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Introduction to the Special feature
Lost in the ecosystem
Introduction au dossier spécial
Perdu dans l'écosystème
Introducción al dossier especial
Perdido en el ecosistema

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Article abstract

The concept of ecosystem is used, from the local to the international level, to analyze the notions of balance and resilience. The introductory research note of this dossier proposes a reflection on this central concept of ecosystem used by economists/managers on the one hand and by biologists/ecologists on the other. The study shows the confusion born from this double appropriation and the need to clarify the meaning of the concept when it is used by researchers.

Introduction to the Special feature
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ABSTRACT

The concept of ecosystem is used, from the local to the international level, to analyze the notions of balance and resilience. The introductory research note of this dossier proposes a reflection on this central concept of ecosystem used by economists/managers on the one hand and by biologists/ecologists on the other. The study shows the confusion born from this double appropriation and the need to clarify the meaning of the concept when it is used by researchers.

Keywords: Ecosystem, ecosystem type, management, biology, ecology

Résumé

Le concept d'écosystème est mobilisé, du niveau local jusqu'au niveau international, pour analyser les notions d'équilibre et de résilience. Cette note de recherche propose une réflexion sur ce concept central d'écosystème utilisé par les économistes/gestionnaires d'une part et par les biologistes/écologistes d'autre part. L'étude montre la confusion née de cette double appropriation et la nécessité de clarifier la signification du concept lorsqu'il est mobilisé par les chercheurs.

Mots-clés : Ecosystème, type d'écosystème, management, biologie, écologie

Resumen

El concepto de ecosistema se utiliza, desde el nivel local hasta el nivel internacional, para analizar las nociones de equilibrio y resiliencia. Esta nota de investigación propone una reflexión sobre este concepto central de ecosistema, empleado por economistas/gestores, por un lado, y por biólogos/ecologistas, por otro. El estudio pone de manifiesto la confusión originada por esta doble apropiación y la necesidad de clarificar el significado del concepto cuando es utilizado por los investigadores.

Palabras Clave: Ecosistema, tipo de ecosistema, gestión, biología, ecología

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"Substitution of produced capital -roads, buildings ports, machines- for natural capital -ecosystems- has not only characterized our investment activities but also shaped our conception of economic progress." (Dasgupta, 2021, p 17).

"... success is not just about how well you perform, but also about how well you align with the partners around you. The collective strength of the ecosystem determines the outcome." (Adner, 2012, p 17)

These citations from renowned researchers in economy (Sir Partha Dasgupta) and in strategy (Ron Adner) highlight the diverse meanings of the word "ecosystem". Dasgupta showed in his landmark report that economic growth has come at a devastating cost to nature. Humanity is destroying its most precious asset: the natural ecosystems that provide the services needed for living on Earth. Adner discussed innovation as the outcome of the interactions between many business actors that constitute what he calls an ecosystem. Both researchers utilized the concept of ecosystem, but with different meanings: Dasgupta studied nature-based ecosystems (NE) while Adner evoked human-based ecosystems (HE).

Between 1968 and 2023, 4 200 peer-reviewed articles with the word "ecosystem" in their title have been published in the academic journals listed in the database EBSCO Business Source Complete, with a continuous yearly growth: a few ones in the 90s, more than 150 since 2015, more than 500 since 2022. The concept of ecosystem is increasingly used in economics and management.

This concept has been introduced in 1935 by A.G. Tansley in an article analyzing the multiple concepts and terms created by biologists to study the evolution of vegetational systems. Tansley defined an ecosystem as a system incorporating organic and inorganic components that can reach a state of stable dynamic equilibrium. He argued that biologists studying vegetation need to adopt a holistic perspective, and accordingly, must integrate external factors like animals or climate in their research.

Tansley's reflection relates to the questions that economists and management researchers explore today: can the economic world cope with the planetary issues that we face? If yes, how? The resilience of the Earth system and human well-being are inseparably linked. There is mounting evidence that business activities are increasingly putting the planet at risk. Six of the 9 planetary boundaries have been exceeded (Richardson *et al.*, 2023). These include climate change; biodiversity loss (terrestrial and marine); disrupted nitrogen and phosphorus cycles; global freshwater use; change in land use; and biogeochemical pollution. Human and business activities need to be managed considering their anthropogenic influences on the Earth living-system. The necessity to consider simultaneously environmental and economic factors is likely to increase the use of the ecosystem concept by management scientists. But as we showed in our first sentences, the concept can have two different meanings.

