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**CAPÍTULO 15 INTERACTIONS BETWEEN SURROUNDING LANDSCAPE BIODIVERSITY
AND INTERMITTENT RIVERS IN MEDITERRANEAN ENVIRONMENTS – CASE STUDY OF
THE CAIA RIVER**

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ESTUDIOS

E

ESPACIOS Y SOCIEDADES EN TRANSFORMACIÓN

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PRÓLOGO

Prólogo

Siento una gran satisfacción profesional al prologar este libro titulado *Espacios y Sociedades en Transformación*, en un momento de grandes cambios en todos los órdenes, hasta el punto que algunos autores señalan que ya no estamos en un ciclo de cambios sino en un cambio de ciclo. Para esos nuevos escenarios tenemos que ir diseñando las herramientas adecuadas que nos permitan adaptarnos con mayor facilidad a las incertidumbres propias de la vorágine del siglo XXI.

Por ello, un grupo de 69 especialistas procedentes de 21 países y 24 universidades de Europa, América y África han aportado sus conocimientos en esta obra colectiva, configurada por 32 capítulos en los que se abordan cuestiones técnicas, jurídicas, económicas, sociales y ambientales para afrontar la renovación de las nuevas estrategias espaciales con implicaciones en los patrones socioculturales.

Se analizan los cambios que imponen los avances y la globalización para su incorporación a los procesos de desarrollo de los territorios desde la óptica de las amenazas (marginalización social, suburbios, delincuencia, crisis ambiental, creación y desaparición de frentedras, etc.) y oportunidades (incorporación de las tecnologías a la planificación y al ámbito social, empresarial, educativo o comercial). Sólo conociendo el peso de las amenazas y las oportunidades se pueden emprender medidas correctoras contra las desigualdades sociales y los desequilibrios territoriales que se divisan en el horizonte de una megalopolización y alteraciones ambientales.

En síntesis, el lector tiene en sus manos una obra que le va a ser de utilidad y orientación en la profundización de estas cuestiones claves para que el futuro no nos coja desprevenidos y evitemos la improvisación

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CAPÍTULO 15 INTERACTIONS BETWEEN SURROUNDING LANDSCAPE BIODIVERSITY AND INTERMITTENT RIVERS IN MEDITERRANEAN ENVIRONMENTS – CASE STUDY OF THE CAIA RIVER

Capítulo 15

Interactions between surrounding landscape biodiversity and intermittent rivers in mediterranean environments – case study of the Caia River

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SUMARIO: I. INTRODUCTION. II. MATERIALS AND METHODS. III. OUTCOMES. 3.1 *Monte da Falagueira: Middle/Upper River*. 3.2. *Caia Spring/Upper Caia* IV. DISCUSSION AND CONCLUSIONS. V. REFERENCES.

ABSTRACT

Landscape is a dynamic mosaic of various structures interacting together. Neglecting or overusing one part of this mosaic may boost up or damage the development of others. For instance, overgrazing may increase soil erosion process which may clog a river/stream. In this regard land use changes, climate change and landscape management may lead to increase the intermittency of the surface watercourses, as well as in the ecosystem services provided by riverscapes for humans. Therefore, the present research focus on the existing interactions between the Caia River, an intermittent river located in the Mediterranean region, and its surrounding agricultural and natural landscapes. The performed analyses considered the identification of the existing interaction between natural and agricultural landscapes with the Caia River defining the predictable ecosystem services provided by each element of the landscape and assessing the potential decrease of the ecosystem services provided in case of landscape changes, which according to the performed research might enclose significant impacts both in ecologic and socioeconomic terms.

Keywords: biodiversity, ecosystem services, intermittent rivers, Mediterranean area.

. INTRODUCTION

Landscape and biodiversity are very complex unity. The interaction within and between them is on different horizontal and vertical, spatial and temporal level (Noss, 1990; Clergue et al, 2005; Bennett et la., 2006).

