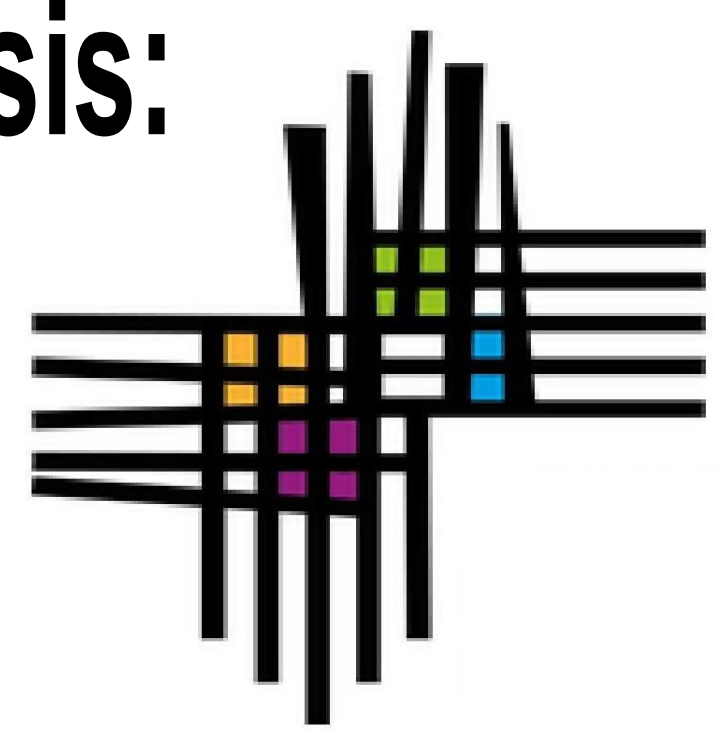


The international landscape perception bibliography analysis: a quantitative method based on graph theory*

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Keywords: *landscape perception, bibliographic analysis, graph theory*

Aim

This research reconstructs and analyses the network of citations between indexed articles present on the main online reference database dealing with the issue of perception for detect most influent scientific papers on landscape perception and which are the mainstream research areas.

Network	Investigation question	Type of graph (G) used	Analysis	
			DegK	CD
Papers network	Which are the most influent works?	G. Topologic Oriented	Not weigh yes	yes
Keywords networks	Which are the main areas of research?	G. Topologic Not Oriented	Not weigh yes	NO

Background

Perception, visualisation and their relationships with cognitive processes have been in last years among the most discussed issues in research on landscape. The space can not be taken as an absolute element, since it is experienced and perceived differently by individuals according to subjective, social and cultural factors. Through cognitive processes, space and its representations is internalized in mental images that affect decisions, actions and behaviours. Scholars are increasingly focusing on the exploration of landscape perception, in order to investigate their visualisation aimed to the choice of sustainable design scenarios in relation to the views and to the aesthetic preferences of the publics.

