eta mugek elkarrekin bizi diren kulturak eta talde sozialak nahastea ahalbidetzen dute, eta, beraz, metakulturen jatorri espazialak dira (Ipsen, 2000: 248-259).

Istanbulen hainbat muga daude kokagune informaletan azken mendean hiria azkar hedatzea ahalbidetu zutenak. Garapen horren ondorioz, nitxo ugari sortu ziren, hain zuzen ere hainbat auzo historiko edo Bosforoko antzinako zenbait herri, bere garaian muga izan eta zenbait hamarkadaz geroztik gaur egun oraindik gizarte publikoaren artean ospe txarra dutenak. Istanbuleko nitxo eta mugen ezaugarri espazialen premisaz eta oinarri teorikoaz gain, ikerlanak bi auzo aztertzen ditu –hiri-ehuneko muga eta nitxo mota desberdintzat hartuta–, eta bai espazio publikoak ere. Era berean, kultura desberdinetako herritarrek espazio publikoak nola erabiltzen dituzten eta nola bizi diren elkarrekin aztertzen du lanak. Ondoren, mugen eta nitxoen garapenaren kontzeptu bat prozesatzen da, espazio publikoa metakulturak sortzea sustatzeko esparru gisa erabilita, gaur egungo hiri-berrikuntzarekin alderatuta. Kontzeptuak jomugan ditu dagoen hiri-ehun informal eta historikoa eta modu naturalean agertzen diren elementu eta testurak.

Gako hitzak: nitxoak, mugak, metakultura, auzoa, hiri-berrikuntza.

RESUMEN

Actualmente barrios informales e históricos de Estambul, a menudo zonas en decadencia olvidadas por el interés público, están siendo arrasados por completo por el gobierno e inversores privados siguiendo el modelo de política del capitalismo neoliberal. Estos desarrollos de renovación urbana establecen fronteras infranqueables y provocan la exclusión de grupos sociales y culturales.

Richard Sennett afirma que a través de la creación de fronteras, la urbanidad, que se basa en la unidad de la diversidad y la diferencia, muere. (Sennett, 2011: 325). Subrayando esta teoría, Detlev Ipsen afirma que la habilidad de diferentes culturas y grupos sociales que conviven en una ciudad necesita que surjan metaculturas.

Una metacultura incluye partes de las culturas dominantes y particulares, que se transforman en una cultura común. Considerando las texturas urbanas, los nichos y las fronteras permiten la mezcla de diferentes culturas y grupos sociales que conviven y por tanto son orígenes espaciales de metaculturas (Ipsen, 2000: 248-259).

En Estambul, se pueden encontrar fronteras en asentamientos informales que permitieron que la ciudad creciese rápidamente en su expansión de área a lo largo del último siglo. Debido a este desarrollo aparecen muchos nichos en forma de viejos barrios históricos o antiguos pueblos del Bósforo que fueron fronteras en su día y que actualmente siguen teniendo mala reputación en la sociedad pública desde hace décadas. Además del fondo teórico y la premisa de las características espaciales de los nichos y fronteras de Estambul, la investigación analiza dos barrios como tipos diferentes de fronteras y nichos en el tejido urbano, espacios públicos y cómo los habitantes de diferentes culturas usan los espacios públicos y viven juntos. A continuación se procesa un concepto de desarrollo de las fronteras y los nichos mediante el uso del espacio público como marco para fomentar la formación de metaculturas en contraste con la renovación urbana contemporánea. El concepto se orienta hacia el tejido urbano informal e histórico existente más los elementos y texturas que aparecen naturalmente.

Palabras clave: nichos, fronteras, metacultura, barrio, renovación urbana.

1. THEORY AND REALITY OF URBAN DEVELOPMENT AND PLANNING IN ISTANBUL

1.1 The radical renewal

In the age of globalization, local municipalities and private entrepreneurs induce an urgency to improve the commercial image of "their' cities threatened by the international competition between the megacities. In this context, the urban fabric of Istanbul changed extremely throughout the last years. Based on changes of legal foundations, the urban renewal strategy enable municipality and private investors to demolish historical and informal neighborhoods and replace the old bottom-up structures withnew top-down projects.These new built projects are following successful international capitalistic models like shopping centers, gated communities or artificial public spaces with entertainment program, customized for high- or middle-class dwellers and tourists. Consequently, new exclusive public spaces are created for only some sequences of societyand without including the structures of previous existing urban fabrics. The new planned urban areas don't adapt to the surrounding or strengthen the characteristics and unique forms of its underlyinglandscape, while the informal and historical bottom-up areas were not planned, but grown together with its surrounding. Furthermore, the former dwellers are displaced to new homes in high-rise apartment buildings on the edge of the city, where their social and economic situation hardly improves, because the new neighborhoods are neither well linked to city infrastructure, like public transport, school, shops or job opportunities, nor find them local. Consequently, social and spatial segregation of economic and cultural groups are the result of urban renewal projects and might cause the increasing of Istanbul's social problems and restrictions on life quality, known from other megacities, like Sao Paulo or Mexico City.Nevertheless, there is a need to transform the informal and historical neighborhoods. Burcu Yigit-Turan pointed out in the paper "Public Space at the Margins of the City of Big Projects', Istanbul", that "informality should not be normalized or aestheticized" (Yigit-Turan, n.d.: 2). She explains, but in her case especially regarding to the new contemporary developing informal settlements, that the dwellers living in these settlements have to accept the disadvantaged locations with hardly any connection to the city's infrastructure (Yigit-Turan). Not only the new developed informal settlements, also the old ones need to be transformed. Often built on very steep areas or river valleys with bad quality self-made buildings in high density, their locations are threatened byearthquake and flooding damagesand need to be developed because of disaster prevention reasons.But is there an alternative transformation towards the neoliberal urban renewal, keeping the spatial quality of the neighborhoods and avoidexclusion and spatial segregation of different cultural and social groups?

1.2 The sociological theory of the open city as a response to urban renewal

In opposition to neoliberal urban renewal developments, sociological approaches refer to the model of the open city. Richard Sennett defines in his essay "The Open City", that boundaries as an urban typology arise in cities through cultural and social segregation of urban population. They prevent exchange of the city's diversity, which necessitates the existence of

urbanity. In his eyes, urbanity is encounter of differences and it is worthwhile to orientate to a city, which allows complexity, diversity and dissonance. In contrast to boundaries, borders enable through their permeability the mixture between social and cultural groups and enables complexity, diversity and dissonance (Sennett, 2010: 290-297). In another publication he points out, that spatial segregation of different groups in society intensifies theirdivision in attitude and everyday life. Therefore, the ability of living together – what he defines as civility– is destroyed. But civility can arise in city districts, where complexity is found, like in informal and historical bottom-up neighborhoods of the city (Sennett, 2005).

In addition to Richard Sennett, Detlev Ipsen declares the informal quarters as places, where the ability of different groups living together can take place. Taking informal structures of Istanbul as an example, the first type of spatial conditions for an open city are borders. He defines borders as uniting areas, which take the elements of their surrounding urban fabric and combines them inside. An area of diversity and mixture is enabled. The second type where integration can arise are niches. They are explained as areas in the city, which are not in the public interest –run down quarters changing their perception through decades–. Ipsen qualifies the two spatial types –niches and borders– as areas where integration can take place because of their low regulation and possibilities for minorities toevolve. But the ability of living together is not only enabled by giving the particular cultures public space for adoption, what would be close to segregation, but to give them a chance to exchange with the dominant culture to allow the arising of a metaculture. Metacultures include parts of dominant and minorities, transforming them into a common culture. Considering the urban fabric, niches and borders enable the mixture of different cultures and social groups through their living in between (Ipsen, 2000: 248-259).

Summarizing, both sociologists explain the need of more unregulated, grown urban areas to be able to create an open city, where not only tolerance between dwellers of different social and cultural background, but also integration and the ability of living together –civility or metacultures– can develop and exclusion and segregation is decreased.

In this paper, the informal neighborhoods of Istanbul, which cover 50% of the urban land and contain 60% city dwellers (Rosa and Weiland, 2014: 96) are defined as borders. Detlev Ipsen already declares Istanbul's informal settlements as borders (Ipsen, 2000: 251). The percentage of informality is caused by the city development in the recent decades in Turkey's industrialization period, the rural exodus. During this progress, many Bosporus villages, small towns and other settlements have been integrated in the urban city area. In addition to that, some historical run down parts had been characterized like that or were unpopular edges of the historical settlements beside the city wall. These two types of urban fabric can be defined as niches. Borders and niches in Istanbul are areas of cultural mixture because of their historical background –for example Sulukule– or their settlement development –like the informal settlements– include sometimes a mixture, sometimes a homogeneous population of minorities and the dominant culture. In addition to that, public space in niches in borders are

Fig. 1: Sulukule in Fatih, a neighborhood on the historical peninsula of Constantinople, was well known for being a gathering place and residence for minorities, before and after its urban renewal. (Wikipedia, 2012 and 2014)

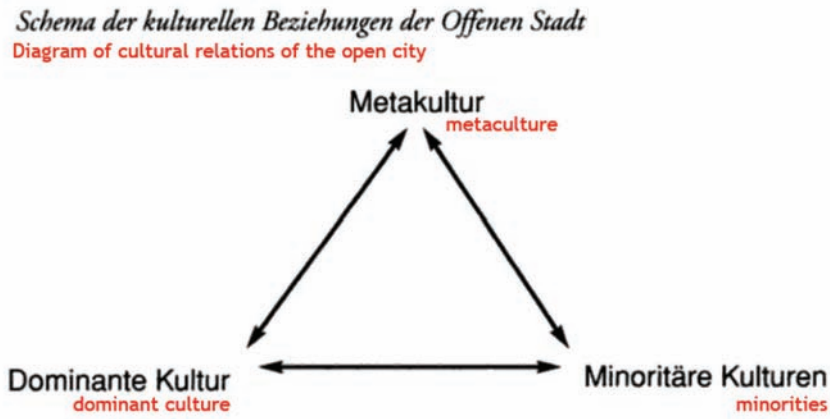

Fig. 2: Diagram of cultural relations of the open city by Detlev Ipsen, translated by the author. (Ipsen Detlev, 2000)

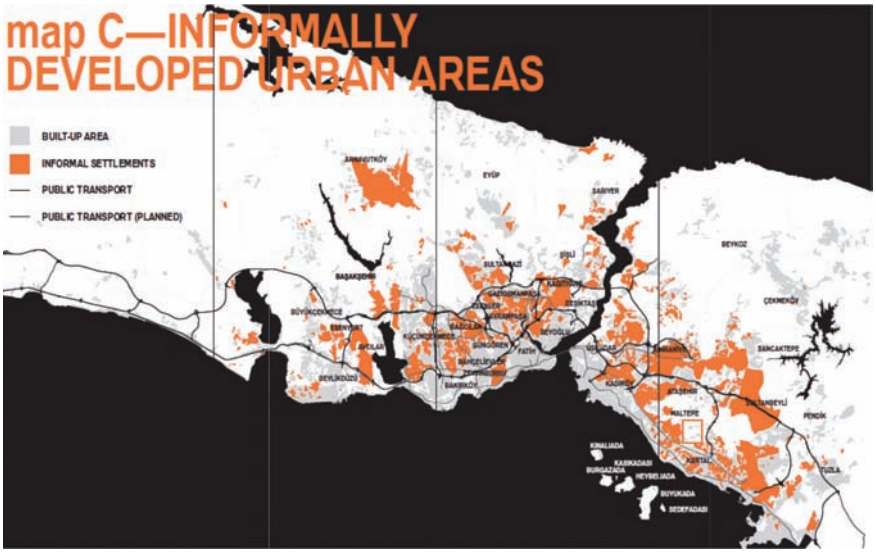

Fig. 3: The informal developed urban areas of Istanbul. (Görlich, Lazos & Horn, 2009)

the places in cities where minorities and dominant culture come together and so exchange and mixture of different cultures can take place.

2. PUBLIC SPACE IN NICHES AND BORDERS OF ISTANBUL

This study intended to decipher how the public space is organized in niches and borders are organized in its grown developed structure and if it is possible, that metacultures exist. The aim is to find a possible planning strategy based on the spatial quality of the existing open space for developing and transforming the current urban fabricin niches and borders, related to the sociological theories of Richard Sennett and Detlev Ipsen as an alternative to the contemporary tools of urban renewal.In addition to that, the relation between the urban fabric of the historical and informal neighborhoods and its characteristic influenced by its topography and morphology will be investigated.

In another research about a new border of Istanbul, the Hilal-Mahalle, Burcu Yigit-Turan figured out, that the exchange ofdwellers from different cultural groups in new contemporary build borders on the edge of the cityis not really existing. She describes that “there is a tension between the groups rather than cohesion” (Yigit-Turan, n.d.: 3). For analyzing the public space regarding to the possible existence of metacultures, in this research two historical neighborhoods in the center of Istanbul, threatened by urban renewal and gentrification and found in the previous mapping, are chosen.

2.1 Deciphering public spaces in two neighborhoods

One field research area is the Ayvansaray-Mahalle on the European side in Fatih, a part of the old city of Constantinople. It is located close to the Golden Horn beside the old Theodosian city wall. As it had been the border of the city beside the wall for decades, still today it is an area, where minorities and poorer groups of the society find a place to live. The other neighborhood is Kuzguncuk-Mahalle on the Asian side of Istanbul in Üsküdar. It was an old fishing village before, located on the Bosporus in a former river valley between green hills. Because of its location, it is still hardly connected to the city.

The research is on one hand based on mappings of natural and built boundaries and urban place typologies. On the other hand, it focuses in sociological studies on observations and experiences in the neighborhood, using the tools of photography and mappings, to be able to compare and link the results of the single mappings with each.

2.1.1 Mappings of natural and built boundaries and urban place typologies

Mapping the urban place typologies demonstrates a summary of the diversity and variety of the public space in the neighborhoods and their locations. Furthermore, centers or more private areas can be located to give an overview of the permeability in the neighborhood. Many shops along a large street added with entrances to a park or playground are central

Fig. 4: Mapping along the E5, Layering. (Alexandra Bauer)

and public. In order to that, stair- or dead and streets belong to the public space, but project to be less open.The Mapping of natural and built boundaries shows in addition to that the areas which are not easily reached or disable permeability.

2.1.2 Mental mapping of observations and experiences

The observation map shows the performative existing urban places which exist through the correlation between people's usage and urban places, like meeting points, where people gather together. Another example are the routes and places, where street sellers walk and stay. During the daytime, they prefer places with a high frequency of people. On Friday midday, when many people visit the mosque, they gather there for selling their food. Beside the performative place, the frequency of people using the public spaces, is observed. Different then the observation, the mental map of experience show the interaction between dwellers of the neighborhood and a foreigner (researcher).

2.2 Inclusive and exclusive urban places in public space

Comparing the spatial and mental mappings, a differentiation between common places, used by dominant cultures and the minorities, and exclusive places in the open space. Exclusive places are dominated by one culture –minority or dominant–. Often, they are dominated by a special usage of one group, like religious institutions or culture centers. Sometimes,

Fig. 5: Aerial photograph of Ayvansaray (left) and Kuzguncuk (right). (Alexandra Bauer)

Fig. 6: Mapping of urban place typologies in Ayvansaray (left) and Kuzguncuk (right). (Alexandra Bauer)

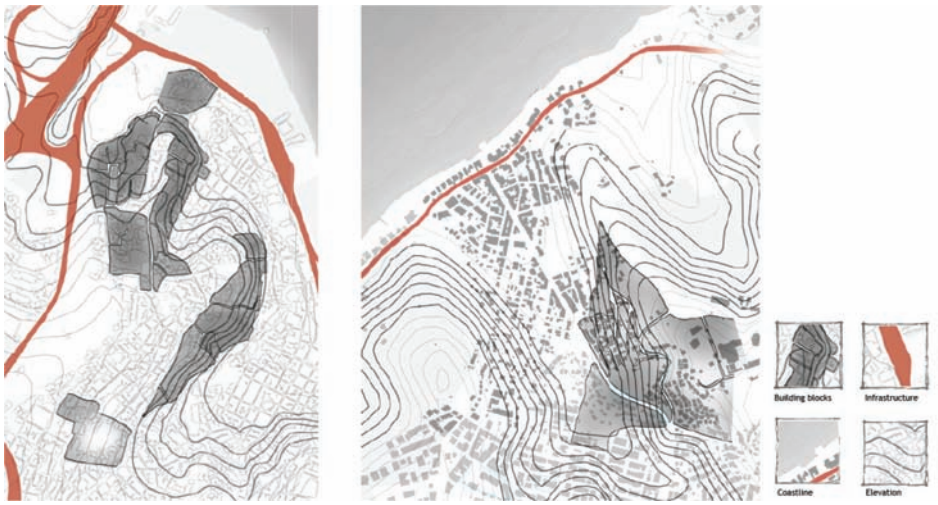

Fig. 7: Mapping of natural and built borders in Ayvansaray (left) and Kuzguncuk (right). (Alexandra Bauer)

exclusive places can be evoked through insufficient permeability caused by boundaries or type of urban form, like dead-end streets or laundry streets. Borders and niches need these exclusive urban places in public space, to give the minorities areas to meet and be able to feel “like at home’, especially in the first time of the arrival. Also, they are necessary for giving the chance of mixing cultures and giving dominant culture and other cultures a possibility to also use these spaces. Without exclusive places, metaculture can’t arise when minority cultures are not shown in the public spaces. These places are for example shops with special food or offer.Beside the offer, also the location of these exclusive places is important for the ability of becoming a point for exchange. In Kuzguncuk, mosque, church and synagogue are placed beside the main street. So, exclusive public spaces are next to the common space, always visible and visitable by everybody.In order to that, churches in Ayvansaray are spread in different areas and walled, not accessible for foreigners except some touristic ones. Some quarters in the neighborhoods, which are not accessible so easy because of boundaries are also very exclusive, like the Romanese quarter in the valley of Ayvansaray. Inside this quarter also a main street and beside a little square exists, where dwellers of this quarter are gathering together. The houses are one to two floor storage and the houses are colorful as an expression of the dwellers. Walking there as a foreigner is not usual and people ask, where you come from and if you got lost. So, the people take responsibility of their neighborhood.

In order to that, common spaces are more inclusive and used by different cultures and social groups. The mixture of different people on the street is visible and in general they offer appropriation and usage independent from social or cultural background. As a foreigner, you can go and nobody wonders, where you come from or who you are. Urbanity is enabled and these spaces can be the origin of metacultures, if they are not dominated by the dominant culture. Places of everyday needs or amusement, like cafeterias, are this kind of urban places. Another case, metacultures can’t arise in common spaces, when nobody feels responsible for the public space, like public transportation hubs or big traffic streets. The Golden Horn waterfront of Ayvansaray for example is used as a public shoreline, but it is a huge area, which is not easily accessible from Ayvansaray because of the main street and is a wide area in the responsibility of municipality, where the neighborhood is not much connected to. Beside the location, the design of the park, as well as the park inside Ayvansaray, in this kind can be found everywhere in Istanbul. It is a common place, but the identification to the neighborhood is not given. In Kuzguncuk, the biggest green open space is the Bostan area. It is a traditional urban gardening area, also in former times used for production of agricultural goods, like today. Not only people caring about the garden, but everybody is able to access and use the garden and festivals from the neighborhood are organized. A mixture of different cultures and people can find there. It is as well enabled through usage and location and used as a public space for everybody. Compared to the standardized parks of Ayvansaray, the Bostan in Kuzguncuk is an urban place, where metacultures can arise. Urban places like the Bostan can not only bring people together, but also through taking responsibility for an urban space enables dwellers, especially newcomers and immigrants, to identify with the neighborhood beside the culture or social group, but with the city Istanbul. This potential of identification is

not only given by green areas, but also by viewpoints, or historical artefacts, like the old city wall in Ayvansaray.

Beside the single urban places in the neighborhood, looking at the whole urban fabric, the permeability given by the common spaces in Kuzguncuk is higher than in Ayvansaray and the orientation given by the main street is easier. In order to that, the borders of Ayvansaray are easy to access, but getting lost inside the Mahalle through the mass of inclusive urban places and structures, is decreasing its permeability and makes the exchange between different cultures more difficult. But beside that, both neighborhoods content as well common and exclusive urban places.

Fig. 8: Mapping of observations in Ayvansaray (left) and Kuzguncuk (right). (Alexandra Bauer)

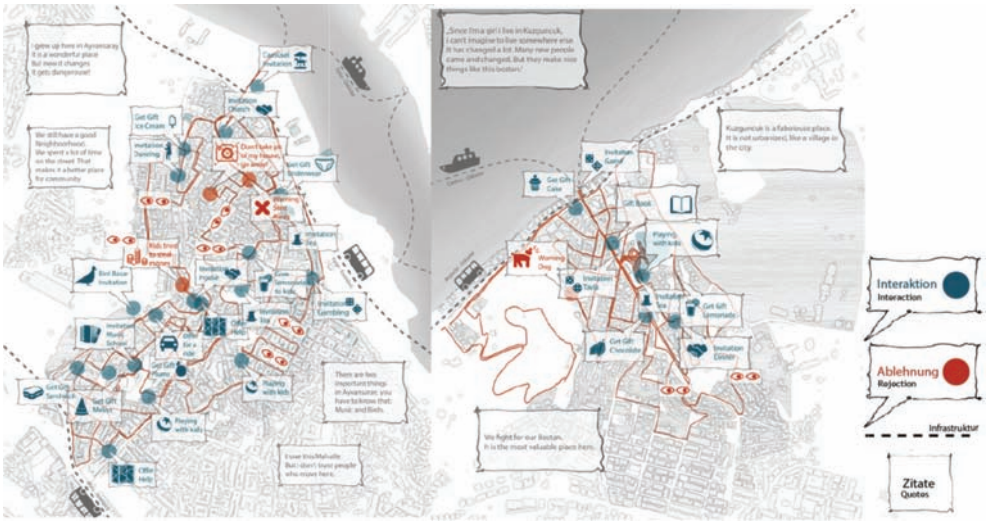

Fig. 9: Mapping of experiences in Ayvansaray (left) and Kuzguncuk (right). (Alexandra Bauer)

Fig. 10: Quarter main street, an exclusive urban space, where people gather together, in Ayvansaray. (Alexandra Bauer, 9/9/2014)

Fig. 11: Celebrating kids' day in Kuzguncuk Bostan. (Alexandra Bauer, 23/4/2014)

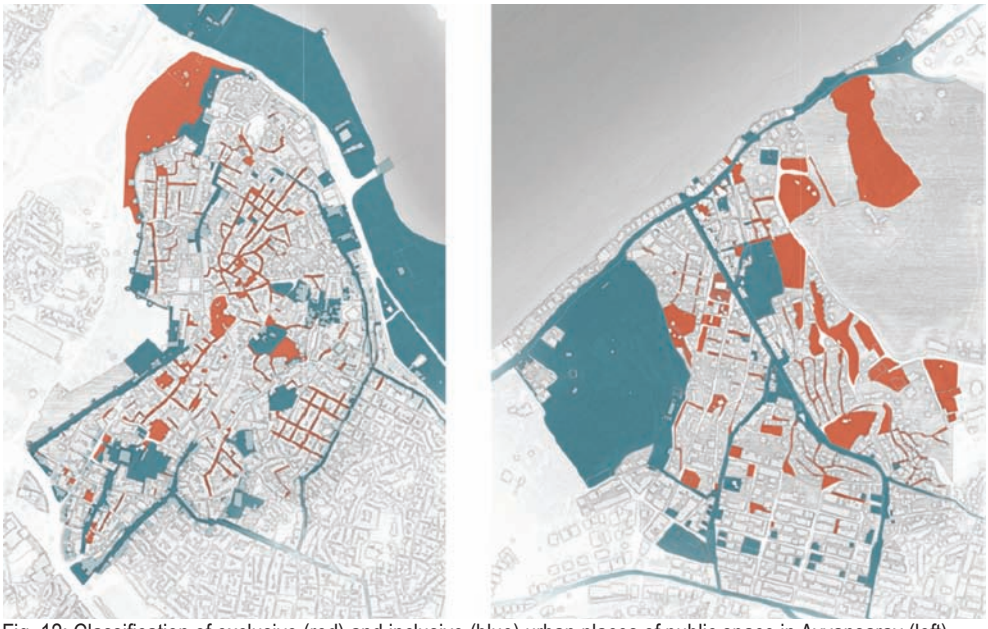

Fig. 12: Classification of exclusive (red) and inclusive (blue) urban places of public space in Ayvansaray (left) and Kuzguncuk (right). (Alexandra Bauer)

Compared to the studies of the contemporary borders of Burcu Yigit-Turan, the Hilal-Mahalle is characterized by exclusive public places or open space, the dwellers don't feel responsible for or give the responsibility to the municipality (Yigit-Turan, n.d.).

3. SPATIAL STRATEGY FOR DEVELOPING AYVANSARAY-MAHALLE

The spatial concept for urban development of Ayvansaray, related to the theory of Richard Sennett and Detlev Ipsen first needs to still contain less regulated and exclusive open spaces, but giving the possibility to bring different dwellers and visitors together in the Mahalle. Permeability, accessibility and orientation should exist for opening up strong exclusive quarters and give urban places of minorities the chance to be discovered by other dwellers. Furthermore, urban places with the possibility of giving dwellers the chance to identify with the city of Istanbul, historical artefacts or special points and through landscape and morphology created spaces, like shorelines or viewpoints, should be opened up for public more and connected to the permeable system. Through the expression of shared and collective ideas, the identity inside the neighborhood and the image of the neighborhood to outside is strengthen in a positive way. So, the deciphering and setting of urban places, for identifying with the neighborhood, is as important as their cultural expression of city or minority culture.For this the especially the elevation boundaries need to be bridged. Furthermore, the transformation should be planned in a process over time for enabling flexibility and let the dwellers get used to the change.

Two examples of small first development steps in Ayvansaray are explained in the following.

3.1 Connecting quarters

The Romanese quarter in Ayvansaray is isolated and hardly accessible through steep elevation and non-permeable blocks. Opening up the inside of the block and creating an accessibility with bridges or stairs can connect the cultural different dwellers. Creating a public space inside the block and using therefore new implemented elements can help to enable a multifunctional open space used by dwellers of neighborhood. Furthermore, it creates a new viewpoint over the neighborhood and gives the new urban space a new and multifunctional quality.

3.2 Enabling multifunctionality in urban places of possible identification

The old city wall in Ayvansaray is a touristic attraction, but also well known for street fights and hiding criminals and drug users. Enabling multifunctionality through a better accessibility and setting unique events, like the dove market on it, strengthen the identification with the urban place.

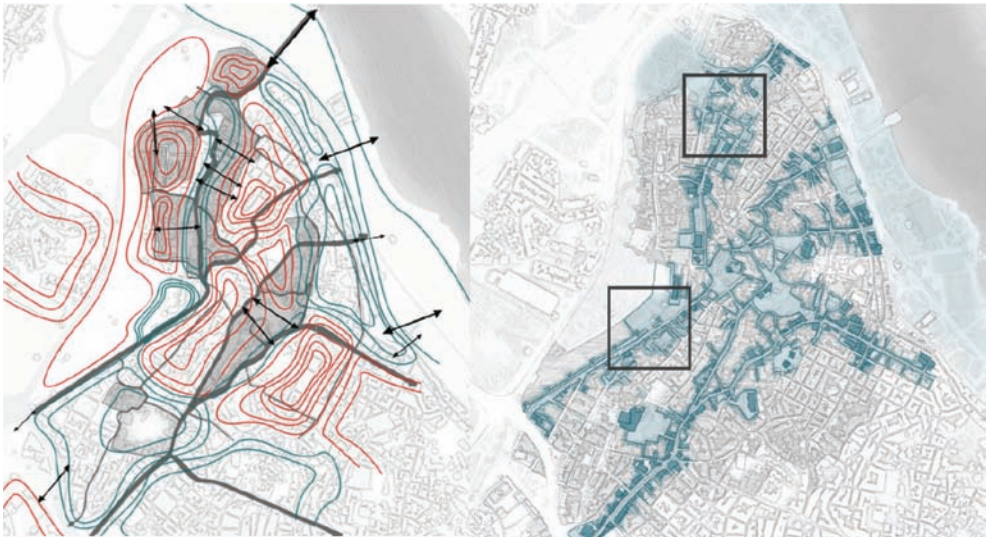

Fig. 13-14: Concept of connecting different cultural and social groups spatial (left) and concept of permeability with important urban places (right). (Alexandra Bauer)

Fig. 15: Connecting different quarters. (Alexandra Bauer)

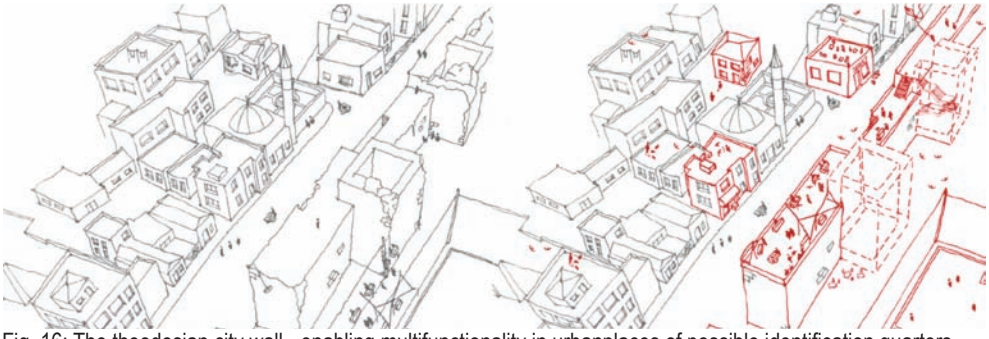

Fig. 16: The theodosian city wall - enabling multifunctionality in urbanplaces of possible identification quarters. (Alexandra Bauer)

4. CONCLUSION: POSSIBLE TRANSFERRING OF THE CONCEPT TO OTHER NICHES AND BORDERS

Taking sociological theories as a basement of new city development, like the theories of Detlev Ipsen and Richard Sennett, but also other well-known ones like Jane Jacobs, can develop a new kind of urban development strategies beside the standardized formal ones the urban renewal projects are based on. The analysis of public spaces in borders and niches of cities can be not only used for developing strategies for historical neighborhoods, but also can be a planning approach for new contemporary informal settlements to develop them into urban quarters involving the dwellers and not replacing them or the urban exclusive places, they already create to build a home.

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PLANNING UNCERTAINTY
Urban Fringe as Resilience Strategy

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ABSTRACT

Today, social structures, habits, and behavioral models are short-lived. The lack of consolidation along with the fast mutability of contemporary spatial reality makes for ineffective cause-effect and anticipatory logic, and replaces forecasting with uncertainty. In this context, the action of regional development and urban planning –which are ruled by estimations and predictive foresights– has to incorporate the unexpected into the classical adjustment of land for a specific use. Negotiation between short- and long-term transformations and recalling dynamic nature processes is key to respond to the indeterminacy of the future or the so-called resilience.

Urban Fringe is a particular category of urban land where ordered and unordered, as well as ruled and unruled planning takes place; it is a category where different degrees of urbanization coexist, where economic tautness shows up as a landscape, where common life is performed as an event space, where ambivalence in spatio-temporal categories cohabitate, and where non-physical division and frontier space are discussed as a political issue. This controversial and complex threshold relates to and interacts with opposite urban conditions, making urban fringe an extraordinary case study to discover and extrapolate approaches to uncertain and ever-evolving urban planning.

Key words: urban planning, urban fringe, uncertainty, resilience.

LABURPENA

Gaur egun, egitura sozialak, ohiturak eta jokabide-ereduak iragankorrak dira. Sendotzerik ezak, batetik, eta gaur egungo errealitate espazialaren aldakortasunak, bestetik, aurrerapen-logika eta kausa-efektu ez-eraginkorrak dakartzate eta aurreikuspena ziurgabetasun bihurtzen dute. Testuinguru horretan, eskualdeko garapenaren eraginak eta hiri-antolamenduak, kalkuluetan eta aurreikuspenetan oinarritzen direnak, ezustekoa txertatu behar dute erabilera berezirako lurralde-atontze klasikoan. Epe laburreko eta luzeko eraldaketen arteko negoziazioa eta prozesu natural dinamikoak aintzat hartzea funtsezkoak dira etorkizuneko zehaztugabetasunari edo erresilientzia delakoari erantzuteko.

Hiri-kanpoaldea hiri-lurzoruaren kategoria berezia da, eta, bertan, planifikazioa antolamenduz eta halakorik gabe egiten da, arauei jarraikiz eta araurik gabe. Kategoria horretan, hainbat urbanizazio-maila biltzen dira, tentsio ekonomikoa paisaia gisa agertzen da, elkarbizitza gertaeretako espazio gisa egiten da, anbibalentzia espazio- eta denbora-kategorietan gauzatzen da eta banaketa ez-fisikoa eta muga-espazioa gai politikotzat hartuta eztabaidatzen dira. Atalase eztabaidagarri eta konplexu horretan, harremanak eta elkarreragina aurkako hiri-baldintzetan gauzatzen dira eta hiri-kanpoaldea kasu praktiko paregabea bihurtzen da zalantzan eta etengabeko bilakaeran ari den hiri-antolamendurako ikuspegiak asmatzeko eta ondorioztatzeko.

Gako hitzak: hiri-antolamendua, hiri-kanpoaldea, ziurgabetasuna, erresilientzia.

RESUMEN

Actualmente las estructuras sociales, los hábitos y los modelos conductuales son efímeros. La falta de consolidación junto con la rápida mutabilidad de la realidad espacial contemporánea provocan una lógica anticipatoria y una causa-efecto ineficaces y sustituye la previsión por incertidumbre. En este contexto, la acción del desarrollo regional y la ordenación urbana, que están gobernadas por estimaciones y previsiones predictivas, tiene que incorporar lo inesperado en el arreglo clásico del territorio para un uso específico. La negociación entre transformaciones a corto y largo plazo y la evocación de procesos naturales dinámicos son claves para responder a la indeterminación del futuro o de la llamada resiliencia.

La periferia urbana es una categoría especial de suelo urbano donde tiene lugar una planificación con orden y sin orden, con normas y sin normas; es una categoría donde coexisten varios grados de urbanización, donde la tensión económica aparece como paisaje, donde la vida común se lleva a cabo como un espacio para eventos, donde cohabita la ambivalencia en categorías espaciotemporales y donde la división no física y el espacio fronterizo se debaten como asunto político. Este controvertido y complejo umbral se relaciona e interactúa con condiciones urbanas opuestas y convierte a la periferia urbana

en un extraordinario caso práctico para descubrir y extrapolar enfoques para una ordenación urbana incierta y en constante evolución.

Palabras clave: ordenación urbana, periferia urbana, incertidumbre, resiliencia.

This Paper is further research on the doctoral thesis “Designing Uncertainty: Resilience Permanency for the Life of a Building,” defended in 2016. The thesis examined design approaches used in planning and drawing architecture for the “Uncertainty” –specifically, designing for cases where circumstances are difficult to predict and how these designs cope with unknowns–. This Paper explores the applicability of some of the conclusions offered for the field of architecture as applied to challenges in Urban Planning –referred to in this Paper as “Planning Uncertainty”–. For its part, Urban Fringe is conceived as a case study to figure out the possible characteristics of “Uncertain Planning”. Both Urban Fringe and Uncertain Planning share the idea of being space and time thresholds.

1. DYNAMIC PERMANENCY FOR A SOCIETY IN CONSTANT CHANGE: A RESILIENCE STRATEGY

Zygmunt Bauman defines modern conditions as “liquid” (Bauman, 2000), where structures change too quickly to be able to solidify and, as a result, reality is in a constant fluid state. Social, economic, and technologic processes –and, therefore, the way of life– update with such speed that we live in a constantly renewed present time. Every prediction is overtaken by such newness that forecasts are born obsolete. Architecture is, by its very nature, an activity of projecting the future: designing means determining physical features that give support to the development of human life. The permanency declared to a building confronts the impermanency of social structures. The contemporary liquidity of social structures shows the precarious inefficacy of architectural and urban thinking to create adaptive, ever-evolving spatial environments. This social theory puts forth an uncertain order; it supports the inconsistency and ambiguity that modern practices have tried to eliminate. Architecture that declares a resolute final state for a built environment heads toward obsolescence from the get-go. Space production must respond to this unclear, complex reality in order to guarantee both its permanency and adequacy to its social requirements –in other words, space productions must establish a resilience strategy–.

Western urban planning has been guided by the logic of prediction or cause-effect linear thinking, and as a consequence it does not build for a reality in constant transformation, but for a ruled and controlled built environment.The difficulty in predicting the future of the contemporary world –weare unable to understand and integrate the reasons that motivate socialtransformations–, situates Uncertainty as the main challenge of architecture and urban design,which means, coping with the unknown, the relational and the subjective (Solá-Morales, 1987).The strategy for best addressing Uncertain Design is resiliency, defined as a realm of materiality in which a certain grade of indeterminacy helps to achieve a built environment, which not only embraces and adapts, but also promotes spontaneous uses and space organization. Resiliency is a deeper understanding of permanency as a dynamic state in continuous revision of architectural interpretation (Iruretagoiena, 2016).

The idea of a stable permanency in architecture has perpetuated a legacy that rewards the timeless essence of design building. We have to look back to find the root of the predisposition

to think of buildings and built environments as concluded realities. The impact of the Vitruvian manifesto on architectural thinking has caused a tendency toward designing built environments as exercises of control. The Vitruvian triad emphasizes the value of firmitas, a principle that supports the resistance to the flux of time, asserting extraordinary effort for a building to remain in its original state of creation and avoid the loss of control over its architecture. This difficulty to accept that time augments denies the fact that the character of space depends on factors out of the control of the designer (Till, 2009). Architectural culture prioritizes static and objective properties such as the visual and the technical, whereas the experience and the social impact are avoid. What time brings in terms of new conditions of life, defined largely by the social characteristics of its age, has no space to act. Stable permanency built into architecture opposes the ephemeralness of cultural values and principles, which affect both the use and the understanding of architectonic spaces. This central concern of the architect in controlling and anticipating the resulting space has made the user a generic, anachronistic, universal historical agent.