The idea of biodiversity was the first time defined in 1916 as biological diversity (Harris, 1916), and ecosystem services were defined by the Millennium Ecosystem Assessment (MEA) in 2005. The intermittent rivers have a specific flow regime variable in all dimensions (Datry

et al., 2017b). Therefore, biodiversity within intermittent rivers change according to the current flow regime and vary within the channel morphology (Datry et al., 2017a). The relation between biodiversity and ecosystem services (ES) was a hot topic around 2010 (De Groot et al., 2016). The intermittent rivers take the attention of the researchers last 15 years (Datry et al., 2017b). There were published several papers described the chemical (e.g., Datry et al., 2017a) and biological processes (e.g., Stubbington et al., 2017) within channels of intermittent rivers, and ES provided by intermittent rivers (Steward et al., 2012; Datry et al., 2017b). The link between biodiversity – ES – intermittent rivers is still not fully described. Therefore, a brief comparative study between agricultural and natural Mediterranean environments landscapes based on the vegetation analysis was carried out within a case study approach in a Mediterranean River – The Caia River.

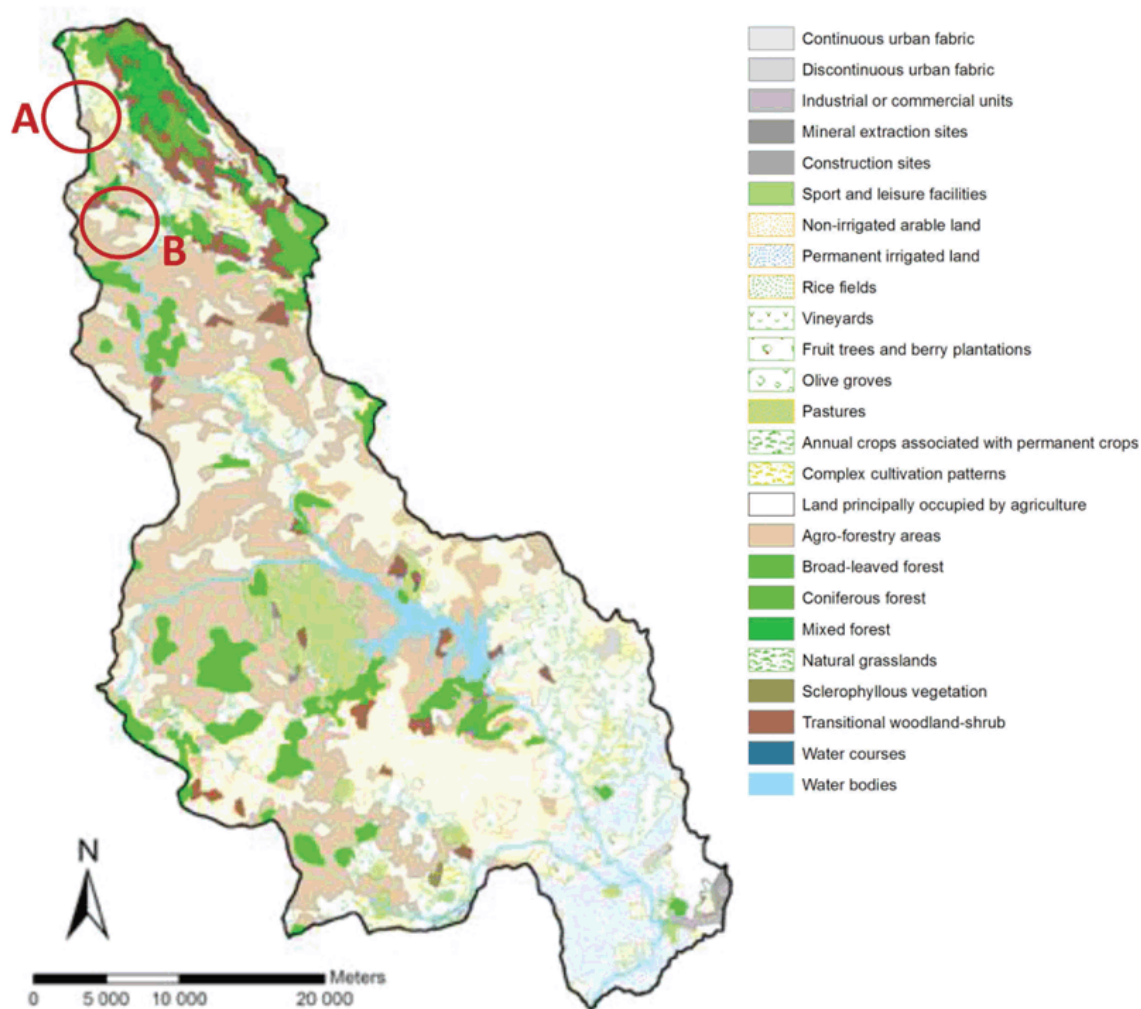
I. MATERIALS AND METHODS

Two locations (**Fig. 1**) have been selected and analyzed in the Caia River: A) in the middle/upper river – near Portalegre (*Monte da Falagueira*): B) at the beginning of the river – into S. Mamede National Park. Case study research and site analysis on the base of the interviews and maps (e.g., CORINE Land Cover) were the main exploratory tools was been used to achieve the aim of the study.

THE CAIA RIVER

The Caia River (about 850 km) is a tributary of Guadiana River. They are transboundary rivers and a shared water resource between Portugal and Spain. The river starts in the Natural Park of Sao Mamede (Portugal) and continues to the south to the border with Spain close to Badajoz (OTALEX-C, 2013). Most of the water is flowing during the winter season and is stored in a reservoir of the Caia Dam. That water is used in the dry season (summer time) for the water supply system, irrigation, and energy. Therefore, the upper part of the river is intermittent and the permanent river is below the dam. Consequently, there are different landscape structure and river morphology.