In addition, each ecosystem meaning covers a wide variety of types. Forests, watersheds, wetlands, deserts, oceans constitute types of NE. Jacobides *et al.* (2018) distinguished 3 main types of HE: business ecosystem, platform ecosystem and innovation ecosystem. Consequently, the word "ecosystem" has at least two meanings, with several types attached to each meaning. It seems at first glance that two streams of research about ecosystems have evolved in parallel. But are they?

The objective of this research note consists in exploring these two research streams. We seek connections between them and areas of confusion. We perform this analysis at the level of ecosystem types because types constitute the main object of research in the NE and HE streams. We rely for that purpose on an analysis of recent publications linking the terms "management" and "ecosystem".

Our results highlight the wide variety of types of NE and HE ecosystems. While it is not surprising for NE, the diversity of HE types shows that the human-based meaning of ecosystems has considerably overflowed to fields of research other than business administration. Results also highlight the independence of each research stream and the rare linkages between them. They underline some areas of confusion associated with the wording of types and constructs developed in each field. These findings incite to be very careful when consulting the literature on ecosystems.

The article is organized as follows. We will start with a brief history of the concept of ecosystem and its introduction in business administration. Then we will describe our empirical study, present our results, and extract from them some recommendations for future research.

A brief history of the ecosystem concept

As said earlier, the concept of ecosystem has been introduced in 1935 by A.G. Tansley who defined it in the following manner: "the fundamental concept appropriate to the biome considered together with all the effective inorganic factors of its environment is the ecosystem, which is a particular category among the physical systems that make up the universe. In an ecosystem the organisms and the inorganic factors alike are components which are in relatively stable dynamic equilibrium" (Tansley, 1935, p 306). Ecosystems are constituents of our biosphere: "they combine the abiotic environment with communities of plants, animals, fungi, and microorganisms to form combinations of life forms that control the multitude of natural processes shaping the world around us" (Dasgupta, 2021).

The concept has been extensively used by biologists and ecologists trying to understand the evolution of populations of animals or plants, or their services to life on Earth. This research sometimes includes human populations when they have an impact on the natural environment. Defining the boundaries of an ecosystem has remained challenging over the years: which components should be integrated? What are the geographical boundaries of the ecosystem under study? A well-known example in ecology is the

evolution of the population of wolves in the Rocky Mountains. The first studies made on the topic have been criticized for adopting a too narrow definition of the ecosystem: for instance, the existence of other predators has been neglected (Peterson *et al.*, 2014). Ecosystems are generally complex, and their diverse components are interrelated: interdependent species evolve in a reciprocal cycle, in which change in one species leads to change in another species, and vice versa. Climate evolution can also unbalance an existing ecosystem and set the stage for a new equilibrium where new species will dominate. In synthesis, the concept of ecosystem is largely used by biologists and ecologists to study the evolution of nature, even if the boundaries of an ecosystem remain often tricky to establish. Tansley already acknowledged in 1935 that the isolation of an ecosystem by the biologist "is partly artificial, but is the only possible way in which we can proceed." (Tansley, 1935, p 300).

In biology, ecosystems are a subdivision of biomes; they constitute the core unit of analysis to understand biodiversity evolution and ways to preserve it (Folke *et al.*, 1996). Recently new conceptions of ecosystems have emerged: humans, who were mainly considered as disruptors of natural ecosystems, are nowadays integrated as components of this ecosystem. The evolution of anthropogenic ecosystems – i.e. human systems combined with natural systems - are nowadays under scrutiny (Ellis & Ramankutty, 2008).

