Protected Landscape: Between Planned and Realized

Patrícia Costa Pellizzaro
Universidade Alto Vale do Rio do Peixe (UNIARP)
Pontifícia Universidade Católica do Paraná (PUCPR)

Letícia Peret Antunes Hardt
Pontifícia Universidade Católica do Paraná (PUCPR)

Carlos Hardt
Pontifícia Universidade Católica do Paraná (PUCPR)

Marlos Hardt
Pontifícia Universidade Católica do Paraná (PUCPR)

Abstract

The accented growth of cities produces many challenges. As a result of this urbanization process, significant interferences occur on the natural resources of protected areas in cities. In view of this presupposition, the general objective of the research is to analyze the physical susceptibility, the biological fragility and the anthropic pressure of the Po Fluvial Park, Piemonte Region, Italy, interpreting three approach scales - regional, surrounding and interior of the conservation unit - and the guidelines of its planning, especially those related to its zoning. From the interpretation of theoretical and conceptual bases, the methodological and technical procedures was developed according to the following phases: thematic mapping from 2000 to 2018, construction of synthesis matrix crossing landscape components, and comparation of previous results with the protection measures related to management of the study area. The analysis shows that there were no significant changes in the period, a fact justified against to recognized quality of the park plan. Thus, the urban and regional administration should consider the protection of abiotic, biotic, and human diversity, including in the set of priorities, aiming at supporting and improving the life quality of the population.

Introduction

The accented growth of cities produces many challenges to be faced by planning, including environmental aspects, that are the focus of this work. In the urban territory, natural resources have few instruments that effectively protect them from degradation, and some of the spaces with the highest degree of protection are instituted as conservation units, which are defined through legal or other effective means, to achieve the nature preservation, ecosystem services and cultural values (IUCN, 2019).

The classification of these protected areas consists of seven categories. Related to the object of this research - Po Fluvial Park, Italy -, the Category V - Protected Landscape / Seascape - is defined by IUCN (2019) as an area where the interaction between man and nature, over time, has produced a space of distinct character with significant ecological, biological, cultural, and visual values. This concept emphasizes the interrelation between human activities and natural resources, with management of the anthropic processes, in a sustainable way.

Despite considerable advances in the state of the art of knowledge about the theme in recent decades, there are still serious gaps and significant obstacles to environmental protection. Considering the assumption that human activities can be interpreted as the main causes of alterations of the natural resources, it is necessary to identify the principal influences of man actions both inside the conservation units and in their surroundings. Therefore, the definition of the zoning of protected natural areas must consider, besides the structural and functional aspects of the landscape, the pressures exerted on them by human activities. The choice of the Po Fluvial Park as study case is justified by its administration plan, awarded in 2010 by the European Council of Spatial Planners, due to its innovative feature regarding not only protection but also the valuation of natural resources (Guerra & Ostellino, 2009).

Structured on these issues, the general objective of the research is to analyze the physical susceptibility, the biological fragility and the anthropic pressure of the Po Fluvial Park, interpreting three approach scales - regional, surrounding and interior of the protected area - and the guidelines of its planning, especially those related to its zoning.

Methodological and technical procedures

The study area was detailed according to three phases. The first of these was the elaboration of thematic maps of its physical, biological, and anthropic components for the period from 2000 to 2018, using the following criteria:

a) physical susceptibility - resistance of abiotic components;
b) biological fragility - sensitivity of biotic items;
c) anthropogenic pressure - level of human intervention on the environments.

The second phase corresponded to the synthesis mapping and matrices were created based on the Saaty model (2005) (Table 1). Then, it was elaborated a comparative analysis, peer-to-peer, among the selected components, considering the relative importance degree of the elements on this scale of importance:

a) 1/9 (0,11) - absolutely less;
b) 1/7 (0,14) - significantly less;
c) 1/5 (0,20) - moderately less;
d) 1/3 (0,33) - slightly less;
e) 1,00 - equally;
f) 3,00 - slightly more;
g) 5,00 - moderately more;
h) 7,00 - significantly more;
i) 9,00 - absolutely more.