Permanency and resilience are not paradoxical objectives, but reciprocal entities. The difference between these two approaches to durability (stable and transient permanency) lies in what is made permanent and what is dynamic. Resilience strategy stands up in perpetuity for structural properties of architecture, as well as for the variability in interpretation and significance of structures (Hertzberger, 1991). Uncertainty places the spontaneous and improvised circumstances at the center of the task of designing, and, in doing so, reclaims the ability of a space to act as a catalyst for future changes. Meanwhile, flexibility opens up the potential of change as a property of a building, leaving resiliency to rely on the flux of time as the actor that determines future needs. In the end, the task of the architect is not to solve a certain situation, but, rather, to suggest and evoke ways of understanding and relating to the space –in reference to the “field conditions” defined by Allen (1999)–.

We cannot conclude that the architect is removed from design making by taking into consideration an active user. On the contrary, the role of the architect is decisively to build a particular space that accepts a manifold of interpretations –an adaptive strategy that intrinsically adds value to a space–. Having an open interpretation will determine its character and use in accordance with the social and economic contexts of its era. This new approach eliminates the need for anticipating the future; instead, it focuses on the modest aim of affecting the future by building architecture as a negotiated and interpretable field –a key strategy for resilience architecture– allowing for an unfolding of architecture over time. A resilience strategy replaces function with experience, a passive user with an active one, and object-oriented resolution with multisensory affection.

2. PLANNING URCERTAINTY, A CONTEMPORARY URBAN REQUIREMENT

Urban planning is understood as an exercise to predefine an urban transformation in time, assuming that time is a lineal and consequential chain –and, because of which, urbanization practice is drawn under predictable and controllable processes–. Estimations of future needs

act as rules in the territory or a city, while spontaneity is considered a threat to the success of the plan. As an activity concerned by large-scale, structural changes in order to determine a certain strategy, urban planning commands and programs long-term changes while establishing rules to regulate physical changes of the territory. The transformative design that urban planning determines implies a complex and drawn-out transformation process, in addition to elevated economic investments. However, urban life entails other time cycles which develop other types of changes –not structural, but nevertheless impactful on everyday life– which are not taken into account in mainstream urban planning.

As with any other natural process, urban life grows as a consequence of a system of cohabitation by many diverse elements interconnected in a certain environmental contexts. This is why, for example, new neighborhoods, when built as tabula rasa, are perceived as strange and lacking a human touch. But above all, anticipated planning does not respond fluidly to the processes and social conditions. Short-term cycles of change respond to the day-to-day requirements usually unaccounted for in the strategies of urban planning because they cannot be anticipated. The proximity of this process to nearby communities and the very real circumstances under which they exist turn this slow-process change cycle into an opportunity for us to embrace a potential field and all us to prepare for what long-term changes may bring in the future. Exploring this, short-term changes play the role of being an adaptive tool to measure and manage unexpected uses and/or demands. Urban planning should be both active and reactive allowing for the devising of customized plans that take form as a consequence of a slow process, guided by tested strategies, which are corrected and improved by the community. The active involvement of the community ensures its vitality. Compared to designing a building's architecture, the planning an urban area is an activity that requires a longer timeframe, thus, urban planning is a practice based in future time. The contemporary condition of Uncertainty boldly highlights the inefficiency of isolating long-term urban planning from urban life. Planning for Uncertainty demands an approach where unforeseen circumstances take part in the transformative long-term planning, that is to say, the short-term planning process. In line with what was previously explained in regard to designing Uncertainty in architecture, the users or citizens have the predetermined role of adjusting a built environment to the circumstances of each epoch (but only if the built environment has been designed to have resiliency). Cyclical short-term changes allow users the opportunity to collaborate on and participate in –through rating and negotiating– the biggest urban transformations. The role of the community is to regulate the effectiveness of large-scale planning, as well as generating a path to get in touch and relate with their architectural reality. This is how Uncertain Planning copes with both surprise and a state of order.

This negotiation is not so much bottom-up planning, but, instead, a place at the table in diverse time-cycles in the planning of built environments. Although urban planning does not determine the design of an urban scenario, it does regulate it, and therefore it affects the conditions of the final urban built environment. Thus, if developing a built environment which allows for an array of interpretations of is the ultimate goal when thinking architecture for Uncertainty, setting the stage for a negotiation between processes (such as those which involve: anticipated and

spontaneous needs, the participation of institutions, entrepreneurs, and local residents, fast and slow changes, small and big challenges, strategic and tactical actions) is the way in which a resilience strategy is brought to urban planning. This is how a prediction is transformed into a provisional hypothesis (Ascher, 2001). However, this does not mean that a plan transforms itself, only that it has the ability to transform the reality which lies within.

3. URBAN FRINGE, NEGOTIATION OF OPPOSITE URBAN CONDITIONS

Planning Uncertainty is about planning strategies and actions in time with the aim of creating an urban built environment that acquires the capacity to catalyze unanticipated, temporary, and spontaneous processes. These urban phenomena cannot be regulated beforehand; however, they constitute part of the essence of urban life. Planning Uncertainty proposes a creation of a built environment that suggests and provokes improvised urban transformations. And as a consequence, the transformative intend of the urban planning becomes dynamic, responsible and reactive to the structural context.

The theory of taking into account Uncertainty in architecture (Iruretagoiena, 2016) says that building a multitude of interpretations in the use and character of a space is at the heart for leaving space to the unknown. This multitude of interpretations is translated as a building of dualities of urban conditions. The indetermination of character enters the realm of complexity through identity and use –performativity– and at the same time engages the community in the experience of planning as the interpreter of that ambiguity. This means that subjective circumstances have structural influence in the planning process, turning planning into a territory's physical and cultural activity (Berque, 2008). The open possibility to declare an urban condition as being in touch with, and as a consequence of, the particularities of each context –defined by the community– is precisely the resiliency of this approach to Planning. The balance of the opposite urban conditions is the fragility and potentiality of this land of opportunity and improvisation.

Urban Fringe landscapes' properties help determining the features of the built environment to be achieved. The search for a cohabitation of opposite urban conditions links Uncertainty to Urban Fringe. This paper's interest highlights Urban Fringe as an example of both spatial ambiguity and the built landscape of what Planning Uncertainty should aim to reach. Urban Fringe is a temporal state of transformation and lies on the boundary that confirms a cohabitation of dualities (urban and rural, ordered and disordered, ruled and un-ruled) operating as an open field (Qviström, 2007). This threshold between opposite urban conditions exists as an in-between time, waiting for a planned building action or, simply, waiting to be planned. This standby time shows, however, a different way of organizing physical space of coexistence. The memory of the past and present, together with the urbanity and the desertion, visualize an organic performativity (functionality?) of rules. The unordered space (rural condition of the territory) is ruled temporarily to adjust for vivid needs. For its part, the ordered (urban condition of the territory) gives support to coordinate the complexity of social cohabitation.

The outstanding state of urbanity of the Urban Fringe questions the virtues of ordered planning and discovers the possibilities of the "non-plan." This unusual state of order tempts some questions: What if rural landscape is thought as an urban condition and, conversely, urban condition is planned as rural? The interest of Urban Fringe is limited to a temporary condition or, on contrary, it is possible and viable to consider the temporary state of its urbanity a permanent state of urban planning? What if Urban Fringe is not thought as a boundary but as a spatial conflict between dual opposites? What if these conditions are built mixed, as ambiguous conditions? What if Urban Fringe is isolated and studied as a threshold in itself? What it is remarkable is that the coexistence of ordering rules and the inclusion of other organic,natural ways of acting in the landscape make urban reality a realm of constant adaptability –involving constantly new inputs– and, therefore, connected to society and the built environment. The cohabitation of the dualities is possible thanks to the understanding of regulation as a communal code which performs depending on the facts of its specific situation. The establishment of a rule as a transitional operational regulation is what this text coins as "performativity of the rule". This definition of urban regulation is useful as a tool to produce multiplicity of alternative realities in accordance to the given context. The performativity of regulation acts as an updating tool for long-term, large-scale processes. Besides, rules will provide the consistency of the dual and opposite urban conditions. Rules render design control adjustable. This is how planning connects with contemporary –uncertain– realities. Besides this, Uncertainty demands a performativityof regulations, that is to say, rules which are revised permanently to verify their efficacy in order to catalyze temporary processes. This is how the initial intends are shaped and reshaped to the context with which the planning works.

The production of space as Lefebvre said is inherently politicalin the way that influences urban life and social relations. The claim for the Uncertainty is as well a defense for the political responsibility of architecture and urban planning as a contributor to the empowering of social relationships though the production of space (Schneider and Till, 2011). This Papers´ proposal is that the transitional condition of Urban Fringe lasts in time when a collaborative political instrument governs the control over the performativity of regulations. This political mechanism confronts the applicability of planning regulations to achieve both the short-term and long-term transformations. The control over the performativity of regulations has to be a political device governed by the community, similar to a political mechanism that confronts the applicability of planning regulations to achieve both short-term and long term transformations. This first approach to Planning Uncertainty drafts the future of planning as a building of ambiguity to negotiate complex urban conditions regulated by the performativityof the legislation and a community evaluating organization.

4. FUTURE RESEARCH ON THE HYPOTHESIS OF PLANNING UNCERTAINTY

The hypotheses explained in this Paper henge on the collaboration between short- and long-term transformative changes that regulate urban planning. The negotiation space is defined by Uncertainty as building spatial ambiguity between dual urban conditions. This is a general statement formulated as an intuition in theoretical and abstract terms that has to be analyzed

deeplyto verify its applicability in practical terms. Firstly, it is necessary to define what characterizes short- and long-term changing processes and which mechanisms should be used to negotiate the distinct nature of planning each.The social agents and actors involved in each process have its own functionality and its own way of processing their needs. A proper study of the differences in production of communal space is clue to determine a regulation that does not abort possibilities.

Secondly, Planning Uncertainty requires an exploration of a planning control of legislation to permit performativity of rules –questioning the rules and expanding the rules–. A low range of rules –laissez-faire attitude– has the risk to trigger a non-plan situation. But ruleshaveas well the capacity and potential to catalyze unknown situations.

Finally, there is a political dimension to be studied. Urban planning starts with an understanding of the political implications of a given context. Planning Uncertainty relies on the community to reshape previsions to the given context and a close attention to the social affections is to be made. This means that apoliticedcommunity is implemented to control, evaluate and regulate constantly the opportunitiesand restrictions of the set of rules.The novelty that this Paper establishes to the role of the social agents and institutions that take part in the production of a territory or a city is that they should constitute a permanent structural and political control device over urban regulations. This political mechanism would deal with the complexity of the processes involved in urban planning so that they would act as spatial agencies in the complex process of social changes –either slow or long term–. This is how a political and planning device would establich Planning Uncertainty.

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MODELING EXTRACTION OF IMPERVIOUS SURFACES FROM LANDSAT IMAGES IN DATA SCARCE URBAN AREAS OF GHANA

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ABSTRACT

This is part of a broader research into nature based interventions in flood management in developing countries. This aspect of the research used different methods to quantify imperviousness and determined the extent of the relationships between imperviousness and spatial and non-spatial data for two year periods (2002 and 2014). The work used a data scarce urban area, Greater Accra Metropolitan area, Ghana as the focus of the research. Land cover maps produced from 30 m resolution Landsat7 and 8 (March 2002 and March 2014 respectively) images at 75 and 77% accuracy respectively were used to calculate coefficient of imperviousness for selected areas.Ordinary least squares regression analysis run between percentage imperviousness, population density, and coefficient of imperviousness gave adjusted R squared value of 0,879. In the second method Landsat images were tasseled cap transformed in PCI Geomatica to produce three bands related to Brightness, greenness and wetness. The greenness band which is inversely related to imperviousness was combined with impervious surfaces extracted from sample test sites of high resolution images and used to develop a model to quantify imperviousness. The high resolution images, georeferenced in Arcmap, were used to extract impervious surfaces and to calculate percentage imperviousness. Regression analysis between the high resolution images and tasseled cap calibrated images produced adjusted R square of 0.925 and 0,986, with Kappa coefficient 0,999 and 0,986, for 2002 and 2014 respectively, showing a strong correlation. Cross validation showed that 85% of calculated imperviousness can be explained by the pixel value of the calibrated model. The outcome of this research confirms the strong relationship between imperviousness and pixel value of the green layer of a tasseled cap transformed image. It also shows a strong relationship between imperviousness, population density and land cover derived coefficients of imperviousness. Of the two methods, the tasseled cap transformed image approach yielded the most reliable and consistent results. This results will be a critical input in flood management, and in the general context of enhanced urban planning.

Key words: population, impervious surfaces, tasseled cap transformation, modeling.

LABURPENA

Garapen-bidean dauden herrialdeetako uholdeen kudeaketan egiten diren naturan oinarritutako esku-hartzeei buruzko ikerketa zabalago baten zati da honako hau. Ikerketaren zati honetarako, hainbat metodo erabili dira iragazgaiztasuna kuantifikatzeko, eta iragazgaiztasunaren eta datu espazialen eta ez-espazialen arteko loturen norainokoa zehaztu da, urtebeteko bi aldi aintzat hartuta (2002 eta 2014). Lanaren ikerketa-guneak datuetan urria den hirigune bat izan du ardatz, Ghanako Akra Handia metropoli-eremua, hain zuzen ere. Lur-estaldurako mapak erabili ziren, 30 m-ko bereizmeneko Landsat 7 eta 8ko irudiez osatuak (2002ko martxokoak eta 2014ko martxokoak, hurrenez hurren), % 75eko eta % 77ko doitasunekoak, hurrenez hurren, aukeratutako guneetako iragazgaiztasun-koefizientea kalkulatzeko. Iragazgaiztasun-ehunekoaren, biztanleria-dentsitatearen eta iragazgaiztasun-koefizientearen artean egindako minimo karratuen erregresio-analisiaren emaitza 0,879ko R karratu doitua izan zen. Bigarren metodoan PCI Geomatics-en bidez eraldatutako Landsat irudiak erabili ziren –"tasseled cap"–, distirarekin, berdetasunarekin eta hezetasunarekin zerikusia duten hiru banda sortzeko. Berdetasun-banda, iragazgaiztasunarekin alderantzizko erlazioa duena, bereizmen handiko irudien lagin-probako puntuetatik ateratako azal iragazgaitzekin konbinatu zen, eta iragazgaiztasuna kuantifikatzeko eredu bat garatzeko erabili zen. Bereizmen handiko irudiak, Arcmap-en geoerreferentziatuak, azal iragazgaitzak ateratzeko eta iragazgaiztasun-ehunekoa kalkulatzeko erabili ziren. Bereizmen handiko irudien eta "tasseled cap" kalibratutako irudien arteko erregresio-analisiak 0,925eko eta 0,986ko R karratuko balioa eman zuen, Kappa koefizientea 0,999 eta 0,986 zelarik 2002rako eta 2014rako hurrenez hurren. Hortaz, korrelazioa handia da. Balioeste gurutzatuak agerian utzi zuen kalkulatutako iragazgaiztasunaren % 85 kalibratutako ereduak pixeletan duen balioaren arabera azal daitekeela. Ikerlan honen emaitzak berretsi egiten du iragazgaiztasunaren eta "talsseled cap" moduan eraldatutako irudietako geruza berdeak pixeletan duen balioaren arteko korrelazio estua. Era berean, korrelazio estua erakusten du iragazgaiztasunaren, biztanleria-dentsitatearen eta lur-estalduraren ondoriozko iragazgaiztasun-koefizienteen artean. Bi metodoetatik, "tasseled cap" moduan eraldatutako irudiak eman zituen emaitzarik fidagarri eta sendoenak. Emaitza horiek funtsezko ekarpena izango dira uhaldien kudeaketarako eta hiri-antolamenduaren hobekuntzaren testuinguru orokorrerako.

Gako hitzak: biztanleria, azal iragazgaitzak, "tasseled cap" eraldaketa, eredu-diseinua.

RESUMEN

Esto forma parte de una investigación más extensa sobre las intervenciones basadas en la naturaleza en la gestión de las inundaciones en los países en desarrollo. Para este aspecto de la investigación se han empleado diferentes métodos para cuantificar la impermeabilidad y se ha determinado el alcance de las relaciones entre la impermeabilidad y los datos espaciales y no espaciales durante dos períodos de un año (2002 y 2014). El trabajo se ha centrado en

una zona urbana escasa en datos, la zona metropolitana de Gran Acra, en Ghana, como foco de la investigación. Se usaron mapas de cobertura del terreno de imágenes de Landsat 7 y 8 de 30 m de resolución (marzo de 2002 y marzo de 2014, respectivamente) al 75 y el 77 % de precisión, respectivamente, para calcular el coeficiente de impermeabilidad de las zonas seleccionadas. El análisis de regresiones de mínimos cuadrados ordinarios realizado entre porcentaje de impermeabilidad, densidad de población y coeficiente de impermeabilidad dio un valor de R cuadrado ajustado de 0,879. En el segundo método se usaron imágenes de Landsat transformadas "tasseled cap" en PCI Geomatics para producir tres bandas relacionadas con el brillo, el verdor y la humedad. La banda de verdor, que guarda una relación inversa con la impermeabilidad, se combinó con superficies impermeables extraídas de los puntos de prueba de muestra de imágenes de alta resolución y se empleó para desarrollar un modelo para cuantificar la impermeabilidad. La imágenes de alta resolución, georreferenciadas en Arcmap, se emplearon para extraer superficies impermeables y para calcular el porcentaje de impermeabilidad. El análisis de regresión entre las imágenes de alta resolución y las imágenes calibradas "tasseled cap" produjo un valor de R cuadrado ajustado de 0,925 y 0,986 con coeficiente Kappa de 0,999 y 0,986 para 2002 y 2014, respectivamente, lo cual muestra una fuerte correlación. La validación cruzada mostró que el 85 % de la impermeabilidad calculada se puede explicar por el valor en píxeles del modelo calibrado. El resultado de esta investigación confirma la estrecha correlación entre la impermeabilidad y el valor de píxeles de la capa verde de una imagen transformada de "tasseled cap". También muestra una estrecha correlación entre la impermeabilidad, la densidad de población y los coeficientes de impermeabilidad derivados de la cobertura del terreno. De los dos métodos, la imagen transformada de "tasseled cap" ofreció los resultados más fiables y consistentes. Estos resultados supondrán una contribución esencial para la gestión de las riadas y para el contexto general de la mejora de la ordenación urbana.

Palabras clave: población, superficies impermeables, transformación "tasseled cap", diseño de modelos.

1. INTRODUCTION

Rapid urbanization in developing countries this past 50 years (Bjeren, 1971; Buehler, 2003; Cohen, 2006; Xu, 2007; Frimpong, 2014) has so compromised the natural landscape that the least amount of rainfall results in floods (Cohen, 2006; UNEP, 2006; ILGS/IWMI, 2012; Asumadu-Sarkodie, 2015). This situation is very common in urban areas in West Africa and other developing regions. Extensive research has been done on the relationship between urbanization and imperviousness (Brabec, 2002; Atuguba, 2006; Dhorde, 2012; Jha, 2012), the extent of which is directly related to runoff generation (Barnes, 2002; Atuguba, 2006; Rain, 2011) and the inability of the natural ecosystem to contain runoff and flooding (Zahran, 2008). Additionally, because research in developing countries is lacking and is less focused on urbanization and its effects on the landscape (Freire, 2014), there are no hard facts to support policy to drive development of infrastructure (Cohen, 2006; Pabi, 2007). Thus, in the increasing incidence of flooding in urban areas, interventions have been introduced based on reports by consultants (Cohen, 2006) which lack local content derived from strategies and concepts developed through long term continual research and, thus, are not working (Frimpong, 2014). Added to this, however, is the challenge to "accurate extraction" of features of the urban landscape such as impervious surfaces (Dhorde, 2012) which is critical to developing "measurable goals" and strategies, guide "urban planning decision making" and "identifying best management practices" for stormwater management and flood control (Bauer, 2007; Li, 2011). The situation can be improved through research which provide timely, less costly and updated data through the use of processes which ensures reliability and is consistent with modern trends. This research was, thus, developed to explore provision of data on imperviousness by using freely and easily available remote sensed images combined with other spatial and non-spatial data to quantify imperviousness in an urban area.

2. IMPERVIOUSNESS INDEX

Imperviousness index is the ratio of the area of impervious surfaces to the total considered area (Drzewiecki, 2009) and is used as a "measure" of "the impact of urbanization on surface runoff" generation (Li, 2011), an "indicator" of "intensity of urban environment" (Brabec, 2002). Matrices of imperviousness can be used to "explicitly quantify, manage and control" "land development" (Li, 2011).Various matrices such as imperviousness ratio, percentage impervious cover, percentage impervious surface area, imperviousness pattern (Bauer, 2007; Su, 2014), impervious surface variable (Zahran, 2008), measured impervious area, average effective impervious area (Wibben, 1976), effective impervious area (EIA), total impervious area (TIA)(Yang, 2013), have been developed to quantify imperviousness. These indices have been developed and are used as the "single most important variable to define the amount of urban development" (Yang, 2013) "a measure of both directed and undirected urban development" (Barnes, 2002); a critical input in developing interventions to address runoff generation to contain foods. These indices are also "critically important" to "land use planners and water resource manages" for the "design and implementation of land use plans and strategies" (Chabaeva, 2004) and to "monitor changes in Land cover in urban

areas" (Drzewiecki, 2009). "Population density" has been shown to be strongly "correlated" to "percentage" "impervious cover" and is used as an indicator of urbanization (Chabaeva, 2004; Dhorde, 2012). Unfortunately in data scarce developing countries, this avenue has not been exploited, creating a vacuum for critical data needed to support urbanization related environmental hazards like flooding.

3. IMPERVIOUSNESS, RUNOFF GENERATION AND FLOODS

Impervious surfaces are surfaces which "water cannot infiltrate" or are "impenetrable" to water and include such constructed surfaces as buildings, rooftops, sidewalks, driveway, roads, and parking lots. Impervious surfaces are "hydrologically active" and "generate a lot of runoff" which leads to floods when they quickly accumulate down stream (Barnes, 2002; Bauer et al., 2005; Drzewiecki, 2009; Li, 2011; Odefey, Detwier et al., 2012). In areas with high imperviousness there is "larger" more intense "surface runoff" generation "downstream", "loss" of vegetation "storage" and more frequent "floods" (Brabec, 2002; Yang, 2003; Bauer et al., 2005; Drzewiecki, 2009) and increased concentration of storm-water flow (Barnes, 2002; Dhorde, 2012). Barnes distinguished other impervious surfaces; stones, compacted soil, soils with high clay content, soils with high ground water tables, saturated soils, all of which are naturally occurring and hydrologically active but "temporal", compared with the other impervious surfaces which are "permanently impervious" (Barnes et al, 2002). For the purposes of this paper, impervious surfaces refers to constructed surfaces which are also hydrologically active.

4. REMOTE SENSING AND GIS APPLICATION TO IMPERVIOUS SURFACE MAPPING

Satellite remote sensing technology and GIS has been successfully used to consistently and repetitively measure Earth's surface conditions such as "impervious surfaces", in a "timely" manner (Bauer, 2007; Xu, 2007) which is considered a better alternative to the "time consuming", "limited" "scope", "expensive" "conventional surveying and mapping" approach (Li, 2011; Acheampong, 2016). Although the "most accurate" means of mapping impervious areas remains the time consuming and labour intensive method of ground surveying and "manual extraction of impervious surface features" using "heads up" digitization (Chabaeva, 2004; Drzewiecki, 2009), the use of satellite remote sensing "over large areas" to "accurately estimate" and quantify impervious surface, which is "critical" for efficient "management" of "urban land", "ecosystem monitoring" and "urban planning"is growing in its popularity (Bauer, 2005; Li, 2011). One such successful means involves using tasseled cap transformed images which involves identifying "impervious surface at the pixel level" (Dhorde, 2012). The method require using tasseled cap transformation to reduce a multispectral satellite remote sensed image to three bands corresponding to "brightness, greenness and wetness, derived at-satellite reflectance-based coefficients" which can be "associated with physical scene characteristics" (Huang, 2003; Yang, 2003) such as impervious surfaces, moister level in soils and vegetation. The brightness component has been proven to be highly correlated to greenness which is "sensitive to the amount of green vegetation" but "inversely related

to imperviousness". This has been used successfully to map out and estimate impervious surfaces in urban areas using the "regression model" approach (Bauer, 2005; Bauer, 2007).

5. OTHER APPROACHES

Several other approaches to determining imperviousness has been developed (Yang, 2003) among which is the work by Chabaeva et al who used "percentage imperviousness as a function of population density"and land use/land cover to quantify imperviousness (Chabaeva, 2004), Dhorde et al who combined population data, land cover data and various indexes to extract impervious surfaces in an urban area (Dhorde, 2012). The research thus sort to use the best approach given the limitation of data scarcity in developing countries to quantify imperviousness in urban areas. To this end the objective of the research was to determine the effectiveness of two methods for impervious surface extraction and estimation using easily available data.

Class	**Description**
Water	Lakes and Rivers
Dense urban	Dense impervious settlements with few to no trees
LesDense urban	Settlements with dispersed vegetation
Tree groves	Clump of trees in urban areas
Saltponds	Industrial sites for salt mining
Fallow lands	Farms and fallow land
Urban Forest	Designated forested areas within settlements
Forest	Undesignated forested areas in fringes of settlements
Riverine	Vegetation along rivers
Road paved	Asphalt and bituminized roads
Road unpaved	Gravel roads
Quarry/Baresoil	Bare soils and areas of active soil and rock extraction
Marshlands	Salty waterlogged areas

Table 1: Land cover types and their description. (Joel Kofi Asiedu & Mengistie Kindu)

6. MATERIALS AND METHODS

6.1 Location

The study site lies within the Greater Accra Metropolitan area (GAMA), a fast growing metropolis with a population of over 4 million in Ghana. GAMA comprises of 8 administrative districts (Kagblor, 2012), although a more recent re-demarcation put it at 15 (Alliance, 2016),out of which 5 were chosen for the research. The five administrative districts are Ga West, Ga East, Ga South Ga Central and Accra Metropolitan Assembly, cover a total land mass of 900 sq km and lies within Geographical coordinates of Longitude 5.804253 and 5.492637dd and Latitude -0.527292 and -0.082525dd North (Programme, 1991; Nyarko, 2002). The site lies within the Coastal Savannah ecological zone of Ghana which experiences two rainy seasons and a pronounced dry season (Darko, 1995; Oppong-Anane, 2006; Glover, 2013; Coulter, 2016)

6.2 Materials

Landsat 7 (2002) acquired on 26/12/2002 with ETM sensor, WRS path and rows 193 and 056 respectively, population data, electoral area maps, high resolution images. Landsat 8 (2014) acquired between 19/12/2014 and 04/01/2015with OLI-TIRS sensor, WRS path 193 and Row 56. AllLandsat images were in Geotiff format with 30m resolution.Boundary maps and population data for two year periods 2000 and 2010 where obtained from Ghana Statistical Services and Land cover maps for 2002 and 2014 prepared from Landsat images. Softwares - PCI Geomatica, Erdas Imagine 2013, ArcMap 10.1 and 10.4, Microsoft Excel were used.

6.3 Methods: Preprocessing / Processing

The Landsat images were downloaded from U. S. Geological Survey web site as Level 1 images while the high resolution images where downloaded from Google earth. The Landsat images where scanned to select those with least cloud cover. The best images for Landsat8 had 1.38 acquired on 22/03/2014 and 19.95% cloud cover acquired on 19/12/2014 respectively. The Landsat images were de-clouded using Erdas Imagine 2013 cloud removal modeler, this gave a poor visual output with a great proportion of the image remaining under clouds for the image with 19.95% cloud cover. PCiGeomatical Cloud removal tool was also used to de-cloud the image, this however gave a far better visual result.Erdas Imagine 2013 Cloud remover modeler was effective in de-clouding images with low cloud cover. Several images with different acquisition dates were used to examine any differences. The Landsat 7 image had 0.0 cloud cover and required no preprocessing.

The Landsat images where clipped to the study site using Erdas Imagine 2013. This was followed by radiometric calibrationand top of the atmosphere at reflectance processing. This was necessary because the “per pixel mapping” approach used “required a non-contaminated reflectance data” (Yang, 2003). The resulting image layers were stacked in Erdas Imagine

Variable Description	Variable key	Coefficient	VIF	StdError	Robust_Pr
Percentage Imperviousness for 2002	PerImp_02	0,803086	3,644996	0,102306	0,000000*
Population Density 2002	PopD_02	-0,000188	2,135760	0,000105	0,001261*
Population Density 2014	PopD_14	-0,000261	4,218699	0,000158	0,072438
Coefficient of Imperviousness 2002 (Less dense urban area)	CoefIm_202	0,078431	2,606136	0,043332	0,095588
Coefficient of Imperviousness 2002 (dense urban area)	CoefIm_203	0,379054	5,769859	0,090475	0,004253*
Coefficient of Imperviousness 2002 (Paved roads)	CoefIm_204	0,042160	2,506343	0,080377	0,300924
Coefficient of Imperviousness 2014 (Less dense urban)	CoefIm_205	-0,028975	1,306978	0,016688	0,000000*
Coefficient of Imperviousness 2014 (dense urban)	CoefIm_206	-0,025007	3,634805	0,049048	0,607209
Coefficient of Imperviousness 2014 (Paved roads)	CoefIm_207	0,395689	3,486931	0,162047	0,004342*
	Robust Pr (*) statistical significance at 5%				

Table 2: Ordinary Least Squares Regression model Coefficients with standard error for percentage imperviousness, population density, and coefficient of imperviousness. (Joel Kofi Asiedu & Mengistie Kindu)

Landsat Image	Band Combination	Image Processing	Adjusted R sq	Acquisition Date
Landsat 7	1 - 5 &7	Tasscp&Toarc	0,802637	26/12/2002
Landsat 7	1 - 5 & 7	Tasscp	0.966605	26/12/2002
Landsat 8	2 - 7	Tasscp&Toarc	0.690464	22/03/2014
Landsat 8	2 - 7	Tasscp	0.72584	22/03/2014
Landsat 8	2 - 7	Tasscp*	0,717971	19/12/2014
Landsat 8	2 - 7	Tasscp	0.965738	19/12/2014
Landsat 8	2 - 7	Tasscp	0.848747	04/01/2015

Table 3: Regression correlation analysis between Greenness layer of Tasseled cap transformed Landsat images and percentage imperviousness. (Joel Kofi Asiedu & Mengistie Kindu)

using a layer combination of 1-5 and 7 for Landsat7 and 2-7 for Landsat 8. They were then tasseled cap transformed (in PCI Geomatica) as explained by Bauer et al, Chabaeva et al,Chander et al (Bauer, 2004; Chabaeva, 2004; Bauer, 2007; Chander, 2009).

Land cover maps were prepared from Landsat 7 (2002) and Landsat 8 (2014) after cloud and haze removal to achieve overall accuracy of 77% using the Confusion matrix method. There were 13 landcover types in each land cover map (table 1). The landcover maps were used to derive coefficient of imperviousness for densely urban, less densely urbanized areas and paved roads according to Chabaeva et al (Chabaeva, 2004).

High resolution historical images of selected model calibration sites in the study area downloaded from Google Earth in tiles and geo-referenced to those locationswere combined with orthophotos for the two year periods. The orthophotos where more convenient to use, amenable to various forms of spatial analysis and allowed a more uniform distribution of model calibration sites both in size and extent. The orthophotos where however limited in their coverage; the 2002 image covered about one fourth while the 2014 image covered about half of the study area. The Google downloaded images although covered a wider area were in tiles limiting the type of spatial analysis that could be done with them. Mosaicking the images required downloading hundreds of tile, making it too tedious and time consuming. Another major challenge was the effect of age and dust on various elements in the images. This was worse with the Google images.

Separate locations were selected for the modelcalibration and test sitesto remove bias. For each model test site percentage imperviousness where determined for coverages of between 2.5-10ha per location as explained by Chabaeva et al. (2004). For this aspect of the research which relied on downloaded Google images, impervious surfaces were limited to roof tops and paved roads. Population data with matching estimated annual growth rate between 2000 and 2010 and between 2010 and 2016 were used to derive 2002 and 2014 populations for each administrative district. This was used to estimate the population density for the various communities within the administrative districts at number of persons per sq km. “Due to the non-linear nature of the data”, as recommended by Chabaeva et al. (2004) “population density was transformed to its Base10” while the coefficient of imperviousness was transformed by the square root of their value. Other forms of transformation (the Quadratic, Reciprocal, and Logarithmic models) were also used.

6.4 Analysis

Using the Ordinary Least Squares tool, a Spatial Analyst Statistical tool in ArcMap 10.1 a regression correlation was run between percentage imperviousness (2014), the dependent variable and population density (2002 and 2014), coefficient of imperviousness (2002 and 2014), and percentage imperviousness for 2002 as the independent variables. Over-all, there were significant differences between the dependent and independent variables at 5% with an adjusted R square of 0,87952, and a Variance Inflated Factor (VIF) of between 1,306978

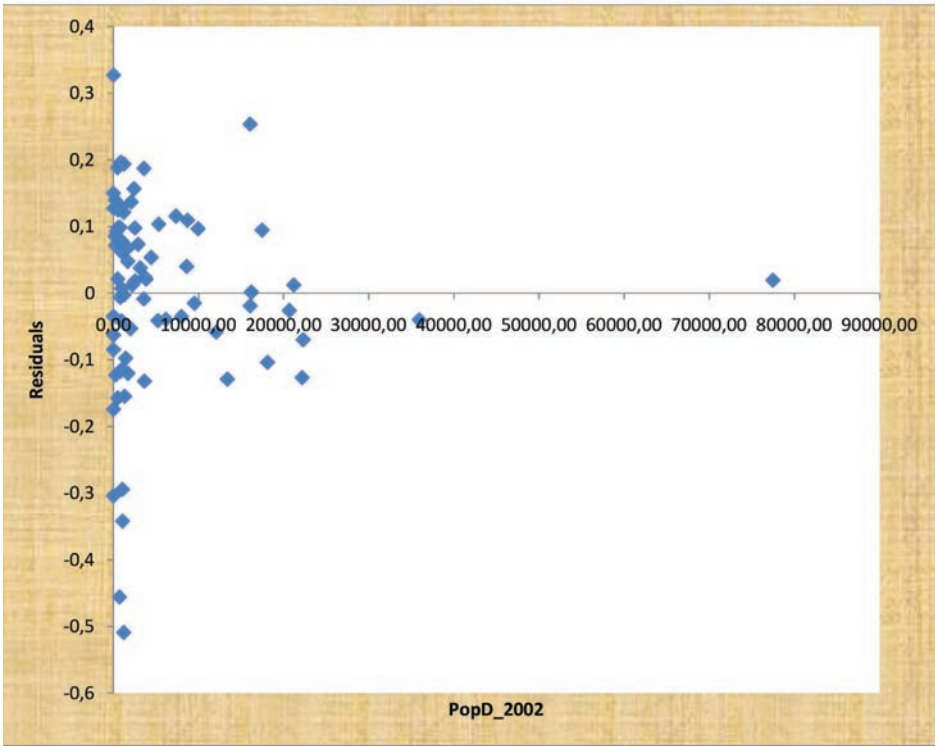

Fig. 1: Residual plot from raw data from population density derived imperviousness.
(Joel Kofi Asiedu & Mengistie Kindu)

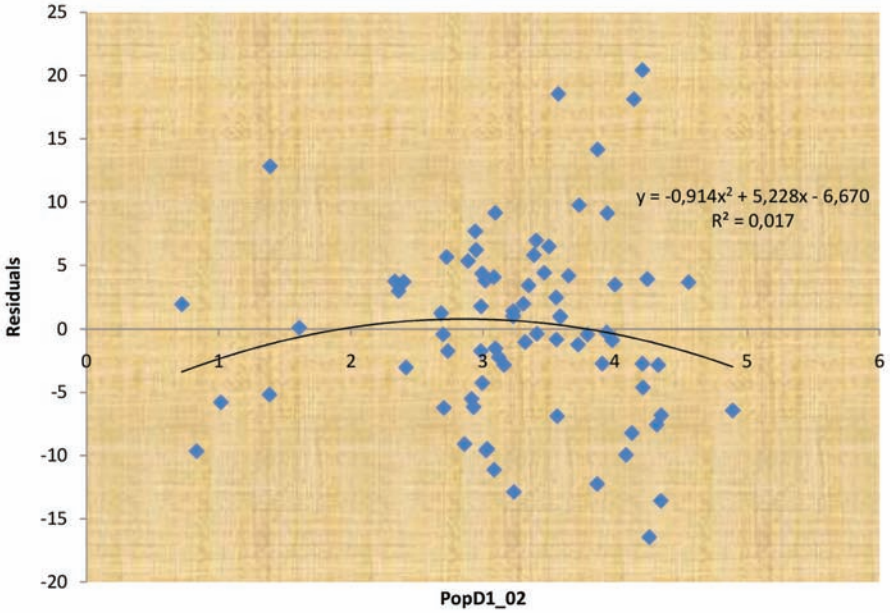

Fig. 2: Residual plot from transformed data for Population density derived imperviousness.
(Joel Kofi Asiedu & Mengistie Kindu)

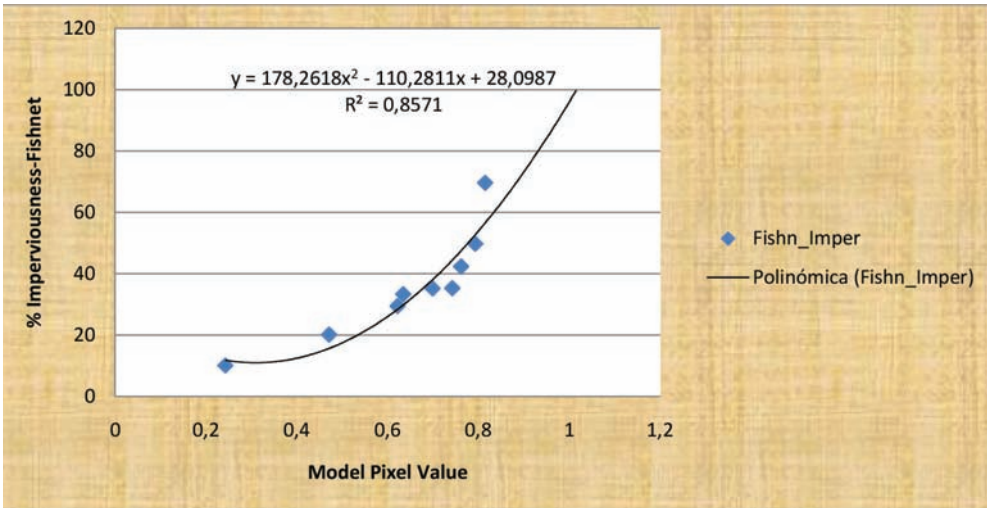

Fig. 3a: Relationship between % Imperviousness and Pixel values from Model without outliers.
(Joel Kofi Asiedu & Mengistie Kindu)

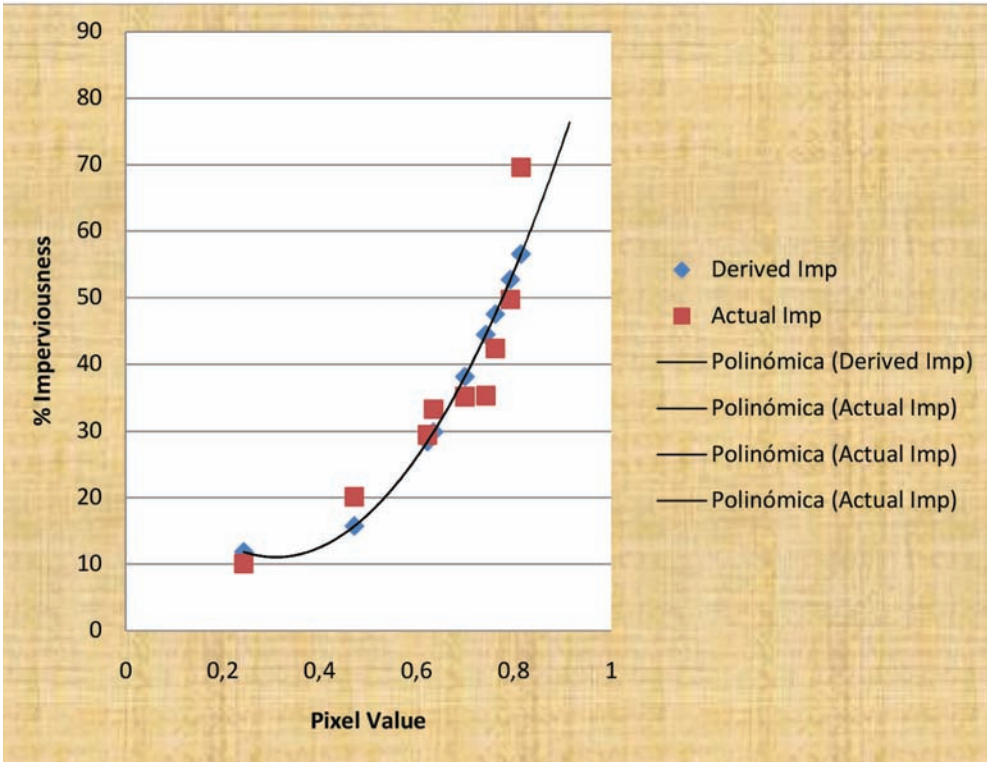

Fig. 3b: Relationship between Calculated Imperviousness and Actual imperviousness without outliers.
(Joel Kofi Asiedu & Mengistie Kindu)

and 5,769859 showing relatively strong correlation with no redundancy between variables for the raw non-transformed data (table 2). There was a slight reduction in the adjusted R square value after transformation (0,835633).There were no significant differences between the coefficient of imperviousness for the two year periods, this however changed when these were separated into their component parts; Less dense urban areas, Dense urban areas, and paved roads.