Figure 1. Land uses identified on the Caia River Basin and location of areas of interests



II. OUTCOMES

The research was done in two different parts of the Caia basin. Both are situated in the upper part of the basin with intermittent flow regime of the river. The first one has mainly agricultural character, and the second one is part of the natural park; therefore, it has the main character of the natural landscape.

3.1. MONTE DA FALAGUEIRA: MIDDLE/UPPER RIVER

Marked by a Mediterranean *macrobioclimate*, of oceanic hue, the stretch of the Caia River bordering the *Monte da Falagueira* (located in Alegrete parish, belonging to Portalegre district – Alto Alentejo Region, Portugal), in biogeographical terms it includes on São Mamede National Park (Oretana Range and Tajo Sector, Lusitania and Extremadura Subprovince, West Iberian Mediterranean Province, Eurosiberian Region) (Rivas-Martínez et al., 2017a). Such territories are influenced by the oceanic *pluviestational* bioclimate, with a *mesomediterranean thermotype* and a sub-humid tropic (Rivas-Martínez et al., 2017b).

In *climatophilous* terms, these surfaces belong to the domain of the *Sanguisorbo hybridae-Quercus suberis* sigmetum (Costa et al., 2012), which were replaced by holm oaks and cork oaks that dominate the landscape. In the *edafoxerophyle* position and as a result of the secondary ecological succession there are remnants of the *Pyro bourgaeanae-Quercus rotundifoliae* sigmetum, which were also transformed into holm oaks.

These mounts are generally poorly maintained, showing obvious signs of overgrazing (Fig. 2), particularly by cattle and even asinine animals. This overgrazing has also caused a heavy load on the riparian vegetation, presenting a fragmented and dense gallery. This fact opens space for the entry of invasive plants, which are now in clear proliferation on these surfaces, as is the case of *Acacia* spp.

In the water line (Caia River) fragments of a complex of vegetation that the *phytosociologists* appears – constituted by *Scrophulario scorodoniae-Alno glutinosae* sigmetum, when there is water on the surface throughout the year. Although an internal band, surrounding this *Scrophulario scorodoniae-Alno glutinosae* sigmetum, appears the *Viti sylvestris-Saliceto atrocinereae* sigmetum, along with the presence of *Salix atrocinerea*, *S. x secalliana*, *S. neotricha*, among others (Fig. 3).