Then, raster files were generated from each thematic map, with each pixel of 10 x 10 m being assigned the weight previously established, which were crossed with each other according to property vectors defined by the application of the analytical hierarchical process (Saaty, 2005) in ArcGis 10.6 software, using the weighted sum overlay tool.

The third phase included the matrix organization of comparison among components and construction of synthesis maps of abiotic susceptibility, biotic fragility and human pressure. These results were compared to the goals and propositions established by plans related to the Po Fluvial Park, especially its zoning.

Results and discussion

Located in the region of Piemonte, Italy, the Po Fluvial Park was established by Regional Law N° 28 (Piemonte, 1990), posteriorly amended by others. Its main objectives are to protect: the natural, environmental, scenic and historical heritage; the natural patrimony composed of the waters; the adequate development of agriculture; the area for scientific research and educational, cultural and recreational activities; and the species of fauna and flora. Among its main management instruments, worth mentioning its zoning, detailed at Figure 1.

In general terms, the Po Fluvial Park has distinctive characteristics of physical susceptibility (Figure 2), presenting a high level in about 50.0% of its internal areas, mainly due to the presence of the water network and, in particular, the phenomenon of spates. In the surroundings, 50.0% of the spaces are classified as low susceptibility, because they have flat relief and no direct influence of the flood quota. In the regional context, the homogeneous distribution of the three classes is observed, being greater susceptibility related to the steeper areas and, therefore, more subject to erosive processes. In the period analyzed (2000 to 2018), no significant changes in the general levels of physical susceptibility are perceptible.

The low percentage of high biological fragility (25.0% - region, 14.0% - surroundings and Po Fluvial Park – Figure 3) stands out, referring to the places where the remnants forest and undergrowth are more preserved. The middle class includes approximately 55.0% of the park and only 22.0% of the surroundings. These characteristics show the relevance of the protection of these fragments for the conservation of ecological diversity, since close to the protected area the low level prevails (63.0%) due to the greater influence of the urbanization process and the development of agricultural activities. Also, no relevant changes were observed in these conditions during the period analyzed (2000 to 2018).

There is a significant percentage of the high class of anthropic pressure (Figure 4). As part of the urban context, 33.0% of the park's areas fall into this category and only 20.0% in the lower one, with the median being predominant, in a different way than in the surroundings (61.0% - high class).

PHYSICAL SUSCEPTIBILITY

ABIOTIC COMPONENTS	hypsometric levels	slopes	distance from surface drainage	flood quota
hypsometric levels	**1.00**	0.33	0.20	0.50
slopes	**3.00**	**1.00**	1.00	1.00
distance from surface drainage	**5.00**	**1.00**	**1.00**	5.00
flood quota	**2.00**	**1.00**	**0.20**	**1.00**
TOTAL	**11.00**	**3.33**	**2.40**	**7.50**

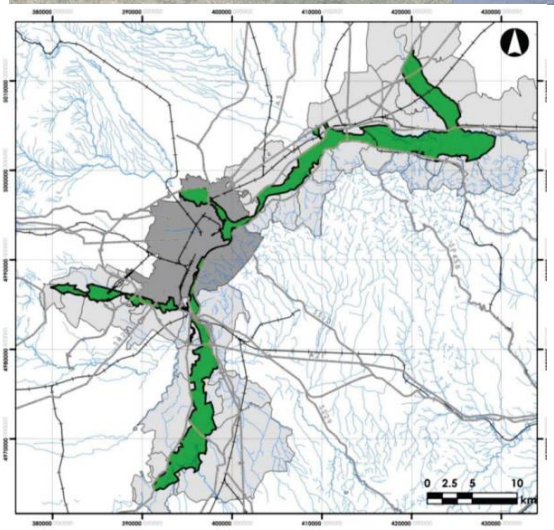
BIOLOGICAL FRAGILITY

BIOTIC COMPONENTS	dimension of forest patches	distance among forest patches	dimension of grassland patches	distance among forest patches
dimension of forest patches	**1.00**	2.00	3.00	4.00
distance among forest patches	**0.50**	**1.00**	4.00	4.00
dimension grassland patches	**0.33**	**0.33**	**1.00**	1.00
distance among grassland patches	**0.25**	**0.25**	**0.50**	**1.00**
TOTAL	**2.08**	**3.58**	**8.5**	**10.00**