Although the transformation improved the performance of the scatter plot (fig. 1-2), a plot of the residuals showed a non-linear pattern, and a best line fit produced a very low coefficient of determination. Other forms of transformation did not fare any better.

In Excel, a regression correlation was also run between the greenness layer of radiometrically calibrated, top of the atmosphere at reflectance processed and tasseled cap transformed Landsat images and percentage imperviousness from the high resolution images. This gave an adjusted R sq of 0.802637 for Landsat 7 (2002) and 0.69046 for Landsat 8 (2014) images (table 3).

When these images were tasseled cap transformed without any radiometric calibration or top of the atmosphere at reflectance processing the adjusted R sq was higher at 0.966605 for Landsat 7 (2002) and 0.965738 for Landsat 8 (2014). Table 3 summarizes some results from the various images used.

Results from the regression analysis was used to develop a model which was run in Arcmap 10.1 using the Spatial Analyst Tool. This produced a simulated imperviousness map showing degrees of pixel imperviousness which was reclassified to between 0.1 and 0.8, equivalent to 10 - 80% levels of imperviousness (fig. 4a-b).

7. ACCURACY ASSESSMENT

Accuracy assessment was done on the simulated imperviousness developed from the model using regression analysis as described by Bauer et al (Bauer, 2005; Bauer, 2007) to determine how well and accurate the model identified and classified levels of imperviousness in the Landsat image. The simulated model was then compared with “true land imperviousness” (Li, 2011) of model tests site from high resolution orthophotos. At this stage of the research the assessment was done only on Landsat images which had not been radiometrically calibrated or top of the atmosphere processed. High resolution images for 40 model test sites were selected within the study area. To avoid bias separate locations from those used in calibrating the model were used. The sites where chosen to reflect different levels of imperviousness. A point feature was used to mark the location of impervious surfaces within the model sites and using the Spatial Analysis tools in Arc Map, “Extract to Point’ and “Extract Multiple values to Points’ the pixel values of the high resolution impervious surfaces in the orthophotos were extracted and matched with corresponding pixels in the calibrated model.

Percentage imperviousness calculated for each test model location was used as a guide in reclassification of impervious areas from < 10 to 80% imperviousness. A regression analysis run between pixel values of calibrated model and high resolution image, pixel to pixel matching, produced a high correlation and kappa values (table 4).

To further validate this results the "Fishnet tool' in Arc map was used to divide the entire study area into 120 x 120m regular grid cells based on which the "Create Random Points' tool was used to randomly select 200 locations. The regular grid cells where laid over high resolution orthophotos based on which percentage imperviousness covering 120 x 120m area was calculated for a sample of the 200 locations using heads-up digitization. The calculated % imperviousness which ranged between 5 and 70% (for 2014 image) was matched with the pixel value of the calibrated model at the corresponding pixel locations, after outliers were removed. A pattern emerged with a high coefficient of determination (0,857) (fig. 3a). As a form of cross validation of the observed pattern, the regression equation in Fig 3a was applied to the pixel values from the calibrated model (without the outliers) to generate derived imperviousness for

Year	Adjusted R^2	Kappa Coefficient	Overall Accuracy (%)
2002	0,925181	0,9999087	99,9994
2014	0,985979	0,9977	99,85

Table 4: Results of Accuracy Assessment for 2002 and 2014 Simulated Imperviousness Models. (Joel Kofi Asiedu & Mengistie Kindu)

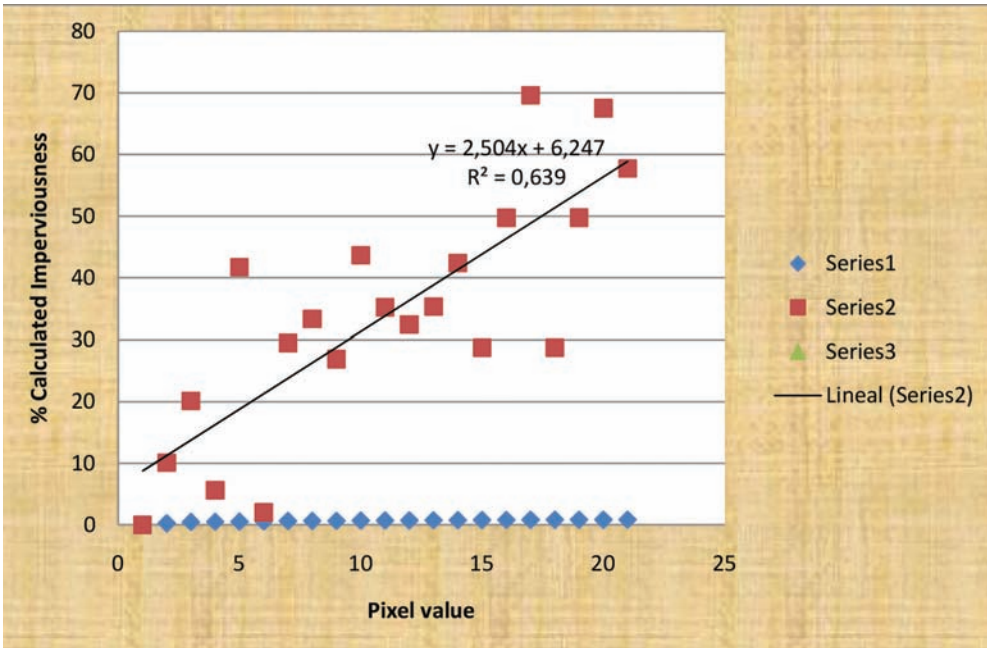

Fig. 4: Raw Pixel values plotted with % Imperviousness. (Joel Kofi Asiedu & Mengistie Kindu)

the respective locations. These where compared with the actual calculated imperviousness (fig. 3b). Fig. 4 shows the relationship with the outliers which produced a lower coefficient of determination (0,639). Transformation of pixel values to log10 without removing outliers did not yield better results. Impervious areas identified for the model calibration and validation were roofs, pave areas and paved roads.

8. DISCUSSION OF RESULTS

The results from the analysis of the percentage imperviousness, population density, and coefficient of imperviousness though not conclusive showed a strong correlation of 0,87952 for the two time periods, 2002 and 2014. Similar work done by Chabaeva et al and Dhorde et al showed a strong correlation between percentage imperviousness, land cover and population density (Chabaeva, 2004; Dhorde, 2012). Using different parameters as has been in this case to extract imperviousness is a means to "strengthen" the "relationship" (Chabaeva, 2004) between dependent and independent variables and to "improve the extraction"(Xu, 2007), however, the non-linear nature of the data which showed no clear trend even after transformation makes it difficult to make any meaningful predictions. This contrasts with Chabaeva et al and Dhorde et al who reported a more linear relationship after transformation. This not-with-standing, coefficients from the regression analysis showing strong relationship between the dependent and independent variables could be used to "predict" "percentage imperviousness" (Chabaeva, 2004). But this may not be sufficient, because for instance, the coefficients for imperviousness of Dense Urban areas although strong did not produce statistically significant difference between 2002 and 2014 (table 2, fig. 4a-b), showing a decreasing trend towards infilling. This contrasts with the Less Dense Urban areas which also had strong coefficients and showed an increase which was statistically significant from 2002 to 2014 (table 2). A similar trend was reported by Acheampong et al (Acheampong, 2016) and Asabere and Owusu-Banahene(Asabere, 1983), but they explained the "fall in density gradients" "as part of the inner city renewal" where planning is used to discourage infilling. This has lead to urban growth patterns in Africa aggregating towards the periphery of urban areas, resulting in "low density often fragmented and sprawling physical development" called "Suburbanization". The complexity of the urban environment then makes it challenging for "accurate extraction of impervious surface information" (Dhorde, 2012), making it imperative to continue trials to produce the best results.

The spatial pattern of the 2002 and 2014 calibrated imperviousness (fig. 4a-b) visually compares well with high resolution images of limited areas of the study area. Combined with the researcher's extensive knowledge of the area it "revealed" a characteristic pattern of "development" (Li, 2011) for the urban area. The regression analysis and accuracy assessment showed a strong correlation between the model and imperviousness from the high resolution orthophotos for the two year periods 2002 and 2014 (adjusted R20.925181 and 0,985979; Kappa of 0,9999087 and 0,985979, respectively). Similar work involving the use of tasseled cap transformation to extract impervious surfaces from Landsat images done by Bauer at al in 2005 and 2007 yielded high correlation of 0,91 (Bauer, 2005; Bauer, 2007) while a range of

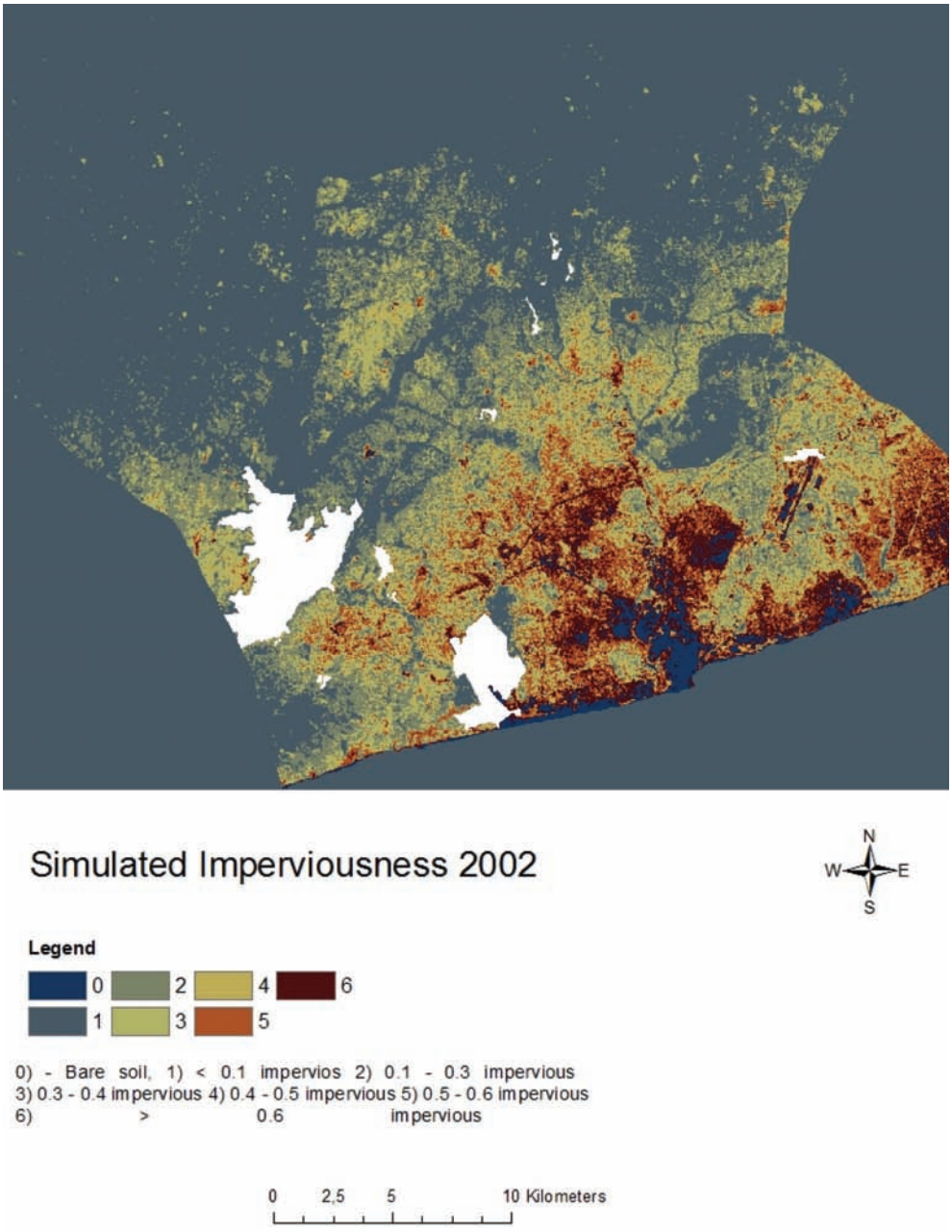

Fig. 4a: Reclassified simulated imperviousness for 2002. (Joel Kofi Asiedu & Mengistie Kindu)

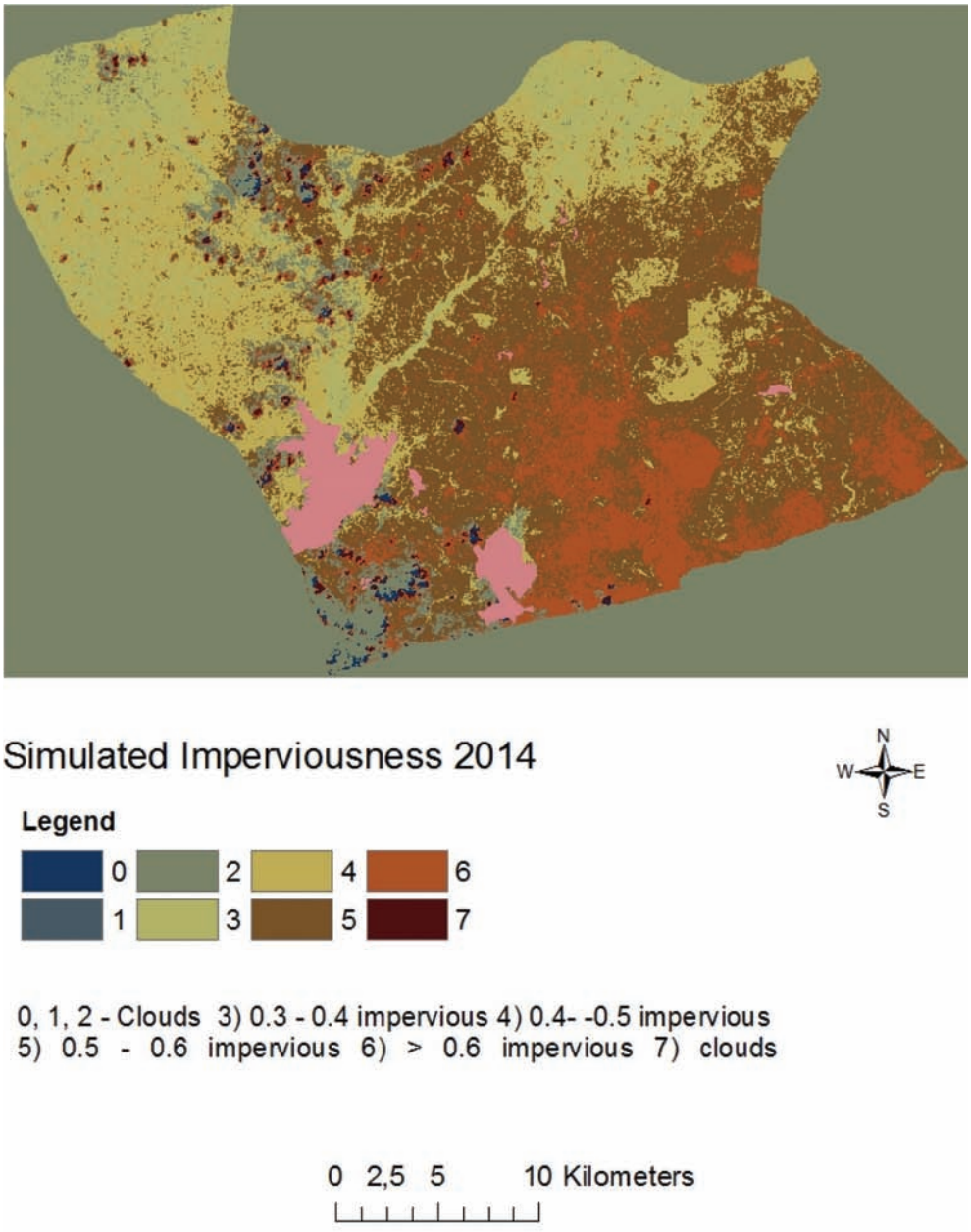

Fig. 4b: Reclassified simulated imperviousness for 2014. (Joel Kofi Asiedu & Mengistie Kindu)

0.82 to 0.91 was reported by Yang et al (Yang, 2003). However unlike Bauer et al, who had a range of 0-100%, the simulated imperviousness produced a continuous range of <10 to 80% for both 2002 and 2014 images. Actual imperviousness though for the 2002 image was up to 67% while that of the 2014 was about 80%. The level of imperviousness in the calibrated model could have been over-estimated due to "similarity and confusion between bare soil and impervious areas" in the images (Bauer, 2005; Drzewiecki, 2009). This is confirmed by the effect of bare surfaces in the 2002 image (fig. 4a). Cross validation done on the calibrated model produced a coefficient of determination 0,639, but this was increased to 0,857 when outliers were removed. Similar works done by others achieved 72% (Li, 2011), 91,5-98,5% (Xu, 2007) with the added advantage of fewer "input variables without compromising quality" of results (Yang, 2003).

9. CONCLUSION

The research has confirmed the strong correlation between imperviousness, population density, and land cover derived coefficient of imperviousness. It has similarly confirmed the strong correlation between the greenness layer of tasseled cap transformed Landsat images and imperviousness. Regression analysis and other forms of Accuracy assessment has given a quantitative value to derived imperviousness from these relationships. This has been further confirmed using reverse assessment on accuracy of results.

Although the work on imperviousness and population density is far from complete it is fair to conclude based on the foregoing results and discussion that extracting imperviousness from the tasseled cap transformed Landsat images provided a more useful outcome. Using this approach, it is possible to extract and quantify imperviousness over extensive areas to about 85% accuracy. Although its reliability is confirmed, the effect of outliers which reduced the precision to 63,9% is very profound and could undermine the effectiveness of the model. This may be improved by increasing the sample size used in the cross validation.

Correction for overestimation due to bare soil areas is an important factor which could be improved by comparing calculated percentage imperviousness for those areas with the pixel values from the calibrated model. The easy availability of Landsat images makes this approach replicable across geographic regions and could be very important in making critical decisions on flood management and in the general context of urban planning and land use management.

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Appendix: Landsat 8 Images (a) & (b) of Study area

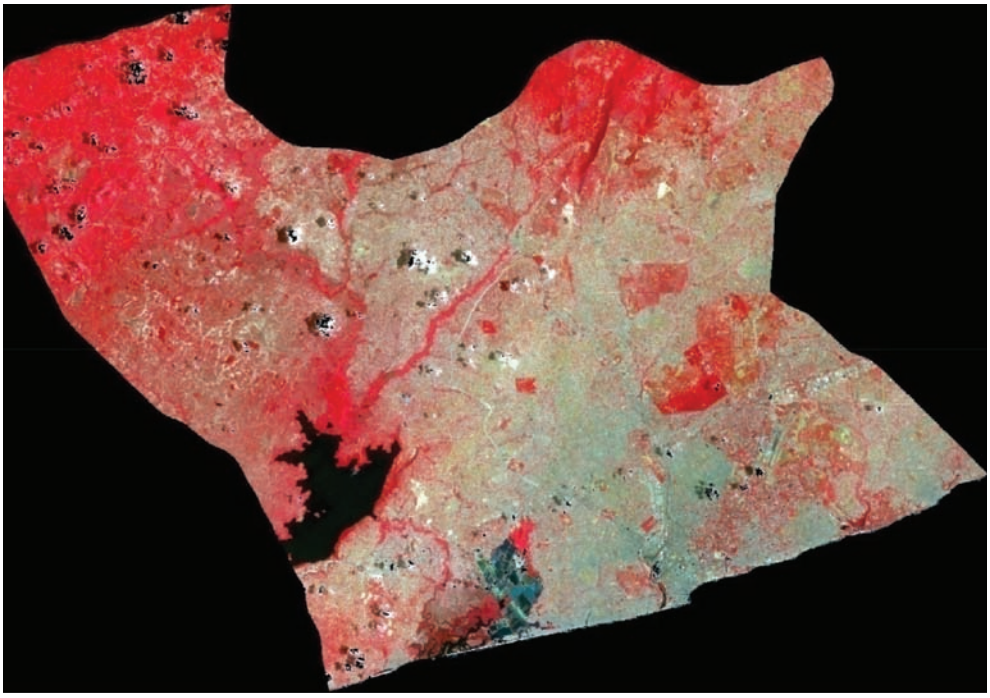

Fig. 5a: De-clouded Landsat 8 with 1.38% cloud cover. (Joel Kofi Asiedu & Mengistie Kindu)

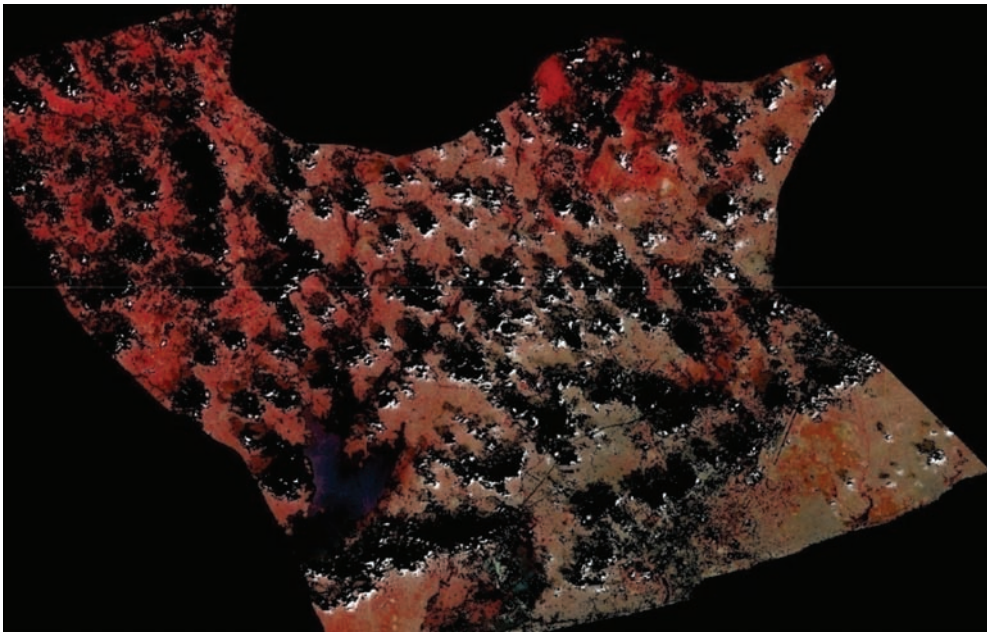

Fig. 5b: De-clouded Landsat 8 with 19.98%. (Joel Kofi Asiedu & Mengistie Kindu)

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LANDSCAPE DESIGN IN THE URBAN FRINGE OF HUESCA
The Padre Querbes urban project

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ABSTRACT

The urban boundary of a city can be considered as a special area between an urbanized field and its natural surroundings and there are several ways of designing this element. Now, it could be said that the period of history in which the proposal arises is involved in its conception due to the influence of the cultural streams of urban design of the moment. In this sense, during the last decade of the twentieth century, a greater formal freedom appears when it comes to shaping urban design. What favours that the design does not only remain in the volumetrization, but that it reaches the thorough definition of spaces, parks and public areas.

Within this framework, Padre Querbes is developed.It was designed in 1999 by Paco Lacruz and the area is located in the boundary of the city of Huesca offering an urban façade to the countryside. The formal freedom of volumetry allows the creation of a large park. And this point is the highlight of the Polygon, that its urban design covers the definition of the whole area including an attention to the landscape unheard of in Huesca until that time through the comprehensive design of the large park. And that is where the Swiss landscape designers Verzone and Woods develop a meticulous agricultural identity project integrated in the urban boundary of Huesca.As such, the inherited landscape is a relevant element in the design of the neighborhood. The buildings and the big park attend to its cultural, social and natural landscape.

Key words: urban fringe, landscape design, urban design, Padre Querbes, Huesca.

LABURPENA

Hirien hiri-muga lur urbanizatuaren eta haren ingurune naturalaren arteko gune berezitzat har daiteke, eta elementu hori diseinatzeko hainbat modu daude. Dena den, esan liteke proposamenaren nondik norakoak zerikusi handia duela haren sorkuntza-aldiarekin; izan ere, historiako garai bakoitzeko hiri-diseinuaren joera kulturalek eragin handia dute. Ildo horretan, XX. mendeko azken hamarkadan, askatasun formal handiagoa agertu zen hiri-diseinua gauzatzeari dagokionez. Horri esker, diseinua ez zen bolumetrizaziora mugatu eta espazio, parke eta gune publikoen definizio osoa hartu zuen eraginpean.

Esparru horren barruan Poligono 24-II izenekoa sortu zen. Paco Lacruz-ek diseinatu zuen 1999an, eta Huescako mugetan dago. Beraz, hiri-fatxada ematen dio mendiari. Bolumetriaren askatasun formalak parke handi bat egitea ahalbidetu zuen. Eta hauxe da poligonoak duen nabarmenena: haren hiri-diseinuak gune guztiaren definizioa biltzen du eta paisaia aintzat hartzen du, orain arte Huescan inoiz egin ez den bezala, parke handi horren diseinu integralaren bidez. Eta hortxe garatu dute Verzone eta Woods paisajista suitzarrek Huescako hiri-mugan txertatutako nekazaritza-izaerako proiektu zehatza. Berez, heredatutako paisaia auzoaren diseinuaren elementu garrantzitsua da. Eraikinek eta parke zabalak paisaia kulturalarekin, sozialarekin eta naturalarekin bat egiten dute.

Gako hitzak: hiri-kanpoaldea, paisaia-diseinua, hiri-diseinua, Padre Querbes, Huesca.

RESUMEN

El límite urbano de una ciudad puede considerarse como una zona especial entre un terreno urbanizado y su entorno natural, y existen varias maneras de diseñar este elemento. Pero se podría decir que el período de la historia en el que surge la propuesta influye en su concepción debido a la influencia de las corrientes culturales del diseño urbano del momento. En este sentido, durante la última década del siglo XX, apareció una mayor libertad formal en lo relativo a la conformación del diseño urbano. Esto favoreció que el diseño no se quedase en la volumetrización, sino que también alcanzase la definición integral de espacios, parques y zonas públicas.

Dentro de este marco surgió el Polígono 24-II. Lo diseñó Paco Lacruz en 1999 y se encuentra en los límites de la ciudad de Huesca, de forma que ofrece una fachada urbana al campo. La libertad formal de la volumetría permitió crear un extenso parque. Y este punto es lo más destacado del polígono: su diseño urbano cubre la definición de toda la zona e incluso presta una atención al paisaje inaudita en Huesca hasta la fecha a través del diseño integral del extenso parque. Y es ahí donde los paisajistas suizos Verzone y Woods desarrollan un meticuloso proyecto de identidad agrícola integrado en la frontera urbana de Huesca. Como

tal, el paisaje heredado es un elemento importante del diseño del barrio. Los edificios y el extenso parque acompañan al paisaje cultural, social y natural.

Palabras clave: periferia urbana, diseño paisajístico, diseño urbano, Padre Querbes, Huesca.

1. THE IMPORTANCE OF THE LANDSCAPE DURING THE CHANGE OF THE CENTURY

The Partial Plan of the Padre Querbes defines in detail the whole scope from the urban design. The concept of urban design in which this article is framed is considered by Jose Luis Sert from his beginnings in the architectural profession, spreaded by Ignasi Sola Morales through his writings, confirmed by José María Ordeig in his research and shared by many other urbanist architects throughout history. From its beginnings, Sert (Bastlund, 1967) carefully pondered the issues of scale and the integration of human and mechanical factors into the open space and its forms. Its intention to express life and movement, its vitality or what happens between what was built, give rise to what is called urban design. Ignasi de Solà-Morales (1994) wrote that “the history of urban architecture of the last fifty years is the history of a desire: to make the city from architecture” where “the structure of the city must be decomposed into smaller units in which the social life and the creative and participative capacities of the individuals could be incorporated to the architecture”. Likewise, Ordeig (2004) comes to define urban design as “the most appropriate expression of architecture in urbanism” where “urbanism must physically concretise the distribution of activities and spaces.”

However, the formal criteria of urban design have been varying throughout the twentieth century. If we focus on the 1990s and the turn of the century, there is greater formal freedom when it comes to shaping urban design. Freedom may be exaggerated in some cases, but it shows a greater independence of tighten that came from instances outside the discipline or fashions that had to be overcome. That is, the need not to end in urban fabrics that were mere repetition of the widening model.

Precisely for this reason, it could be said that a highly valuable trend appears, such as the use of design criteria experienced in the twentieth century, without complexes or prejudices, and with an open mind that would facilitate adaptation to the place and the specific situation. However, it seems fair to point out that, in recent years, values that have been dormant since the 1980s have been booming, such as everything related to natural values: criteria of sustainability and landscape perception are, at present, the protagonists of many Projects. In any case, it is necessary to recognize the primacy of these criteria that until now have been little valued and that must be taken into account as it was in the design of Padre Querbes.

As a consequence of this formal freedom, the attention to the resulting open space would become another of the main characteristics of that decade. This could be due to the period of urban expansion and the location of urban projects in boundary areas more in contact with nature. So that would take into account the surrounding space, both natural and the city itself. It would try to link the new projects through the open space and its design with the nearest urban environment carrying out a job of sewing.

For this, the urban design of this period would focus primarily on the free space either by the management that would give shape, either by the attention to the territory or the landscape

approach that would lead to its subsequent detailed design. This meant the manifestation of the landscape design criteria that were taking place at that time in Europe.

In this way, Padre Querbes or also called Polygon Padre Querbes would represent that evolution towards greater freedom of design, within the parameters of the recomposition of the city and attention to traditional types. That is, aware of the need to continue the city (plot, paths, types) the design would not remain in a mere repetition of the block of the extension. The new form that the plot acquires and the interstitial spaces that are created would be spatially relevant. Likewise, it is important to emphasize the importance of adapting to the environment and, with it, the attention to the landscape. It should be noted that in Padre Querbes the design criteria would respond to those that were taking place in Europe at the time, at the beginning of the 21st century, arriving at an exhaustive detail of each dimension. It is interesting, therefore, to analyse the entire process under which Padre Querbes was developed, showing this change in urban morphology and attention to the landscape.

Therefore, the conception of the urban design described with the moment when the urban project of the Padre Querbes was designed, means that the free space, the large park and the space between the building, was treated with a special sensitivity taking into account the immediate landscape of its surroundings and the agricultural culture of the region of Huesca.

2. THE FORMAL CONFIGURATION OF PADRE QUERBES

2.1 Backgrounds

The Polygon Padre Querbes is located in Huesca, a medium-size Spanish city located in the north of the country, very close to the Pyrenees. It has a population of approximately 50,000 inhabitants and is the provincial capital of the same name (fig. 1). In the research on the urban intervention of Padre Querbes, it has been possible to verify a hypothesis that may be valid for a general reflection on the city. This hypothesis, in this case, has to do with the peculiarity of Huesca, which as Antonio Naval defines it “is not outstanding in the panorama of urban cores and therefore is limited to the group of smaller cities, but not least personal and unrepeatable, with characteristic features that are vital and therefore capable of attracting interest” and as Carlos Labarta also states: “Huesca is a small regional capital whose architectonic and urbanistic advantages exceed those that might be assumed by its size”. It is considered, given the thesis on the urban design of Huesca in the second half of the twentieth century, that this is an example of urban coherence at a time when the largest cities in Spain cannot boast of it, among other things, of the urban discourse itself of the 20th century and not only of its geomorphic configuration.

Now, as in any other city, not all areas of Huesca acted equally. Padre Querbes represents a model of a contemporary city, with a formal freedom that draws attention to its urban environment while integrating and giving continuity to the existing fabric.

Fig. 1: The Padre Querbes in the urban context of Huesca. (Own elaboration from cad file, 2014)

Fig. 2: The Padre Querbes before the urban intervention. (Francisco Lacruz and Monserrat Ruiz, 1999)

But before delving into its urban design let us see the character of this polygon in its beginnings, prior to its development. The plot of this performance was located in a part of the city where buildings of very diverse scales were mixed which gave rise to an urban border devoid of structure. High-rise buildings at the end of the Pyrenees avenue, the Garden City on the other side of the Fraga street, the new open buildings of Polygon 24 and the Quinto Sertorio neighbourhood formed a diverse context in its urban morphology that, once the construction of the contiguous Polygon 24, would gain a clear dominance of residential use, because it had industrial character mainly before.

In addition, within the scope of activity of Padre Querbes, premises with offices on the ground floor were already built for a sports and tannery centre (fig. 2).

The called Padre Querbes housed an area that had undergone a process of degradation and functional obsolescence that advised a direct urban intervention. This was intended to be rehabilitation through a comprehensive reform operation. The result of the proposal would be that where the city had nothing, a public and free surface would appear, by free and properly urbanized cession, occupying almost fifty percent of the area occupied by Padre Querbes. In 1999, the architects Francisco Lacruz and Concepción Ruiz Monserrat, together with the lawyer José Antonio Garcés Nogués, carried out the Modification of the General Plan in Padre Querbes.

The proposal for the development of Padre Querbes consisted, following the philosophy of the Advance of the General Plan of Huesca approved in 1994, to propose an intervention aimed at reclassifying an area that at that time was occupied by educational and sports facilities of a private nature, old and obsolete. The marked residential character, that was going to win the next environment and the diagnosis made in the Advance of the General Plan of Huesca relative to the situation of the real estate market in Huesca, determined the implantation of the residential use in the land like solution more in agreement with the reality. From this would design a new residential building area and a public park complete with the corresponding road, pedestrian and parking areas.

2.2 Structuring ordering and general volumetry

After analysing the urban environment and other factors of the moment such as social or economic, among others, they chosen open types with single-family houses with private garden, collective open blocks with communal and private gardens, respectively, and large non-residential public spaces in order to achieve the lowest possible occupation and to ensure that most of the land was the public park. This seemed to be the habit that was requested by most of the population and that was the attempt of city that the architects intended to realize. The typology of houses took into account those provided in Polygon 24 adjoining and at the same time served the demand for single-family homes pursued from the public display processes of the General Plan of Larrodera (so named because it was the first General Urban

Plan of Huesca Written in 1958 by the architect Emilio Larrodera). This provided an area for single-family homes in Huesca.