The concept of ecosystem has been exported outside the biological and ecological context. Note that the world of business and organizations considered the systemic approach as early as 1959 by Stafford Beer in the English-speaking community, and in 1979 in the French-speaking world thanks to Jacques Mélèse. Then Moore introduced the concept ecosystem in the business world (Moore, 1993). He defined an ecosystem as an economic community supported by a foundation of interacting organizations and individuals. His reflection was based on his review of some innovation processes. He found that these innovations emerge from a *business ecosystem* that crosses a variety of industries. In a business ecosystem, companies combine their capabilities to innovate. He cited the example of Apple who leads an ecosystem with companies from at least 4 industries, including big ones like Sony and Motorola and multiple customers in various market segments. The ecosystem perspective helps to understand how companies engage in collaborative strategies to thrive in competitive markets. Research about such business ecosystems focuses on the role, satisfaction and power of firms that participate in the ecosystem. Adner (2017) identified two categories of research: the affiliation approach and the structural approach. The affiliation approach considers the ecosystem as a community of interconnected actors defined by their position in the network. According to the structural approach, an ecosystem is defined as the alignment structure of partners that need to interact for satisfying a particular economic value proposition. Research using the affiliation approach deals with the role and power of actors in the network. Research relying upon the structural approach generally looks at the satisfaction of actors and the generation of economic value for customers.

Moore's and subsequent researchers working on business ecosystem borrow the biologists' view of interrelated components that coevolve. The main difference is that Moore and followers considers the ecosystem as purely made up of human organizations and individuals, while biologists have defined ecosystems from a holistic perspective, integrating any organic and inorganic component that could influence the system. When biologists speak of ecosystems with researchers in management or economics, it is not sure they have the same meaning in mind. Hence some possible confusion: the same word refers to a human-based system (HE) or to a nature-based system (NE)[1].

Two research streams with multiple types of ecosystems

As said earlier, the concept of ecosystem is increasingly used. It is the basic unit of analysis for ecologists, biologists and researchers in natural science. But it is also used by researchers in business administration and economists to analyze the evolution and economic performance of firms and industries.

Two streams of research have developed, each one around one meaning of the concept. When examining inside each field, we see that the object under study is rarely the concept of ecosystem itself, but a subcategory. In both streams, researchers often call these categories: types of ecosystem. In the HE research stream, recent work has identified three main types of HE: business ecosystem, platform ecosystem and innovation ecosystem (Jacobides *et al.*, 2018). Research in NE studies a particular forest, a watershed, a grassland, a mangrove, wildlife in a particular geographic area. Each research stream attached to one meaning of "ecosystem" has generated its own types of ecosystems.

Consequently, it seems at first glance that the two streams of research about ecosystems have evolved independently. But is it the reality? Researchers have created this concept to study nature, management thinkers have borrowed it for its properties (a community, co-evolution of its components) and applied it in a new field, business administration, to explain innovation and business performance. But the two research streams seem to follow their own development path without any consideration for the other one.

In this research note, we explore deeper these two research streams that develop around the same concept. To our knowledge such exploration has never been conducted. Former state-of-the-art research has focused on an ecosystem type (e.g. innovation ecosystem or marine ecosystem), but none seems to have analyzed the structure of the whole literature developed around the concept of ecosystem and its different meanings.

We seek connections between the two streams of research and areas of confusion. For that purpose, we inspect the variety of ecosystem types in NE and HE research streams. Most research in both streams studies a particular type, this is why we explore linkages and confusion at the level of types. Connections are based on facts (for instance, a similar component). An area of confusion is more subjective: it corresponds to a case where the researcher has chances to be bewildered: in our case, when the reader of an academic article could face difficulties for classifying a particular article into one research stream.

We elaborated an empirical study for identifying these possible connections and areas of confusion.

Empirical study

We selected the database EBSCO Business Source Complete to identify the use and meanings of the ecosystem concept in the management field because this database collects thousands of articles published in economics, finance and management. We query the database with the following criteria:

1. We will consider that anthropogenic ecosystems as nature-based ecosystems because they are primarily studied by researchers in natural sciences.

- Articles published between 2015 and 2024; as said in the introduction, the number of articles developing research about ecosystems has sharply increased since 2015.
- Articles published in peer-reviewed academic journals, to ensure the quality of the research;
- Articles containing "ecosystem" and "management" in their title. We want to identify the meaning of ecosystems in research dedicated to managerial activities.

The query led to the selection of 201 articles. We reviewed these articles and eliminated redundancies and short introductions to special issues. Our final sample consisted of 186 papers.