ANTHROPIC PRESSURE

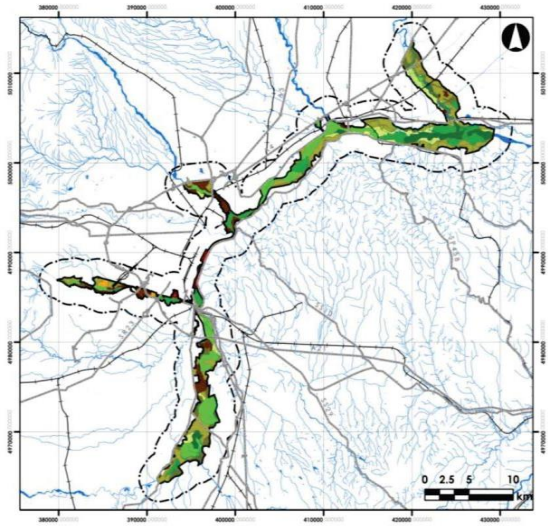
HUMAN COMPONENTS	agricultural land. urbanized 1, urbanized 2, road system, industrial and mined areas, and road	distance among agricultural areas	distance among urbanized areas 1 (less dense)	distance among urbanized areas 2 (denser)	distance among road system	distance from industrial areas	distance among mining areas
agricultural land, urbanized 1, urbanized 2, road system, industrial and mining areas, and road system	**1.00**	9.00	9.00	9.00	9.00	9.00	9.00
distance among agricultural lands	**0.11**	**1.00**	0.20	0.20	0.33	0.20	0.33
distance among urbanized areas 1 (less dense)	**0.11**	**5.00**	**1.00**	0.33	1.00	0.33	0.50
distance among urbanized areas 2 (denser)	**0.11**	**5.00**	**3.00**	**1.00**	5.00	3.00	5.00
distance among road system	**0.11**	**3.00**	**1.00**	**0.20**	**1.00**	0.25	1.00
distance among industrial areas	**0.11**	**5.00**	**3.00**	**0.33**	**4.00**	**1.00**	2.00
distance among mining areas	**0.11**	**3.00**	**2.00**	**0.20**	**1.00**	**0.50**	**1.00**
TOTAL	**1.67**	**31.00**	**19.20**	**11.27**	**21.33**	**14.28**	**18.83**

Table 1. Comparative matrices of the physical, biological, and anthropic components of the study area. Source: Based on principles of Saaty (2005). Note: **X.XX** = importance degree.



LEGEND

PO FLUVIAL PARK LIMIT
WATER BODIES
HIGHWAYS
RAILWAYS
SURROUNDINGS *COMUNES*
TURIN
PO FLUVIAL PARK



LEGEND

SURROUNDINGS LIMIT
PO FLUVIAL PARK LIMIT
WATER BODIES
HIGHWAYS
RAILWAYS
N1
N2
N3
A1
A2
A3
U1
U2
U3
T

Area (park): 5.167,71 ha
Area buffer zone: 9.968,95 ha
Torino coordinates: 45°04'13.76" N; 7°41'12.55" E
Population (*comunes*): about 1.300.000 inhab.
Demographic density: about 17 inhab./ha
Provinces – Cuneo, Torino and Vercelli (35 *comunes*)

Zones:
N1 = Exceptional Natural Interest
N2 = High Natural Interest
N3 = Relative Natural Interest
A1 = Exceptional Agricultural Interest
A2 = High Agricultural Interest
A3 = Relative Agricultural Interest
U1 = Consolidated Urbanization
U2 = Urban Expansion
U3 = Mixed Zone
T = Zone of Oriented Transformation

Figure 1. Maps of characteristics of Po Fluvial Park – Trato Torinese. Source: Adapted from ISTA (2019), Parco Po Torinese (2019) and Piemonte (1995; 2002).