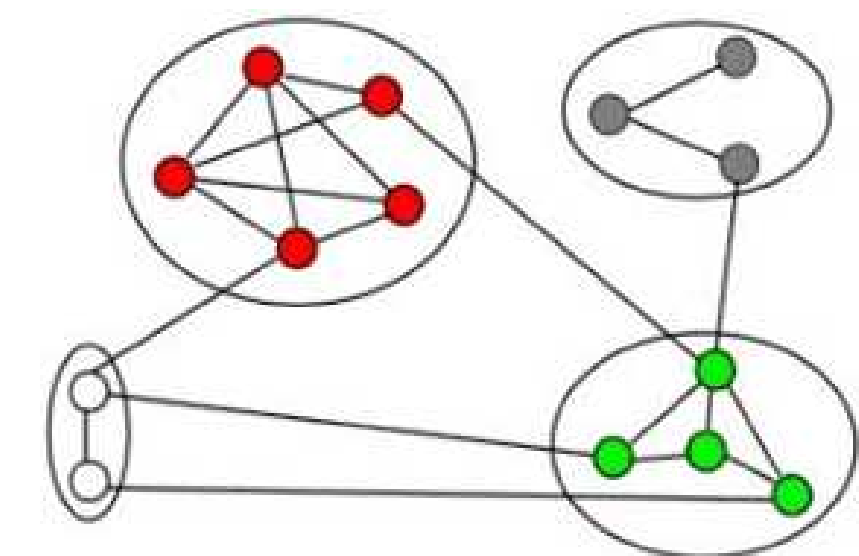
Method

We have been applied the network analysis approach to the most relevant studies focused on the landscape perception and visualisation carried out by international scientific community. **It has been built a network of 29470 citations between 19658 articles.** The use of automated systems for support to knowledge were introduced by Eugene Garfield to reconstruct and analyse the progress and the evolution of research in human genetics after the discovery of DNA. The concept of "*network bibliography*" is derived from the use of the graph theory for the analysis of and analysed through mathematical structures called graphs. A graph G is a triple consisting of a non-empty set of vertices V(G) (also called nodes), a set of arcs or edge E(G) disjoint from the set V(G) and a attribute ψ , which associates each arcs. A graph can be described in three different ways: a)through its mathematical formalisation; b)through its graphical representation; c)through its representation in matrix form. The capability of influence of an article can be quantified by calculating the degree of DegKi of vi(G) as the number of connections e (G) to it connected.

G={V(G); E(G); ψ (G)}		Representation by incidence matrix				
		e1	e2	e3	e4	e5
V(G)={v1; v2; v3; v4; v5}						
E(G)={e1; e2; e3; e4; e5} con						
$\psi(G)={\psi_0(e_i)=v_1, v_2; \psi_0(e_2)=v_2, v_3; \psi_0(e_3)=v_3, v_4; \psi_0(e_4)=v_1, v_3; \psi_0(e_5)=v_2, v_4}$						
Mathematical representation	Graphic representation	Representation by incidence matrix				

$$\text{DegK}_i^{\text{TOT}} = \text{DegK}_i^{\text{in}} + \text{DegK}_i^{\text{out}}$$

The network of articles has been processed using an oriented graph, because it occurs the condition **$\mathbf{a_{ij}} \neq \mathbf{a_{ji}}$** . In other words, if the item "A" cites to the article "B", it is impossible that it is also verified the opposite condition, i.e. the paper "B" cites the paper "A". Hence, the previous indicator will separate into "*incoming degree*" (**$\text{DegK}_i^{\text{in}}$**) and into "*outgoing degree*" (**$\text{DegK}_i^{\text{out}}$**) where the first indicates the number of papers cited in the examined article, the second is the number of citations received by the other works. The graph of the keywords quantifies the rate at which two key words appear together on the same document; in this case, so it is bi-directional relationship **$\mathbf{a_{ij}} = \mathbf{a_{ji}}$** . This structure differs from the first to the weight of the arcs **$\mathbf{e(G)w}$** . Finally for the graph of the papers it was executed the analysis of the Community Detection (CD) using the algorithm Louvain. This procedure creates clusters of articles on the basis of different density of citations in the graph. It creates the Communities where it is maximum the density of citations between articles and where it is simultaneously minimum the number of citations between articles from different Communities.