As for the general ordering of the proposal, it is worth noting the decision to group the building in one part of the area, leaving the other one open to a large park. Specifically, the building was concentrated in the northern part of the area, leaving the large public park in the South. The action was designed with the intention of respecting the green zones, for that reason the building was staggered, so that the tallest buildings were located to the North and those of smaller height to the South, so that the public and private gardens always presented an adequate sun exposure.And it exists also a direct relationship between the private green spaces of the plots with single family dwelling and the park mentioned. Due to the staggered

Fig. 3: The urban proposal for the Padre Querbes. (Francisco Lacruz and Monserrat Ruiz, 1999)

arrangement of the building volume within the area, there are three typologically distinct fringes (fig. 3).

First, the strip next to Polygon 24 is shaped by open building blocks. It consisted on five blocks, each of them consisting of one or two buildingswith a L-shaped and leaving an interior space where play areas and swimming pools are located. This trip is the tallest with ground floor plus four and attic.

Secondly, the intermediate strip consists of closed semi-intensive building block. It consisted on four blocks in which the buildingsare staggered from the four storeys in the front with the central road until the two plants in the facade towards the park. In terms of volume, this strip means the transition between the building of the first strip and the single-family houses of the third strip. To achieve this, special care was taken in the design of the stepped terraces towards the park which, as far as possible, would present a clear and urban volumetric composition, with the intention of putting the dwellings directly into the park through the “trays” that formed the terraces.

And the third strip, consisting of three parcels, was arranged obliquely, breaking the orthogonality of the two previous strips and allowing the integration and fusion between the built and the large park. It consisted of single-family dwellings with a ground floor height plus two that were grouped together by one, two or three edges. These houses have a suitable building scale which would make the group integrate in the park in a natural way. Private gardens would be transitional spaces between the dwellings and the park (fig. 4).

In terms of endowments reserved a plot for private equipment, green area with swimming pool, which would have access to dwellings of some specific buildings. Traffic was based on the specific interrelation with Polygon 24, the extension of existing streets, and the creation of a vial of its own, in order to establish a level of traffic that would specifically resolve North-South and East-West communications, both exteriors and interiors.

A distinctive urban intervention was proposed, where its stepped form gave room to new typologies and allowed an appropriate transition from Polygon 24 to the adjacent premises and the Garden City. Also, the effect of mass in the near perception of the block from the open space was diminished.

It is key in this action to analyse the housing typology that occupies the graduated volumetry characteristic of this urban intervention. The typological variety is one of the features that favours the staggered volumetry of the performance and with this the main objective of the project is achieved, its integration with the natural surroundings and the continuity of the existing urban network.

The typology of housing varies according to the proximity to the large park. To do this, the first strip made up of C-shaped blocks consists mainly of dwellings in a plant and of various sizes.

Fig. 4: The current situation of the Padre Querbes. (Own elaboration from google maps, 2015)

Fig. 5: The proposal of landscape design for the park. (Verzone Woods Architects, 2002)

The typology in the second strip could be very varied here, with ground floor houses with private gardens, floors on raised floors with large terraces and duplexes on the higher floors. The third row of houses and the closest to the park differs from the previous two as single-family homes with their private garden at the same level as the large park. Likewise, the layout of the building obliquely to the two previous strips allows a greater front in contact with the public park. It seeks with these houses a scale of proper building that makes the group is integrated in the park in a natural way. The private gardens will be spaces of transition between the houses and the park.

3. DESIGN OF THE LANDSCAPE IN THE PARK OF PADRE QUERBES

3.1 Authors of the project

The large free space that remained in the southern part of the urban intervention was designed by another team different from the one that had designed the Partial Plan as a whole. Specifically, the landscape team was Verzone Woods Architects (team consisting of: Craig Verzone, Cristina Woods, Bernadino Espejo, Martin Gauthier, Nicole, Nancy Coulter, Amanda Bennett and Alayna Fraser) stablished in La Cura of Rougemont in Switzerland. They elaborated the project in 2002 being executed during the triennium of 2004 to 2007. The reason why this team designed the resulting park was due to the accumulated experience in this type of projects more of landscape than of building and the close relationship that reached with the team who had drafted the urban design proposal.

The architect Paco Lacruz and the Verzone Woods Architects met at Harvard while attending a master's degree in urban design during courses 92-94. Therefore, a little later, once settled in Zaragoza and La Cura of Rougemont respectively, Paco Lacruz would count on them to carry out the exhaustive detail of the Park of the Padre Querbes.

3.2 The morphology of the park

Since the building had been organized in the northern part of the area, this encouraged the creation of a large public park of approximately 14 400 m^2 in the South. Its morphology is closely related to the volumetry of its surroundings. There are two areas of greater surface located, on the one hand, in the limit in contact with the existing city and on the other, in the interior of the neighbourhood bounded by edification.

Both areas are connected by a trapezoidal area bounded in one of its sides by the School John XXIII and in its opposite side it receives the single-family houses. Through this last side is sewn the park with the building. There are three strips that relate the park to residential use. The immediate access to the houses is done through these spaces, where there is no place for motorized traffic, improving the walking and the pedestrian stay. Likewise, these spaces extend from the first residential strip (fig. 5).

Fig. 6: The garden access for the Padre Querbes. (Own elaboration, 2012)

Fig. 7: The longitudinal park in the South of the Padre Querbes. (Verzone Woods Architects, 2008).

Fig. 8: The interior garden in the Padre Querbes. (Own elaboration, 2012)

3.3 The design of the park

The general proposal that would follow the design of the park was based on creating a nice backdrop for the new buildings and connecting them through the open space with its urban context. Different criteria and materials were used to achieve this goal.

First, two main gardens served as anchor points at the ends, joined by a longitudinal space connecting them. One of them, the garden in contact with the existing city, has a different design from the rest of the park. It is a square area and bounded by the School Juan XXIII and a small existing warehouse. And is blurred on its side in contact with the large park. The predominant pavement is the lawn and we find lines in the East-West direction relating the park to the existing city. Plant elements and banks follow this linearity and rise from the ground to create what could be a field planted with the product packaged and distributed over the surface while waiting for its collection for storage.

It could say that it is through this space from where the pedestrian accessesto the large park. There are two well-defined accesses through pavement, furniture and vegetation. A wooded area has both entrances, one with lawn pavement and the other with hard pavement, reddish and located on the side next to the existing warehouses. Once these accesses are crossed, the pedestrian is located in a hard pavement area from where the longitudinal space that leads to the other garden located inside the neighbourhood starts (fig. 6).

This space contains a path that meanders through meadows and play areas scattered, remembering the events related to agricultural practices in the region. This part of the park is divided in two areas longitudinally separated by a line of trees of average height following a broken line. The first one is placed next to the fence that delimits the School Juan XXIII. This contains play areas on hard pavement at the same time that can be walkable until reaching the interior of the neighbourhood. And the second is the resultant strip that consists of a large surface of lawn where there is no defined path and yes spaces of stay. It is possible to emphasize the variation in the topography, which helps to create zones with more or less sunshine depending on the time of the day and the season of the year. Small water canals from the building part arrive to this longitudinal space, and they flow into a larger canal that follows the broken line of trees that divides the space into two longitudinal (fig. 7).

In this way, one reaches the most interior and protected space, which is the other main garden of the proposal. This, while limited within the proposal and more isolated from the existing city, is open by severalaccesses to the natural environment of the city of Huesca. Concretely, these accesses are placed in three of the corners. The pavement varies between a soft surface of turf and a hard surface in yellow and red colours. In the central part of this garden is a small hill generating the space of stay par excellence of all the great park. From the highest point and also on its slopes, the neighbour feels protected by the building and at the same time have a view of the whole park. This fact could be related to the settlement of the historical old townof Huesca on a mound, from where the whole plain which surrounded was envisioned.

Fig. 9: The park between the buildings. (Elena Lacilla, 2012)

Fig. 10: The park between the buildings. (Elena Lacilla, 2012)

As a remarkable element of this garden is a pergola located on the east side of the garden, metallic and facing the small hill (fig. 8).

Second, there are three interstitial spaces between the buildings. These spaces suppose the colonization of the park from the open spaces between the building. What it means to enhance the presence of the natural landscape instead of spaces destined for the traffic. In fact, it makes the dwellings and the park in direct relation at the same time that the motorized traffic disappears from the scene of the park, strengthening the presence of the natural landscape in all the areas of the neighbourhood.

These spaces have been designed with the aim to achieve a direct relationship between the private gardens and the public park. The main pavement is the lawn, giving continuity to the rest of the large park. It is worth noting the existence of the canals that run through each of these three interstitial spaces in parallel and attached to the private plot of the single-family houses. For that reason, the accesses to the houses have small slats of wood to cross these channels. These strips continue towards the first building strip carrying out the presence of the park and the agricultural identity of Huesca over the neighbourhood (fig 9).

Now, if the park is looked as a whole, it must be said that its design is uniform in all its areas, achieving a open space, unitary and continuous throughout the neighbourhood. This is achieved thanks to the presence of elements that give continuity. These elements are mainly water, vegetation and furniture.

Regarding to water, its presence is constant throughout the neighbourhood. A water slide and a network of canals are inspired by the rich tradition of local irrigation in agricultural use. This system crosses interstitial spaces relating the buildings and public spaces and providing a horizontal structure in the park. It is necessary to point out the importance that the water takes in this project being this element later exported to other landscape projects in Huesca. Regarding to vegetation, the garden hedges, herbs and tuber plant alignments are mixed with rows of native, deciduous and evergreen trees, which make visiblethe seasonal change. Also, the street furniture was custom designed for the park, including platforms, picnic tables, water fountains and steel fittings (fig 10).

4. CONCLUSIONS

Padre Querbes neighbourhood arises from totally different criteria to those that were giving in the city of Huesca until then more in line with the recovery of traditional typologies. In this urban and landscape project, a different solution arises. It is like if the representation we have of the city, had been fragmented and then recomposed in a new possibility, breaking with the established system that supposed both the extension of the annex and the actions of the West. The architect Paco Lacruz proposes, in this boundary of the city, an ordering in which the free space becomes particularly prominent. The layout of the building is due to the future design of the urban park.

Because of this, a new way of dwelling is proposed where the typological diversity depends on the location in relation to the park. The tallest building is considered farer from the park and the single-family housesare totally integrated in it. Likewise, the volumetry of the building does not respond to clean and straight lines, but contains spaces that harbour different spaces for new uses.

Regarding to the open space, the large park of Padre Querbes merges with the dwellings in an attempt to create a dialogue between them through the landscape. The latter would mean the highest point in terms of attention to landscape design in the city of Huesca. The detail

with which it is designed and the criteria of over-designing the whole space to the last square metre would begin to be common since then throughout the first decade of the 21st century. Therefore, the 1990s reflected in Huesca, thanks to this urban project of Padre Querbes, the evolution from a dogmatic design to greater freedom and, therefore, a greater adaptability to the landscape and historical conditions. However, thanks to the formal freedom of design that sought 24-II, the continuity was achieved with the existing city and the landscape surroundings more immediately.

It is highlighted that the urban intervention has several factors that could be considered in a general way. First of all, the urban design increases the possibilities of social relation between the inhabitants of the neighbourhood due to the creation of an only public space instead of dividing the public realm in smaller plots. Secondly, the identity of the neighbourhood is linked with the neighbours thanks to the landscape design which reminds them the agricultural life of Huesca.And thirdly, these neighbours belong to different ages and kind of families, because of the variety of the typology that the Polygon offers.

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CULTIVATING GARDENS IN THE CITY BORDERS OF SANTIAGO
Urban greenery proposals for expansion of the city (1909) and for times of crisis (1935)

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ABSTRACT

The city of Santiago of Chile has an urban history where the relation between city and nature is something infrequent, overcoat from town planning. The presentation seeks to present two exceptional cases in the first half of the 20th century about ideas where the expansion of the city was thought integrating nature as a fundamental component of the project: the Linear City of 1908 and the Workers Gardens of 1935, that had projections in the future of the city.

Both projects have a transnational history in its origins where authors took and adapted ideas developed in other countries that sought to be introduced in Santiago: Arturo Soria's offers for the Linear City of Madrid (1898) and the projects effected by Henri Ford in Detroit (1929). In both cases, there is an approach and consideration of nature in the urban space with a different focus. While the City Linear –presented by Carlos Carvajal in Chile– sees in nature the possibility for the construction of owners of land to build their own individuality and with it, to stop the threat of the anarchistic movements in the beginnings of the 20th century; in case of the Working Gardens –presented by a chilean agronomist linked to projects of popular housing– nature and land was a possibility of construction of autonomy to the working groups in the middle of an economic crisis in the decade of the 1930s.

This ideas and projects shape a construction of edge urban landscape that consider nature and different social groups in special manner and have implied a development in the future of the city.

Key words: environmental urban history, urban agriculture, linear city, labourers vegetable garden, Santiago de Chile.

LABURPENA

Santiago Txilekoaren hiri-historian hiriaren eta naturaren arteko harremana eskasa izan da, batez ere hiri-antolamenduari dagokionez. Aurkezpen honen helburua da XX. mendearen lehen erdialdeko ezohiko bi kasu erakustea, horietan hiriaren hedapena naturaren integrazioa proiektuaren funtsezko osagaitzat hartuta pentsatu baitzen. Bata Hiri Lineala izenekoa da (1908), eta bestea, Langileen Baratzeak izenekoa (1935), eta biek ere hiriaren etorkizunean eragina izan zuten.

Bi proiektu horien jatorria historia transnazional bat izan zen; izan ere, egileek beste herrialde batzuetan sortutako ideiak hartu eta egokitu zituzten, eta Santiagon sartzen saiatu ziren. Hain zuzen ere, Madrilgo Arturo Soriako Hiri Lineala (1898) eta Henry Ford-ek Detroit-en gauzatutako proiektuak (1929) hartu zituzten kontuan. Bi kasuetan natura hiri-espazioan aintzat hartzeko ikuspegia izan zen ardatza, baina ikuspegi desberdin batekin. Esate baterako, Hiri Linealean –Txilen Carlos Carvajalek aurkeztua–, naturak aukera eman zien lur-jabeei euren indibidualtasuna eraikitzeko eta, horren bidez, XX. mendearen hasierako mugimendu anarkisten mehatxua geldiarazteko. Aldiz, Langileen Baratzeetan –herri-etxebizitzen proiektuetan ziharduen Txileko agronomo batek aurkeztuak–, naturak eta lurzoruak autonomia eraikitzeko aukera ematen zien langileei 1930eko hamarkadako krisialdi ekonomikoan.

Ideia eta proiektu horiek hiri-paisaia mugakidea gauzatu dute, betiere natura eta talde sozial guztiak modu berezian aintzat hartuta, eta eragin handia izan dute hiriaren etorkizuneko garapenean.

Gako hitzak: ingurumeneko hiri-historia, hiri-nekazaritza, hiri linealak, langileen baratzeak, Santiago Txilekoa.

RESUMEN

La ciudad de Santiago de Chile tiene una historia urbana en la que la relación entre ciudad y naturaleza es algo infrecuente, especialmente en el caso de la ordenación urbana. El objetivo de esta presentación es mostrar dos casos excepcionales de la primera mitad del siglo XX en los que la expansión de la ciudad se pensó con la integración de la naturaleza como componente fundamental del proyecto: la Ciudad Lineal de 1908 y los Huertos de los Trabajadores de 1935, que tuvieron su proyección en el futuro de la ciudad.

Ambos proyectos tuvieron su origen en una historia transnacional, ya que los autores tomaron y adaptaron ideas surgidas en otros países y trataron de introducirlas en Santiago: La Ciudad Lineal de Arturo Soria de Madrid (1898) y los proyectos llevados a cabo por Henry Ford en Detroit (1929). En ambos casos se produce un enfoque y una consideración de la

naturaleza en el espacio urbano, pero con una perspectiva diferente. Mientras que la Ciudad Lineal –presentada en Chile por Carlos Carvajal– vio en la naturaleza la posibilidad para los propietarios de terrenos de construir su propia individualidad y con ella detener la amenaza de los movimientos anarquistas de comienzos del siglo XX, en el caso de los Huertos de los Trabajadores –presentados por un agrónomo chileno vinculado a proyectos de viviendas populares– la naturaleza y el suelo constituían una posibilidad de construcción de autonomía para los grupos trabajadores en medio de la crisis económica de la década de 1930.

Estas ideas y proyectos conforman una construcción de un paisaje urbano limítrofe que considera la naturaleza y los diferentes grupos sociales de una manera especial e implican un desarrollo en el futuro de la ciudad.

Palabras clave: historia urbana medioambiental, agricultura urbana, ciudad lineal, huertos de los trabajadores, Santiago de Chile.

In a 4300 km length country from North to South and with an average width of 180 km, Santiago de Chile can be considered as a “central” spot of the territory. (119 km from the pacific coast and 2075 km south from the northest city of the country).

Historically –as usually in Latin America– the capital city was the pivotal axis regarding the political, economic, cultural and urban development of the country. The city is located in the central valley taking as an end scene the heights of the Andes mountain chain, which settle itself as a scenic component of strong presence in the city. We will refer to the first half of the XXth century when the city was surrounded by countryside. The two proposals we present here, want to show two options which consider the surrounding environment as a crucial part of the project. In the first case in 1909, is a transformation project with ideas for the extension of the city over the countryside. In the second case, smaller project that considers a special settlement in the urban fringe landscapes which are proposed as a construction of social groups also, where associativity is integrated with an environmental approach to the sites – not so prevalent in this time not now either–. Both ideas are proposed in a time that is previous of a formal town planning which happens in Santiago only in 1932 when the state brought an Austrian town planner –Karl Brunner– to make a general proposal for the city as a whole.

Fig. 1: Image of the outskirts of Santiago. (National Library in Santiago)

1. 1909: LINEAR CITY, USING THE ENVIRONMENT TO TRANSFORM AND EXTEND THE CITY

During the 19th and the 20th century the city of Santiago underwent important changes. A local historian has asserted that"it seems undeniable that between the end of the XIXth century and the beginning of the 20th century the settlement pattern of the Chilean population knew a decisive change that lead it from the rural to the urban" (Salinas, 2014:29). The city of Santiago grew the most[1] and between 1900 and 1930, the population turned from 330 000 to 700 000 inhabitants. The doubling number of inhabitants in 30 years implied a series of transformations that started in 1900 with the introduction of electric trams. In 1905-10 the construction of the sewage system and in 1906, the state starts to take initiatives in order to solve the housing problems, founding the Popular Housing Paydesk (*Caja de la Habitación*).

Along with the rise of population and the city improvements, they are also times of social unrest and popular protests where "… it was the adoption of a political thinking from the part of the proletarian class what seemed to frighten the authorities the most. Particularly the anarchist and socialist ideas were repeatedly mentioned in the police infractions" (De Ramón, 2007: 194) according to a city historian. This fear to the social riot or to the politicization of proletarian groups is also present in the urban proposals that look for the creation of organized and controlled environments producing areas that enabled the development and display of each family's individuality, avoiding the sum of forces and the collective chaos. All these changes, together with the imminent arrival of the public celebration of the independence centenary of the country (1910) was an excellent occasion to show the improvements, made a re-consideration with respect to the growing up and expansion of the foundational city.

A first transformation of the foundational nucleus of city was done in 1870-1873. In the beginning of XX th century the challenges where the expansion of the city and the connection with the city outskirts. In 1909 when Carlos Carvajal, an engineer who was the Architecture Inspector of Santiago townhall, made a new proposition which was basedin the ideas and the project of Arturo Soria for the Linear City of Madrid.The occasion for presenting the project was the First Panamerican Scientific Congress[2] celebrated in Santiago between December 25, 1908, and January 5, 1909. In that opportunity Carlos Carvajal, presents the Linear City proposal.

The Linear City proposal had been thought, designed and executed in Madrid since 1882 by the town planner Arturo Soria (and Urbanization Company of Madrid), and was studied exposed and spread by the engineer Carlos Carvajal in Chile, who sought to complement the expositions of Soria seeking to make them more local.

1 Santiago with the arrival of inner immigrants, welcoming 80% of the total migration of the country in 1920, due to the fact that the city was the receptor of the economic benefits produced by the agricultural development of the center and the south of the country, as well as the excess from the exploitation of the saltpeter from the north.

2 These was the Fourth American Scientific Congress, but the first where United States participate, reason why it was called the First Panamerican Scientific Congress

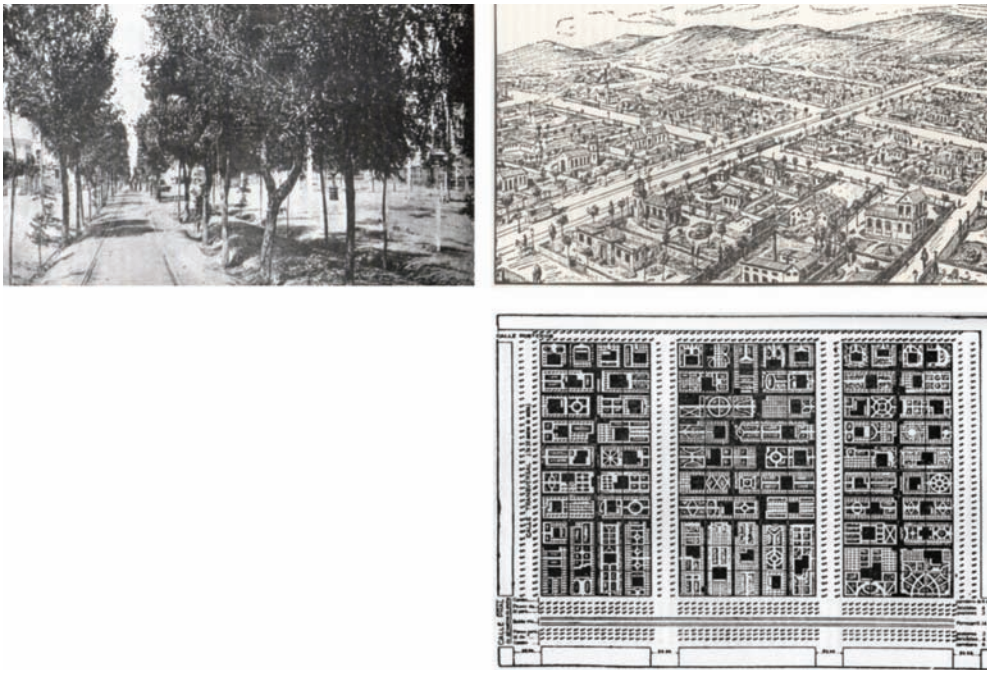

Fig. 2: Carvajal's project developed in Madrid with the main avenue, a bird eye view over the hole project and a floor plan of the with the square where each property had its own garden. (Carvajal, 1912)

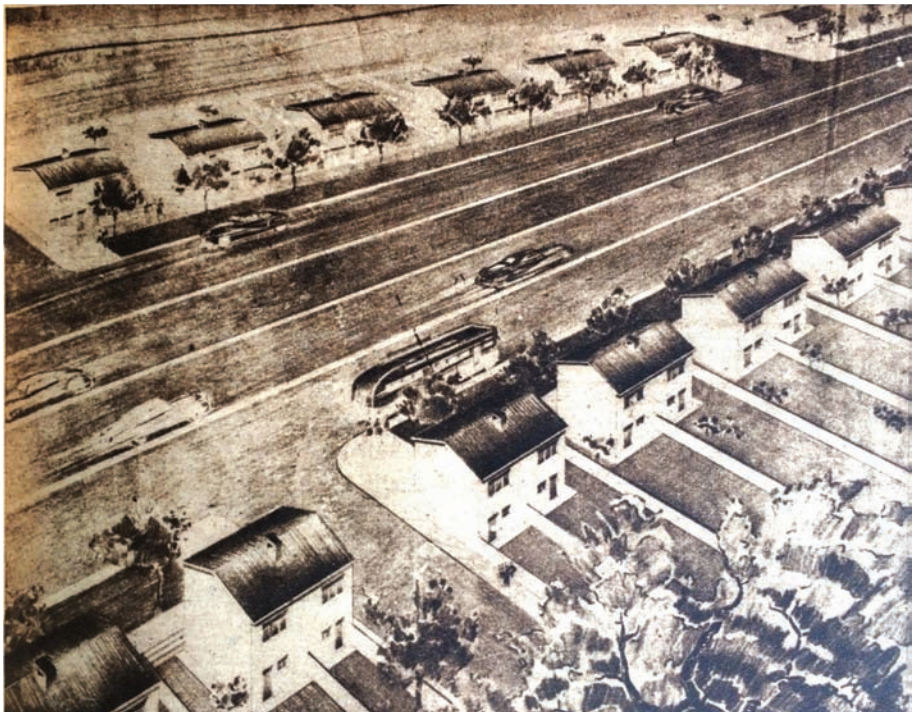

Fig. 3: Linear City "Pedro Aguirre Cerda" of homogeneous building and of wide and beautiful perspective which construction projects the Popular Housing Paydesk. (From ZigZag Revue, N. 1932 / 2 April 1942)

In general terms, the proposal of the Linear City was recounting to forms of growth and expansion of the city and was opposed, –though not explicitly–, to the enlargements in the preexisting city. The intention of the proposition was to expand the city to its outskirts. The offer was seeking to expand the city towards its edges generating a round change in the landscape that was chasing for "ruralizing the city and urbanizing the field". It was at the time, a proposal thought for the edges of the city, that opposed to the centralization of cities which had a central point, that agglutinated economic appreciation, where the people were meeting obliged to hire properties belonging to investments of great capitals.The Linear City was seeking to liberate of the slavery of the rentals and to construct free owners, also as a way of security for avoiding anarchism. Free owners will not be anarchist they thought.

They defend the construction of owners with their own land and "as practical aim, the linear cities will bring the division of the territorial property doing that each one is an owner of the house who lives and who this one is a healthy, comfortable and independent house. For every family a house, in every house a garden and an orchard, this one is the idea that will try to realize the linear city" (Carvajal, 1912).

Nature is the proposal was seen as an efficient way to create a "circular air zone of sanitary protection" (Carvajal, 1912) around each house that would give independence and healthy air in connection with the house that avoid powder and smoke (and with that health problems like tuberculosis). The challenge of the plan in "urbanizing the field and ruralizing the city", were the topic of mobility (displacement as they call it then) was a key topic in the irruption of technology appearing in conformation and functionality of landscape. And here "…the straight line is the most perfect and also in many cases, the line of better resistance and therefore the best …". So, for Carvajal, "it is necessary to give to the city the most logical and adapted form to the typical inventions of this century of railroads and streetcars for the persons rapid transport and bundles; of telegraphs and of telephones that suppress the distances in the communication of the thought and the word" (Carvajal, 1912). That is to say, it was the same technology –and its implicit geometry– the one that was dictating the best options that were integrating a harmonic design that was making possible also to join field and city: the straight line.

Thus, the Linear City was conformed as an extension of the existing city in the shape of a line that was structured concerning a central street where was located a streetcar that was interrelating the city expanded through a line with the urban preexisting edges. To the sides of the railroad appear the individual owners who constituted a social sure construction against the powerful forces of the anarchism.They wanted to form owners as a safety way of protection against the anarchist movements, because they thought that land owners who could cultivate their own agriculture was a way of having something of your own and rest interest in political revolutionary movements.

The properties of the Linear City were raised as a "house garden", because for Carvajal (and Soria) thesafety and health of a city begin by dividing the owners construction in isolated

properties one of each other and that where surrounded by a garden where they could also cultivate their own agricultural products. For Carvajal "… the house garden, it comes to be like the source of blue and green beams for our existence, becoming oxygenated and giving life it cures those who live in them and we must name tomb houses those mansions of the darkness where one develops the tuberculosis, anemia and other plagues that today they afflict to the big cities" (Carvajal, 1912: 52).

The Linear City Proposal such as Carvajal presented it was never built, but finally it was carried out in some specific streets of Santiago that would have been inspired in Carvajal's ideas for executing their design. Here the linear city of "Pedro Aguirre Cerda" in the outskirts of the city of Santiago, published as a project in 1942 in the ZigZag Magazine. There are several streets of Santiago that are based in the propositions of Carvajal (in these moment part of research about the relation with his proposal).

2. 1935: LABOURERS VEGETABLE GARDENS A PROPOSAL FOR A CITY IN ECONOMIC AND SOCIAL CRISIS

In the thirties an environmental view of the city –that integrates the countryside and the city– appears again in Santiago, this time in a social housing project: the *Labourers Vegetable Gardens*.

The thirties begin with complex scenery: to the international economic crisis repercussions it was added in Chile the end of the saltpeter production in the north, that had constituted– until then–, the main economic income of the country[3] and that in practical terms generated a workers migration to the center of the country. This adverse scenery worsen social and economic problems in the capital city of Santiago with serious housing problems. There are concrete actions, the creation of "Popular Housing Paydesk" in 1936 and the mounting and spread of the "Economic Housing Exhibition" in the same year. More than Santiago´s transformation (like in the beginning of the century), the greatest problem in the thirties was the serious economic crisis with the poverty and the severe housing shortage.

The beginner of the Labourers Vegetable Gardens in Chile was an agronomist: Víctor Robinovitch, who from his position, in charge of the Technical Section of Agriculture in the Popular Housing Paydesk would launch a different proposal of housing projects. This proposal counterposed the new models of modern architecture that were raised from the public institutions (for housing of popular groups) and that were spread by the disciplines´ media (mainly magazines)."The project in his general lines, tends to facilitate the means in order that the working families could live in situation of major expansion, not submitted to the modern building, which restricts in inconvenient form the houses; that makes the rooms narrow and that, for such a consequence, contributes to the disintegration of the families".[4]

3 This was a consequence of the invention of the synthetic saltpeter in Germany in 1929.

4 Cooperative Society of Labourers Vegetable Gardens José Maza Ltda.: "The Chilean Labourers Vegetable Gardens. It is translated this heartfelt popular longing", San Vicente Graphic Workshops, Talleres Gráficos San Vicente, Santiago of Chile, 1941, p. 18.

The Labourers Vegetable Gardens was definitely a different proposal,which even though it had strong implications in terms of plotting, of extension, of circulation, of experience and conformation of the urban landscape, would not be of interest for the disciplinary magazines of architecture of those days. The way to spread it was through labourer's newspapers that follow the speeches and proposals of Victor Robinovitch to which they invited to give due to the interest that his proposals produced.

The idea of Robinovitch was inspired after he read in Ford News Review, Henry Ford's approach in order to face the economic crisis of 1929 in North America, where he created the "Spare Time Gardens" for his workers and employees with the objective of "having products as soon as possible and that they could work in the exploitation of the vegetable garden in their free time" (Robinovitch, 1935).

As an agronomist, for Robinovich the proposal seemed to accomplish not only with the housing requirements but also with a way of facing a crisis at the same time that enabled to improve dramatically how people fed themselves:

> The workers as well as their families enjoyed working the land and seeing grow and ripen their products. The long summer afternoons were dedicated to dig, weed and cultivate the land, and at the end of the day something was picked up to supplement the home food. Fresh vegetables, recently extracted from the soil, were seen for the first time in thousands of worker's houses. But better than all this was the proven fact that through this healthy and useful labor hundreds of families, with no or little income, could escape from the degradation of receiving from the charity, because the products from their vegetable gardens actually prevented the margin that there is between indigence and independence. (Robinovitch, 1935)

The Labourer Vegetable Garden, was seeking to generate autonomy in the workers having each one a productive unit that was making possible to confront the times of crisis being able to produce its own food or across the restoration of domestic industries. It was considered a social construction, and a space that was making possible to improve the popular supply, health and also a better moral construction of the family. In addition, it was promoting social organization across the cooperativism, because to accede to the Labourers Vegetable Gardens, it was necessary to be grouped in cooperatives.

There is a point and is that the working garden was –for the groups that were acceding to him– a way of being opposed to the new modern buildings that the state was facilitating:

> The project in his general lines, tends to facilitate the means in order that working families could live in situation of major expansion, not submitted to the modern building, which restricts an inconvenient form the houses; that makes the rooms narrow and that, for such a consequence, contributes to the disintegration of the families. This project tends to stimulate in this respect to the working families to which they dedicate part of the breaks, or of rest, to the work of the garden, to this expansive entertainment that is going to produce a reduction to him in the cost of life, and that will allow children and wife have, a suitable distraction, in his spirits, by means of the culture and development of the domestic industries, helping to

achieve, simultaneously, that the family chiefs separate of the vices and of the sites of corruption, making them endear his homes.[5]

The law for the execution of Labourers Vegetable Garden was finally a reality in March of 1941, after a long battle even in public institutions, where some persons did not approve the idea since the beginning. This was six years after Robinovitch's ideas were spread by labourer's independent magazines.

The new law established the possibilities of building labourers vegetable gardens but also what they called family orchards. This was a solution that was extended to other cities in the country such as La Calera, Los Angeles, Osorno, Concepción and Talcahuano.


El Huerto Obrero

El Frente toma Acuerdos

EL CULTIVO DE LA FRUTAS y Hortalizas en los Sitios de los OBREROS

El Huerto Obrero

El Huerto Obrero en los E.E. U.U.

Fig. 4: Some articles of Victor Robinovtich. (*La Habitación* review, 1935)

Fig. 5: A Chilean Working Garden. (Sociedad Cooperativa de Huertos Obreros "José Maza Ltda", 1941)

5 Sociedad Cooperativa de Huertos Obreros "José Maza" Ltda.: "Los Huertos Obreros Chilenos. Se traduce en realidad esta sentida aspiración popular", Talleres Gráficos San Vicente, Santiago de Chile, 1941. P. 19.

3. CONCLUSION

The work presented here is an approximation to attempts of two different projects for the occupation of the urban fringe landscapes in a Latin American city as Santiago, were the occupation of the border many times had an informal use.

In one case, in the beginning of the 20th century (1909), a proposition for the expansion of the city using new technologies as the train with an incorporation of individualized nature space that gave health, space and social peace, creating owners of properties with their own gardens and orchards that ensure social peace. In the second case, in middle of the thirties (1935) a proposition of a social housing project that incorporate a piece of land for the workers who could built a certain autonomy cultivating their own orchard in times of deep economic and social crisis in the city and the country.

Even these cases were not so successful; they showed possibilities of making projects in the urban fringe landscapes, integrating an urban vision to the outskirts of the city. Both projects were proposed not only for the capital city of Santiago but for the whole country (other cities) and the environmental focus of their proposition was something that was not integrated in the urban proposals of that time, so they have a big significance if we look at them today. In a way, they prepare the way to urbanism as a key tool for the construction of a modern city in Chile with the integration of the outskirts or borders.

In the case of Carlos Carvajal and the Linear City, his propositions on using the outskirts to extend the city, was also against the discussion of the time that wanted to make enlargements in the center of Santiago. He wanted to expand the city and consider that was a way of building a modern space using a straight line that follow the new technologies as trains and trams: ruralize the city and urbanize the field, building free owners that could pay their own properties instead of slavery tenants of the center downtown. At the end, these could build social peace and it could be a safety policy against the irruption of the anarchistic movements. The straight line could organize the expansion, the mobility, the individual sites and houses –that he called as garden-house where organized around the straight line of the train–.

Victor Robinovitch and the Labourers Vegetable Gardens, wanted to build a different alternative to the modern collective houses that the government built for some workers. The Labourers Vegetable Gardens was a different way of urbanization of urban fringe landscapes that gave big possibilities of expansion, of work and of their own autonomy to workers that were always dependent of their jobs.

So, while one proposal (Linear City) wants to participate in modernity using technology and geometry that they related with a modern way of life and they could implement to inhabitants in the outskirts of the city; the other proposition of the thirties, (Labourers Vegetable Garden) wants to build a special refuge from the modern collective architecture (for the poor) that they saw as a threat for themselvesand propose a type of urbanization in the urban fringe that give

big possibilities of expansion, of work, and of autonomy to working classes that were always dependent people. They were expecting a lifestyle that they thought labourers vegetable garden could build for them.

Both proposals appear and place in the edges of the city, in which appears possible to have a new type of relation with a natural space that offer advantages in the way of living. These special environmental existing conditions in the edge grant health, ventilation, light, individuality and possibilities of being an owner in case of the Linear City, whereas for the Labourers Vegetable Gardens, the conditions of the edge grant possibilities of association to reach common aims, major possibilities of space, land and with it, a longed autonomy with possibilities of their own food production, better familiy life and the introduction of small domestic industries.

Even if none of the projects can be qualified as a success, since they were raised on a small scale, they constitute a way of approaching the fringe urban landscape and therefore they write part of the history of the urban periphery, an urban history to be written respect of the interventions of the 20th century. They raised forms of habitability that later influenced other punctual projects and they correspond also to liberal political visions –in case of Carvajal– where there is promoted a society build by owners of individualized plots who were living in similar conditions and with a certain homogeneity of the territory. And, in the case of Labourers Vegetable Gardens, years later some people would link them to José Martí's proposals for Cuba and they constitute a project of construction of working groups –already from the denomination that the project had–. In both cases, there is a presence of an urban environment that is loaded by urban and political potentials.

It is the history of outskirts of the city far from downtown and historical places where relation with environment is strongest and has political content. In both cases we have an approach to urban environment and to urban frindge with an ideological construction even before a social or a real concrete project. In the first example of 1909 nature and environment was a space to built health by having green and air around the individual houses, an idea for building owners. In the case of 1935, environment near the city and land made possible to have a productive unit for workers that gave then independence andeconomic possibilities in middle of economic crises.