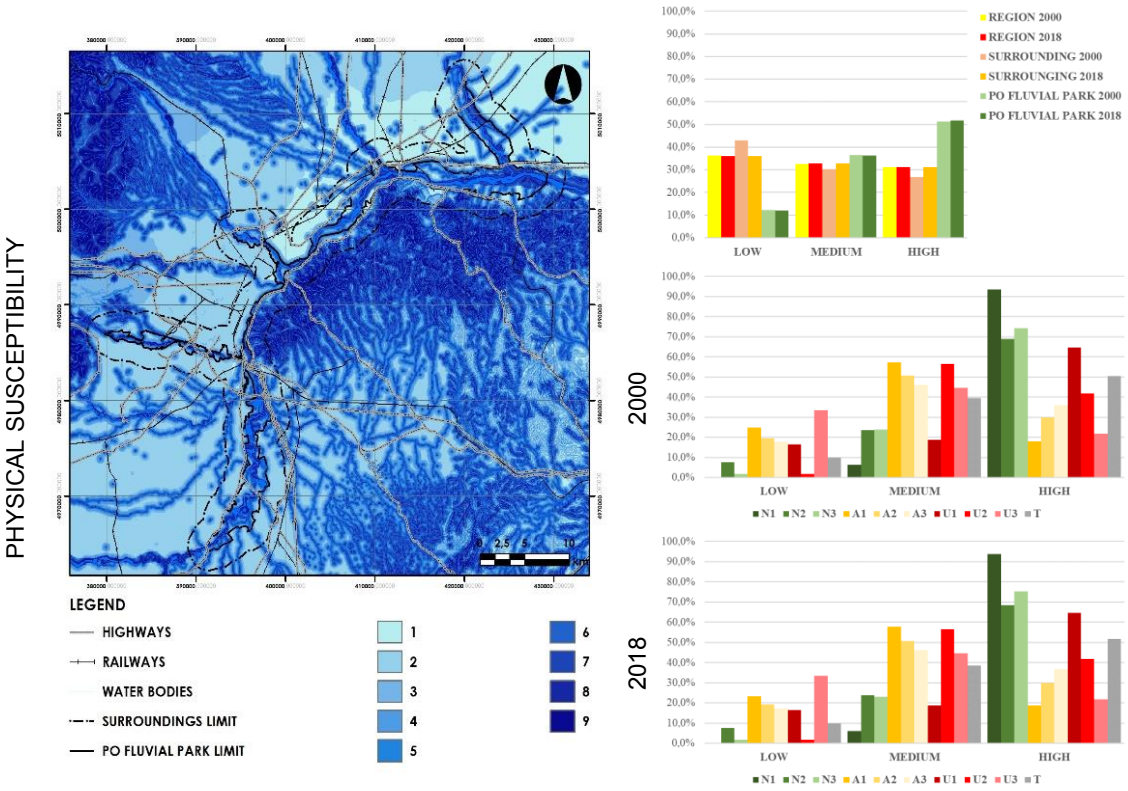


Figure 2. Characterization map and graphs of the physical susceptibility of the Po Fluvial Park region in 2000 and 2018. Source: Based on ESRI (2018) and Piemonte (2000).