Two researchers independently analyzed each article to identify:

1. the ecosystem definition: is the research dealing with NE or HE?
2. the type of ecosystem studied by the authors – for instance an "innovation ecosystem". In many cases, the task was easy because the type was cited in the article keywords. For other cases we found it in the abstract or in the full text. Nonetheless, the researchers quickly face a difficulty. Ninety papers were primarily dedicated to a method for managing an ecosystem (e.g. ecosystem-based management) or to the functions of an ecosystem (e.g. ecosystem services), rather than to the ecosystem itself. Among them, fifteen papers were even dealing with methods without any description of a particular ecosystem. For the other ones, the researchers could identify the ecosystem under study. They decided to account for the precise ecosystem examined in these papers and to separately account for the methods or functions constituting the core topic of each article.
3. the journal in which each paper was published. As we look for linkages between two apparently parallel research streams, some journals could constitute places where both streams meet.

The two researchers compared their analyses. They converged about the NE/HE classification of ecosystems but had diverse definitions of the ecosystem type for 20 cases. They exchanged their views on each of these cases till reaching a consensus. They then reviewed together the list of identified types to reduce those very close types to one: for instance, "start-up ecosystem" was merged with "entrepreneurial ecosystem".

The results of their investigations are presented below.

Results

We will first examine the diversity of ecosystem types studied in our dataset of 186 papers. We will then analyze the publication journals of these articles. Then, we will identify possible connections between the streams and areas of confusion.

Variety of ecosystem types

All the cases could clearly be attached to one ecosystem meaning: 79 cases deal with HE, while 107 focus on NE. When looking at the type of ecosystem studied, the 79 HE divide into 19 types. The 107 NE split into 21 subcategories. These results are displayed in Table 1; they show the amazing number of 40 different ecosystems that are studied by researchers. While it is not surprising for NE due to the diversity of natural ecosystems, the 19 deserve attention.

TABLE 1
Types of ecosystems

Human-based ecosystems (HE)	Frequency	Nature-based ecosystems (NE)	Frequency
Business ecosystem	**31**	**Forest ecosystem**	**19**
Innovation ecosystem	**11**	**Marine ecosystem**	**17**
Entrepreneurial ecosystem	6	Agro-ecosystem	9
Healthcare ecosystem	4	Urban ecosystem	8
Platform ecosystem	4	Water ecosystem	8
Service ecosystem	4	Coastal ecosystem	6
Career ecosystem	3	County/district ecosystem	5
Blockchain ecosystem	2	Grassland ecosystem	3
Circular ecosystem	2	Grain storage ecosystem	2
Human resource management ecosystem	2	Lake ecosystem	2
Public service ecosystems	2	Mangrove ecosystem	2
Agile management ecosystem	1	National Park ecosystem	2
Carbon credit ecosystem	1	Arctic region ecosystem	1
Digital tourism ecosystem	1	Ocean Current ecosystem	1
Learning ecosystem	1	Island ecosystem	1
Media ecosystem	1	Land ecosystem	1
Smart ecosystem	1	National wildlife ecosystem	1
Solidarity ecosystem	1	Rice ecosystem	1
Work ecosystem	1	Silvo-pastoral ecosystem	1
		Tropical ecosystem	1
		Tropical savanna ecosystem	1
		Not specified	*15*
Total	**79**	**Total**	**107**

Human-based ecosystems

Among the 19 HE types, two constitute the object of study in more than 5% of the articles of our sample: "business ecosystem" and "innovation ecosystem". These two types were cited as main types of HE by Jacobides *et al.* (2018) in their analysis of the use of the ecosystem concept in strategic management.

In term of diversity, the HE types cover various fields of research:

- business administration: business ecosystem, innovation ecosystem, entrepreneurial ecosystem, platform ecosystem, service ecosystem…
- industries: digital tourism ecosystem, media ecosystem…
- functional area: human resource management ecosystem
- social affairs and public administration: healthcare ecosystem, solidarity ecosystem, public service ecosystem
- work: career ecosystem, work ecosystem
- technologies or methods of management: blockchain ecosystem, agile management ecosystem