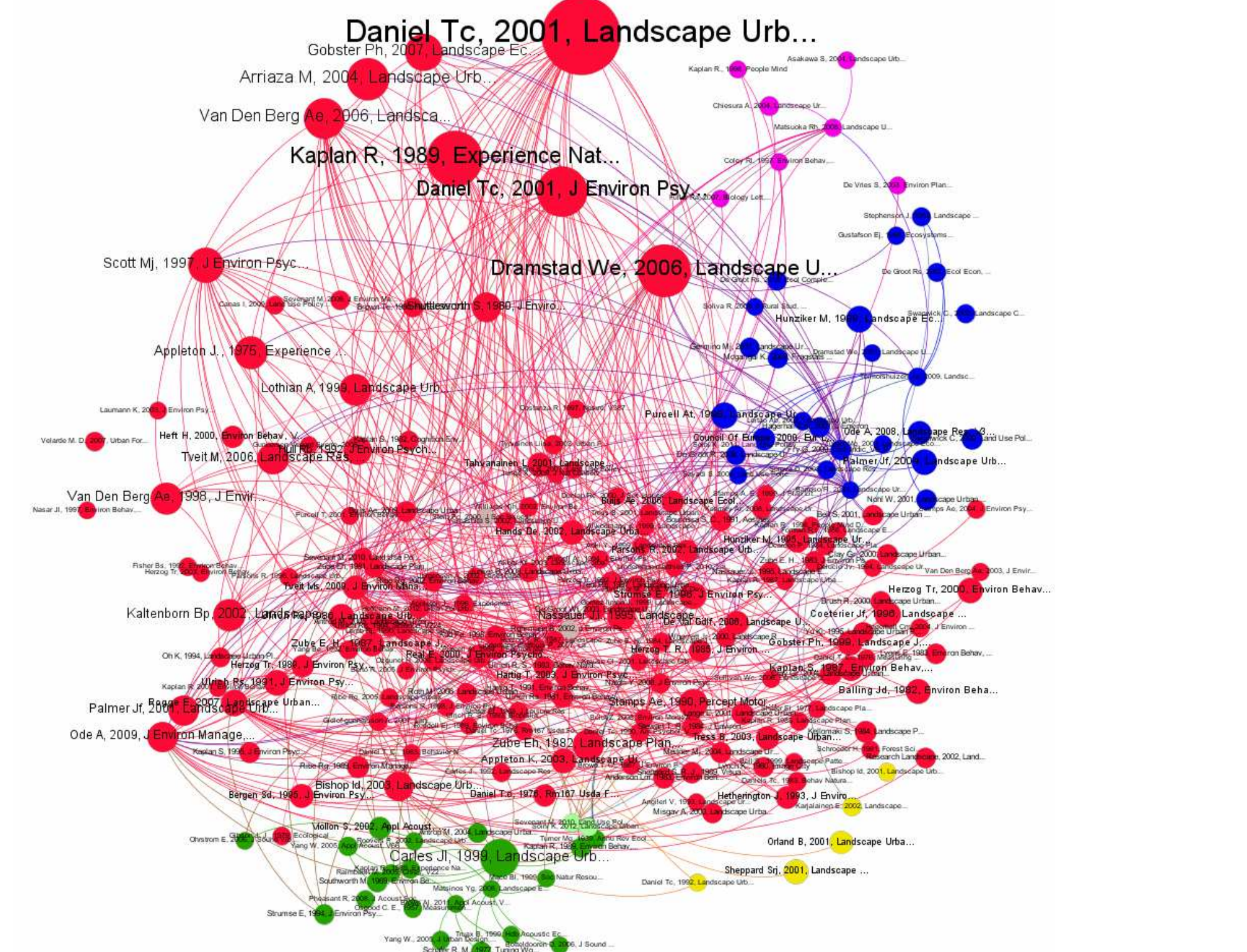


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Results

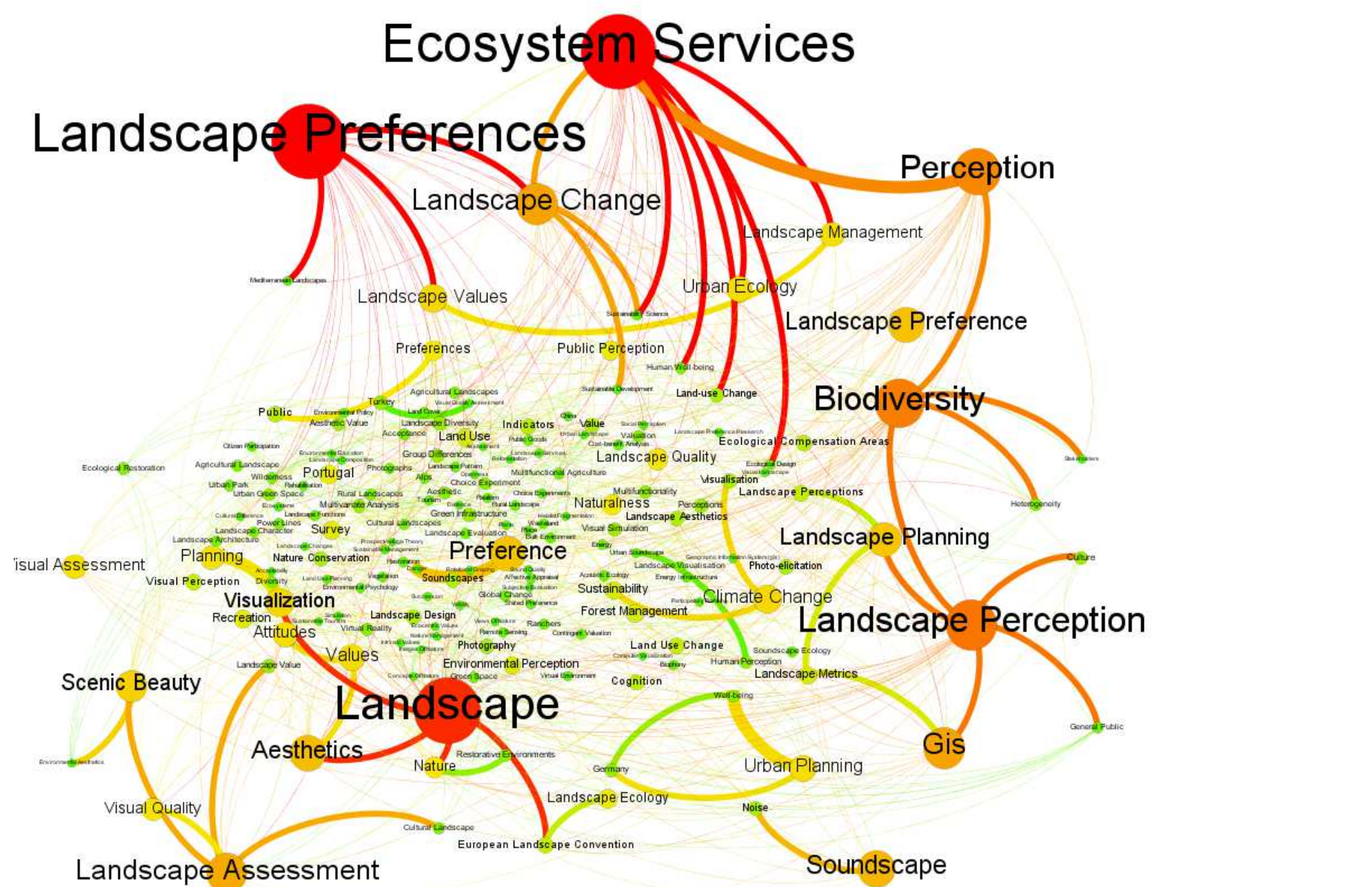
Network of articles with at least 10 citations in the main 5 Communities distinguished by colours. The dimension of the nodes is proportional to the number of citations