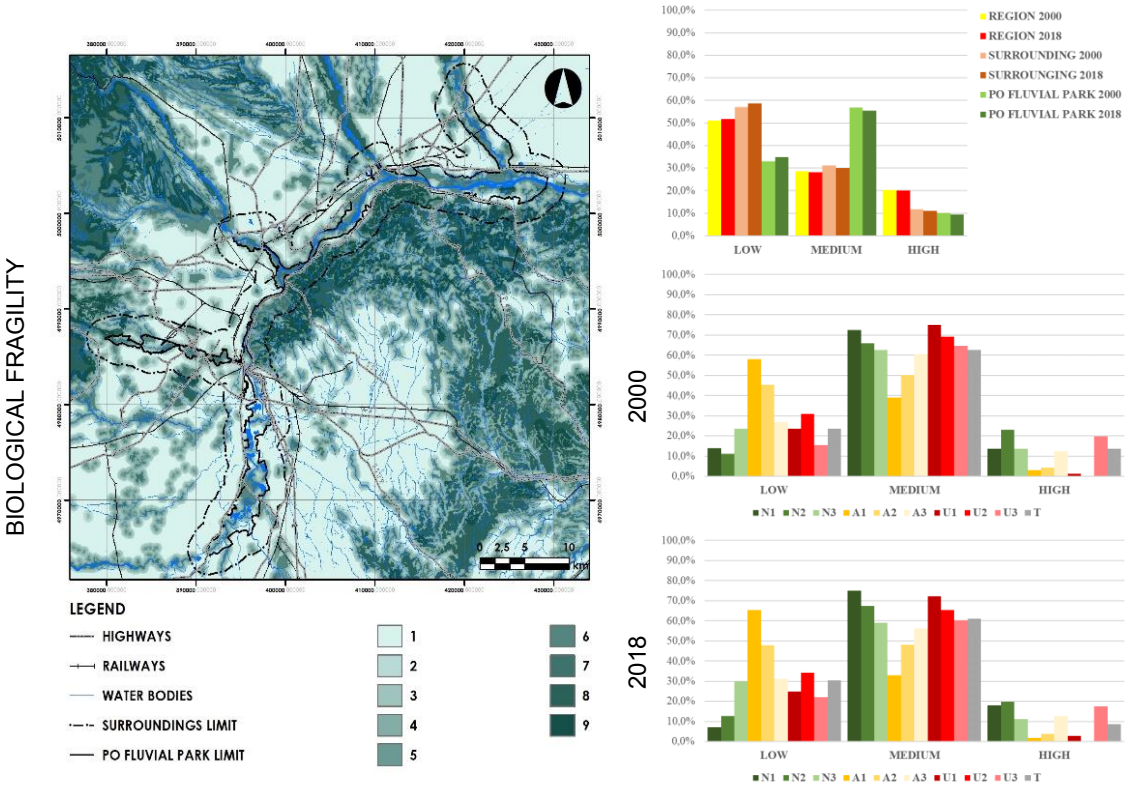


Figure 3. Characterization map and graphs of the physical susceptibility of the Po Fluvial Park region in 2000 and 2018. Source: Based on ESRI (2018) and Piemonte (2000).

