

Review

The Impact and Outreach of Soundscape Research

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Abstract: Soundscape has been growing steadily as a research field since its interdisciplinary concepts were first introduced about 50 years ago in music theory and acoustic ecology, and it currently affects a broad spectrum of disciplines ranging from social sciences to urban planning and noise control engineering. In spite of its strong research appeal, it is not clear what the actual impact and outreach of soundscape science is at a societal level; that is: how soundscape research is received by community. Using the Altmetric database, this review aims to map how and where soundscape research is “mentioned”, considering the number of mentions over time, their geographical spread and effectiveness of publication outlets. Results show that mentions are growing with time, they mostly originate in the United States and the United Kingdom, and they are generated by a limited number of research items.

Keywords: soundscape; sound perception; outreach; impact; altmetric

1. Introduction

Soundscape represents a paradigm shift in the field of environmental acoustics in that it combines physical, social and psychological approaches to the characterization, management and design of natural and urban sound environments. Although the concept was introduced in the late Sixties [1,2], significant attention to it has mainly been paid in the last two decades in the field of community noise and environmental acoustics by researchers, and recently by practitioners, including policy makers [3,4].

The scientific production in this field has been considerable and it is growing steadily. Aletta and Xiao [5] reported that more than 2400 soundscape-related papers have been published in peer-reviewed international journals in the last 20 years. Notwithstanding, soundscape has not always been successful at attracting attention from world-wide policy makers and, consequently, awareness among community stakeholders.

It is generally assumed that high-level research should pursue a significant societal impact and, being an emerging science, soundscape aims at doing this too [3]. Several bibliometric indicators are typically used to measure the impact of a research field. However, this kind of metrics related to citations counts can only measure the impact on research itself; the research impact on society might not always be necessarily straightforward, while funding bodies (and the public opinion) are increasingly demanding for evidence from scientific projects that lead to positive outcomes going beyond science.

Bornmann [6] has suggested that the societal impact of a scientific discipline should be assessed through the social, cultural, environmental and economic returns it is able to provide from its results (research outputs). Previous work has suggested that the most effective way to measure the societal impact of soundscape research would involve case studies [7], but this procedure is often

time-consuming and not always economically feasible [8]. Therefore, alternative assessment methods should also be sought.

While the body of soundscape literature is still growing steadily, there is limited understanding of what is the (measurable) impact of soundscape science [5]. Thus it is important to explore: “What is the outreach of soundscape research?”

As a preliminary attempt, this review aims to map how and where soundscape papers (and other research items) are mentioned in non-academic outlets, going beyond conventional journal citations. For this purpose, the Altmetric database was searched and the community feedback analyzed, considering evolution over time, geographical spread and publication outlets [9]. The overall “outreaching” needs of this discipline can be contextualized in a broader framework for soundscape research, which is discussed in Section 2, resulting from international research networking efforts [10].

2. A Soundscape Framework: From Research to Outreaching

Considering the soundscape discipline as a whole, it is important to establish a framework about what are its needs, taking into account both research and practice facets. Such a framework is shown in Figure 1, adjusted based on [11]. Five main issues are considered, and will be discussed in the following sub-sections [11]. The present review (Sections 3 and 4) will focus particularly on the last “Outreaching” aspect (Section 2.5).