Most cited articles (Order by DegK ^{tot})		DegK ⁱⁿ	DegK ^{out}	DegK ^{tot}
Daniel T.C., 2001, "Whether scenic beauty? Visual landscape quality assessment in the 21st century", <i>Landscape and Urban Planning</i> , Vol. 54,		113	154	267
Kaplan R., 1989, <i>The Experience of Nature</i>		0	100	100
Dramstad W.E., 2006, "Relationships between visual landscape preferences and map-based indicators of landscape structure", <i>Landscape and Urban Planning</i> , Vol. 78, (Alpha paper)		61	93	154
Daniel T.C., Maltner M.M., 2001, "Representational validity of landscape visualizations: the effects of graphical realism on perceived scenic beauty of forest vistas", <i>Journal of Environmental Psychology</i> , Volume 21, Issue 1,		47	87	134
Arriaza M., 2004, "Assessing the visual quality of rural landscapes", <i>Landscape and Urban Planning</i> , Vol. 69,		0	68	68
Van Den Berg Ae., 2006, "New wilderness in the Netherlands: An investigation of visual preferences for nature development landscapes", <i>Landscape and Urban Planning</i> , Vol. 78, (Alpha paper)		56	64	120
Charles J.L., 1999, "Sound influence on landscape values", <i>Landscape and Urban Planning</i> , Vol. 43, (Alpha paper)		25	59	84
Gobster PH, Nassauer JI, Daniel TC, Fry G., 2007, "The shared landscape: what does aesthetics have to do with ecology?", <i>Landscape Ecology</i> , Vol. 22,		18	56	74
Scott Mj., 1997, "Picture or place? a multiple sorting study of landscape", <i>Journal of Environmental Psychology</i> , Vol. 17, (Alpha paper)		46	52	98
Appleton J., 1975, <i>The Experience of Landscape</i>		0	46	46

Community	Nodes	Arcs	% Nodes	%Arcs	Main topics
1	6975	11107	35,48	37,69	Visual Scenic; Landscape Evaluation; Preferences
12	3434	4109	17,47	13,94	Urban green space; Human well-being
7	2160	2866	10,99	9,73	Public Space Project, Urban Forest
11	2036	2208	10,36	7,49	Sound Landscape; Preferences System; Assessment
4	1162	1341	5,91	4,55	Risk Perception; Urban neighbours
Resto	3891	7839	19,79	26,60	Not Defined
Tot	19658	29470	100	100	

Graph of the keywords



Keyword	Frequency
Landscape Preferences	161
Ecosystem Services	110
Landscape	97
Landscape Perception	74
Biodiversity	71
Perception	68
Landscape Change	60
Gis	60
Landscape Assessment	58
Soundscapes	54
Aesthetics	52
Preference	50