TABLE 2

Academic journals publishing the 79 HE articles

HE stream	Nb of papers		Nb of papers
Jal of Business & Industrial Marketing	4	Intl Jal of Construction Management	1
IEEE Transactions on Engineering Management	3	Intl Jal of Human Resource Management	1
Industrial Marketing Management	3	Intl Jal of Information Management	1
Technovation	3	Intl Jal of Information Security	1
Benchmarking: An International Journal	2	Intl Jal of Innovation & Technology Management	1
Creativity & Innovation Management	2	Intl Jal of Production Economics	1
Electronic Markets	2	Intl Jal of Public Sector Management	1
Intl Jal of Operations & Production Management	2	Intl Jal of Artificial Intelligence Tools	1
Jal of Business Research	2	Jal of Business & Economics Review	1
Jal of Cleaner Production	2	Jal of Business & Projects	1
Knowledge & Process Management	2	Jal of Business Models	1
Supply Chain Management	2	Jal of Business Strategy	1
Academy of Management Annals	1	Jal of Business-to-Business Marketing	1
Acta Universitatis Danubius: Œconomica	1	Jal of Digital Convergence	1
Administrative Sciences	1	Jal of Global Information Management	1
Administrative Theory & Praxis	1	Jal of Intl Economic Policy	1
American Jal of Business	1	Jal of Knowledge Management	1
Australian Jal of Public Administration	1	Jal of Management & Marketing Review	1
Brazilian Business Law Jal	1	Jal of Managerial Psychology	1
Computer Communications	1	Jal of Media Business Studies	1
Construction Management & Economics	1	Jal of Technology Management & Innovation	1
Contemporary Accounting Research	1	Jal of Theoretical & Applied Electronic Commerce Research	1
European Management Review	1	Management & Organization Review	1
European Planning Studies	1	Management Systems in Production Engineering	1
Europe-Asia Studies	1	Marketing & Management	1
Finance Contrôle Stratégie	1	Personnel Review	1
Future Generation Computer Systems	1	Project Management Jal	1
Global Jal of Flexible Systems Management	1	R&D Management	1
Human Relations	1	Revue des Sciences de Gestion	1
Human Resource Management	1	Risks	1
Human Resource Management Review	1	Sinergie: Italian Jal of Management	1

Human-based ecosystems are not confined to the field of business activities. The use of the HE concept has reached many other research fields where management science can be applied: social affairs, public administration, technologies, methods of management.

Only 3 HE papers deal with environmental concerns: two are dedicated to circular ecosystem and 1 to carbon credit ecosystem. It means that less than 4% of the papers from the HE stream of research consider simultaneously the economy and the natural environment.

Nature-based ecosystems

The 21 NE types reflect the variety of ecosystems that makeup biodiversity. Ecosystems are defined by their geography (a county, a coast, a national park, a urban district…), their vegetation (a forest, a mangrove, a grassland, a rice plantation…), the animals living in the region (national wildlife), a human activity (an agro ecosystem, grain storage), or even the combination of vegetation and human activity (a sylvo-pastoral ecosystem). This definition of ecosystems around some human activity is consistent with the evolution of the NE research stream that nowadays explores anthropogenic ecosystems (Ellis & Ramankutty, 2008).

It is worth noting that ecosystems also vary in size. Some articles focus on a very local ecosystem: a forest, a bay, or a meadow. Others are devoted to large, international ecosystems like the Arctic region.

Only 4 of the 107 articles do not consider sustainability issues in their framework: 3 seek to optimize the economic productivity of some agro-ecosystem, the last one looks at the best way to manage a grassland to avoid invasive species. The remaining 96% of articles link in one way or another a nature-based ecosystem and planet sustainability. This leads us to the following conclusion: in our sample of peer-reviewed academic articles, there is a clear disequilibrium between the percentage of papers from the HE research stream (4%) and the percentage of papers from the NE research stream (96%) that deal with Earth-living issues.

Connections between the two streams

We looked for connections between the research streams in two ways:

- through types of ecosystems: are some types shared by the two streams?
- Through publication outlets: are there academic journals that publish papers from both streams?

The examination of ecosystem types does not show any type that pertains to both streams (see Table 1). HE researchers on one side, NE researchers on the other side, have independently developed their own subcategories.