Along with those *Salix* sp., (in the flood bed), appears *Ficario ranunculoidis-Fraxino angustifoliae* sigmetum. Lastly, (at the base of the slope), where rocky outcrops of granite appear; still, regarding the influence of the flood bed with a significant return period allows to live some *Celtis australis* – who witness the potential of a new vegetation series.

In the border of the riverside formations, between *Celtis australis* and *Fraxinus* sp. permanent communities of moist heathlands emerge, denominated by “gorse/Heather”, where is possible to verify *Ulex minor* var. *lusitanicus* and *Erica lusitanica* – which constitutes a habitat que of common interest (4020 – Temperate Atlantic moist heath of *Erica ciliaris* and *Erica tetralix*).

Given the high anthropic action of these territories with a secular mobilization of soils occur with rocky outcrops and small frequency soil very stony – providing the appearance of a vegetation dominated by *Digitalis thapsia* corresponding to the association of *Digitali thapsi-Dianthetum lusitani* (Costa et al., 2012).

Figure 2. Overgrazing of agricultural landscape (author: Kaletová, 2018)



Figure 3. River bed and riparian vegetation of Caia River (author: Kaletová, 2018)



3.2. CAIA SPRING/UPPER CAIA

This area is also influenced by a Mediterranean macrobioclimate. Due to the higher altitude in comparison to *Monte da Falagueira* it has greater oceanic influence; translating into greater atmospheric humidity and edaphic with a sub-humid upper umbilical and a mesomediterranean thermotype (Rivas-Martínez et al., 2017b).

In biogeographic terms the Caia spring/upper River is also located in the National Park of S. Mamede (Oretana Range and Tajo Sector, Lusitania and Extremadura Subprovince, West Iberian Mediterranean Province, Eurosiberian Region) (Rivas-Martínez et al., 2017a).

At the level of the vegetal cover the climatophilous domain belongs to the black oak (*Quercus pyrenaica*), inserting in the series *Arisaro simorrhini-Quercus pyrenaicae* sigmetum (Raposo et al., 2016). The tree cover is scattered formed by *quercus* – resulting of the ecological succession of the edafoxerophile serie *Sanguisorbo hybridae-Quercus suberis* sigmetum, accompanied by pre-forested forests as well as by *Arbutus unedo* and bushes of *Calluno-Ulicetea* (Fig. 4). The natural vegetation cover is clearly in a progressive dynamic, including high regeneration of black-oak (*Quercus pyrenaica*) and also of *Castanea sativa* on the undercover de *Pinus pinaster*.

Near to the Caia spring/upper River water lines subsidiaries are characterized by acidic waters (current and permanent) where a series of *Scrophulario scorodoniae-Alno glutinosae* sigmetum develops. Furthermore, in the inner band of this river comes a community association of *Viti sylvestris-Saliceto atrocineriae* sigmetum – mainly where there is a large flow range, with the presence of *Salix atrocinerea*, *S. x secalliana*, *S. neotricha*, among others. In the outer area (temporarily flooded by the full bed) there is *Ficario ranunculoidis-Fraxino angustifoliae* sigmetum – thus, some plots of deep soils formerly used as gardens and even irrigated crop areas; nowadays, are also progressing ecologically in view of the abandonment of the agricultural uses referred to above.

Figure 4. Vegetation of Caia River within natural landscape (author: Castanho, 2019)



V. DISCUSSION AND CONCLUSIONS

There is a significant difference in the number of species as well as in the abundance of the vegetation between natural and agricultural landscape (**Fig. 3 and 4**). The natural landscape has dynamic development of native species, till the agricultural landscape open space for the invasive species.

A comparison of ES provided by both landscapes shows the differences. It was noticed that the natural landscape provide fifteen ES, and agricultural landscape fourteen (Castanho et al., 2019). The list of ES differs; while in the case of the agricultural landscape are the provisioning ES dominant, for the natural landscape regulating and cultural ES prevailing. Wider biodiversity of natural vegetation brings wider opportunities for common people as well as for the scientist. The agricultural landscape mainly consists of the main grown crops which could be grown also in the river bed, or it is used for the pasture during the summer time. Therefore, the natural vegetation was damaged and increases the success of the invasive species.

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