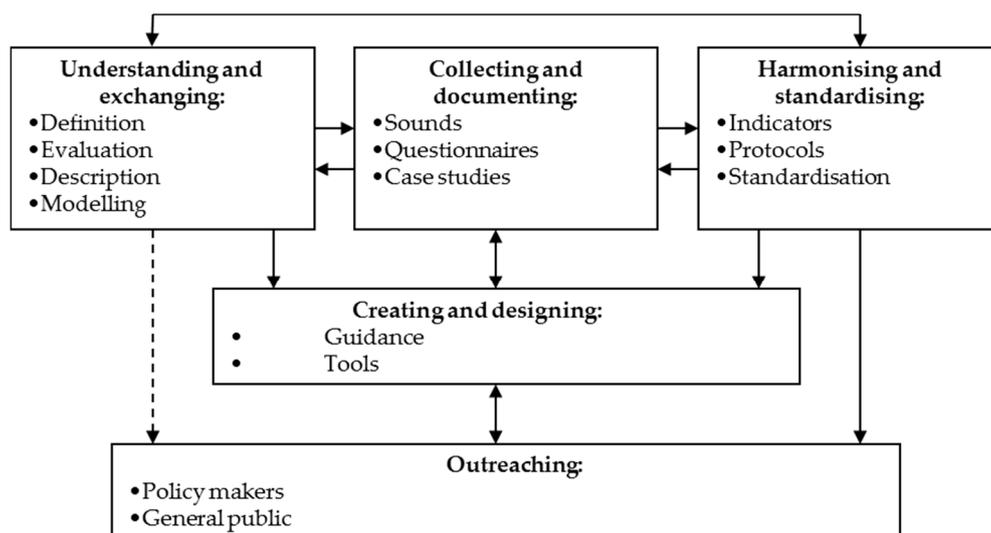


Figure 1. Soundscape framework considering both research and practice; Figure adapted from [11].

2.1. Understanding and Exchanging

There is a need to better understand the overall and diverse effects of soundscapes on citizens, in positive or negative ways [12]. For this, several aspects need to be considered:

- Soundscape *definition*, to define the scope [13].
- Soundscape *evaluation* with interdisciplinary cross-breeding of innovative and emerging scientific concepts and methods related to the main facets of soundscape research, connecting physiological (sensory), psychological, psycho-physical, cognitive, emotional, social, physical and architectural approaches [14]. It is also important to examine cultural differences [4].
- Determining essential factors for soundscape *description* [15].
- It is important to integrate the knowledge acquired from different fields into explicit *modeling* (physics and computational intelligence) [16].

2.2. Collecting and Documenting

Given the wide scope of soundscape, it is important to gather and maintain a repository of experimental *sound* data to be re-analyzed and studied from inter- and trans- disciplinary perspectives. Also it would be useful to create a database of *questionnaires*, and a database of *case studies*. Such databases would be an invaluable resource for scientists and practitioners for years to come, supporting further developments of the discipline.

2.3. Harmonising and Standardising

- While soundscape has been researched from different perspectives, it is important to review and harmonize the current vocabulary and methodology and consequently, to develop a new set of *indicators* to characterize sound quality of environments that improves significantly on the conventional decibel level approach that has been the basis of current European and international regulations [4,16]. The indicators should be suitable to assess health-related quality of life and functional health which can then be used to evaluate claims related to health-promotion benefits [17].
- There is also a need to develop *standard protocols*, such as text and/or audio-visual documentation, which can be used to better assess cross-contextual and cross-cultural differences that may be responsible for discrepancies of study results [18,19].
- The indicators and protocols could lay the foundations for *standardization* and lead to future European/international standards [20].

2.4. Creating and Designing

- There is a need for practical *guidance* in soundscape design, based on research as well as successful practical examples. It is also of significance to provide guidelines for preserving architectural heritage sites from soundscape perspectives [21,22].
- It would be important to develop *tools* and corresponding software for the design and implementation of soundscapes for use by urban planners and policy makers. Auralisation tools are especially relevant and important for soundscape design [23].

2.5. Outreach

- It is important to create awareness and promote communication concerning urban soundscapes and quiet areas amongst the *policy makers* and stakeholders, especially with the requirements in the Environmental Noise Directive (END) [24]. It should also be recognized that soundscape studies are not only for the improvement of the current sound environment but also for the conservation of our sound environments which can be classified as acoustic heritages [21].
- It is equally important to create awareness amongst the *general public*, especially given that soundscape is relevant to a much wider range of citizens than noise [25,26].