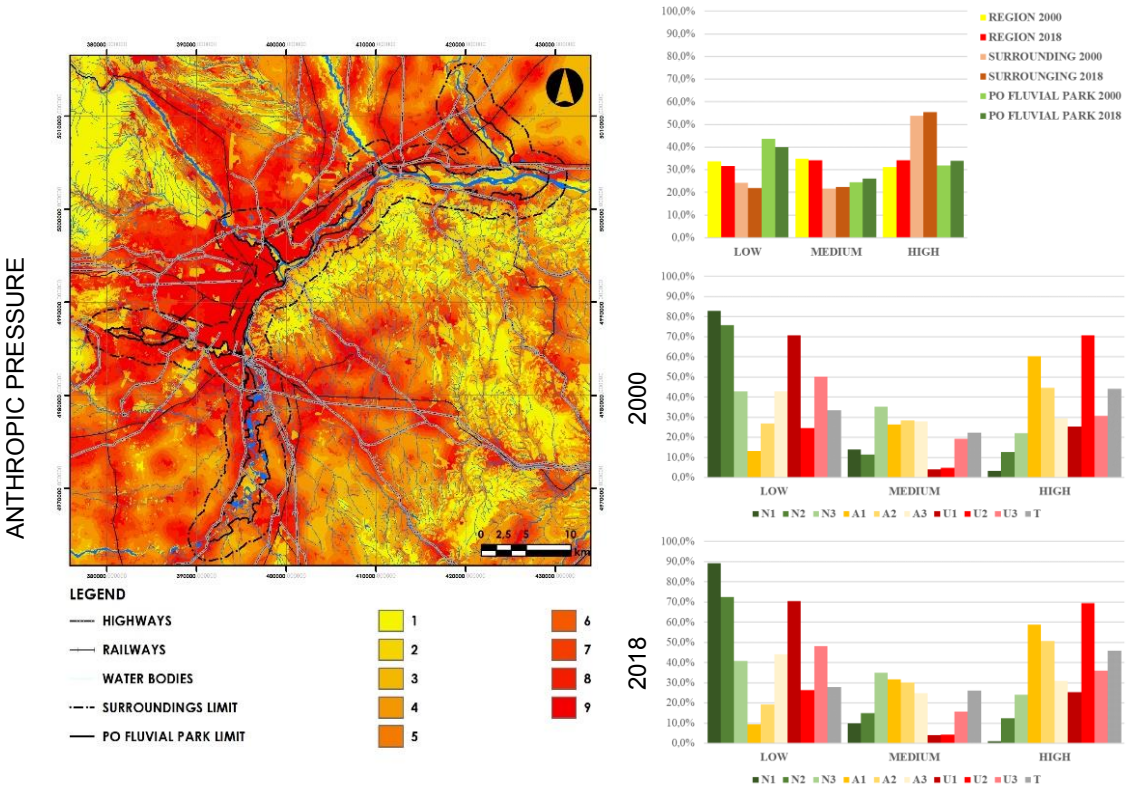


Figure 4. Characterization map and graphs of the physical susceptibility of the Po Fluvial Park region in 2000 and 2018. Source: Based on ESRI (2018) and Piemonte (2000).

The regional scope is less impacted by human actions, with 38.0% of the spaces inserted in the lower class. Again, no significant changes in anthropic pressure could be observed in the period analyzed (2000 to 2018).

Aiming to synthesize the results obtained in the previous phases, the Table 2 allows the comparative analysis of data. It is observed that both the regional and surrounding areas do not present high levels of physical susceptibility and biological fragility, with only higher percentages of anthropic pressure, mainly due to the presence of the metropolitan region of Turin. In the Po Fluvial Park, it is seen that there is coherence between the evaluated aspects and the zoning, since the zones of Priority Natural Interest have a higher percentage of areas with high physical susceptibility.

The zones of Priority Agricultural Interest are inserted in areas of medium physical susceptibility and medium and low biological fragility.

In the same way, in the Urban zones' areas with high to medium physical susceptibility and medium biological fragility predominate. However, they present higher levels of anthropic pressure, especially the zone of urban expansion and mixed uses, since they include dense urban areas and industrial sites.

The Oriented Transformation Zone, due to its special characteristics has a homogeneous distribution among the three aspects analyzed. Regarding the temporal analysis, no significant alterations were observed on the three scales analyzed. However, in some areas of the park there were changes of over 5.0%. These results show that the actions aimed at environmental protection and recovery within the Po Fluvial Park were effective throughout the analyzed period, as well as demonstrate the coherence between the proposed zoning and the area management. In summary, the adequacy of park planning can be verified.