The 79 HE papers have been published in 62 peer-reviewed journals (see Table 2). This result highlights the extreme dispersion of the publications about human-based ecosystems. All these journals are dedicated to economics, engineering, or management science. We noticed that 20% of the journals are dealing with international business, which is consistent with the fact that ecosystems of business affairs often gather companies from multiple countries (Moore, 1993).

There are fewer places of publication for the 107 NE papers (see Table 3). They split into 35 journals, with 4 dominant outlets that published 56% of the articles:

- Journal of Cleaner Production: 23 articles
- Ecological Economics: 15 articles
- Coastal Management: 12 articles
- Forest Policy & Economics: 10 articles

Two among these 4 outlets deal with the economics of ecology: Forest Policy and Economics, Ecological Economics. A few ones in the full list are journals that publish papers in economy or business administration: for instance, Accounting, Auditing & Accountability Journal; Annals of Operations Research, International Journal of Economics & Business Administration. Furthermore, one journal belongs to the two lists: Journal of Cleaner Production has published 23 NE papers and 2 HE papers, representing .13% of our total sample.

Accordingly, we found that the NE and HE research streams have progressed independently. Each stream has developed its own set of ecosystem types, without any identified overlap. But connections exist in terms of publication supports. We found that some journals welcome articles from both independent research streams dedicated to ecosystems.

Areas of confusion

We started this research note with the issue that the same concept has two meanings in research, which is likely to bring a first category of confusion for the reader of academic publications. We found that some journals publish research from the NE stream and research from the HE stream, even if these streams are not connected. This can be a second area of confusion for the reader. He/she needs to be very careful when selecting in these journals the papers that could be useful for his/her own research.

Two other areas of confusion emerged from our investigation. We said that, when we were identifying the ecosystem type under study in each paper, we faced the issue that many articles were primarily focusing of a management method like ecosystem-based management or some functions like ecosystem services. We decided to account for these methods and functions. The examination of these methods and functions highlights other areas of possible confusion.

Confusion about methods of management

Thirty-nine articles of our sample of 107 NE papers are primarily dedicated to methods for managing ecosystems (see Table 4). Among them, 29 papers discuss or apply a method called Ecosystem-Based Management (EBM) and 9 study a sub-category of this method entitled Ecosystem Approach to Fisheries Management.

EBM is a method for managing natural resources that builds on a wide range of ecological, environmental and human factors that could influence resources stocks and evolution. EBM views the ecosystem as a unit of analysis where all the factors and their multiple impacts are considered with their effects on ecosystem functioning. EBM has been extensively applied to marine ecosystems, and especially to fisheries and the preservation of multiple species.

TABLE 3

Academic journals publishing the 107 NE articles

HE stream	Nb of articles
Jal of Cleaner Production	23
Ecological Economics	15
Coastal Management	12
Forest Policy & Economics	10
Environment, Development & Sustainability	9
Jal of Environmental Assessment Policy & Management	5
Jal of Environmental Planning & Management	4
Environmental Policy & Governance	2
Accounting, Auditing & Accountability Jal	1
Agricultural Management / Lucrari Stiintifice Seria I	1
Annals of Operations Research	1
Bulgarian Jal of Agricultural Economics & Management	1
Contemporary Economic Policy	1
Contemporary Economics	1
Ecology Law Quarterly	1
Environmental Policy & Law	1
Environmental Science & Technology	1
Habitat International	1
Interfaces	1
International Jal of Economics & Business Administration	1
Jal of Forest Economics	1
Jal of Rural Economics	1
Jal of Stored Products Research	1
Jal of the American Oil Chemists' Society	1
Jal of the Association of Environmental & Resource Economists	1
Landscape Research	1
Management Research & Practice	1
Marine Fisheries Review	1
Ocean Development & International Law	1
Organization & Environment	1
Planning Practice & Research	1
Policy Studies Jal	1
Resource & Energy Economics	1
Review of European Comparative & International Environmental Law	1
Revista Economică	1

TABLE 4

Methods of management and functions of nature-based ecosystems

Article main topic	Nb of articles
Methods for managing ecosystems	**39**
Ecosystem-based management (EBM)	29
Ecosystem Approach to Fisheries Management (EAFM)*	9
Ecosystem accounting	1
Functions of ecosystems	**51**
Ecosystem services	49
Ecosystem disservices	2

Ecosystem-based management does not require understanding the whole complexity of an ecosystem. The method is adaptive and new knowledge acquired is incorporated to improve the method. The EBM method fits with the complex adaptive systems theory (Hartvigsen *et al.*, 1998). The notion of complex adaptive systems tries to incorporate how multiple impacts at the micro level can lead to unpredictable transformations at the macro level.