Carvajal and Robinovitch –both professionals formed in Chile– understood the importance of the relationship of man with his territory that had a social component and ideas related to classes and cultures. The historian David Arnold points out: "The environment or physical environment has not only been a place but also a battlefield where they have fiercely contained ideologies and cultures" (Arnold, 2000:11). In the case of both proposals, that initially were carried out in other sceneries, are adapted to the chilean reality precisely because they enable the construction of certain ideals. The Linear City synthesized by Carvajal in "ruralize the urban life and urbanize the country" looked for the construction of owners, of individualities and a social order –by then menaced–. In the Labourers Vegetable Gardens, Robinovitch looks

for the construction of social class autonomy that happens to be too disturbing for a certain establishment of the country. Both made a special approximation to land and environment from the perspective of urban planning, something that was not frequent in the contemporary city. In 1984 in his book "Nature and City" Michael Hough begins his work saying that: "The disengagement of the land is a disease of the contemporary city". And then he added: "The concepts of "humanity" and "nature" have been understood for a long time as separated problems. This dichotomy has had a deep influence in the thought of the humanity: on one hand the cities where the persons live, and for other one the not urban regions beyond the city, where the nature lives …" (Hough, 2004). It is time to change, time to rescue and to value these first approximations of town planning to an integration of the city with its environment, writing the history of fringe urban landscapes. This work is an approximation to that.

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III. METHODOLOGIES AND TOOLS FOR REGIONAL PLANNING

PRE-PARTICIPATION
Claiming ones' Right to the City

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ABSTRACT

This paper focuses a fragment of my PhD research specifically related to the often lack of understanding of the "Right to the City" (Lefebvre, 1968; Harvey, 2008) by citizens, local authorities, NGO's and architects, and how that inhibits more participatory forms of engagement in the making of shared public spaces.

It will start by narrating an episode from one of the research projects, *outros espaços*, that took place in Beja, Portugal, and which illustrates a level of apathy, neglect and disinterest (Dürrschmidt, 2005; Lefebvre, 1970; Sousa Santos, 2013) in the collective making and ownership of public spaces. It will explore the scope of participation in relation to the "Right to the City".

This paper argues that without a basic understanding and dissemination of the importance of claiming the "Right to the City" by all, participation by itself is void (Miessen, 2010), only leading to ephemeral relational actions (Bishop, 2012) with no further consequences at an urban and social level. In response to the described scenario, it will present part of a proposed methodology to be used by local authorities, architects and all other parties involved in the making and use of public spaces. It intends to raise awareness of the importance of observing and experiencing the city as an extension of ones' homes in order to claim it as ones' own, leading to a compromise between the strategic view of local authorities and tactical appropriation by the citizens (Certeau, 1980).

Key words: right to the city, participation, public spaces, apathy, methodology.

LABURPENA

Artikulu honek nire doktore-tesiaren zati bat du ardatz: hain zuzen ere, herritarrek, tokiko agintariek, GKEek eta arkitektoek ez dutela ulertzen askotan "hirirako eskubidea" (Lefebvre, 1968; Harvey, 2008), eta horrek espazio publiko partekatuak egiteko prozesuetan parte hartzeko konpromiso mota gehiago sortzea eragozten duela.

Hasteko, Beja-n (Portugal) egin zen ikerketa-proiektuetako batean izandako gertakizun baten berri emanez hasiko da, "outros espaços". Izan ere, pasadizo horrek garbi erakusten du zernolako zabarkeriaz, utzikeriaz eta axolagabekeriaz (Dürrschmidt, 2005; Lefebvre, 1970; Sousa Santos, 2013) jokatzen den espazio publikoen jabetzan, eraikuntzan eta erabilera kolektiboan. Parte-hartzearen norainokoa aztertuko du "hirirako eskubidea" ardaztzat hartuta.

Artikulu honek azaldu nahi du ezinbestekoa dela denok "hirirako eskubidea" aldarrikatu behar dugula ulertzea eta ideia hori zabaltzea, zeren, bestela, parte-hartzea, berez, alferrikakoa baita (Miessen, 2010) eta ekintza erlazional iragankorrak baizik ez baitakartza (Bishop, 2012), hiri- nahiz gizarte-mailan ondoriorik izango ez dituztenak. Adierazitako hipotesi horri erantzuteko, metodologia-proposamen baten zati bat aurkeztuko du, tokiko agintariek, arkitektoek eta espazio publikoen eraikuntzan eta erabileran diharduten beste alderdi batzuek erabil dezaten. Artikuluaren helburua da hiria etxebizitzaren luzapen gisa behatzeak eta esperimentatzeak garrantzi handia duela barneraraztea, betiere norberarena balitz bezala aldarrikatzeko eta tokiko agintarien ikuspegi estrategikoaren eta herritarren jabetze taktikoaren arteko konpromisoa lortzeko (Certeau, 1980).

Gako hitzak: hirirako eskubidea, parte-hartzea, espazio publikoak, zabarkeria, metodologia.

RESUMEN

Este artículo se centra en un fragmento de mi tesis doctoral relacionado específicamente con la frecuente falta de entendimiento del "derecho a la ciudad" (Lefebvre, 1968; Harvey, 2008) por parte de ciudadanos, autoridades locales, ONG y arquitectos y cómo eso inhibe la creación de más formas de compromiso participativo en la construcción de espacios públicos compartidos.

Comenzará con la narración de un episodio de uno de los proyectos de investigación, "outros espaços", que tuvo lugar en Beja, Portugal, y que ilustra un nivel de apatía, abandono y desinterés (Dürrschmidt, 2005; Lefebvre, 1970; Sousa Santos, 2013) en la propiedad y la construcción y colectiva de los espacios públicos. Explorará el alcance de la participación en relación con el "derecho a la ciudad".

Este artículo sostiene que sin una comprensión y una difusión básicas de la importancia de que todos reclamemos el "derecho a la ciudad", la participación en sí misma es nula (Miessen, 2010) y solo conduce a acciones relacionales efímeras (Bishop, 2012) sin mayores consecuencias a un nivel urbano y social. En respuesta a la hipótesis descrita, presentará parte de una propuesta de metodología para ser usada por las autoridades locales, arquitectos y otras partes involucradas en la construcción y el uso de espacios públicos. Pretende concienciar de la importancia de observar y experimentar la ciudad como una extensión de la vivienda para reclamarla como propia y alcanzar un compromiso entre la visión estratégica de las autoridades locales y la apropiación táctica de los ciudadanos (Certeau, 1980).

Palabras clave: derecho a la ciudad, participación, espacios públicos, apatía, metodología.

> (The city is) man's most consistent and on the whole his most successful attempt to remake the world he lives in more after his heart's desire. But, if the city is the world which man created, it is the world in which he is henceforth condemned to live. Thus, indirectly, and without any clear sense of the nature of his task, in making the city man has remade himself.
>
> Robert Park

1. INTRODUCTION

This paper focuses on a fragment of my PhD research specifically related to the often lack of understanding and practice of the "Right to the City" (Lefebvre, 1968; Harvey, 2008) by citizens, local authorities, NGO's and architects and how that may affect the way in which participatory projects may, or may not, have adhesion by those who would supposedly benefit from them. This, I argue, leads to the inhibition towards more participatory forms of engagement in the making of shared public spaces.

Beja II's Park narrates an episode from a project I initiated during my PhD, *outros espaços*. It took place in Beja, Portugal, between 2014-15. Beja II's Park is one of various registered examples that illustrates a level of apathy, neglect and disinterest (Dürrschmidt, 2005; Lefebvre, 2003; Sousa Santos, 2013) in the collective making and ownership of public spaces. *Outros espaços* was an initiative by atelier urban nomads (a-un), an architecture, art and design platform which I founded in 2011. a-un's work mostly comprises projects for the collective making of shared public spaces using participatory processes for their conceptual development, construction, programme and maintenance. It intended to be a collaboration with Beja's Municipality, local authorities, Beja II residents' association, local NGO's and the local secondary school.

Beja II's Park raises questions regarding the meaning and scope of participation (Miessen, 2010; Bishop, 2012) considering the understanding and practice of the Right to the City. A proposal for a methodology that could be used for the making of public spaces, balancing the strategic approach of local authorities with the tactical appropriation by the citizens (Certeau, 1980), will conclude the paper.

2. THE RIGHT TO THE CITY

In current times, one often comes across various social movements that focus on urban questions including "a nascent right to the city movement" (Harvey, 2008). The "Right to the City" is quoted as being "championed" by the geographer David Harvey (Perry, 2016). Harvey's essay on the "Right to the City" revisits and reframes the firstly proposed writings on the subject by the French philosopher and sociologist Henri Lefebvre, *Le droit à la ville* (1968). Harvey (2008) states that "Lefebvre was right to insist that the revolution has to be urban, in the broadest sense of the term, or nothing at all".

Lefebvre claimed that the city did not accommodate for the need of creative activity –the oeuvre– which goes beyond the redefinition of the forms, functions and structures of the city and the social needs encountered in urban societies. What Lefebvre designated as the oeuvre, implies the need for "information, symbolism, the imaginary and play". For such to happen: "The right to the city cannot be conceived of as a simple visiting right or as a return to traditional cities. It can only be formulated as a transformed and renewed right to urban life" (Lefebvre, 1995). But how to transform and renew the right to urban life? According to Lefebvre, the specific urban needs would have to be free from exchange value, commerce and profit. Neither architects, nor planners, sociologists or economists have the capacity to "create new social forms or relations". The architect can merely help "trends to be formulated", but should not have the ambition to be the sole creator of such transformations as their proposals tend to be mere interpretations of "inhabiting" rather than result from an understanding of the needs of the inhabitants. Policies can influence social acts and events, but continue to be detached from those by them affected. For Lefebvre, the power rests on the people –individual or in teams– and on the practice of social life. Only then can the "renewed city become the oeuvre" (Lefebvre, 1995). These would have to defeat the ruling strategies and ideologies that have become obstacles for the empowerment of the people. A collaboration of the social and the political are imperative for an urban reform to happen. The power of the people alone would not suffice.

The right to the city rests, therefore, on the people who inhabit the city. Are the inhabitants, however, aware of their rights, and truly interested in converting the theoretical approach to "the right to the city" into praxis?

Harvey's revisit of Lefebvre's writings stresses the importance of reclaiming the city by its inhabitants, as the city is, instead, currently being absorbed, transformed and stollen from the citizens by capitalism, questioning the ways in which surplus should be invested and distributed amongst society. For Harvey:

> (…) what kind of city we want cannot be divorced from the question of what kind of people we want to be (…) The right to the city is, therefore, far more than a right of individual access to the resources that the city embodies (…) It is, moreover, a collective rather than an individual right since changing the city inevitably depends upon the exercise of a collective power over the processes of urbanisation. The freedom to make and remake ourselves and our cities is, I want to argue, one of the most precious yet most neglected of our human rights. (Harvey, 2008)

Similarly to Lefebvre's view, Harvey defends that it is up to the people toclaim their right to the city as a collective entity, in relation to a political, economic, social and urban context. To dissociate the people from the governmental agencies that make decisions regarding the use and shape of the city would mean to create cities that are not designed for their inhabitants, but for speculative inhabitants fantasized by those in, and with, power who, according to Harvey, are mostly those whose vision for the city mostly intends to promote entrepreneurism, the "concentrations of wealth, privilege and consumerism" (Harvey, 2008).

Harvey states that cities are being transformed without any effective criticism. What was once public is being bought by developers who create “cities of fortified fragments, of gated communities and privatised public spaces kept under constant surveillance” (Harvey, 2008). The lack of social and economic balance often leads to a human existence purely based on the need of survival that, according to Harvey, inevitably leaves no space to reclaim the “ideals of urban identity, citizenship and belonging (…)” (Harvey, 2008). The current phenomena of “urban restructuring through “creative destruction” is not exclusive of our times, but the repetition of what has happened in the past. Harvey quotes Engels’ observations from the end of the 19th century when gentrification was already happening.Poor urban conditions were not tackled, but the people who lived in slums in central urban areas would merely be dislocated in order to make profit from the land. The gap between the people, local government, and private capitalist interests prevails.

Despite the power over the city by the wealthy investors, one would question why the people, and the democratically elected governments, continue to support an uneven distribution of the surplus in detriment of a more equitable society and, consequently, more equitable cities.

In 2005 Unesco held the summit “*Politiques urbaines et le droit à la ville*”. The right to the city was discussed and the “World Charter of the Right to the City” drafted. The document’s contents aimed to be disseminated by non-governmental organizations, professional associations, social movement groups, civil society, local authorities, national governments in order to defend and promote democratic values, dignity, equality, diversity and justice for cities and, consequently, for all citizens. The right to the city becomes an extension of the human rights. The Charter consists of twenty-three articles all focused on the importance of creating cities by all and not merely for all, as defended both by Lefebvre in 1968 and by Harvey fifth years later, instead of cities solely for the wealthy fragment of society. City, in this context is the denomination given to any town, village, city, capital, locality, suburb, settlement or similar; and citizens those who live in the city permanently, or in transit (Sané, P. et al., 2006).

The Right to the City implies that “all citizens have the right to participate directly or by representation in the control, planning and governance of the cities in order to increase transparency, efficiency and autonomy of the local public administrations and popular organisations. All citizens have the right to participate in the planning, layout, control, management, rehabilitation and improvement of the cities” (Sané, P. et al., 2006). However, do all citizens wish to participate? Do they see value in being part of the decision making process, or would they rather delegate such decisions to others who they can later blame if they perform poorly or against the citizen’s desires? Is it pertinent to empower the citizens to take action in the making of their cities without providing them the knowledge or expertise to do so?

Article XX: “Measures for the implementation of the Right to the City” of the Chart states that:

> 1. (…)The cities guarantee the participation of all citizens and the civil society organisations in the process of legislative revision (…).
>
> 2. The cities shall provide human rights education to all the employees involved in the implementation of the Right to the City and the corresponding obligations (…).
>
> 3. The cities shall promote the teaching of the principles of the Right to the City in schools and universities and in the popular means of media communications.
>
> 4. The citizens should supervise and evaluate the degree to which these rights are being observed overall.

I defend that although the collective creation of the chart is of fundamental importance, the dissemination of its contents towards the implementation of the stated rights is what can effectively initiate change, the emergence of new social movements and the engagement of governmental agencies. The lack of awareness of such rights due to a defective communication of the contents of the chart makes its existence partially redundant leading to the violation of the "Right to the City" and its appropriation by private capitalist investors. Without an awareness of the consequences of the later, citizens will most likely un-conscientiously continue to subscribe to capitalism in detriment of proactive citizenship becoming themselves part of the mechanism that feeds into the system in which they are trapped. To have a city for all, differs from having a city made by all. An active, aware and conscious participation in the making of our cities is essential for the creation of cities that reflect the principles of a democratic society. Only then, can the citizens unite to oppose the violation of the Right to the City by those who inadequately and opportunistically take over the space that belongs to us all.

3. BEJA II's PARK

July 2014. As a PhD researcher and a practitioner, I approached Beja's Municipality and proposed to develop a collaborative participatory project that intended to regenerate the neglected public space adjacent to Beja II, a housing estate built in the late 1970s. Beja II had been identified by the Municipality and subsequently by the IHRU (Institute of Housing and Urban Rehabilitation) as an ARU (Area of Urban Rehabilitation). *Outros espaços* emerged from an initial dialogue with the engineer responsible for the urban department, with the architect working for the Municipality, with the office of social development representative who had been working weekly in the neighbourhood as part of the Municipality's "logic of participatory proximity" and, finally, with the secretary of the residents' association. Social problems had been identified and the "nature of the social tenants" made the buildings' shared spaces hard to maintain. Since 2011 that the Municipality intended to provide new amenities for the neighbourhood's inhabitants, as well as offer social support to those who most needed through a supposed "logic of participatory proximity". Despite being aware of such needs, the Municipality's plan for the neighbourhood was rather vague and, even if well-intended, there was no understanding of the importance of providing adequate spaces for different activities.

An assumption of the type of activities to be provided had been made prior to any consultation. Despite presenting a list of potential actions, there was no plan on how to implement those actions, nor a plan about how to captivate the population.

However, the seeds seemed to be in place for a collaborative participatory project for the making of a public space. *Outros espaços* appeared to be ideal in the presented context. The supposedly collaborative process started in October. A meeting with the potential partners was arranged and another visit and meeting was scheduled for December. The first communication problems started to emerge when no-one replied to any email. Each partnering entity was supposed to suggest a list of responsibilities they wished to take on-board though nothing happened between one meeting and the other.

Together with the local architect, who appeared to have been to Beja II no more than a couple of times, I was driven to the site five minutes walk from the office. There we met the secretary of the residents' association who was writing by hand the names and addresses of each resident on individual envelops to post the condominiums' monthly invoice. It seemed to be a caricature, though it was real.

December's meeting lead to no more than the agreement of a date for an assembly in the neighbourhood - January 6th. We should all be present and so should the residents. It would be their first opportunity to voice their interests and desires for their neighbourhood. That evening, around 30 people turned up what was a promising start. D., the secretary of the residents' association, had distributed the posters we made and helped spreading the word. Some voiced their wishes and needs: spaces and equipment to play and activities for the local children; green spaces, more trees; places with shade; yoga, gymnastics; traditional games; new football pitch; carpentry workshop; allotments; spaces to learn how to use the computer; spaces to learn how to knit and stitch; to seat, read the paper and talk; to play cards and domino; spaces for the elderly to socialize, were some of the suggestions.

We had gathered plenty of outline suggestions that could then be worked out in detail with the project partners and residents. In February we returned for a week in order to go deeper into the resident's needs and desires. Door-to-door questionnaires about people's interests and activities, interviews about the history and transformation of the neighbourhood and on-site observations were all scheduled for that week. Sadly, this time no one seemed to have been informed. The posters had not been distributed and the word had not been spread. That same week we met with the architect who had already drawn a Sketchup outline proposal for the site. Although it did provide green spaces, those were generic, similar those that could be found anywhere across the country. The park was not a space made by the residents, nor specifically for these residents, but for a generic audience.

Despite the supposed "logic of participatory proximity" of the Municipality, the design proposed was all but participatory. The thought of having embarked on a collaborative and participatory venture was obliterated. We tried to prevent the Sketchup proposal to be developed further

and drew a masterplan proposal based on the suggestions made by the residents and which could then be tailored to more personalised designs that could potentially fit into the bigger infrastructural scheme.

We returned to the neighbourhood for another two weeks post the un-productive week of fieldwork. Two main activities had been designed based on the findings from the assembly, this time working with the local school. Once again, communication had been challenging. By July we decided to put the project on hold to rethink our strategy as neither the municipality, nor the other partnering entities appeared to be interested in developing a collaborative approach to the design of Beja II's public spaces. Instead, when, months later, I contacted the Municipality an updated version of the Sketchup proposal was out for tender with no detailed design and, mostly, with no acknowledgement of any of the consultation done with the residents and of the work we (atelier urban nomads) had developed.

On the 14 May 2017, the park will be officially opened. The residents will probably be pleased with the modern park that will replace the neglected space that once connected the buildings. Public space will be provided, but will it ultimately fulfill the needs and desires of the residents and become a socially binding space, or will it soon become another run down space due to the lack of maintenance and sense of ownership? It is too early to find out. Was the Right to the City retrieved by the residents, or was the construction of the generic park a mere means to pacify the users providing something that is better than what they once had, yet not what they may effectively need?

Fig. 1: Door-to-door questionnaires, Beja II. (Atelier urban nomads, 2015)

4. APATHY

Beja II's Park reveals that despite the supposed interest in developing a project following a "logic of participatory proximity" neither the Municipality, nor any of the project partners or users revealed to be interested in following a collaborative approach to the design and making of the public spaces of Beja II.

We were faced with apathy, as defined on the Oxford Dictionary: the absence or suppression of passion, emotion or excitement; lack of interest in or concern for things that others find moving or exciting. The active approach required for any participatory project to succeed seemed to have given place to a passive, disinterested attitude by all boycotting the ethos of *outros espaços*.The Municipality's project was being perceived as unconnected to *outros espaços* –theirs and ours–.

The sociologist JörgDürrschmidt considers that the phenomena of shrinkage in cities creates what he defines as a "shrinking mentality", an "everyday internalisation of crises, with mentalities that cannot follow the rapid political and economic changes, with broken-hearted biographies and identities, with mobility as well as the refusal to move or to be moved, with societal recognition and shame" (Dürrschmidt, 2005). This leads to seclusion and containment within residential and familiar comfort zones and, as established by the sociologist Sighart Neckel, it "emerges from the inner feeling that one has been personally degraded and exposed".

In the conclusion of The Urban Revolution, 1970, Lefebvre states that "(…) one of the most disturbing problems still remains: the extraordinary passivity of the people mostly directly involved, those who are affected by projects, influenced by strategies". He questions "Why this silence of the part of users? Why the uncertain mutterings about 'aspirations' assuming anyone even bothers to consider them? What exactly is behind this strange situation (where there) has been no trace of any political movement (…)?" (Lefebvre, 2003).

Dürrschmidt's and Lefebvre's statements help to understand why there may be a lack of interest from the part of the citizens/users. Having been promised change numerous times and seen nothing happening, their disinterested reaction, absence of belief were not surprising. However, their passivity and shortage of autonomy to take action regardless of the support of the Municipality revealed a certain level of dependency, accommodation and reliance on the government to generate change, rather than any will to take initiative, to switch from being passive agents to become agents of change. Instead, they adopted an attitude of resignation and indifference transpiring either an unawareness of their Right to the City, or its dismissal.

What was more surprising, though, was the attitude of those who were supposedly interested in having a different approach –more inclusive, less top down– and who intended to promote a "logic of participatory proximity" on the first place –the project partners–. Boaventura de Sousa Santos, Portuguese sociologist, states that thirty years post the implementation of

democracy in Portugal, public space still does not exist as the government continues to control public opinion. Democracy remains fragile. This allows for a different reading of what would otherwise be perceived as apathy and disinterest from the partners. The "logic of participatory proximity" was merely a placebo to convince the residents they were being involved in the design of their neighbourhood whilst the Sketchup proposal was being developed separately from any input from the residents.

5. LOGIC OF PARTICIPATORY PROXIMITY

Participation in relation to architecture projects is a controversial topic. Numerous articles and books, covering both art and architecture, have been recently published and participation has, according to the architecture critic Peter Blundell-Jones, become a buzzword (Blundell-Jones, 2005). Though the term Participation can be interpreted in various ways, most projects that fall into these categories share the will to promote democratic ideals (Helguera, 2011). Participatory projects become political acts. Direct action, activism, spacial agency and through the power of "acting together (one) can reach beyond individual ambitions and objectives" (Schneider, 2013). However, participation is often no more than a romantic notion of "negotiation, inclusion, and democratic decision-making" (Wizman, 2011).

Both the architect and critic Markus Miessen and the art critic Claire Bishop are avid skeptics of the value and effect of the participative involvement of user/audience when it comes to architecture and art projects, respectively:

> Frankly speaking, not everyone should always be asked or invited to be included in the decision making process. There seems to be a false and perverted sense of urgency regarding inclusion, which is most often fuelled by the fear of losing power, sustaining constituencies, and shaping and controlling stakeholders in order to be able to use them strategically (...). Participation has become a radical chic, one that is en vogue with politicians who want to make sure that, rather than producing critical content, the tool itself becomes what is supposed to be read as criticality. (Miessen, 2011)

> At present, the discourse revolves far too often around the unhelpful binary of "active" and "passive" spectatorship, and - more recently - the false polarity of "bad" singular authorship and "good" collective authorship. (…) What matters are the ideas, experiences and possibilities that result from these interactions. (…) to find ways of accounting for participatory art that focus on meaning of what it produces, rather then attending solely to process. (Bishop, 2012)

Outros espaços intended to challenge the skeptic approach towards participation with the idea that by involving both the residents and the partnering entities that would supposedly collaborate in the making of the project, a more inclusive design could emerge from a collective action, transformation and a maintenance programme would keep the space alive once the atelier had departed. However, our intentions were redundant, as our understanding of participation substantially differed from the understanding of those supposedly involved. Our aim to help reclaim the Right to the City was not being acknowledged by anyone involved. Consequently, participation became no more than the ephemeral partake in one-off

inconsequential activities as ultimately the project for the public space was being back staged by the Municipality's architect without taking into account any of the information gathered through the involvement of the residents.

In the eyes of the Municipality, their design had, however been participatory, it had followed "a logic of participatory proximity" through the supposedly weekly visits of the social assistants and the atelier's presence on site. To participate was perceived as the mere presence of the residents in organised events by the council regardless of whether or not their supposed involvement was consequential. For us, *outros espaços* intended to be a route towards a long-term project that would gradually be built conquering the interest of the most reluctant residents through a collection of collaborative actions developed through time. However, once we acknowledged the project was solely of our interest our practice became equally inconsequential.

In relation to Relational Aesthetics, Bishop emphasises the importance of surpassing the momentary effect of the involvement of the audience in the artists' own project that tends to be claimed as co-authored, drawing on the way in which relational art should, at least, attempt to have an impact at an urban, economic, or social scale in the long run. By not having managed to trigger collaboration between the different entities involved, *outros espaços* became a mere piece of relational work making participation no more than a romantic attempt to provoke change, as recurrently criticised by Miessen.

The Right to the City, as claimed by Lefebvre ought to result from a close political and social (users) collaboration. The architects can not, in isolation, trigger any change unless the ones who may be positively affected by change are willing to take action. Architects can, however help to set the trend. The lack of communication, therefore of transparency, between the parties involved led to the interruption of *outros espaços* as the trend can only be set when someone acknowledges it being beneficial.

6. MATRIX : CONCLUSION

In response to the described scenario, as one of various examples of similar situations that have happened in projects of analogous nature, it became clear that prior to the development of any participatory project, there is a need to advocate the importance and value of understanding and claiming the Right to the City not just by citizens, but by those who should supposedly encourage it. Acknowledging the vulnerability of public spaces and how these should not be taken for granted would prevent them from being, as described by Harvey, wrongly and eagerly appropriated by capitalist entities, sold off by those we embraced as our representatives in name of "modernity" and profit, or simply converted into generic spaces. However, if awareness is not present, stating the Rights to the City becomes redundant as those who may benefit from them will not put them into practice.

Matrix is a proposed methodology, a series of adaptable briefs, to be used by local authorities, architects and all other parties involved in the making and use of shared public spaces (outdoors or/and indoors). It intends to raise awareness of the importance of observing and experiencing the city as an extension of ones' homes in order to claim it as ones' own. It is a compromise between the strategic view of local authorities and tactical appropriation by the citizens (Certeau, 1980). It is participatory, though it does not necessarily intend to artificially make any design process more democratic, but to expose the difference between one being involved in the making of one's environment, appropriating it as one's own, and allowing others to decide on ones' behalf accounting for the implied vulnerabilities.

Matrix represents a journey that can take different routes towards the making of shared public spaces, but which always takes off from the same starting point: the spread of the importance of being aware of our Right to the City. To do so, instead of being a proposal for an institutionalised promotion of the Right to the City through the distribution of, for instance, printed information designed off-site, the Matrix starts by proposing the collective making of site and user specific visual information that could take the form, for example, of a brochure/ pamphlet, a video, a storyboard, a performance illustrated or enacted by local people from the specific sites where it intends to be distributed. It could result from a discussion and a public debate where politicians, local entities and residents were all to take part, not in a one-off event, but as part of a series of events providing various opportunities for different people to attend, allowing to conquer the attention of the most skeptic citizens. It should be perceived as an incremental process and the Matrix read as a flexible methodology under construction, susceptible to changes, and which is part of a network of projects that follow the methodology rather than being perceived in isolation.

The merge of tactics and strategy translates into complementary forces –the social and the political–, as stated by Lefebvre. Only by having the two working together, can participatory projects have a long-term impact, only then is the Right to the City put into practice and cities can then reflect those who inhabit them, becoming places made by all and for all.

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A STRUCTURAL EVALUATION OF URBAN TOPOGRAPHY
Pure Landscape, Architecture and Infrastructure: Istanbul Case

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ABSTRACT

This paper presents a structural approach on urban topography, based on the process of "structures of places' described by Christian Norberg-Schulz (1976) in relation with the genius loci concept. Istanbul is chosen as the sample city due to its influential topography.

Urban topography defines a multi-dimensional framework, a complex whole formed with natural and artificial processes as existing and jointed layers of cities like; physical shapes of earth surfaces, architecture, urban pattern, geographical history and cartography in given landscapes. "Structural approach" emphasises formation and rise of the physical layers and offers a three dimensional structure within the parts of "pure landscape", "architecture" and "infrastructure" as strong shaping tools of topography.

Due to the levels of the structures of places; "Urban topography" refers to the first step: Environmental level. The "pure landscape" refers to the second step: Natural phenomena. "Architecture" and "infrastructure" are also refer to the second step: Man-made phenomena.

The purpose is:

- To emphasize how structural approach relates to urban topography as an urban design proposal.
- Searching for potentials to explore "latent" topographies and offers in urban scale.
- Generating ideas for cities based on a more profound interaction with their topographies and geographies, not against them.

Key words: urban topography, structures of places, genius loci, Istanbul.

LABURPENA

Artikulu honek hiri-topografiaren egiturazko ikuspegia aurkezten du, Christian Norberg-Schulz arkitektoak (1976) genius loci kontzeptua dela-eta deskribatutako "tokien egituren" prozesua oinarritzat hartuta. Istanbul hartu du hiri adierazgarritzat, hiri haren topografia eragin handikoa dela aintzat hartuta.

Hiri-topografiak esparru multidimentsional bat definitzen du, osotasun konplexu bat, prozesu naturalez eta artifizialez osatua, hirietan dauden eta artikulatuak diren geruza gisa, lur-azalen, arkitekturaren, hiri-patroiaren, historia geografikoaren eta kartografiaren hiri fisiko gisa, paisaia jakin batzuetan. "Egitura-ikuspegiak" geruza fisikoen osaera eta igoera nabarmentzen ditu eta hiru dimentsioko egitura eskaintzen du "paisaia hutsa", "arkitektura" eta "azpiegitura" zatien barnean, topografiaren osaerarako tresna indartsu gisa.

Tokien egituren mailak direla-eta, "hiri-topografia" lehen urratsari dagokio: ingurumen-mailari. "Paisaia hutsa" bigarren urratsari dagokio: fenomeno naturalei. "Arkitektura" eta "azpiegitura" ere bigarren urratsari dagozkio: gizakiak eragindako fenomenoei.

Helburua hau da:

- *Nabarmentzea nola uztartzen den egitura-ikuspegia hiri-topografiarekin, hiri-diseinurako proposamen gisa.*
- *Hiri-mailan eskaintza eta topografia "sorrak" aztertzeko aukerak bilatzea.*
- *Hirietarako ideiak sortzea, oinarritzat hartuta hiriek topografiekiko eta geografiekiko elkarreragin estuagoa izan behar dutela eta ez haien aurka jardun.*

Gako hitzak: hiri-topografia, tokien egiturak, genius loci, Istanbul.

RESUMEN

Este artículo presenta un enfoque estructural de la topografía urbana basado en el proceso de las "estructuras de lugares" descritas por Christian Norberg-Schulz (1976) en relación con el concepto de genius loci. Se ha escogido Estambul como ciudad representativa por su influyente topografía.

La topografía urbana define un marco multidimensional, un todo complejo formado por procesos naturales y artificiales como capas existentes y articuladas de ciudades como formas físicas de superficies de tierra, arquitectura, patrón urbano, historia geográfica y cartografía en paisajes determinados. El "enfoque estructural" enfatiza la formación y el ascenso de las

capas físicas y ofrece una estructura tridimensional dentro de las partes de "paisaje puro", "arquitectura" e "infraestructura" como fuertes herramientas de conformado de la topografía.

Debido a los niveles de las estructuras de los lugares, la "topografía urbana" se refiere al primer paso: el nivel ambiental. El "paisaje puro" se refiere al segundo paso: los fenómenos naturales. La "arquitectura" y la "infraestructura" también se refieren al segundo paso: los fenómenos provocados por el hombre.

El objetivo es:

- *Enfatizar cómo se relaciona el enfoque estructural con la topografía urbana como propuesta de diseño urbano.*
- *Buscar potenciales para explorar ofertas y topografías "latentes" a escala urbana.*
- *Generar ideas para ciudades basadas en una interacción más profunda con sus topografías y geografías, no contra ellas.*

Palabras clave: topografía urbana, estructuras de lugares, genius loci, Estambul.

1. INTRODUCTION

Cities are multi-layered structuresthat emerged themselves from the earth surfaces they settled. Physically, they areaccumulated formations including natural and artificial processes based on morphologies of specific landscapes and geographies. These accumulations become more compound in time and change with continuous joints. Itis an extremely dynamic and changeable process which indicates a strong topographical base for urban studies.

Topography of a city named as “urban topography” in archaeology and architectural disciplines as a term. From architectural point of view, urban topography is a structuraltotality of citiesincludingbuilt structures landscapes, urban pattern, cartography, history, geography and infrastructuresstrongly connected withthe earth surfaces. Although its usage is not broad in scope, the term generally related with some kind of a fiction between specific (iconic) buildings of a city or an urban form to work on two dimensioned plans.But it is a state ofajoint between different formations of an untouched landscape and a multi-dimensional human effect.This fiction isignored in time andtopography perceived as a fact to tame for a long time.

Several works have been made to disclose the relationship between architecture and topography. Viollet le-Duc’s analyses on structural anatomy of mountainous landscapes, Norberg-Schulz’s focus on the concept of genius loci with strong topographical references of the earth’s surface, Dimitris Pikionis’s descriptions on the sensorial relationship between genius loci and topos as the landscape and David Leatherbarrow’s interpretations on topography as built and unbuiltare instructive sources to understand the scientific background.[1] But, generally it has been used as a conceptual reference for an increasing amount of excellent architectural projects in the last two decades (Jauslin, 2012). Along with good examples, the general approach is very similar to David Gissen’s description: Contemporary architects producing some conditions to advance an agenda that; “Buildings approaching the forms of mountains and caverns; structures that appear as rivers and clouds” Although it is interpreted as an effort to “bring nature back into the view and experience of the city”, considering the role of topography in cities, related proposals are not able to fully-grasp meaning and function of topography in urban scale.

These efforts raised series of important questions about effectiveness, accuracy and evaluation (Gissen, 2008). Because today citiesare struggling with undecipherable urban issues. There are problemsabout comprehending the living environmentin a reasonable way which causes a growing distance between cities and their topographies. Despite recent efforts in urban, landscape and architectural discourses, the relationship is even more broken today because of the recent perception of topography as “a supplementary innovation” (Jauslin, 2012). Beside arguments in academic level, another problem is administrative. Especially cities in rapid development are great commodities for governments to achieve their economic purposes

1 See Viollet-le Duc, E., *Le Massif du Mont Blanc*, 1876. Norberg-Schulz, C., *Genius Loci: Towards a Phenomenology in Architecture*, 1980. Pikionis, D. Sentimental Topography, 1989. Leatherbarrow, D. *Topographical Stories*, 2004.

that topography is not even a subject for any strategic plan,as if the whole city settled on an emptiness. These factors can be the reasons of ever-growing chaos in cities.

Disconnected from realities of the ground and sense of the place; urban topography sometimes expressed but rarely evaluated as a main research focus and still it has not formed a comprehensive meaning.At this point, the word “structure” can be an important term to abstract the person from mainstream discussionsand focus on urban topographyin a pure way of thinking.

2. THE STRUCTURAL APPROACH

Structure of a city is a complex whole to be viewed as raw material. It is a detailed presentation of formation, rise and posture of cities in given landscapes which are already designed, full of problems and mostly approached with learned knowledges and practises, far from the main logic of setting on earth. That requires a focus from primary to a multi-dimensional structure. So the structural approach is a morphological analysis of cities that accommodate natural and man-made layers in different dimensions on earth.

- Concentrateson present situation instead of future scenarios or re-thinking concepts.
- Includes “underground” and “undersea levels” to be able to fully describe the complete urban structure with its extensions.
- Aims to reveal latent or ignored potentials.

As there are many researches abstracted from reality of localness, the “structural approach” focuses on “questioning the earth”, “character of a specific geography”, “physical shapes of natural and man-made artefacts” that are associated with urban topography in three dimensional levels: The pure landscape, architecture and infrastructure as strong shaping tools.

- The “pure landscape” identifies morphologies of earth surfaces without human effectin two perspectives: The geographical characteristics and physical shapes of topography.
- “Architecture” identifies urban pattern and buildings of a cityas a man-made joint on the pure landscape and focuses integration and conversion of urban topography.
- “Infrastructures” identify cutting-linking elements of a city in different dimensionsand define the extensions of urban topography.

In this context, topography of a cityand what it represents is a kind of test bed for devising new ideas and “structural approach” might produce a new topographical reality latent within previous examples.

3. THE STRUCTURE OF PLACES

Due to the research background described in introduction, methodologies applied on topography-architecture relationship are independently based on surface forms, structureor the genius loci concept. The distinguishing marks of these researches that the key focuses never linked together, maybe they were enough point of departures for their times. Also, despite there are partly attributions on urban or territorial scale, theydid not applied for urban studies. Considering the complex and chaotic conditions of contemporary cities, a structural approach on urban topography linked with the structure of places of as the process of the genius loci concept can be a different point of view.

Related with the structural approach, this study is done by the Norwegian architect and phenomenologist Christian Norberg-Schulz. He defined the structure of places in terms of countries, geographies, regions, landscapes and settlements which form a series with a gradually diminishing scale to be able to grasp the genius loci. First, he described an "environmental level" as a comprehensive term for phenomenas in everyday life-world. Than distinguished the natural level as the primary components of given (usually defined in geographical terms) and man-made levels as settlements of different scale with various elements which transform nature into a cultural landscape (Norberg-Schulz, 1976).

The paper accepts levels of the structure of places as a reference that: "Urban topography" refers to the environmental level. The "pure landscape" refers to the natural phenomenas. "Architecture" and "infrastructures" are also refer to the man-made phenomenas.

4. URBAN TOPOGRAPHY OF ISTANBUL (1st STEP: ENVIRONMENTAL LEVEL)

Istanbul is an ancient city located at the transition point between the Mediterranea and the Black Sea regions. Previously it was the centre of Byzantion, Roman Empire, Byzantine Empire, Ottoman Empire and today it is the most important city of Turkey.

The cityreaches across the East-West and the North-South axes of the world, and all their possible variants. It is at the centre of a geography of capital flows that stretches both East and West (EU-Asia). This situation creates an extreme dynamism specifically as a global policy nexus, and as a city for human capital and talent (Sassen, 2009).