AREAS		PHYSICAL SUSCEPTIBILITY			BIOLOGICAL FRAGILITY			ANTHROPIC PRESSURE		
		LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH
REGION	2000	36.2%	32.7%	31.1%	51.0%	28.7%	20.2%	33.8%	34.9%	31.3%
	2018	36.1%	32.7%	31.2%	51.7%	28.3%	20.0%	31.6%	34.2%	34.2%
	variation	**-0.1%**	**0.0%**	**0.1%**	**0.7%**	**-0.4%**	**-0.2%**	**-2.2%**	**-0.7%**	**2.9%**
SURROUNDING	2000	43.1%	30.2%	26.7%	57.0%	31.3%	11.7%	24.3%	21.8%	53.9%
	2018	42.8%	30.4%	26.9%	58.8%	30.1%	11.1%	22.0%	22.5%	55.5%
	variation	-0.3%	0.2%	0.2%	1.8%	-1.2%	-0.6%	-2.3%	0.7%	1.6%
PO FLUVIAL PARK										
N1	2000	0.2%	6.3%	93.5%	13.8%	72.6%	13.6%	82.8%	14.0%	3.2%
	2018	0.3%	6.0%	93.7%	7.1%	75.0%	17.9%	89.2%	9.8%	1.0%
	variation	**0.1%**	**-0.3%**	**0.2%**	**-6.7%**	**2.4%**	**4.3%**	**6.4%**	**-4.2%**	**-2.2%**
N2	2000	7.6%	23.6%	68.9%	11.1%	65.8%	23.1%	75.8%	11.5%	12.7%
	2018	7.7%	23.8%	68.5%	12.8%	67.4%	19.8%	72.6%	15.0%	12.4%
	variation	**0.1%**	**0.2%**	**-0.4%**	**1.7%**	**1.6%**	**-3.3%**	**-3.2%**	**3.5%**	**-0.3%**
N3	2000	1.8%	23.8%	74.3%	23.6%	62.6%	13.7%	42.8%	35.2%	22.0%
	2018	1.7%	23.0%	75.3%	29.9%	59.0%	11.1%	40.9%	34.9%	24.1%
	variation	**0.1%**	**0.8%**	**-1.0%**	**-6.3%**	**3.6%**	**2.6%**	**1.9%**	**0.3%**	**-2.1%**
A1	2000	24.9%	57.2%	17.9%	58.1%	38.9%	3.0%	13.3%	26.3%	60.4%
	2018	23.4%	57.8%	18.7%	65.4%	32.9%	1.8%	9.3%	31.8%	58.9%
	variation	**-1.5%**	**0.6%**	**0.8%**	**7.3%**	**-6.0%**	**-1.2%**	**-4.0%**	**5.5%**	**-1.5%**
A2	2000	19.4%	50.8%	29.8%	45.3%	50.3%	4.4%	26.9%	28.4%	44.7%
	2018	19.3%	50.8%	29.9%	48.0%	48.1%	3.9%	19.2%	30.1%	50.7%
	variation	**-0.1%**	**0.0%**	**0.1%**	**2.7%**	**-2.2%**	**-0.5%**	**-7.7%**	**1.7%**	**6.0%**
A3	2000	17.8%	46.2%	36.0%	26.8%	60.7%	12.5%	42.8%	27.8%	29.4%
	2018	17.2%	46.2%	36.7%	31.1%	56.2%	12.7%	44.2%	24.9%	30.9%
	variation	**-0.6%**	**0.0%**	**0.7%**	**4.3%**	**-4.5%**	**0.2%**	**1.4%**	**-2.9%**	**1.5%**
U1	2000	16.6%	18.7%	64.7%	23.7%	74.9%	1.4%	70.8%	4.0%	25.2%
	2018	16.6%	18.7%	64.7%	24.9%	72.3%	2.8%	70.5%	4.1%	25.4%
	variation	**0.0%**	**0.0%**	**0.0%**	**1.2%**	**-2.6%**	**1.4%**	**-0.3%**	**0.1%**	**0.2%**
U2	2000	1.7%	56.5%	41.8%	30.9%	69.1%	0.0%	24.6%	4.7%	70.7%
	2018	1.7%	56.6%	41.7%	34.3%	65.5%	0.1%	26.4%	4.2%	69.5%
	variation	**0.0%**	**0.1%**	**-0.1%**	**3.4%**	**-3.6%**	**0.1%**	**1.9%**	**-0.5%**	**-1.2%**
U3	2000	33.5%	44.6%	21.8%	15.6%	64.6%	19.9%	50.1%	19.3%	30.6%
	2018	33.5%	44.6%	21.8%	22.1%	60.4%	17.5%	48.2%	15.7%	36.1%
	variation	**0.0%**	**0.0%**	**0.0%**	**6.5%**	**-4.2%**	**-2.4%**	**-1.9%**	**-3.6%**	**5.5%**
T	2000	10.0%	39.6%	50.5%	23.6%	62.6%	13.7%	33.6%	22.3%	44.1%
	2018	9.8%	38.6%	51.6%	43.32%	50.16%	6.52%	27.9%	26.1%	46.0%
	variation	**-0.2%**	**-1.0%**	**1.1%**	**-9.4%**	**5.7%**	**3.7%**	**-5.7%**	**3.8%**	**1.9%**

Table 2. Comparative analysis among physical susceptibility, biological fragility, and anthropic pressure. Source: Based on ESRI (2018). Notes: = more than 50.0%; **X.X**% = more than 5.0%.