If EBM is dedicated to the management of natural resources, it has nothing to do with the Resource-based management, a managerial framework used in the field of business administration. This resource-based view of the firm suggests that resources that are valuable, rare, difficult to imitate, and non-substitutable avantageously position the firm to create an economic rent (Barney, 1991). An appropriate management of these resources and capabilities provides superior performance.

Consequently, the ecosystem-based management aims to preserve natural resources while the resource-based management of the firm seeks to create economic performance. Therefore, even if there is a proximity in their title, their purpose is quite distinct.

Confusion about function and type

The topic of 4 papers from the HE research stream is called "service ecosystem", while the topic of 49 articles from the NE research stream are devoted to "ecosystem services" (see Table 1 and Table 4). Both expressions made of the same two words have completely different meanings.

Service ecosystem refers to an industry: it is an ecosystem of companies that interact to deliver a service activity. One of the 4 "service ecosystem" papers deals with the service industry in general, the other ones respectively with healthcare service, waste management in building refurbishment projects, and customer service.

Ecosystem services can be defined as the benefits that natural systems provide to humans (Balmford *et al.*, 2002). Ecosystem services have become a framework for managing ecosystems in a human dominated world (Harris *et al.*, 2006). Ecosystem services include the following services (Millennium Ecosystem Assessment 2005):

- Provisioning services are products that humans can take from the ecosystems, such as drinking water or coal.
- Regulating services are benefits that humans gain from the regulation of ecosystem processes, such as climate regulation or air quality maintenance.
- Cultural services are nonmaterial gains humans extract from ecosystems, such as recreational, aesthetic or religious benefits.
- Supporting services are those that are required to generate all other services, such as photosynthesis or nutrient cycling.

Consequently, "service ecosystem" (HE stream) has nothing to do with "ecosystem services" (NE stream). Nonetheless, the authors of one paper about "service ecosystem" cite ... "ecosystem services" as one keyword of their paper! An unfortunate choice that contributes to the confusion between research streams.

These developments highlight the difficulties that emanate from wording proximity, multiple meanings, or common publication supports. We identified four areas of confusion:

- the use of the same concept, ecosystem, in two research streams with two different meanings;
- the publication of articles about ecosystems from both research streams in the same journals;
- the close wording of methods in each research stream: ecosystem-based management in NE research stream and resource-based management in the HE stream;
- the same words used for qualifying a type of ecosystem in the HE stream – service ecosystem – and in the NE field for qualifying the services provided by natural systems to society – ecosystem services -.

Conclusion

The concept of ecosystem is increasingly used by researchers in many disciplines, from natural sciences to business administration and economics. Two main independent research streams have developed, one around nature-based ecosystems and another one around human-based ecosystems. Wording proximity, common publication supports, or multiple meanings are likely to generate confusion for the reader. As it is probably too late to modify the naming of the concept in one research stream, researchers need to clearly explain the meaning of ecosystem in their research project and to select rigorously the literature on which they elaborate this project.

Our identification of connections and areas of confusion does not pretend to be exhaustive. This first exploration of the ecosystem research field must be seen as an initial clearing about the concept meaning and use. We simply wanted to alert about the disconcerting use of the concept of ecosystem in research dealing with management. But our study has limitations. For instance, the criteria we chose for selecting papers can be discussed: database, search terms, period of publication. Future research could build on our clearing in two directions. First, a systematic literature review could be performed to identify the underlying structure of the research about ecosystems. The analysis of cross-citations could help assess linkages between streams of research. Second, we explained that research about natural ecosystems has evolved and includes now anthropogenic ecosystems. In our paper we decided to classify them as natural systems. But as the anthropogenic ecosystem is based on a specific paradigm about humans and nature, it could be worth exploring the works done about the management of such ecosystems. It looks particularly relevant at a time when we must act with nature to ensure our survival.

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