While the city is trying to take a position due to strict changes in the world and gaining more importance day by day, radical urban transformations, ambitious infrastructure projects, a construction boom to feed a non-productive economy, immigrations from Syria and political stress has dominated Istanbul for almost ten years. Also, the city is exhausted by terror attacks and a failed coup attempt. All these processes has left harsh footprints. The city has turned into an open air construction site. Land uses has changed. The relationship between topography and the city is underestimated. Borders of the city spread in each dimension and

a fifteen million population created a multi-cored urban structure without any response to topography. Yet the city retains its exuberance and charm.

Background of works on topography of Istanbul started withmaps, paintings, writings and engravings made by curious western and Turkish artists, architects, poets and geographers between 15th and 19th century.[2] They found inspiration in local character and explained this phenomena in their works referring to landscapes and urban milieu (Norberg-Schulz, 1976) of the city. The common characteristics of these works are:

- They are the only descriptive sources on geography, urbanization and architecture of Istanbul between 15th-19th centuries.

- Most of the maps has scale and proportion problems due to lack of technology but they are very instructive.

- The citydepicted with sharper landscapesurfaces than real in engravings and painting. Probably they are exaggerationsofartists'due to their perception.

With the beginning of the 20th century, architects and urban planners like Le Corbusier, Bruno Taut, Nomidis & Schneider, Henri Prost, W. Müller-Wiener, Semavi Eyice, Doğan Kuban and Paul Magdalino are interested with mapping and architecture of the city but most of them focused on historical topography of Istanbul.[3]

- According to Le Corbusier (1915) architecture and urbanization of Istanbul was remarkable and it would be a model for European cities.

- Henri Prost (1939) defended a necessity of redevelopment of the city to be able to fit the modern world.

- The map of Müller-Wiener (1965) became the most realistic historical map of Istanbul.

Since the last two decades the attention has mostly concentrated on practical functions whereas identification has been left to chance. Especially with coastline fills, "the relationship with the natural environment is reduced to fragmentary relations" (Norberg-Schulz, 1976). Although an interest to topography of the city hasstarted againin Istanbul,still it is not a main focus outside of theworks of Doğan Kuban, Hülya Yürekli, Sercan Özgencil Yıldırım, Murat Güvenç and Sibel Bozdoğan. Because one has to deal with the reflections of recent politic pressures on urbanization. As a result, harsh urban transformations and infrastructural projects became the mainstream topics in Istanbul.

2 See Christoforo Buondelmonti, Matrakçı Nasuh, Kauffer, Eugene Flandin, Pierre Loti, Thomas Allom, Antoine-Ignace Melling, Henry, W. Bartlett, Hoca Ali Rıza, Konstantin Aivazovsky, Amadeo Preziosi, Fausto Zonaro, Osman Hamdi, Julia Pardoe and M. Barbie du Bocage.

3 See Kuban, D. (1998), Kent ve Mimarlık Üzerine İstanbul Yazıları.Müller-Wiener, W., 1977, *Historical Topography of Istanbul.* Magdalino, P. (2007), *Medieval Constantinople; Studies on the History and Topography of Byzantine Constantinople.*

The Structure of Places - Structures of Urban Topography - Istanbul		
1st step: Urban Topography - Environmental Level		
2nd step - Natural Phenomena	2nd step - Man-made Phenomena	
Pure landscape	Architecture	Infrastructure
Geographical characteristics: Mediterranean A passage from the Mediterranean to the Black Sea An intersect point between two continents	Urban pattern: 'Seven Hill' urban fiction Bosphorus settlements Expansion of borders Multi-cored urban structure	On the ground: Street patterns Transportation Bridges on Bosphorus Coastline fills
Physical shapes of topography: A waterway between two land pieces A peninsula and an estuary Series of valleys and hills among a waterway	Buildings	Under the ground: Tunnels
		Under sea level: Tunnels in Bosphorus

Table 1: Levels of structures of places-structure of urban topography in the Istanbul example. (Yasemin Küblü)

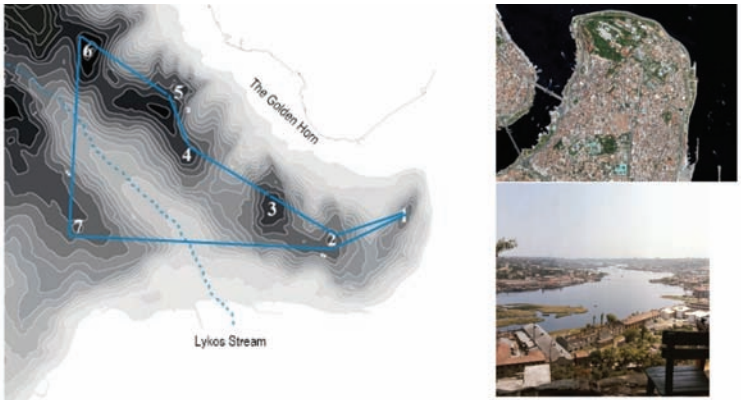

Fig. 1: Historical Peninsula and the Golden Horn. (Yasemin Küblü)

Fig. 2: Le Corbusier's sketch (1915) and the Historical Peninsula (Küblü, 2015).

Fig. 3: Right: Settlement typology of Bosphorus (Yürekli, H. n.d.); Üsküdar from Bosphorus (Küblü, 2013).

As abstracted from recent agenda,if what lies behind existence of Istanbul is wondered, it is obviously topography. Even all built structures would erased, it is still possible to read the city because of its unique location in a special geography which createsa strong “genius loci”. So, the structural approach can be suitable to focus on the chaotic urban topography of Istanbul.

4.1 The Pure Landscape of Istanbul (2nd Step - Natural Phenomena)

4.1.1 Geographical Characteristics

Istanbul is located in the Mediterranean geography, in the north-west Marmara region of Turkey with a surface area of 5 313 km² (TÜİK, 2008) [Url1]. It is the only city in the world that sits on two continents (Europe and Asia).

The city commands a unique geographic position that it is the only gateway from the Mediterranean Sea to the Black Sea. Even before Constantine moved his capital east it was recognized as a crucial location for commercial passage. The Bosphorus holds the key to Black Sea trade and the Golden Horn is a splendid natural harbour. Any long distance travel between the Middle East and Europe, between the Balkans and Western Asia, perforce passed through the city. And its urban economy always reflected its privileged location (Mantran, 1962; Keyder, 1999).

4.1.2 Physical Shapes of Topography

The city is structured by water from Marmara Sea to Black Sea and naturally surrounded by series of hilly topographies among Bosphorus which leads to experience of different landscape fragments byconnecting north and south of the city. This fiction defines the orientation due to the slopes of the hills that open to Bosphorus and Golden Horn and it gives a clear identity of “Istanbul today”, in global context.

According to Braudel (1995), unless the existence of the Golden Horn and Bosphorus, it is impossible understand Istanbul as the heir of Constantinopolis. So, according to the structural approach natural morphology of Istanbul divided into four subtitles.

A peninsula and an estuary: Istanbul’s historical peninsula is surrounded by the Marmara Sea at southeast and limited by Golden Horn at north with twisted forms. It has a triangle form including small bays, narrow passages spread in sea and opening to wide plain areas in the west which gives the peninsula its uniqueness. Three side of the triangle has sharp lines as cape forms. Lykos stream (now Divan Yolu) was passing in the centre of the triangle geometry. It was distinguishing the 7th hill from the others (Prokopius; Yıldırım, 2008).

The Golden Horn is a narrow, twisted inner strait and has a stagnant water surface in comparison to strong currents of Bosphorus with four miles length. It is the best natural

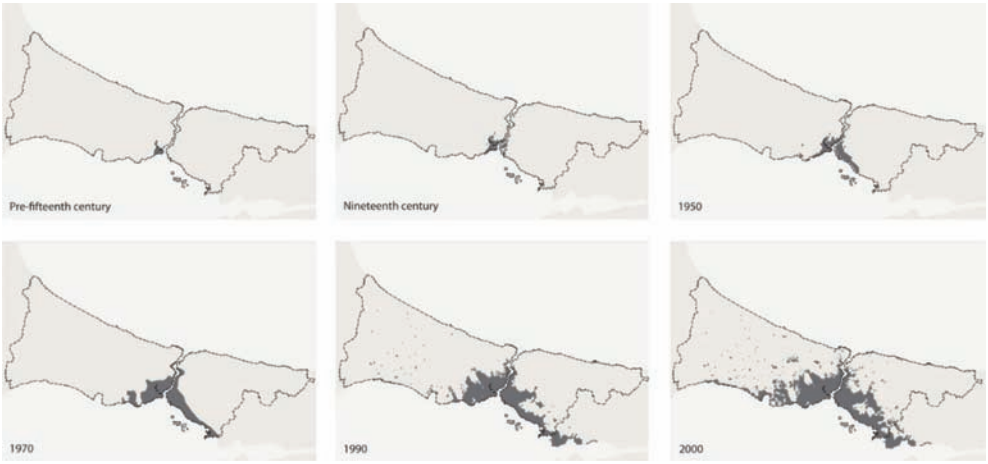

Fig. 4: Historical Evolution of Istanbul's Urban Footprint. (Urban Age Istanbul, 2009)

Fig. 5: Beşiktaş neighborhood and skyscrapers of Levent-Maslak business district in the back. (Yasemin Küblü)

Fig. 6: İstanbul from the Bosphorus Bridge (Yürekli, n.d.); Le Corbusier's sketch from the same perspective, 1915.

harbour in the region and the only safe shelter excluded from the tough nature water from Marmara Sea to Black Sea.

A waterway between two land pieces and series of hills: The Bosphorus is a twisted strait between European and Asian side of the city that has 31 km length and 690-1700 m width. It is a robust sea surface geography between two and a half land pieces which gives the character of Istanbul and creates deep perspectives with 100-110 m height at both sides.

4.2 Architecture in Istanbul (2nd Step - Man-made Phenomena)

4.2.1 Urban Pattern

General character of urban pattern in Istanbul is oriented towards slopes of the hills in a figure-ground relationship with the landscape. Due to immigrations from Anatolia since 1960s and radical urban transformations in last ten years;it is possible to mention several types of settlements today.

“The seven hill urban fiction” is the first thing comes to mind, when Istanbul becomes subject. It is designed by Roman geographers and crowned with iconic mosques of the architect Sinan. Today there is a unique meeting of seven hills, architecture and the sky. It is a perfect genius lociof natural and man-made processes. Probably that is the reason why Le Corbusier specifically focused on the instructiveness of this topography and architecture (Yürekli, n.d.).

“Bosphorus settlements” are the second type of settlements of Istanbul after Historical Peninsula. A typical Bosphorus settlement starts from coastline to valleys and reaches to hilltops. This typology is also same for Historical Peninsula, but the difference is, settlements are placed opposite to each other in two sides of the Bosphorus like tribunes of a stadium. Due to the opening of valleys towards sea, settlements become denser on the slopes of the hills and coastlines are left for settlements in one single line.

Due to the easiness of constructions in base of valleys,some small streams have been lost by burying underground and filling the coastline. These actions caused damage of original topography of the Bosphorus.

“Expansion of borders”: Although there was some small settlements on other sides of Bosphorus and Marmara Sea (Üsküdar and Kadıköy), Historical Peninsula was the only settlement of Istanbul until nineteenth century. With the beginning of the 19th century due to increase of population, the city started to expand among coastlines of the Bosphorus.

Since the second half of the 20th century, an uncontrolled migration flow started from Anatolia and still continues today. It resulted with spread of borders in each dimension.

Expansion of borders created a “multi-cored urban structure” due to recent urban transformation in Istanbul.The city started to lose its character as “a city formed by sea”. The figure-ground relationship is corrupted, just as much as the landscape lost its identity as comprehensive extension. Any enclosure became a centre as a focus for its surroundings (Norberg-Schulz, 1976).

Especially peripheries as the victims of recent construction boom,has no relationship with topography of their environment andoriginal character of İstanbul. They are unorganized settlement types that they can easily be replaced anywhere in the world. This situation creates a growing distance between topography of the city and peripheral settlements.

Today, urban core of İstanbul has two different characters: coastline settlements –their inner extensions– and peripheral settlements. First type considers a strong combination of structure-topography-genius loci. But for second type, it is only possible to mention existence of man-made structures without any connection with topography.

4.2.2 Buildings

Built structures of Istanbul should consider according to how they rest on the ground and rise towards the sky. Especially iconic buildings like the mosques in historical peninsula and skyscrapers of Levent-Maslak business district are dominant figures on urban topography. Today Istanbul is effected by uncontrolled building density and skyscraper topography both in vertical and horizontal. This situation created new a joint layer changed structure of topography. So, topography of Istanbul is not consisting of settlements on the slopes of the hills. There is a verticality against natural morphology and settlement typology of Bosphorus which is an ignored present situation.

Also rising densities and increase of building heights creates a denser and a closed surface cover on the city. It causes loss of sea perspectives which is a typical characteristic of Istanbul.

4.3 Infrastructures of Istanbul (2nd Step - Man-made Phenomena)

In global competition infrastructures are crucial for the economic welfare of a region, which is recognized by a largely supported political consensus across ideological or political borders. (Nijhuis, Jauslin & Vries, 2013). The distinctive infrastructural elements of Istanbul are the ingredients to disclose structure of urban topography in different layers. Some of them are harmonious with topography, some of them are not. Since ten years due to rapid changes in Istanbul, infrastructural projects have started in general of the city and they created a huge impact in urban scale: Topography of the city has gained a multi-dimensional structure especially with the spread of transportation on the ground, underground and undersea levels.

4.3.1 On the Ground

“Street pattern”: Due to slopes of the hills, street and rail transit networks are positioned near coastlines and follow a harmonious route with them. Streets are opening towards sea, in this way, sea effect (smell, sound, wind) enters inner parts of the city and defines the orientation. As some parts of the historical walls in the Historical Peninsula are ruined with earthquakes and demolished to open wide streets in the past, streets are following these footprints today, exactly in the same way.

“Transportation networks” are mainly located nearcoastline to use the advantage of elevation. Towards hilltops slight changes can occur in topography (12-15 m sudden changes in elevation at connection point of one street to another). At this stage, staircases become important elements to provide links on topography.

“Bridges on the Bosphorus” are connecting two sides of the city, Europe and Asia continents and many countries with high time frequencies. Istanbul has two bridges cross over the Golden Horn (Galata Bridge and Haliç Metro Bridge) connecting old Istanbul to Beyoğlu and three bridges on Bosphorus connecting Europe to Asia. Boğaziçi Bridge connects Beylerbeyi to Ortaköy, Fatih Sultan Mehmet Bridge connects Beykoz to Maslak and Yavuz Sultan Selim Bridge connects Poyrazköy to Garipçe.

According to Norberg-Schulz sometimes a landscape can get its value through a bridge. Before the meaning of the landscape was “hidden”, and the building of the bridge brings it out into the open. It is also acceptable for Istanbul.

The Bosphorus Bridge is a perfect example as providing a special perspective to watch the blank space in the centre of Istanbul, from a line which was not there before. It should not be a coincidence that Le Corbusier draw a silhoette from the same perspective in zero level. This is a determining and witnessing of an important state (Yürekli, n.d.).

With opening of the 3rd bridge (thousands of trees cut down for the construction), northern part of the city started to attract attention. Now the area is vulnerable for future constructions. This is a signal rocket for expansion of the city towards the north and deformation of natural topography of Istanbul more and more.

“Coastline Fills”: Naturally there is not wide plain areas on topography of Istanbul. With the beginning of 20th century, plain areas are started to be a part of topography with first fills. As a result, width of coastlines increased nearly 120-150 m towards the sea. These actions deformed natural topography of coastlines (Yürekli, n.d.). Once a coast and water was defining a limit-passage-border, today they are not absolute. As a result, coastline topography encounters with continuous changes in Istanbul. But today coastlines are filling to get benefit for economic reasons (i.e. Galataport project). These infrastructural projects are cutting

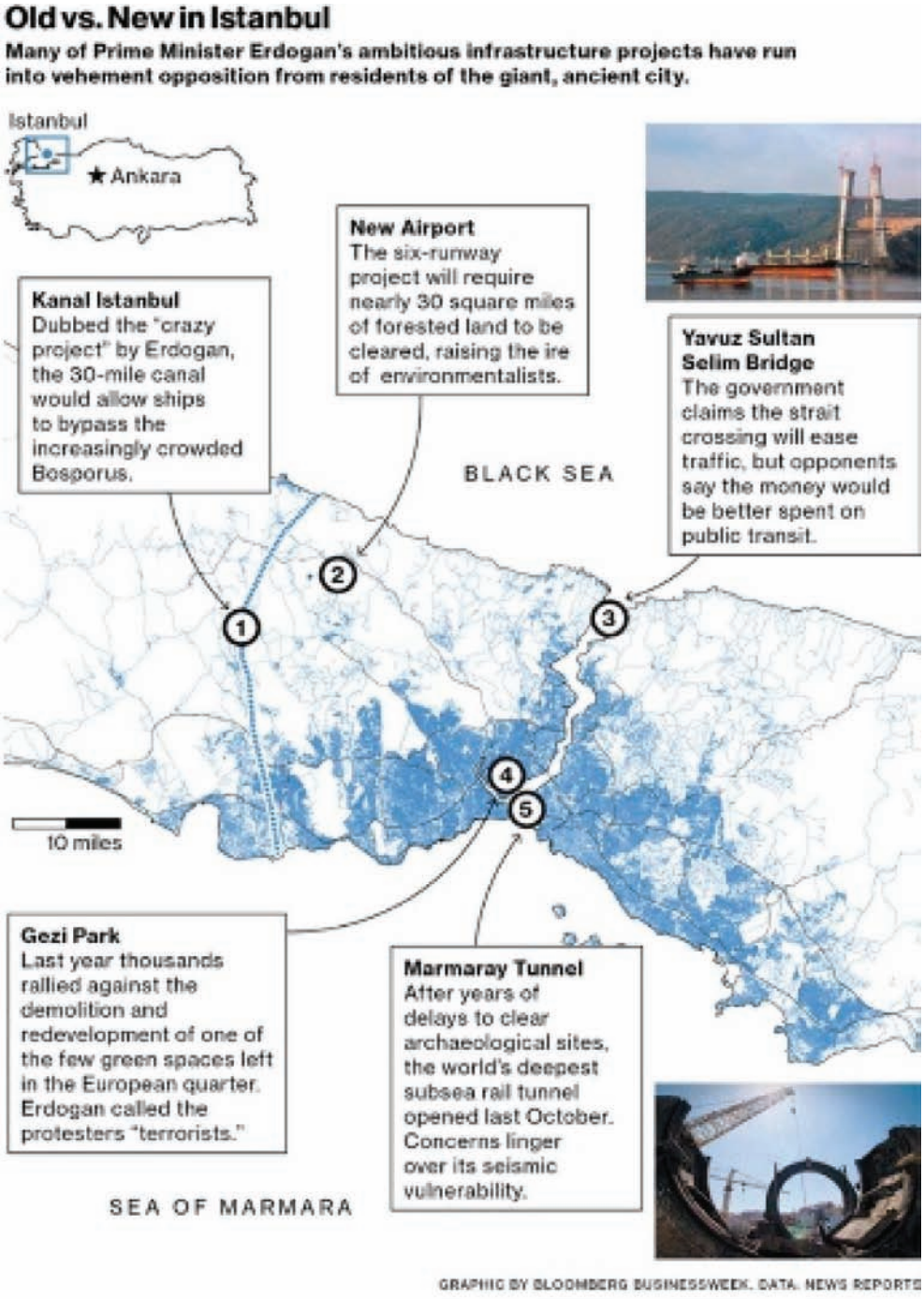

Fig. 7: Some of the recent infrastructural projects of the government (2014).

the relationship between locals and sea and the Bosphorus is getting narrower with each constructions.

4.3.2 Under the Ground

The use of underground is a preference in the city. It creates a hidden urbanism and disclose of hidden structures of topography. With recent urban transformation projects, it is possible to observe this in some of the networks of Istanbul. Metro tunnels are extended and other transportation networks are partly taken into underground to alleviate disorder in daily life. These actions made underground of Istanbul more urbanized.

4.3.3 Under Sea Level

Comings and goings on water surface is a different kind of urbanization in İstanbul. Also under sea level of the city as the extension of coastline, has its own variety.

The underwater of Bosphorus (nearly 70 m depth) is different from cities like Prag or Budapest which built on shallow rivers. So, connection of two sides of the city can be different sometimes (Yürekli, n.d.).

Inner part of the Bosphorus surface has been urbanized recently with the construction of Marmaray Tunnel (2014) which connects two sides of the city in four minutes. Another upcoming undersea construction project, Eurasian Tunnel is going to connect very far routes of Historical Peninsula and Kadıköy's Kartal district. If infrastructures are the skeletons forms of urban topography; tunnels in Bosphorus definitely added an undersea layer to structure of the city and they modified urban topography.

5. CONCLUSION

Considering contemporary cities especially the ones in rapid developments, the structural approach suggests a new perspective for urban studies.

Despite widespread perception of topography as a latest trend or a supplementary instrument in architecture, it represents a complete evaluation on cities. Throughout with this perception it can be possible to understand multi-layered structures and discover overlooked formations of cities.

Withthe Istanbul example, the structural approach on urban topography is not a call for a new manifesto. It is an offer to think on present conditions of cities with intervention of topography, instead of rootless urban scenarios. All these actions are the proofs of a new kind of topography in cities in rapid developments in the world. And the structural approach may show an existence of an unrealized topography (surfaces, urban limits, layer). Questioning "the earth surfaces and geographies cities settled, integration of cities with bare ground and

representation of the whole" assumed to be an appropriate approach for spirit of the time for urban studies.

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RECENT LANDSCAPE TRANSFORMATIONS IN OVIEDO REGION

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ABSTRACT

Dynamic is a significant attribute of landscape, a process of continuous interaction between natural and human factors. The current global trends on landscape transformations around cities such as the increased demand on mobility, the spread of residential function and the new infrastructures, are building a landscape that has been named as peri-urban, Cittádiffusa or Zwischenstadt among others.

The central area of Asturias in Northern Spain, where Oviedo region is located, is an example of this kind of landscape. In the last decades an urban diffusion process altered the traditional landscapes; consequently, many functions have been removed from urban fabric and moved to rural areas. By 1970, the area studied was characterized by a clear distinction between urban and rural landscapes with strong presence of agricultural activities. The industry was located near commodities and commercial function was exclusively placed within the urban fabric. By then, the area was attending a collapse of historic landscape construction model, since it built the new regional highway and the first industrial parks. The new infrastructures triggered a new territorial model determined by the increment of accessibility and the private car availability. Aiming to study these recent landscape transformations, historic aerial photography is used in order to quantify the land uses dynamic and, therefore, to unveil the emerging the new territorial model.

Focusing on these recent landscape transformations, the new territorial model will be assessed in order to evaluate their impact and the role of the planning instruments in their configuration.

Key words: urban diffusion, Oviedo, landscape transformations.

LABURPENA

Dinamismoa paisaiaren ezaugarri adierazgarria da, faktore naturalen eta giza faktoreen arteko elkarreragin etengabeko prozesu bat. Hiriei dagokienez paisaia-eraldaketetan egun dauden joera globalak, hala nola mugikortasun-eskaera handiagoa, bizitegi-funtzioa zabaltzea eta azpiegitura berriak, bestelako pasaia sortzen ari dira, eta horri hainbat modutan deritzo, besteak beste periurbano, cittádiffusa eta Zwischenstadt.

Asturiaseko erdialdea (Espainiaren iparraldean dago), zehazki Oviedoko eskualdea, era horretako paisaiaren adibide garbia da. Azken hamarkadetan, hiri-sakabanaketaren prozesu batek eraginda, betiko paisaiak aldatu egin dira eta, horren ondorioz, funtzio asko hiri-ehunetik desagertu eta landa-ingurunera eraman dira. 1970ean, aztertutako eremuaren ezaugarri nagusia hiri- eta landa-paisaien arteko bereizketa zen, eta nekazaritza-jardueren presentzia handia. Industria lehengaietatik gertu zegoen eta funtzio komertziala hiri-ehunean soilik betetzen zen. Garai hartan, paisaia historikoko eraikuntza-eredua gainbeheran zegoen gune horretan, eskualdeko autobide berria eta lehen industrialdeak egin ondoren. Azpiegitura berriek lurralde-eredu berria sortzea ekarri zuten, irisgarritasuna handitzearen eta herritarrek auto partikularra edukitzearen eraginez. Paisaia-eraldaketa berri horiek aztertzeko, airetik ateratako argazki historikoak erabili dira, lurzoruaren erabilera kuantifikatzeko eta sortzen ari den lurralde-eredu berriaz jabetzeko.

Paisaia-eraldaketa berri horiek ardatz hartuta, lurralde-eredu berria ebaluatuko da, haren eragina eta haren konfigurazioan erabiltzen diren antolamendu-tresnen funtzioa aztertzeko.

Gako hitzak: hiri-sakabanaketa, Oviedo, paisaia-eraldaketak.

RESUMEN

El dinamismo es un atributo significativo del paisaje, un proceso de interacción continua entre los factores naturales y los humanos. Las actuales tendencias globales de las transformaciones del paisaje en torno a las ciudades, como la mayor demanda de movilidad, la expansión de la función residencial y las nuevas infraestructuras, están creando un paisaje que se ha denominado periurbano, cittádiffusa y Zwischenstadt, entre otros.

La zona central de Asturias, en el norte de España, donde se encuentra la región de Oviedo, es un ejemplo de este tipo de paisaje. En las últimas décadas, un proceso de dispersión urbana ha alterado los paisajes tradicionales y como consecuencia muchas funciones han desaparecido del tejido urbano y se han trasladado a zonas rurales. En 1970 el área estudiada se caracterizaba por una clara distinción entre los paisajes urbanos y rurales y una fuerte presencia de actividades agrícolas. La industria se encontraba cerca de las materias primas y la función comercial se localizaba exclusivamente en el tejido urbano. En aquella

época la zona asistía al colapso del modelo de construcción del paisaje histórico tras la construcción de la nueva autovía regional y los primeros polígonos industriales. Las nuevas infraestructuras propiciaron la aparición de un nuevo modelo territorial determinado por el aumento de la accesibilidad y la disponibilidad de coches particulares. Para estudiar estas recientes transformaciones paisajísticas, se han empleado fotografías aéreas históricas para cuantificar la dinámica de uso del suelo y descubrir el nuevo modelo territorial emergente.

Con el foco en estas recientes transformaciones del paisaje, se evaluará el nuevo modelo territorial para analizar su impacto y la función de los instrumentos de ordenación en su configuración.

Palabras clave: dispersión urbana, Oviedo, transformaciones del paisaje.

1. INTRODUCTION

The European Landscape Convention define landscape as “an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors” (Council of Europe, 2000) and thus, the concept of landscape is considered an element of cultural, ecological, environmental and social interest, additionally it is understood as positive resource to foster economic activity and to the quality of life of the population. The agreement aims to promote the protection, management and planning of European landscapes.

Since its origin as an academic discipline, Geography found in the landscape its preferred object of study: “Der TotalcharaktereinerErdgegend” (Humboldt, 1848). Throughout history many different approaches and methods to address landscape analysis have been developed. Obviating the differences between them, it could be said that there is a widespread consensus about its dynamic character (Bertrand, 1968; GarcíaFernández, 1975; Antrop and Van Eetvelde, 2000).

In the recent years, the experiences based on the use of geographic information systems, aerial photography and satellite imagery allow us to study deeply land uses changes. Moreover,the sources and techniques mentioned above, enable us to incorporate the dynamic variable since the same territory is covered by well kwon time intervals (Fernández García, 2010). Therefore, landscape analysis could be undertaken in a period of several decades, which constitutes a valuable knowledge to improve sustainable planning and management of future landscapes (Antrop, 2005).

The landscape created by the transformation of the countryside around cities, commonly referred to as suburban or urban fringe landscapes, is considerably dynamic, but remain poorly understood (Lewis and Maund, 1976; Lucy and Philips, 1997; Antrop, 1994, 2000). Indeed, the conceptual debate about the terminology concerns the efforts of several scholars. Among them, Nilsson et al. (2013) highlighted that these urban transformations which take place outside the urban cores can be summarized by the term peri-urbanisation. (Nilsson et al., 2013). Within the European context other scholars preferred to define this spatial phenomena as Zwischenstadt (Sieverts, 2000), Cittàdiffusa (Indovina, 1990), spread city (Webber, 1998) or territories-in-between (Wandl et al., 2014).

According to Adell (1999) and Caruso (2001), the periurban landscape is characterized by a dispersed population, a high mobility and a great heterogeneity of land uses. The PLUREL project defined peri-urban areas within the EU as a discontinuous built-up areas which contains settlements of less than 20 000 inhabitants with an average density of at least 40 people per km^2. At the European level, the first phase of peri-urbanization occurs as a result of the relocation of industrial and commercial activities and the introduction of new residential typologies in rural areas, notwithstanding some differences in relation with cultural contexts. Thus, the northern European countries have a long tradition of suburbanization of residential function, whereas in the Mediterranean countries the model of compact city

gains more presence. Another point of view can be introduced since the regional planning and urban policies are radically divergent within Europe; Germanic and Scandinavian States are more concerned about the spatiality order, the relation of new urban developments with transport, meanwhile the French approach is focused on regional development policies. In the Netherlands the optimization of soil and the spatial planning has a long tradition. Portugal has carried out a great effort to modernize the country and to delude the regional disparities. Meanwhile in Spain, the construction of the democratic State since 1977 has led to a configuration in which the role of the seventeen of Autonomous Regions over the regional and urban planning is crucial. Thus, the competence over this affairs corresponds totally to those regions, and the difference among them are significant, especially when are observed with the margin of thirty years.The complex recent dynamic is strong related with the indefinition state of this kind of landscapes as Qviström and Saltzman (2014) have pointed out, the rural-urban fringe often remain in a limbo waiting for an effective planning generating ephemeral landscapes following Brassley (1998).

At the present moment, the increasing complexity of the peri-urban landscapes is reinforced by the sum of new functionalities to those mentioned before. Among these new functions include leisure, education, research and knowledge or even administration. It is established that the disorderly growth of functions, urban yesteryear, in outer space to cities, is increasing (FernándezGarcía, A., 2003). Economic and technical changes, high-capacity roads and improving telecommunications and mobility and generalization of private vehicles are some of the elements that characterize the new urban model (Ascher, 2009).

The region of Oviedo exceeds the administrative boundary of the municipality so it is not possible to analyze without a Regional Planning approach. The European Charter of Regional Planning, adopted in Torremolinos in 1983 in its preamble states the intention to “reduce regional disparities and to reach a deeper insight into the use and organization of space, the distribution of activities, the protection of the environment and the improvement of the quality of life” (CEMAT, 1983). The evolution of land uses in Spain over the last decade shows the negative effects of a territorial model based on an unsustainable growth.

Integrated landscape studies have been pointed, to a greater extent, to natural, rural and agricultural landscapes, while urban landscapes collect the influence of urban planning and urban geography. Since 1970 the changes occurred within the Oviedo peri-urban landscape have altered the traditional landscape model in the north of Spain; a one defined by the clear dichotomy between rural and urban areas, with strong presence of agricultural activities and a concentration of functions such as commerce, industry among others. Therefore, the word “model’ is addressed in order to refer a simplified version of reality which help us to demonstrate certain landscape properties. There is no previous specific work concerning the recent landscape transformations in the region of Oviedo and, consequently, that is the void that intends to cover this research.

1.1 Data and Methodology

The landscape is a complex phenomenon that requires a holistic approach in which all factors involved and the relationships that exist between them are taken into account. Geographic information systems (GIS) facilitate the juxtaposition of the different layers which are identified with the components of the landscape. To achieve this goal both quantitative techniques (landscape metrics) analysis of the landscape as the qualitative explanation result of bibliographic research and field work will be used. As a part of these landscapes, the changes in urban landscapes are produced in a larger time scale perception than of the inhabitants; therefore, aerial images constitute a way of being aware of changes (Svenningsen et al., 2015). Diachronic method is applied to explain the dynamics of the landscape in the different phases, comparing the generated orthophotos.

The collection of historic aerial photography, held by the Department of Geography at the University of Oviedo, is a valuable source in order to understand the urban development processes. The archive holds digitalized aerial photographs collected from different flights since the 1940s, which allows the analysis of landscapes through time. The photograms were scanned at 600 DPI for further digital processing with the photogrammetric software AgisoftPhotoScan, which solves the triangulation and the block adjustment of a set of frames in order to perform georeferenced orthophoto mosaics radiometrically and geometrically corrected. As a result, it is possible to integrate them into a GIS and derive landscape indicators such soil consumption or elaborate thematic cartography.

2. LANDSCAPE ANALYSIS

The area studied is placed in the north of Spain (aprox. 43.4º N, 5.8º W) and it covers 104 km^2. The selected area was defined taking into account both physic elements and functional factors. Oviedo, the capital city of the autonomous region of Asturias is located in a basin with a moderate topography. Since 1970 the traditional landscapes were altered by an urban diffusion process; thus, several functions have been removed from urban fabric and relocated in to rural areas. This shift has produced changes in the land uses.This region is an example, almost exhaustive, of the transformations that characterize the peri-urban areas and more generally, those located in the rural areas of industrialized countries.

The landscape analysis of the region of Oviedo is approached from its abiotic components (climate, relief, lithology, etc.), abiotic (vegetation and soils) and anthropic, whose footprint on the territory is manifested mainly in the different land uses, the infrastructures and along with it the inheritance of the past as the parcel plots shapes, the road network or places names.

2.1 The biotic and abiotic frame

The peri-urban area of Oviedo is located in a Mesozoic and Tertiary basin and is characterized by its flat topography and the heterogeneity of land uses whichconfigures a blurred landscape.

The lithology is dominated by sandstone and limestone. The climate is characterized by an annual average temperature of 12.5°C with an average annual precipitation of 960 mm, a relative humidity near to 80% and more than 1700 hours of sunshine. Thestudied area, is the largest extension of soils with a flat topography within Asturias, that is, the amount of areas which slope are lower than 3% sums up 100 km^2.

The prolonged and intense anthropic activity has had a great incidence in the current landscape. The vegetation is a clear example of the transformations occurred since the natural forest has been relegated in isolated spots, generally in the borders of the region where the topography are steeply and the average height is higher. However, the presence of allochthones species throughout reforestation policies, such as eucalyptus and pine abound in the study area, due to their economic use. The absence of forest patches in the center of the region is a result of anthropic action but also reflects the importance of dairy production in the past.

Soils are the nexus between the biosphere and the lithosphere; therefore, have a great relationship with geology and climate. Taking into account the anthropic component of the landscape, soils are a fundamental factor for activities related to agriculture and therefore for life. As a result, areas with better soils have been the scene of a long process of anthropization, a relationship between nature and society that has given rise to complex landscapes in which the overlapping elements such as the parcels plots,

2.2 The anthropic component through history

The regional population soared up in the period 1970-2015 from 210 098 to 297 122 inhabitants. Although the general tendency in Asturias is the demographic decrease, the Oviedo region maintain their levels of population due to a diversified economy in which Tertiary sector employs accounts for a 75% of total employment, whereas employment in the agricultural sector is about 4% (SADEI).

The role of anthropic component in the landscape dynamic encouraged Fernández García and Herrán Alonso (2014) to distinguish three phases; the first one covers the period from the mid-nineteenth century to the mid-twentieth century in which the grasslands replaced labor lands as a result of dairy specialization, in this stage, the first communication infrastructures were constructed and the first Industries were located in former rural landscapes. The second stage was developed between 1950 and 1975 and was characterized by the increase of urbanization, the rapid advance of motorization, which went from a total of 22 427 vehicles in the year 1960 to 195 967 in 1975. Moreover, the industrial function was consolidated in the periphery through the creation of industrial estates. The last stage, which encompasses the recent transformations, began in the 1980s and its most significant process was theperiurbanization, the location of a greater number of functions in the periphery to the detriment of the agricultural function.

The rapid transformations experienced by the study area are manifested in the heterogeneity of land uses and is due to the loss of traditional uses and the natural values. As a result, there is a disordered territory and aprogressive lacking of identity (FernándezGarcía and Herrán Alonso, 2014).

2.3 The recent landscape dynamic

Dynamic is a significant attribute of landscape, a process of continuous interaction between natural and human factors. The current global trends on landscape transformations around cities such as the increased demand on mobility, the spread of residential function and the new infrastructures, are building a landscape that has been named as peri-urban, Cittá diffusa or Zwischenstadt among others.

Under the natural conditions mentioned above, the competitiveness over soils increased when the accessibility was improved. Therefore, the consumption of soil was accelerated with the construction of new infrastructures producing a fragmented landscape and leading to an urban diffusion process. The landscape fragmentation is manifested, mainly, by the dense road and railway network and the urban diffusion process is determined by the spread of traditional urban functions such us, commercial, leisure activities and residential over the traditional rural landscapes that surrounds the city.

3. RESULTS

Focusing on land uses changes, the main transformation occurred between 1970 and 2015 are summarized in the table. For this purpose eight categories of and land uses were mapped in both years to quantify changes in land uses.

As the table 1 shows there is a huge increase in built-up areas, especially in urban continuous fabric. Dispersed residential function has also soared up within the period studied. Although

Category	1970	2015	Variation
Built-up area	**6,2**	**24,2**	**18**
Urban continuous	4,1	13,1	9
Urban discontinuous	1,2	4,5	3,3
Industrial	0,8	6,1	5,3
Commercial	0,1	0,5	0,4
Agriculture	**90,5**	**70,6**	**-19,9**
Rain-fed agriculture	9,5	1,1	-8,4
Herbaceous	79,1	68,8	-10,3
Fruits	1,9	0,7	-1,2
Scrubland-Pasture	**2,9**	**2,1**	**-0,8**
Forestry	**4,4**	**7,1**	**2,7**
TOTAL	**104**	**104**	

Table 1: Land cover changes, 1970-2015. (Icaro Obeso Muñiz)

their increment is not so dramatic in quantitative terms it supposes a high spatial impact because of the soil consumed. The industrial surfaces rose from 0,8 to 6,1 km^2 due to two principal factors; on the one hand the increment of industrial activities in the Oviedo region is related with the good accessibility provided by the infrastructures and on the other the construction of several industrial parks in the region because of the crisis of heavy industries and mining which were allocated in other parts of Asturias. Oviedo has profited from this situation and has managed to bring together much of the productive activities of the province. It is clearly detailed that the variation in built-up areas corresponds approximately with the loss of agriculture land. The sharp decrease in herbaceous area linked to areas of flat topography, and, as mentioned before this areas have been deeply transformed in the last decades.