Conclusion

It is possible to consider the adequacy of the interpretation of physical susceptibilities, biological fragilities, and anthropic pressures, allowing the management guidelines aiming at the conservation of natural resources. From the comparative analysis in the three scales studied, it is observed that in the regional, there is a homogeneous distribution, with low levels referring to the spaces with plane relief and less influence of the water network; therefore, reveal more adequate conditions for the development of agricultural activities and urban occupation.

The surrounding areas are less physically susceptible than those of the region, prevailing low biological fragility (62.0%) and high anthropogenic pressure (60.0%). These data show the presence of high degree of urbanization (14.0%) and the development of agricultural activities (50.0%). On the other hand, within the specific scale (park interior), those with a high physical susceptibility (50.0%) predominate, especially due to the direct interference of the hydrological conditions and the flood quotas, being therefore highly susceptible to floods. The landscape interpretation between the years 2000 and 2018 shows that there were no significant changes, a fact justified in view of the recognized quality and detail of the management plan of the Po Fluvial Park.

References

ESRI - Environmental Systems Research Institute. (2018) World imagery. Available at: <http://services.arcgisonline.com/ArcGIS/rest/services/World_Imagery/MapServer> (Access 28 June 2018)

Guerra, S.; Ostellino, I. (2009) Parco Fluviale del Po Torinese: dal bilancio sociale 2005 al progetto per il futuro. Torino, TO, IT: Ente di Gestione del Parco del Po Torinese.

ISTAT - Istituto Nazionale di Statistica. (2019). Popolazione residente: Piemonte. Available at <http://dati.istat.it/Index.aspx?DataSetCode=DCIS_POPRES1> (Acess 14 Nov. 2019)

IUCN - International Union for Conservation of Nature. (2019) Protected areas. Available at: <https://www.iucn.org/theme/protected-areas/> (Access 14 November 2019).

Parco Po Torinese (2019). Aree protette del Po Torinese. Available at: <http:// http://www.parchipocollina.to.it/> (Access 14 November 2019)

Piemonte (1990). Sistema delle aree protette della Fascia Fluviale del Po. Available at: <http://arianna.consiglioregionale.piemonte.it/base/leggi/l1990028.html> (Access 20 Jun. 2018)

Piemonte (1995). Piano d'area del Parco del Po. Available at: <http://gis.csi.it/parchi/po/index.htm> (Access 23 September 2012)

Piemonte (2000). Carta tecnica e ortofoto digital. Torino, TO, IT.

Piemonte. (2002) Bollettino Ufficiale N°29. Available at: <http://www.regione.piemonte.it/governo/bollettino/abbonati/2002/29/siste/00000097.htm> (Access 14 November 2019).

Saaty, T. (2005). Theory and applications of the analytic network process. Pittsburgh, PA, US: RWS.

Torino (2011). Piano territoriale di coordinamento provinciale: aggiornamento e adeguamento. Available at <http://www.provincia.torino.gov.it/territorio/sezioni/pian_ territoriale/attuaz_ptc/attuazione.html> (Access 07 March 2012).

Acknowledgement

To Roberto Gambino, Giuseppe Cinà, and Gabriella Negrini by the assistance. To National Council for Scientific and Technological Development (CNPq) and Fundação Araucária Foundation by the financial support. To European Union's Erasmus Mundus Programme by the doctoral scholarship.

Endnote

Updated article from the text previously published at European Journal of Scientific Research, v.149, p.423-450, 2018.