The main reasons for these land use changes are the processes of urban diffusion, the inefficiency of the management instruments and the new infrastructures. In 1976, the highway that connects the main cities of the center of Asturias was inaugurated. Since then, it is widely assumed that the urban diffusion process begins (Fernández García, 2003, 2007). Due to the progressive increase of the private car, the improvement in accessibility and the resulting reduction of travel times, along with the low value of the soil in the periphery, many urban functions moved to the rural areas and consequently emerged a new type of landscape; the peri-urban.

4. RECENT LANDSCAPE TRANSFORMATIONS

As mentioned before, there are three stages in which the landscape transformation of Oviedo region can be classified. The third one, according withFernándezGarcía and Herrán Alonso, 2014 began in 1980 and is characterized by the spread of residential function with new urban developments disconnected from the continuous urban fabric but near to highways and shopping malls. Moreover, the abandonment of agricultural functions has led to a sort of social fallow, or fallow lands. In relation with the accessibility from highways, the topography and the costs of land, in this fallow lands, the most important transformations have been undergone.

Industrial areas on the periphery are the result of national and regional economic planning policies. Since 1980, several financing funds have promoted the construction of industrial estates (Fernández García, 1997). Despite the concentration in polygons, there is also scattered industry, which constitutes another further proof of the failure of management policies. A concrete example of ineffective policy, though of another type, is located in Bobes, where a traditional agrarian landscape was totally removed with the intention of building another industrial estate. With the onset of the crisis, and as a result of the shortage of funding, this project has been paralyzed.

Other functions such as the commercial one have had a great impact at regional scale. Two shopping centers are located on the outskirts of the city of Oviedo, one of them was built in 1977 Pryca / Carrefour linked directly with the highway. In 2001 a new shopping center

was inaugurated near of an important intersection of highways Parque Principado / Intu Asturias, a strategic place since the area drawn by the isochrones of thirty minutes from this point represents the area of maximum coverage of Asturias, that is the point of maximum accessibility for the majority of the population of the Autonomous Community. This spatial structure follows a model of land occupation defined by the predominance of private interests over public ones. Plain topography and accessibility are the main factors to consider when planning the development of economic activities, especially when this process is based on short-term policies and the pursuit of rapid benefits.

From this point of view, agricultural landscapes have a great disadvantage because of their recent abandonment and fossilization process in the last two decades, but also because of the lack of competitiveness in economic terms. In addition, ineffective spatial planning policies have led to extreme land use. Consideration of the soil simply as an economic resource rather than as a natural resource often implies the neglect of its nonrenewable resource status. Despite the existence of territorial planning instruments since 1991, reality has proven to be ineffective in the face of fragmentation processes and urban diffusion in the central area. The various attempts to upgrade the instruments have been in vain.

The landscape of the Oviedo region is determined currently by the predominance of the anthropic component in comparison with the biotic or abiotic, a key fact within the peri-urban landscapes, especially those located in countries that have undergone processes of industrialization. On the other hand, what is not so frequent on this sort of landscape is the role of the private initiative; in Oviedo region, the private stakeholders organize the space and constrain the development of public policies. In this context, characterized by normative laxity, huge competitiveness above vacant soil, high accessibility over the most coveted soils and the lack of effective regional planning instruments are leading to high consumption rate of soil. Therefore, far from the consideration of soil as a finite resource as the Food and Agriculture Organization of the United Nations (FAO) pointed, meaning its loss and degradation is not recoverable in a human lifespan; and consequently, triggering an unsustainable development because of soil formation is an extremely slow process, soil can be considered essentially as a non-renewable resource.

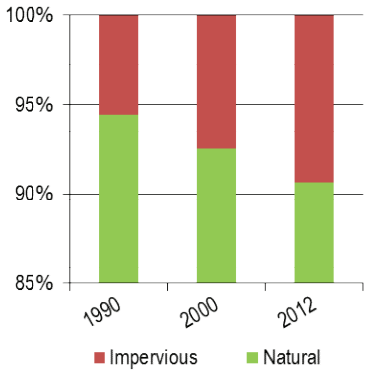

Table 2: Soil consumption since 1990. (Own elaboration from historic aerial imagery)

Fig. 1-2: Peri-urban area of Oviedo, above (1970) and below (2011). (Above, Orthomosaic derived from the photogrammetric flight of the Asturias Deputation, 1970, Dept. of Geography, University of Oviedo; below, Orthomosaic derived from the photogrammetric campaign of PNOA 2011, IGN)

5. CONCLUSIONS

The configuration of the landscape of the region of Oviedo has experienced important transformations in the last four decades. By 1970, the area studied was characterized by a clear distinction between urban and rural landscapes with strong presence of agricultural activities. The industry was located near commodities and commercial function was exclusively placed within the urban fabric. By then, the area was attending a collapse of historic landscape construction model, since it built the new regional highway and the first industrial parks. Understanding model as a simplified version of reality and not a prediction of future growth. The new infrastructures triggered a new territorial model determined by the increment of accessibility and the private car availability. Aiming to study these recent landscape transformations, historic aerial photography is used in order to quantify the land uses dynamic and, therefore, to unveil the emerging the new territorial model.

The territorial landscape has been modified as a consequence of the construction of infrastructures, the laxity of territorial planning instruments and structural changes in both society and the economy. The traditional dichotomy between urban and rural areas has partly lost its validity and instead appears, in constant evolution, a peri-urban landscape, very fragmented and dominated by the heterogeneity of land uses among which agriculture has been losing prominence. A huge increase in built-up areas take place, especially in urban continuous fabric. Dispersed residential function has also soared up within the period studied. Both corresponds approximately with the loss of agriculture land.

The landscape of the Oviedo region is determined currently by the predominance of the anthropic component in comparison with the biotic or abiotic, a key fact within the peri-urban landscapes: traditionally urban functions such as residential, commercial and industrial have been moving towards the periphery favored by its fast accessibility and the low cost of the soil. Furthermore, the consideration of soil as an economic and non-natural resource has meant that its consumption rate is unrecoverable in a human lifespan, therefore, can be highlighted as unsustainable in the long term.

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A PATTERN LANDSCAPE
Revising the spatial scope in regional planning according to natural morphologies

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ABSTRACT

The identification and preservation of natural landscape has received a proper fit in the urban management systems, generally through regional planning. However, due to the fragmentation of administrative competencies in force, most of the time there are important imbalances between landscape units and affected areas.

This paper proposes the overcoming of the legal delimitation in favor of the territorial components, in order to facilitate resilient planning strategies, in line with the natural dynamics of self-regulation. Thus, the scope of regional plans would distance itself from the artificial administrative delimitations, boosting a blurring of local, regional and even national boundaries, more in line with natural reality.

According to the pattern characterization studies carried out by Christopher Alexander, this research proposes a spatial delimitation methodology based on the prior identification of landscape units. We start from a triple differentiation between areas, sets, and fluxes, depending on the basic criteria of continuity, connectivity or discreteness, respectively. The first two categories collect units related to water, relief and soil science, such as watersheds, axialities, geological masses, etc., while the third assumes discrete environments such as radio electric space and prevailing winds, among others.

Finally, it is expected to define more complex units –systems– by combining compatible patterns (as green infrastructure does), pointing to the relevance of the landscape perspective for the correct spatial delimitation of regional planning.

Key words: landscape; pattern; natural morphology; characterization; regional planning.

LABURPENA

Paisaia naturalaren identifikazioa eta babesa modu egokian landu dira hiri-kudeaketako sistemetan, oro har eskualde-antolamenduaren bitartez. Hala ere, indarrean dauden administrazio-egituren zatikatzea dela-eta, eskuarki desoreka handiak izaten dira paisaia-unitateen eta eraginpeko eremuen artean.

Artikulu honek lege-mugaketak gainditua lurralde-osagaien alde egitea proposatzen du, antolamendu-estrategia erresilienteak errazteko, betiere autoerregulazio-dinamika naturalarekin bat eginez. Izan ere, horri esker, eskualdeko planetan alde batera utziko lirateke administrazio-mugaketa artifizialak, eta tokiko, eskualdeko eta nazio-arloko mugak ezabatuta, lotura handiagoa lortuko litzateke errealitate naturalarekin.

Christopher Alexanderrek egindako patroi-karakterizazioko azterlanekin bat eginez, ikerlan honek mugaketa espazialeko metodologia bat proposatzen du, paisaia-unitateen aldez aurreko identifikazioan oinarritua. Hasteko, eremuen, multzoen eta fluxuen arteko bereizketa egingo dugu, hurrenez hurren jarraitutasunaren, konektibitatearen eta diskrezioaren oinarrizko irizpideen arabera. Aurreneko bi kategoriek urari, erliebeari eta edafologiari buruzko unitateak biltzen dituzte, hala nola ibarrak, axialitateak, masa geologikoak, etab. Hirugarrena, aldiz, ingurune diskretuei dagokie, espazio erradiolektrikoari eta haize nagusiei, besteak beste.

Azkenik, unitate konplexuagoak –sistemak– definitzea aurreikusten da, eta horretarako, patroi bateragarriak uztartuko dira (azpiegitura berdean bezalaxe) eta eskualde-antolamenduaren mugaketa espazial egokirako paisaiaren ikuspegiak duen garrantzia nabarmenduko da.

Gako hitzak: paisaia, patroia, morfologia naturala, karakterizazioa, eskualde-antolaketa.

RESUMEN

La identificación y la preservación del paisaje natural han recibido un tratamiento correcto en los sistemas de gestión urbana, generalmente a través de la ordenación regional. Sin embargo, debido a la fragmentación de las competencias administrativas vigentes, la mayor parte del tiempo se producen importantes desequilibrios entre las unidades del paisaje y las áreas afectadas.

Este artículo propone la superación de la delimitación legal a favor de los componentes territoriales para facilitar estrategias de ordenación resilientes en línea con la dinámica natural de autorregulación. Así, el ámbito de los planes regionales se distanciaría de las delimitaciones administrativas artificiales para desdibujar los límites locales, regionales e incluso nacionales y alinearse más con la realidad natural.

De conformidad con los estudios de caracterización de patrones realizados por Christopher Alexander, esta investigación propone una metodología de delimitación espacial basada en la identificación previa de unidades del paisaje. Comenzamos por una triple diferenciación entre áreas, conjuntos y flujos, dependiendo de los criterios básicos de continuidad, conectividad o discreción, respectivamente. Las dos primeras categorías recogen unidades relativas al agua, el relieve y la edafología, como las cuencas, las axialidades, las masas geológicas, etc., mientras que la tercera se refiere a los entornos discretos, como el espacio radioeléctrico y los vientos dominantes, entre otros.

Finalmente, se prevé definir unidades más complejas –sistemas– combinando patrones compatibles (como lo hace la infraestructura verde), apuntando a la relevancia de la perspectiva del paisaje para la correcta delimitación espacial de la ordenación regional.

Palabras clave: paisaje; patrón; morfología natural; caracterización; ordenación regional.

1. LANDSCAPE AND REGIONAL PLANNING

In the last decades, the study on the concept of landscape has been developed thanks to an appropriate multidisciplinary approach. Starting from an initial environmental and ecological component, new perceptual and cultural dimensions have emerged, since the human dimension has been integrated as a differentiated and inseparable element of the landscape. In this way, "landscape as a place" has evolved from descriptive or typological positions of nature (mountains, valleys, geomorphologic systems…) towards an open and relational comprehension (cultural landscape, urban, notion of identity, etc.). It is a development that evidences in a certain way the evolution from a taxonomic society, with pretensions of objectivity, to a liquid modernity, plural in that it is open to the infinite individuals (Reed & Lister, 2014: 15).

"Landscape as a tool", however, is in itself conditioned to mucho more static methodological patterns. The interest of its integration in the territorial planning systems, strengthened in Spain since the ratification of the European Landscape Convention in 2007 (in force since March 1, 2008), has given rise to interesting experiences on the part of the regions, or "autonomic communities" –administrations responsible for the spatial planning–, but always depending on the respective legal frameworks (García García & Borobio Sanchiz, 2012).

As an example, in Catalonia the different landscape regions were established prior to the scope of the subsequent partial territorial plans, while in the Valencian Community an ambitious territorial action plan (PATIVP, by its Spanish acronym) was launched that characterized and valued the landscape on a regional scale. In Navarre, the Territorial Management Plans (POT) pointed the need for a landscape planning, which was then non-existent and currently under development as a Navarre Landscape Strategy (EPN). Finally, the Basque Country region, with a strong tradition of regional planning –both partial and sectorial–, impelled the creation of the Catalogs and Landscape Determinations in its different functional areas.

This recent (and commendable) incorporation of the landscape into the planning system raises a double question. On the one hand, the administrative framework where the urban planning instruments are framed requires a legal security and definition that combines deficiently with the phenomenological and perceptive approaches of the landscape understood as place, often open and difficult to characterize. On the other hand, the regional competences and, to a lesser extent, the administrative realities (municipalities, counties, metropolitan areas…), while providing an indisputable identity component –which often has its reflection in the physical landscape– impose unquestionably the ambit and the final delimitation of landscape.

Thus, it is not difficult to realize the great amount of mismatches, especially in border regions, among the described landscapes units and the competent administrative delimitations. The hydrological basin of Urumea river (equally divided on surface in the provinces of Guipúzcoa and Navarra), the enclaves or historical territories which stands enclosed –as the Treviño County (Burgos) or Petilla de Aragón (Navarra), making a little island in the midst of Álava

and Zaragoza, respectively–, or the non-strict correspondence between the watershed and the Spanish-French frontier in the Pyrenees (Capdevila i Subirana, 2009), are clear examples of this. At this point, some questions ought to arise: to what extent should the historical-administrative construct, proper to the human temporal dimension, be above the natural dimension? How can we combine the defining elements of "landscape as a place" with the methodological requirements of "landscape as a tool"?

The present paper tries to contribute to these reflections through a proposal of an objective landscape characterization, which emphasizes the territorial component over purely administrative. In this way, the need of administrative overlapping –autonomous and even national– in the spatial planning is also pointed out, in order to better manage the natural dynamics of the territory.

2. LANDSCAPE AND ITS NATUREAS DELIMITATION CRITERIA

The European Landscape Convention specified the collective concept of landscape, defining it as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" (Consejo de Europa, 2000: 2). A comprehensive definition that has severed as a support, starting and common point, for the countries involved to start developing a whole series of landscape policies in this way.

The analysis and determination of the landscape requires the arduous task of incorporating into the study all the elements that define it, integrating in an indispensable and obligatory way the human being (as defined in the European Landscape Convention). This means that the landscape warns a specific territory, in a certain time and with concrete interactions – and conditions– between humanity and its environment. The landscape becomes a result. What can mean, in Eduardo Martínez de Pisón words, that, like a bee, a fox, any animal, has a territory, the human being has landscape; a landscape that can be understood as the sum of "territory and culture" (Orte Menchero, 2011). Therefore, to correctly define any landscape it will be advisable to first analyze its territorial component, determined by all its natural characteristics, to then introduce the human factor that molds it in all its dimensions.

With these premises, the landscape can be defined as the reflection of the relation that humanity conserves with its territory through time, an assertion that entails not a few peculiarities. Because depending on the type of governance policies that have been carried out in a territory, the links that occur in it will change enormously. A clear example of this fact can be found in the change that Spain experienced after the mechanization of the agricultural sector in the 60s: a change in the relation with the territory (in this case, the agrarian activity) implied a strong change at the landscape. Likewise, the scale is an element to take into account when analyzing and determining the landscape. Factors that on a large scale can differentiate markedly different landscapes may not be of any use in distinguishing landscapes at reduced scales. By way of illustration, the vegetation of our territory at national level can help to make great landscape differentiations between the north and the south. However,

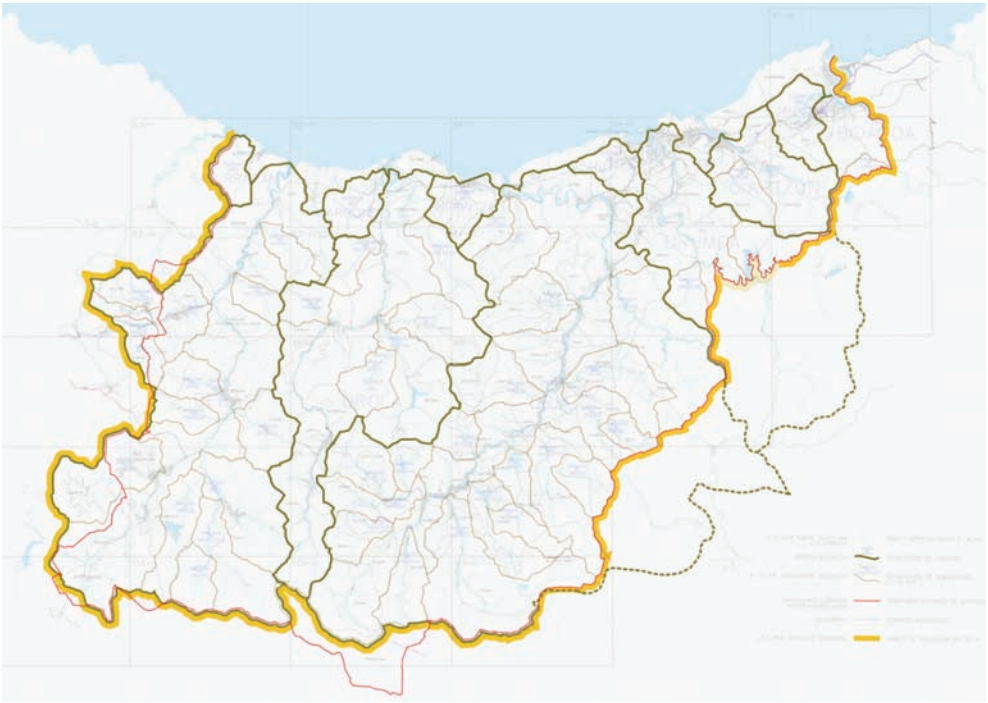

Fig. 1: Guipúzcoa base map, with delimitation of watersheds, historical territory (in red) and legal scope (yellow). (Gobierno Vasco, 2013)

taking this same element into account on a much smaller scale (local scale, for example), it may not be provide characteristics that support the existence of differentiated landscapes (Margalef 1995).

In summary, the landscape usually requires a work that exceeds the administrative limits for its correct determination. Without underestimating the reality and the difficulty involved in this challenge, it is convenient to consider that, when dealing with landscape, preference should be given to the criteria that define and identify landscape itself, over the criteria of management. The aim is to restrict the historical element that underlies the administrative boundaries with the objective of allowing the landscape component (with all the elements that define it, both territorial and cultural) to articulate the determination.

3. A CHARACTERIZATION APPROACH

In the late 1970s of past century, Viennese architect based in California Christopher Alexander popularized a research methodology consisting in pattern identification. His most popular book, A Pattern Language, applied this characterization –as the subtitle reads– to constructions, buildings and towns (Alexander et al., 1977). The interesting part of this work is not so much his claim to absolute taxonomy, as the discovery, beyond the formal, of the connection between patterns and human perception. In particular, the possibility of a rigorous

and compatible approach to scientific reasoning from subjective categories linked to the phenomenological dimension (wholeness, centers, value as an objective concept, emotional comfort, human well-being, etc.).

What would have happened if Alexander had continued the progression in scale of his language a step further, to cover territory? At that time,the concept of landscape hadn't developed the possibilities linked to the perception yet, and perhaps the creators of this methodology were oblivious to the potential that their application would have entailed. But the situation is very different nowadays. This article aims at this point to extend the set of patterns to the landscape scale, under the hypothesis that their recognition would facilitate the connection of the place itself with the planning delimitation criteria.

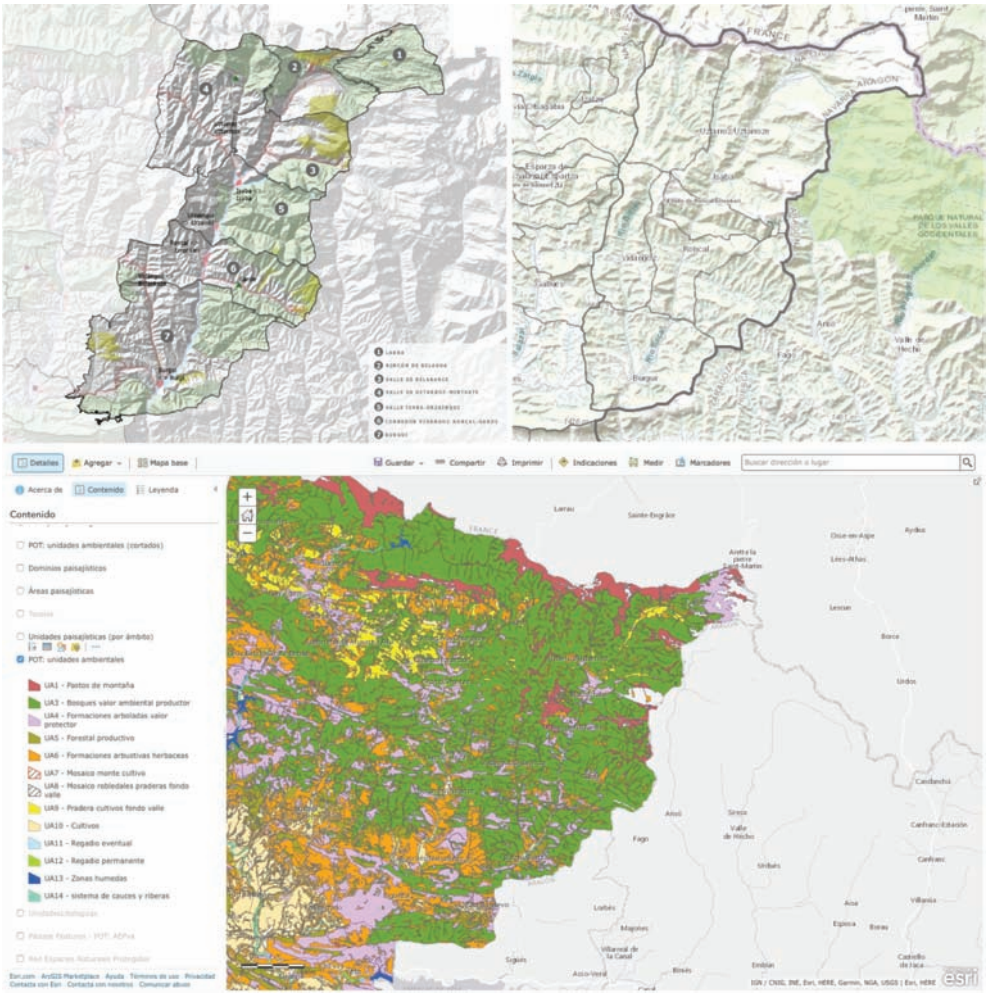

Fig. 2: Comparison between landscape units as initially proposed in the Roncal Valley (Navarra) with the local council boundaries in force and the environmental units defined by the POTs. (Own elaboration from Pons Izquierdo et al., 2016)

Based on the need to characterize morphological units in the territory in a sequential way –"the language is in truth a network" (Alexander et al., 1977: xviii)– have been established initial sets of patterns in function of their relationship with basic strategies concatenated. Thus, the basic criteria of continuity, connectivity and discreteness, ordered from greater to lesser links with the physical form of the territory, allow us to define a triple differentiation between areas, sets and fluxes.

This search for a spatial link of the elements that compose and determine the landscape responds to the need to understand its nature in a complete and comprehensive way. Furthermore, trying to determine the landscape following exclusively landscape criteria –leaving aside administrative and political attributes–, leads to the recurrence of a spatial language strategy (patches, edges, corridors and mosaics) as developed twenty years ago at Harvard University Graduate School of Design (Dramstad et al., 1996).

3.1 Areas

We start by defining the areas, understood mainly as those elements that present a superficial continuity. It means the most recognizable and the less abstract scale. This continuity is defined by a series of objective elements or patterns, such as watersheds, floodplains or coastlines. Identifying patterns that present a clear and evident continuity in the territory.

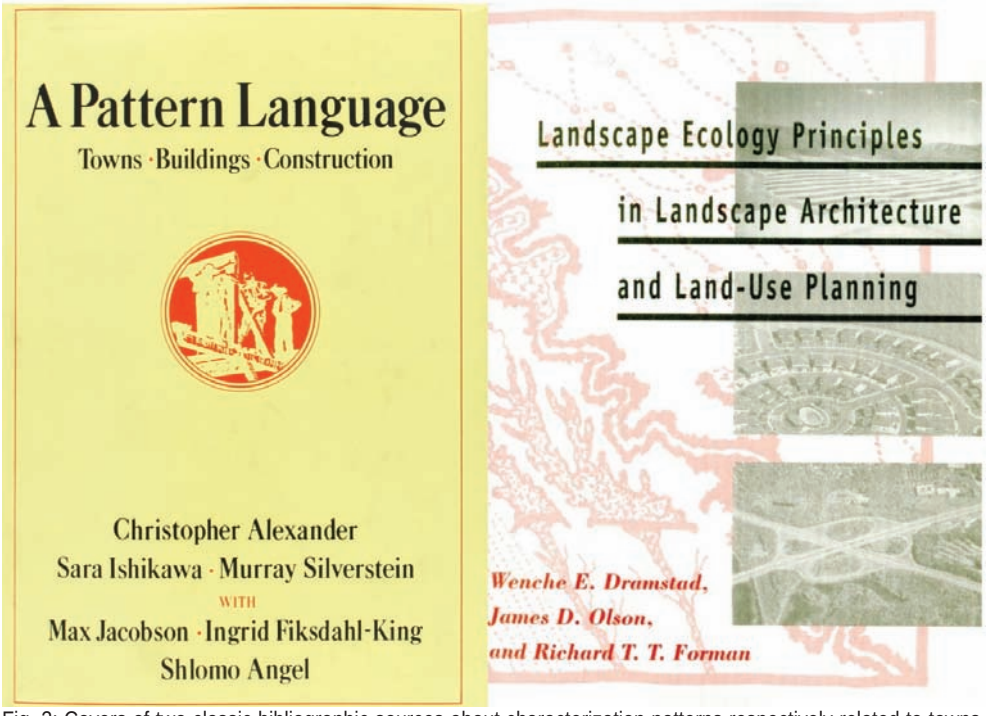

Fig. 3: Covers of two classic bibliographic sources about characterization patterns respectively related to towns, buildings and construction, and landscape. (Alexander et al., 1977; Dramstad et al., 1996)

Depending on the scale at work, these objective components of the territory allow a certain subdivision (drainage river basins can be considered as the union of several sub-basins), but always require a non-arbitrary treatment according to physical categories such as extent, gravity, contiguity, height above sea level, etc.

Therefore, criteria linked to the historical-administrative cultural construct wouldn't be acceptable here, for they respond to categories outside the natural territorial dynamics. Thus, for example, the Urumea river basin could be considered more fundamental when defining a landscape than the administrative boundaries (regional in this case), since the precipitation that falls in the municipality of Goizueta will always end in San Sebastián, regardless of historical edges.

3.2 Sets

A second group of patterns called sets would be formed by those systems that, without requiring a complete continuity, present a character of connectivity for geometric or spatial reasons. Axialities, geological masses, mountain systems vegetation areas are among these patterns, all of which allow a certain leap frog, as well as a subdivision and combinability almost infinite (depending on the scale, lithological substrates, plant communities, etc.). Within this second level –more related to spatial abstraction– other elementscan also be identified. Elements such as land uses, ownership and property management, more linked to the cultural abstraction.

It should be noted that we are here facing a landscape component that includes a double property. On the one hand, natural morphologies are displayed, and on the other, they admit a cultural component that can become very strong. This makes it a very interesting element, because it shows the relationship between territory and culture. The territory allows people to act on it in order to obtain the maximum yield (pastures for livestock, mining areas, orchard regions or forest management masses), and this efficient use of the environment becomes a cultural featureover time: it determines a way of life, some types of settlements, even the understanding of the natural dynamicstemporality. Finally, this unique relationship often presents a continuity that does not go along the administrative boundaries (a clear example could be the Basque region called "La Rioja Alavesa", illustrating the link of land uses that shares with the neighboring region).

3.3 Fluxes

Finally a third set of patterns –fluxes– is described, grouped by their finite elements discreteness character, such as dominant winds, fauna distribution or pollen concentrations, noise, mobile reception or the radio electric space with all its variety of frequencies. These mentioned elements do not always have a direct impact on the definition of a landscape, but of course they can determine (although indirectly) their nature and identity.

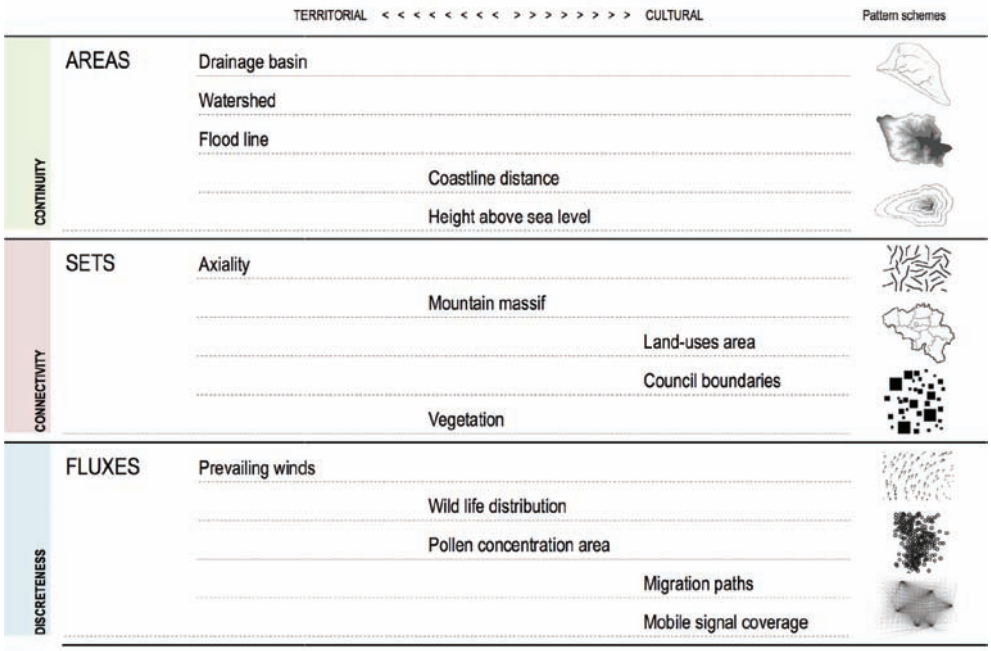

Fig. 4: Spatial landscape patterns according to natural morphologies and culture features, as exposed in this paper. (Juan Ramón Selva-Royo & Javier Zulategui-Beñarán)

In the same way that occurs with the higher levels of areas and sets, elements that exceed the territorial component towards cultural considerations also appear here. Thus, the "Camino de Santiago" or "Cañadas Reales" (paths through which transhumance developed) provide a temporal component to the landscapes through which they pass. In this sense, the Bardenas landscape in South Navarra would not be the same during the winter (with great number of cattle grazing from the mountainous north of the community) than in summer (when the cattle moved to more northern areas where the climate did not presented drought during the summer period). This dynamism means a stepfurther in the sequence of spatial correspondences, from the geometric delimitation to its infinitesimal unreachability, finally claiming a further characterization according to the temporal variable.

4. APPLYING THE SPATIAL SCOPE TO LANDSCAPE PLANNING

The patterns above proposed establish the landscape analysis in an orderly manner, grouping the elements that define it in areas, sets and flows. They can be applied effectively to approach the concept of landscape leaving aside management, administrative or political criteria, and betting on the natural or spatial parameters –continuity, connectivity and discreteness– whether patterns linked to the territory or to the culture. In short, it is a question of giving priority to the delimitations linked to the landscape itself over the current administrative districts.

Thereby, for the landscape definition in a particular demarcation, it is first necessary to identify and group the three levels (areas, sets and flows) into all the elements to be considered.

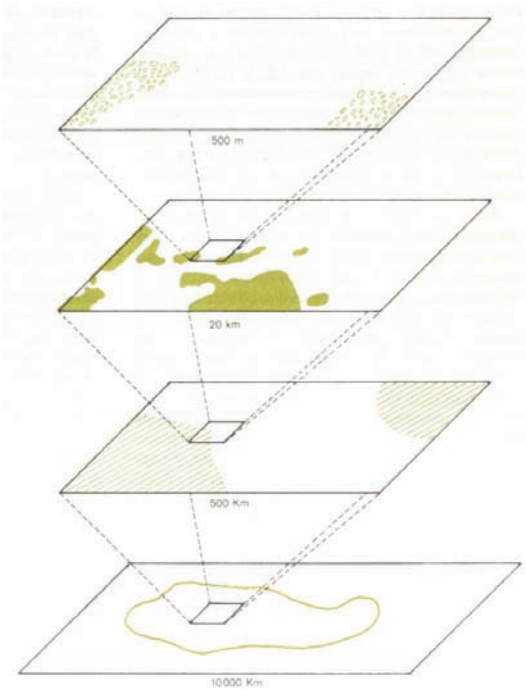

Fig. 5: Depending on the work scale, the distribution of a species varies, showing the relevance of the scale in landscape analysis. (Margalef, 1995: 239)

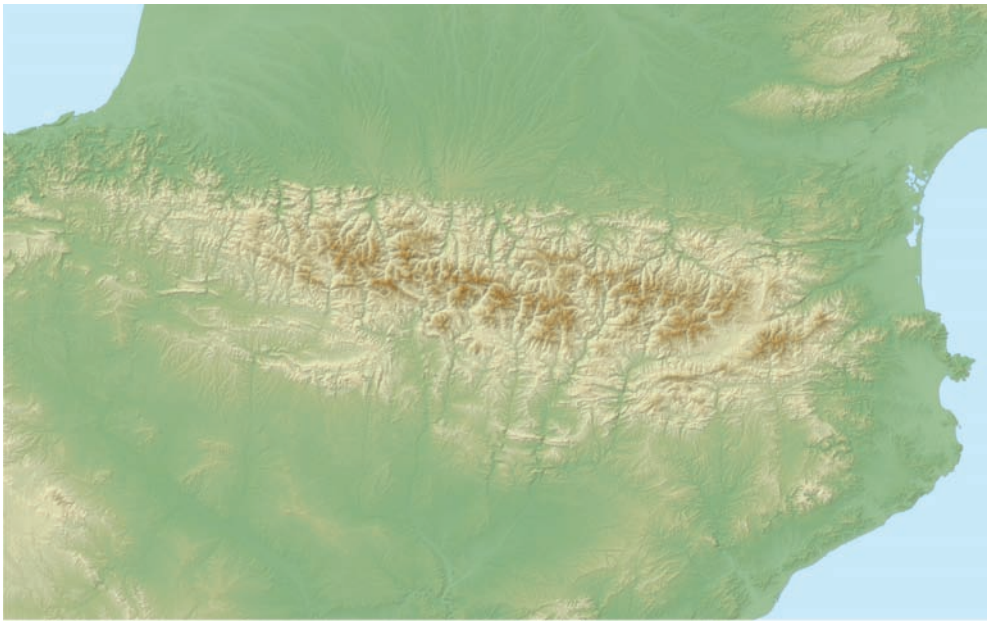

Fig. 6: Fragment of a large blank map showing the relief of the Pyrenees Mountains with no boundaries. UTM projection, GWS84 geoid, shaded relief with composite image of N-W, W and N lightning positions.(Eric Gaba – Wikimedia Commons user: Sting, GFDL)

Then prioritizing the level of areas (with marked continuity) and other elements of perceptual continuity (visual, productivity, etc.) should be taken into account, even beyond the initial demarcation. This non-arbitrary level, according to physical categories such as gravity or extension, can be combined with sets if the occasion requires. In this way a landscape unit can be defined by a very marked hydrological basin, while some pattern of sets –such as axialities– can redefine or guide this limit if the landscape criterion so requires. The flows, more abstract in their spatiality, could determine possible subdivisions of the landscape unit rather than absolutely condition its delimitation.

It should be noted that, although we start from the premises of totality and non-confusion for the landscape units (the whole territory is defined by landscape criteria, with units not superimposed), the described methodology allows the generation of different scenarios according to the primacy granted to the different systems. These systems could in turn be even considered simultaneously on the same territory, to make a final adjustment in scope and internal structure.

The proposed characterization assumes that the landscape does not comprise lines or boundaries: it is the result of the sum of many components, which –depending on the area in which the study is focused on– will not always possess the same consideration and importance. The scale of work itself in the analysis of the landscape completely influences the consideration of the elements that comprise it (as well as its transcendence and value).

Once patterns have been combined and applied to the territory, it would be advisable to determine guidelines on how to manage those areas with the existing regional plans. At the moment (in Spain), this attribution is in the hands of the regional autonomous administrations, which tend to reduce the complexity of the landscape delimitation in favor of the local management criteria.

For this reason, it would be desirable for the spatial scope to be applied from higher instances to the autonomous –either as a guideline or (preferably) binding, with the subsequent legislative changes– from “ad hoc” commissions at a state or European level.Such is the aim of the recent Irish experience about green infrastructure and its implication in favor of centralization of landscape principles in public sector planning (Lennon et al., 2017). These supra regionalboards would ensure a wider landscape framework, even admitting a shared representation of the autonomous governments involved according to the respective territory.

5. CONCLUSIONS

In conclusion, this paper has focused on the treatment of landscape from its own physical and cultural consideration. For this, an appropriate characterization based on the spatial scope is vital. Patterns such as areas, sets and fluxesmight serve as efficient tools to overcome administrative boundaries.

Similarly that this determination is not correct only by administrative criteria, it is also not acceptable if purely morphological criteria (such as elevation lines, visual basins or watersheds) are considered. The use of the three level patterns and their combination in systems –as the green infrastructure does– can be a useful tool to evaluate all the elements that set up the landscape in each situation.

Finally, we suggest the reconfiguration of administrative competences on planning and management of the environment,highlighting this way the current debate on the integration of the landscape perspective –both from ecology and design (Waldheim 2016: 55)– into the planning system. Undoubtedly, this paradigm shift requires a holistic understanding, which seems to be the key to the future sustainability of the territory.

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URBAN ECOSYSTEM SERVICES ASSESSMENT FOR URBAN AND REGIONAL PLANNING
A methodological framework for Madrid City

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ABSTRACT

Urban ecosystem services assessment is attracting growing interest from policy making and urban and regional planning. Several methodologies have been developed to evaluate urban ecosystem services and tested in different urban settlements around the world, but policy makers and planners are not still using them widely. We developed a methodological framework –based on Erhard et al. (2016)– to assess the impact of local policies and urban planning on ecosystem services, using Madrid, Spain as a case study. Firstly, we collected data on green areas inventories in order to estimate overall ecosystem capacity to provide services. Secondly, we analyzed the evolution of five drivers of change affecting quantity and quality of urban ecosystem services and the urban policies that affected these drivers and services. Third, we analyze the capacity of the urban ecosystem to provide ecosystem services. We give some recommendations for applying and improving this methodological framework. Our research reveals that land use change is the most important direct driver of change since it affects all other drivers, and the urbanization processes in the urban fringe of the last decades have increased services demand and reduce urban ecosystem capacity to provide services.

Key words: urban ecosystems, ecosystem services, assessment, regional planning, urban fringe.

LABURPENA

Hiri-ekosistemetako zerbitzuen ebaluazioak gero eta interes handiagoa sortzen du politika-diseinuaren eta hiri- nahiz eskualde-antolamenduaren artean. Hiri-ekosistemetako zerbitzuak ebaluatzeko hainbat metodologia garatu dira, baita mundu osoko zenbait hiri-kokagunetan probatu ere, baina legegile eta hirigileek oraindik ez dituzte kasu guztietan erabiltzen. Esparru metodologiko jakin bat garatu dugu –Erhard et al. (2016) obran oinarritua– tokiko politikek eta hiri-antolamenduek ekosistemetako zerbitzuetan duten eragina ebaluatzeko, eta horretarako, Madril (Espainia) hartu dugu kasu praktikotzat. Lehendabizi, berdeguneen inbentarioei buruzko datuak bildu genituen ekosistemak zerbitzuak emateko zeukan ahalmen guztia kalkulatzeko. Bigarrenik, bost aldaketa-eragileren bilakaera aztertu genuen, betiere hiri-ekosistemetako zerbitzuen kantitatea eta kalitatea eta eragile zein zerbitzu horiek eraginpean hartzen dituzten hiri-politikak aintzat hartuta. Hirugarrenik, hiri-ekosistemak ekosistemetako zerbitzuak emateko duen ahalmena aztertu genuen. Era berean, esparru metodologiko hau aplikatzeko eta hobetzeko gomendioak ematen ditugu. Gure ikerlanak garbi erakutsi du lurzoruaren erabilera-aldaketa dela zuzeneko aldaketa-faktorerik garrantzitsuena, gainerako faktoreei eragiten baitie, eta azken hamarkadetan hiri-kanpoaldeetan izan diren urbanizazio-prozesuek zerbitzu-eskaera areagotu dutela eta hiri-ekosistemak zerbitzuak emateko duen ahalmena murriztu.

Gako hitzak: hiri-ekosistemak, ekosistemetako zerbitzuak, kokagunea, eskualde-antolamendua, hiri-kanpoaldea.

RESUMEN

La evaluación de servicios de ecosistemas urbanos está suscitando cada vez más interés entre el diseño de políticas y la ordenación urbana y regional. Se han desarrollado varias metodologías para evaluar los servicios de ecosistemas urbanos y se han probado en diferentes asentamientos urbanos de todo el mundo, pero los legisladores y los urbanistas aún no las están empleando de forma generalizada. Hemos desarrollado un marco metodológico –basado en Erhard et al. (2016)– para evaluar el impacto de las políticas locales y el ordenamiento urbano en los servicios de ecosistemas empleando Madrid, en España, como caso práctico. En primer lugar recabamos datos de inventarios de zonas verdes para calcular la capacidad total del ecosistema para proporcionar servicios. En segundo lugar analizamos la evolución de cinco motores de cambio que afectan a la cantidad y la calidad de los servicios de ecosistemas urbanos y las políticas urbanas que afectaban a dichos motores y servicios. En tercer lugar analizamos la capacidad del ecosistema urbano para proporcionar servicios de ecosistemas. Asimismo ofrecemos algunas recomendaciones para aplicar y mejorar este marco metodológico. Nuestra investigación revela que el cambio de usos del suelo es el factor directo de cambio más importante, ya que afecta al resto de factores, y que los procesos de urbanización en la periferia urbana de las últimas décadas

han aumentado la demanda de servicios y reducen la capacidad de prestación de servicios del ecosistema urbano.

Palabras clave: ecosistemas urbanos, servicios de ecosistemas, asentamiento, ordenación regional, periferia urbana.

1. INTRODUCTION

Human well-being depends on ecosystems services (ES), which are the benefits people obtain from ecosystems (Millennium Ecosystem Assessment, 2003). More than half of the world's population live in urban areas and it is estimated that, by 2050, this number will reach the 66% (United Nations, 2014). Moreover, urban land area is expanding faster than urban populations (Elmqvist et al., 2013). The majority of the services that urban inhabitants need for their well-being come from other ecosystems, so cities are strongly dependent (Folke et al., 1997; Rees, 1997, 2003). But many services can, and need to be, provided by urban ecosystems (Gómez-Baggethun and Barton, 2013). For these reasons, ecosystem services need to be taken into account in urban and regional planning, fostering ecosystem services supply in urban and nearby areas and minimizing demand, making urban settlements more resilient (Walker et al., 2004; Hopkins, 2008).

Following categories proposed by Spanish National Ecosystem Assessment (2013), we consider three types of ES: provisioning, regulating and cultural. In urban ecosystems, defined as those systems in which people live at high densities and where built structures and infrastructure cover much of the land surface (Pickett et al., 2011), regulating services, such as urban temperature regulation, noise reduction, air quality regulation and moderation of climate extremes, and cultural services, such as outdoor recreation, are especially relevant (Gómez-Baggethun et al., 2013). These services need to be provided locally, whereas other services, such as food and water provision or carbon sequestration, are mainly provided by other ecosystems. The ecosystems located at the urban fringe, such as forests or agricultural land, play an important role to supply these services. Nevertheless, far from maintaining and fostering ecosystem services in urban areas, local, regional and national Spanish governments have promoted and facilitated the urbanization of the urban fringe in many Spanish cities (Méndez, Echaves and Abad, 2015), destroying important ecosystems and increasing services demand.

Cities are often rich in biodiversity (Aronson et al., 2014) and urban species provide a wide range of ecosystem services. Urban green areas include not only city parks, but also the wide array of macro- and micro-urban places (Elmqvist et al., 2013), from urban forests, to private gardens, community allotments or even street trees. Urban and regional planning must map and assess urban and peri-urban green areas and the services they provide in order to improve their management (Maes et al., 2016). Although it is an emerging new research field, several authors reviewed recent urban ecosystem services (UES) assessments (Haase et al., 2014; Luederitz et al., 2015; Pulighe, Fava and Lupia, 2016). These studies suggest that i) most assessments on UES evaluated regulating services, especially local climate, air quality regulation, and carbon sequestration and storage; ii) most studies only assess provisioning of ecosystem services, whereas demand is rarely evaluated and; iii) links between research and planning are quite limited.

In this context, the aim of this paper is to propose a methodological framework to assess UES that could be applied to evaluate the impact of urban planning and policy-making in the city of Madrid (Spain) between 2003 and 2015. Our hypothesis is that urban developments and the construction of roads infrastructure have dominated Madrid City Council's policies in this period, increasing demand of provisioning and regulating ecosystems services, and urbanizing important ecosystems in the urban fringe that supplied services to Madrid citizens. The specific objectives include: i) evaluate all relevant UES in the city; ii) assess the impact of urban planning on supply and demand of UES; iii) propose useful criteria for policy-makers and urban and regional planners to design plans and policies taking urban ecosystem services into account.

2. DESCRIPTION OF THE CASE STUDY AREA

Municipalities are the smallest administrative units with normative competencies, and urbanization processes such as the urbanization of the urban fringe are carried out by local governments. For this reason, our case study area comprises the entire municipality of Madrid, Spain. Madrid, located in the middle of Spanish Inner Plateau, is home of 3 165 541 people (Spanish Statistical Office, 2016) and it is the capital and the largest city of the country. The municipality is divided into 21 districts with different socio-economic realities and urban structures. The city is characterized by a densely populated urban centre with scarcity of green areas. The only exception is the Retiro Park and Madrid Río that, with 118 and 101 hectares respectively, are the largest parks in the central districts of Madrid (Ayuntamiento de Madrid, 2013a). The surrounding districts are less densely urbanized and their green area is larger. The urban park Casa de Campo, on the west side of the city, and El Pardo forest, on the north, stand out. Nevertheless, in the last decade, the city council has promoted the construction of new urban developments in the urban fringe (Calvo et al., 2007), urbanizing relevant natural and semi-natural areas for the supply of ecosystem services.

Although general urban planning and policies did not direct to maintain and foster UES, some interesting initiatives have been carried out by the city council in the last years, such as the promotion of communitarian urban allotments, the project *Madrid+Natural*, which implements nature-based solutions for climate change adaptation, or an environmental impact assessment of municipal policies. This research is part of the first stage of this municipal assessment, and it proposes a methodological framework to asses urban planning and policies impact on supply and demand of ES.

3. CONCEPTUAL AND METHODOLOGICAL FRAMEWORK

3.1 General conceptual framework

The Millennium Ecosystem Assessment Conceptual Framework (2003) is designed to assess the consequences of changes in ecosystems for human well-being. We adapted this conceptual framework for urban ecosystems and the objectives of this paper (fig. 1). Changes

in factors that indirectly affect ecosystems (indirect drivers of change), such as demographic, economic or sociopolitical, can lead to changes in factors directly affecting ecosystems (direct drivers of change), such as land use change, pollution or resource consumption, that modify the flow of ecosystem services affecting human well-being at different spatial and temporal scales. Therefore, economics, politics, science and technology must be directed to guarantee human well-being (blue arrow).

Following this conceptual framework we propose a methodological framework to assess the impact of urban planning and policy-making, as indirect drivers of change, on the five relevant direct drivers of change in Madrid (land use change, climate change, pollution, species introduction and removals and resource consumption) and the supply and demand of ES.

3.2 Methodological framework

Our methodological framework to asses UES is based on MAES (Mapping and Assessment of Ecosystems and Ecosystem Services) analytical framework (Erhard et al., 2016). It incorporates elements of the DPSIR (drivers, pressures, state, impact and responses) and other ecosystem assessment frameworks into a simplified approach. Different drivers (D) such as demography, economy or politics exert pressures (P) on the state (structure) of ecosystems (S), with impacts (I) on ecosystems functions. Following the general conceptual framework, the indirect drivers of change are the drivers that affect the direct drivers (pressures) on the structure and functions of the urban ecosystem, affecting ecosystem services provision for human well-being. Policy-making and urban planning will respond (R) the needs of the ecosystem to maintain ecosystem services supply (fig. 2).

4. URBAN ECOSYSTEM STRUCTURE

We conducted a review of municipal inventories and reports on urban planning and green areas to analyze the structure of the urban ecosystem of Madrid. We completed this information with the data from Urban Atlas (European Environment Agency, 2010) and other reports and statistical databases. In order to connect the urban ecosystem structure and UES supply we used the concept of service providing units (SPU), defined as the smallest distinct physical unit that generates a particular (or several) ES and is addressable by planning and management (Andersson et al., 2015). We find SPU at different spatial scales, depending on the analyzed ecosystem services and the research question. For example, an urban park can be a SPU that provides cultural services such as recreation, but this park houses individual trees that are SPU themselves, since they supply regulation services such as carbon sequestration and air quality regulation. We identified, mapped and described SPU in Madrid municipality (fig. 3 and table 1).

Although there is not a biodiversity index for Madrid municipality, we deduce urban developments, pollution, invasive alien species and lack of connectivity between green areas, are reducing urban biodiversity. Trees are important SPU in urban environments (Andersson

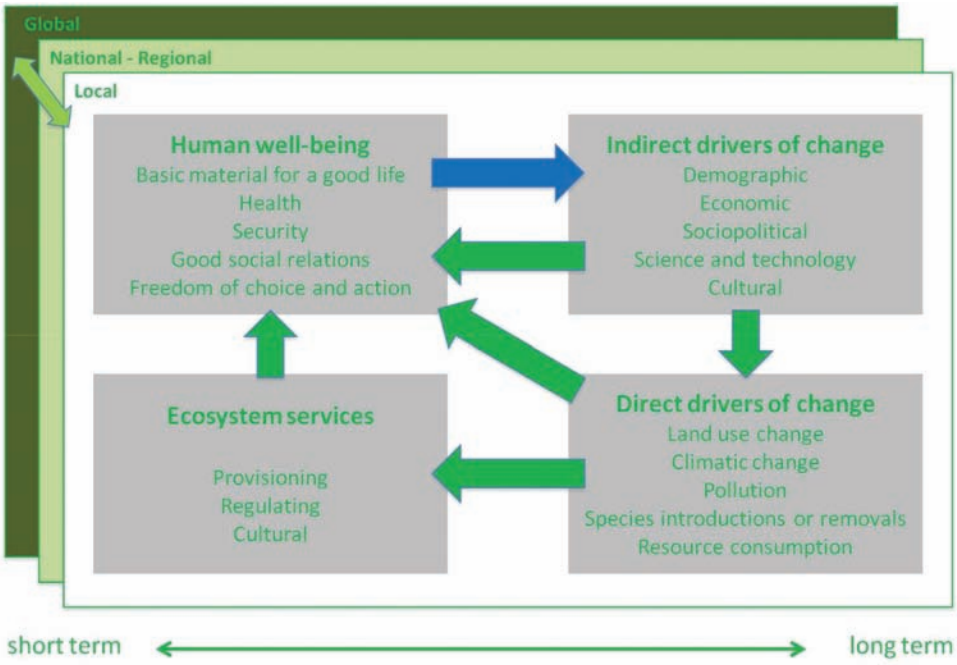

Fig. 1: General conceptual framework. (Own elaboration from Millennium Ecosystem Assessment, 2003)

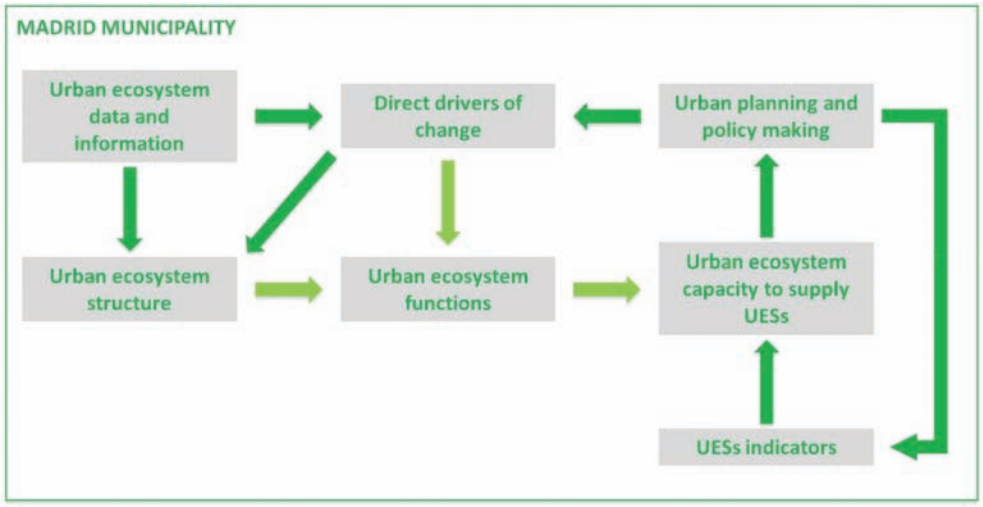

Fig. 2: Methodological framework. (Own elaboration from Erhard et al., 2016)

SPU class	SPU	Main SPU in Madrid	Ecosystem services provided	References
Individual organisms	Microorganisms		*Regulating:* waste treatment, water purification. *Cultural:* scientific knowledge, environmental education.	
	Insects		*Regulating:* waste treatment, pollination. *Cultural:* environmental education, aesthetic benefits.	
	Other animals		*Regulating:* seeds dispersal. *Cultural:* environmental education, aesthetic benefits.	
	Vegetation	Street trees	*Provisioning:* food, energy. *Regulating:* air quality regulation, water purification, noise reduction, runoff mitigation, climate regulation. *Cultural:* scientific knowledge, environmental education, aesthetic benefits.	Ayuntamiento de Madrid, 2013a
Water bodies	Rivers and watercourses	Manzanares River	*Provisioning:* water, energy. *Regulating:* water purification, urban temperature regulation. *Cultural:* scientific knowledge, environmental education, recreation, aesthetic benefits.	European Environment Agency, 2010; Ayuntamiento de Madrid, 2013b
	Reservoirs	El Pardo reservoir	*Provisioning:* water, energy. *Regulating:* global climate regulation. *Cultural:* recreation, aesthetic benefits.	European Environment Agency, 2010; Ayuntamiento de Madrid, 2013a
	Aquifers	Tertiary detritus aquifer	*Provisioning:* water. *Cultural:* scientific knowledge, environmental education	Canal de Isabel II
	Other artificial water bodies	Artificial lakes in Retiro Park and Casa de Campo	*Regulating:* urban temperature regulation. *Cultural:* scientific knowledge, environmental education, aesthetic benefits.	European Environment Agency, 2010
Structures of abiotic origin	Soil		*Provisioning:* metallic and non-metallic materials. *Regulating:* noise reduction, runoff mitigation, global climate regulation. *Cultural:* scientific knowledge, environmental education.	
Green areas	Green urban areas (urban parks, sports and leisure facilities...)	Casa de Campo, Finca de Tres Cantos, Juan Carlos I, Retiro Park, Madrid Río	*Regulating:* noise reduction, runoff mitigation, global climate regulation, urban temperature regulation. *Cultural:* environmental education, recreation, aesthetic benefits.	European Environment Agency, 2010; Ayuntamiento de Madrid, 2013a
	Urban allotments		*Provisioning:* food. *Regulating:* pollination, seed dispersal. *Cultural:* scientific knowledge, environmental education, recreation, aesthetic benefits	Red de Huertos Urbanos de Madrid, 2017
	Green roofs, vertical gardens…		*Regulating:* air quality regulation, noise reduction, climate regulation. *Cultural:* aesthetic benefits.	
	Agricultural, semi-natural areas, wetlands and forests	El Pardo, Soto de Viñuelas	*Provisioning:* food, materials of biotic origin. *Regulation:* pollination, seed dispersal, climate regulation. *Cultural:* environmental education, recreation, aesthetic benefits.	European Environment Agency, 2010; Ayuntamiento de Madrid, 2013a

Table 1: Urban SPU in Madrid municipality ant the services that they supply. (Own elaboration)

Direct driver of change	Evolution during 2003-2015	Municipal policies that positively affected the direct driver	Municipal policies that negatively affected the direct driver	ES supply			ES demand			References
				Provisioning	Regulating	Cultural	Provisioning	Regulating	Cultural	
Land use change	Negative	New urban parks	New urban developments (PAUs)	↓	↓	↑	↑	↑	↑	Ayuntamiento de Madrid, 2013a, 2013b
Climate change	Negative	Promotion of public transport and bicycle; environmental education; new urban parks	New urban developments (PAUs), M-30 ring road tunneling	–	–	–	–	↑	–	Morata, 2014; Ayuntamiento de Madrid, 2016d
Pollution	Positive	Promotion of public transport and bicycle; environmental education; new urban parks	New urban developments (PAUs), M-30 ring road tunneling	–	–	–	–	↓	–	Ayuntamiento de Madrid, 2015, 2016c; Ecologistas en Acción, 2016
Species introduction and removals	Negative		New urban developments (PAUs); management of green spaces	–	↓	↓	–	–	–	Ayuntamiento de Madrid, 2013a; Molina *et al*., 2016
Resources consumption	Positive	Management of green spaces; environmental education		–	–	–	↓	–	–	Carpintero *et al*., 2015; Ayuntamiento de Madrid, 2016a, 2016b

Table 2: Direct drivers of change evolution and their impact on supply and demand of ES. (Own elaboration)

et al., 2015; Salmond et al., 2016). They provide multiple regulating and cultural services, such as air quality and urban temperature regulation, or aesthetical benefits. In Madrid, there are 293 356 trees (Ayuntamiento de Madrid, 2013a). Most of them, 247 343, are street trees, 13% more than 2003.

The main watercourse of Madrid municipality is Manzanares River. It constitutes an important ecological corridor, which crosses the western and southern districts and three of the most important green areas in Madrid (El Pardo, Casa de Campo and Madrid Río). In the municipality there is only one reservoir of 1,179 hectares located at El Pardo (Ayuntamiento de Madrid, 2013b). However, water is provided by other reservoirs outside the municipality and, occasionally, in drought periods, from the aquifer located under the city (Canal de Isabel II, no date). Regarding artificial water bodies, two artificial lakes in Retiro Park and Casa de Campo (European Environment Agency, 2010) provide several regulating and cultural services.

Soil provides several important regulating services, such as noise reduction, runoff mitigation and global climate regulation. In urban environments soil has been widely waterproofed, reducing the supply of these services. Only in green and other small urban areas soil still maintains its functions.

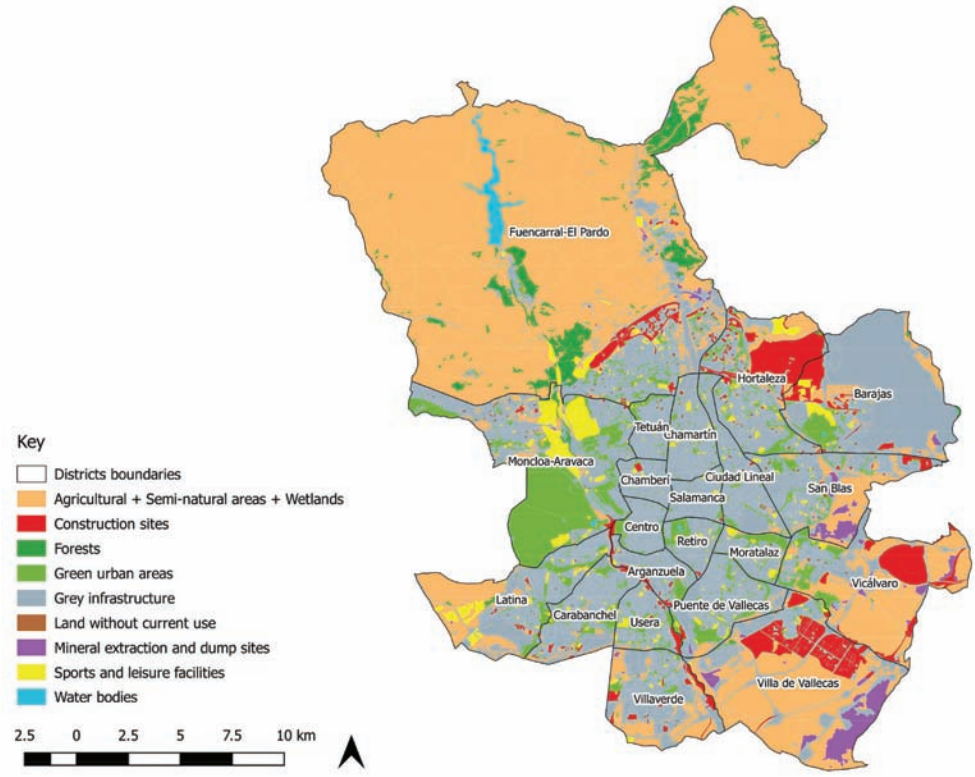

Fig. 2: Methodological framework. (Own elaboration from Erhard et al., 2016)

Green areas include urban parks, forests, protected areas, private gardens, urban allotments and green areas in buildings. Urban parks add up to 6400 hectares, providing important regulating and cultural services. However, their distribution is very heterogeneous, with some districts with more than 1800 hectares (Moncloa-Aravaca) and others with less than 50 hectares (Chamberí, Salamanca and Centro) (Ayuntamiento de Madrid, 2013a). The largest urban park is Casa de Campo, in Moncloa-Aravaca district, with 1722 hectares. There are also four parks with more than 100 hectares, two of them located at the suburbs. The largest green space in the municipality is El Pardo, located at the north of the city. It is a Mediterranean wooded meadow with holm oaks and a Natura 2000 protected area. However, most of it is closed to general public, so it is an important area for regulating services but not for cultural. Urban allotments do not occupy a large area in the city but, promoted and created by citizens in their own neighborhoods, they have increase in number in the last years (Red de Huertos Urbanos de Madrid, 2017). Although food production is really low, they have demonstrated to play an important role for cultural services (Camps-Calvet et al., 2016).

5. DIRECT DRIVERS OF CHANGE

We analyzed five direct drivers of change (land use change, climate change, pollution, species introduction and removals and resource consumption) and how they generally affected to supply and demand of ES during 2003 and 2015 when it was possible. For this purpose we reviewed different statistical databases and municipal reports. We also reviewed urban policies and plans of the mentioned period in order to identify which municipal actions have mainly affected direct drivers of change. A summary of the analysis is showed in table 2.

Land use change through urbanization processes is the most important direct driver since it affects all other direct drivers of change. Urbanized area has increased in the last decade due to the new urban developments known as PAUs, most of them located in the south-west urban fringe of the municipality (Calvo et al., 2007; Ayuntamiento de Madrid, 2013b). Whereas natural and semi-natural areas in northern Madrid are mainly Mediterranean wooded meadows with holm oaks, the south-west is dominated by steppes and agricultural land, so these ecosystems and the services they provide have been the most affected by urbanization. These new urban developments also increase UES demand, not only provisioning ones during the construction phase, but also provisioning of water and energy for the new residents, or regulating services, such as air quality regulation, since they create new mobility necessities that increase air pollution (Calvo et al., 2007). The total area of urban parks has also increased, as a consequence of the incorporation of new urban green areas into the municipal management (Ayuntamiento de Madrid, 2013a). Outlying districts have been the main beneficiaries, whereas green spaces growth in central districts has been very low or even negative. Probably, the increase in urban parks area had a positive effect on cultural services to the detriment of provisioning or regulating services provided by the pre-existing ecosystems occupied by the new urban parks.

Climate change scenarios for Madrid forecast that temperatures and duration of heat weaves will increase, while total precipitation and number of raining days will decrease (Morata, 2014). Greenhouse gases emissions have decreased between 2005 and 2014 but they still are very high. Road transport and residential, commercial and institutional sector are responsible of the 69% of the emissions in 2014 (Ayuntamiento de Madrid, 2016d). Whereas carbon dioxide emissions are the main responsible for this drop, fluorochemicals, especially hydrofluorocarbons from refrigeration and fire extinction equipments and air conditioning have strongly increased.

Air pollutants (Ayuntamiento de Madrid, 2016c) and waste (Ayuntamiento de Madrid, 2015) in Madrid have been reduced during the studied period, but they still are very high. Air pollution is one of the main environmental and public health problems in Madrid. Some air pollutants such as nitrogen oxides (NOx), suspended particles (PM10 y PM2,5) and tropospheric ozone (O3) exceed legal and recommended limits by the World Health Organization (Ecologistas en Acción, 2016). Urban planning should be directed to reduce the use of cars and air pollution, but this issue has been ignored. New urban developments have increased car dependency and the M-30 ring road tunneling only promotes its use. Nevertheless, the ring road tunneling has lower noise levels in the adjacent neighborhoods (Ayuntamiento de Madrid, 2011).

Urban tree diversity has increased in the last years (Ayuntamiento de Madrid, 2013a), which has a positive effect on regulating services such as pest control. However, most of them are non-native species so biodiversity, pollination and connectivity are not promoted as it could be with native species. Although there are not many studies about them in urban areas, alien invasive species is a serious problem for ecosystem performance. Monk parakeet (Myiopsitta monachus) is a great example of how its population can increase in a few decades, reaching more than 7000 individuals in Madrid City (Molina et al., 2016).

Madrid urban ecosystem is completely dependent on other ecosystems for the supply of provisioning services, so resource consumption directly affects other ecosystems. Although it is still very high, reduction on water, food (Ayuntamiento de Madrid, 2016b), energy (Ayuntamiento de Madrid, 2016a) and materials (Carpintero et al., 2015) consumption is due to the recession that begun in 2008 and not to the municipal policies. In fact, in the last years resources consumption has increased again.

6. URBAN ECOSYSTEM SERVICES

In sections 4 and 5 we described the SPU located at Madrid municipality and identified the services they provide, and how urban planning and policies have affected direct drivers of change and ES supply and demand, so we have an overall view of urban ecosystem capacity to provide services.

With more than three million people living in Madrid, the demand of provisioning services such as water, food, energy or materials, although has decreased since 2008, is still very high.

Apart from a small part of food (from urban allotments), water (from the aquifer) and materials (from a sepiolite mine), these services are mainly supplied by other ecosystems.

Regulating services are mainly provided by urban trees, water bodies and green areas, but their spatial distribution is unequal. Outlying districts have more green areas than central ones, and therefore, the provision of regulating and cultural services is higher. This is especially important for regulating services that only are provided locally, such as runoff mitigation, urban temperature regulation and noise reduction, and for cultural services, since main beneficiaries will be nearby inhabitants. Other regulating services are also important, such as air quality and global climate regulation, but demand of these ES is extremely high. Green areas, again, are the main SPU for these services. El Pardo and Casa de Campo play an important role providing these ES, but they only filter and storage a small amount of the air pollutants and greenhouse gasses emissions in Madrid City.

Cultural services, especially recreation and aesthetic benefits, are provided by urban parks and water bodies, such as Manzanares River or artificial lakes. They also are unequally distributed along the city, so a big part of Madrid population has to move to other districts to access to these cultural services.

7. DISCUSSION

Madrid is a big city with a high demand of ES. We identified areas that provide provisioning, regulating and cultural ES inside the municipality of Madrid. Although there are large green areas that supply important regulating and cultural services, they are unequally distributed along the city and mainly located at the urban fringe. Provisioning services in the urban area are insignificant. Land use change is the most important direct driver of change since it affects all other drivers, and the peri-urbanization processes of the last decades have increased services demand and reduce urban ecosystem capacity to provide services. Urban planning and policies have not been directed to maintain and promote the capacity of the urban ecosystem to provide ES and to reduce its demand.

Our research confirms our hypothesis that urban developments and the construction of roads infrastructure have dominated Madrid City Council's policies between 2003 and 2015, increasing demand of provisioning and regulating ecosystems services, and urbanizing important ecosystems in the urban fringe that supplied services to Madrid citizens. It also reveals that Madrid, as it was expected being a city, is highly dependent from other ecosystems (Folke et al., 1997; Rees, 1997, 2003) and cannot be self-sufficient and resilient without acknowledging and accounting for their dependence on ecosystems from nearby or distant regions (Doughty and Hammond, 2004; Andersson, 2006; Elmqvist et al., 2013; Montes and Duque Gutiérrez, 2015). Nevertheless, we can reduce such dependency, increasing UES supply and minimizing demand through urban and regional planning, taking into account not only the urbanized area but also the ecosystems in the urban fringe. Quantifying ES supply and demand allows us to know how big it is such dependency and which services are deficient.

The Millennium Ecosystem Assessment (2003) suggests that ecosystem services must be assessed at different spatial scales. In the case of cities, we can assess ES at a metropolitan or regional scale to estimate the balance between supply and demand within the territory the urban ecosystem is located. But also, at a neighborhood scale, in order to identify spatial distribution of SPU inside the urban area. So urban planning must promote equally distributed UES supply and reduce its demand, while regional planning must recognize urban areas dependency on the surrounding ecosystems, managing the ecosystem services that the urban area needs. Municipal and regional administrations must coordinate, connecting urban and regional planning and incorporating social-ecological criteria.

Urban ecosystem services assessments usually are disconnected from planning and policy-making (Haase et al., 2014). Moreover, environment issues are not a cross area in municipal administrations, and they are disaggregated in different areas and departments (Navarro and Alba, 2017), so the necessary ecological vision to maintain and foster UES is missed. The European Union has introduced ecosystem services in regional and urban planning through the concept of green infrastructure, defined as a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services (European Union, 2013). Although there are cities which are incorporating green infrastructure in urban planning (Maes et al., 2016), methodologies to assess UES that can be widely used by planners and policy-makers need to be improved.

Our research is a first step to estimate overall ecosystem capacity to provide services and to assess urban planning and policy-making impact on supply and demand of ES in Madrid City. Next steps will include improving the methodological framework and ES assessment. In order to quantitatively assess the impact of planning and policy making on UES we propose to develop a list of indicators to assess supply and demand of provisioning, regulating and cultural relevant ecosystem services in Madrid based on the previous work of Gómez-Baggethun and Barton (2013), Gómez-Baggethun et al. (2013); Rocha et al. (2015) and Maes et al. (2016). These indicators must be measured before, during and after the policy is implemented, in order to identify changes on supply and demand of ecosystem services. Service providing units and ecosystem services mapping and assessment can be improved using GIS techniques that help us to understand urban ecosystem structure and its capacity to provide ecosystem services (Pulighe, Fava and Lupia, 2016). Our purpose is to help to understand how Madrid City works as an urban ecosystem and its capacity to provide ecosystem services. The results and the methodological framework can be used by planners and policy-makers for citizens well-being.

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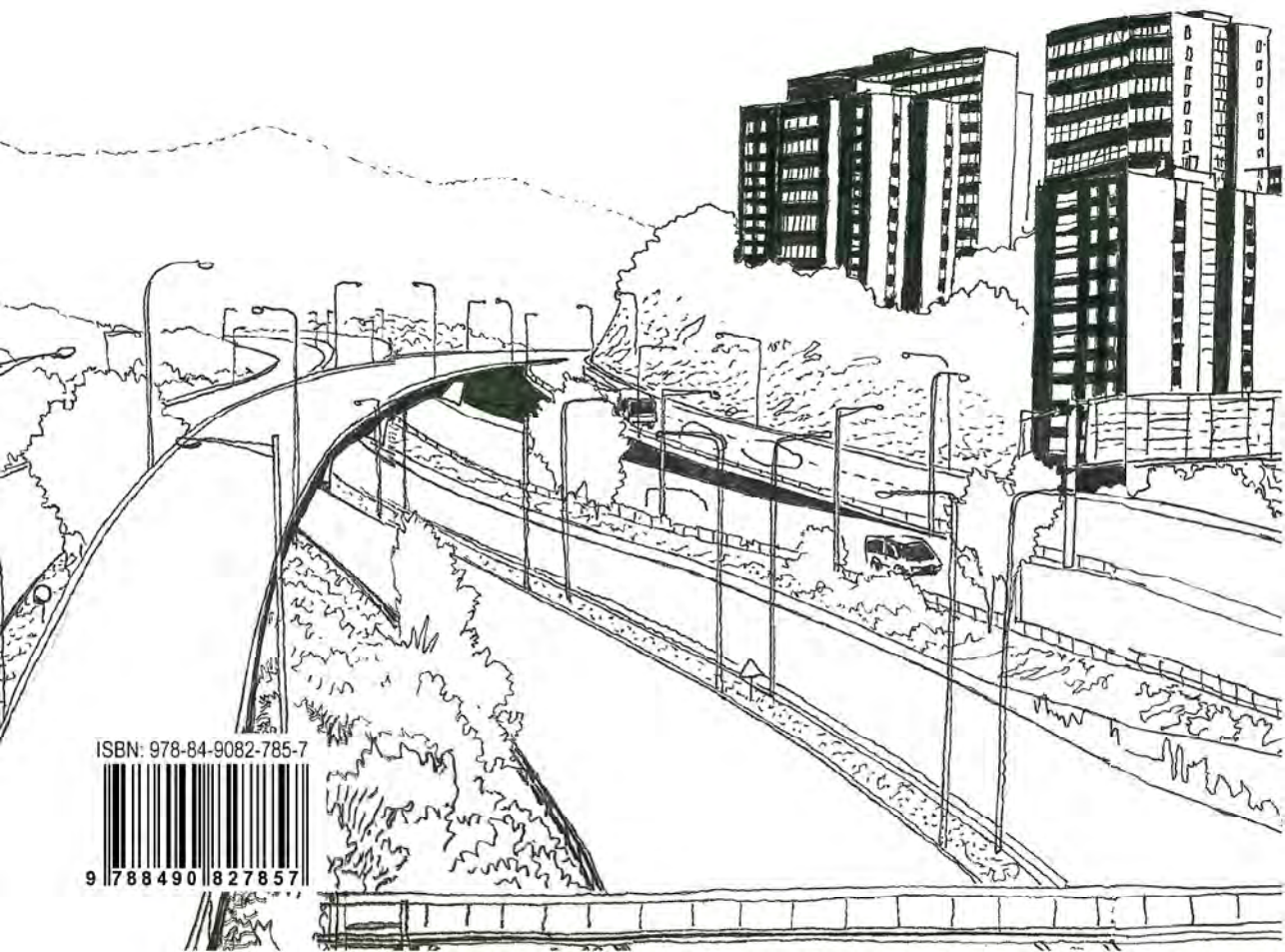

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