3. Methodology for the Review of Soundscape Literature in Non-Academic Outlets

A concept of “alternative metrics” that could be better measures of societal impact was proposed by several researchers [27,28]. This gradually led to the development of a new digital initiative called “altmetrics” (short version for “alternative metrics”), which can be accessed online, within a subscription scheme [9]. Altmetric (or altmetric.com) is a data science company that started operations in 2012. It tracks in real-time where research outputs are mentioned online and provides analysis tools to follow the “mentions” (links or written references) to those scholarly outputs; where mentions are categorized by “sources of attention” which include mainstream media and news outlets, social and academic networks, public policy documents, post-publication and peer-review fora, Wikipedia pages and, more recently, registered patents [9].

Several studies have investigated the relationships between conventional bibliometric indicators, altmetrics, and overall outreach of scientific papers to provide research stakeholders with a more comprehensive picture of the engagement with research work, particularly that which takes place in non-academic contexts [29,30]. Thus, it is of interests to apply the “altmetric approach” also to soundscape studies.

For the purpose of this review, the full Altmetric database was searched for all research outputs with keywords containing “soundscape”. A set of 461 research outputs was retrieved, ranging from year 2006 to 2018, and it was sorted by Altmetric Attention Score. Out of the 461 items tracked by Altmetric, 292 were outputs with mentions, from 12 different “sources of attention” (i.e., Twitter, News outlets, etc.), accounting for 1887 total mentions. The distribution of mentions for the sources of attentions was: Twitter, 75.6%; News, 10.3%; Facebook, 6.5%; Blog, 4.2%; Wikipedia, 1.2%; Google+, 0.9%; Policy documents, 0.6%; Patents, 0.4%; Others (Peer review, Vide, Weibo, Reddit), 0.3%. The source of attention’s category is defined by Altmetric itself. For the mention to be valid, the research item has to be directly cited/linked in the web post (e.g., through an URL or DOI identifier, as in the case of social media or news outlets) or properly referenced (e.g., through conventional citation, as in the case of policy documents or Wikipedia pages).

The term “soundscape” has started to spread also in popular culture and it is being sometimes used beyond a strictly research-oriented focus (e.g., as a synonym for “music event” or similar). The titles of the 292 outputs with mentions retrieved through the Altmetric search were thus inspected to confirm they were within the scope of the review. In all outputs, the term “soundscape” resulted to be mainly used within an “ecoacoustic” understanding [31], or aligned with the general definition of an “acoustic environment as perceived and/or understood by people, in context” [13,32]. Therefore, all the outputs were considered to be valid for the purpose of this review.

Finally, it is worth noticing that the word “soundscape” is often used in its English version also in different linguistic regions. The translation of the term (and that of several related perceptual attributes/adjectives) is part of an ongoing debate in international research networks [33,34]. The analysis of the geographical distribution of the mentions (discussed in Section 4.2) revealed that most of them come from English-speaking countries, but several other regions are represented too. Considering these data, additionally queries were submitted to the Altmetric database, translating the “soundscape” search term in German (*klanglandschaft*), Spanish (*paisaje sonoro*), Dutch (*geluidsomgeving*), French (*paysage sonore*), Italian (*paesaggio sonoro*), and Swedish (*ljudlandskap*). Only four additional Twitter mentions (in Spanish) were retrieved and they were therefore dismissed as the effect on the review was considered to be negligible.

4. Outreach of Soundscape Studies in Non-Academic Outlets

4.1. Overall Number of Mentions Over Time

The Altmetric Attention Summary reported in Figure 2 provides an overview of the number of mentions containing “soundscape” as keyword in the Altmetric database, over time, sorted according to their source of attention. For the sake of this review, the sources of attention were limited to: News mentions, Blog mentions, Policy mentions, Twitter mentions, Facebook mentions, Wikipedia mentions, and Google+ mentions. The time interval was limited to years 2011–2018, as mentions before 2011 were very sparse (less than 10 items). These limitations resulted in 1831 mentions, with Twitter being the most populated source ($n = 1393$), followed by News ($n = 190$) and Facebook ($n = 122$). Mentions were aggregated from a daily to a yearly temporal resolution, to enhance readability: it can be seen in Figure 2 that the number of mentions is increasing steadily over time with a trend that seems to be confirmed also for 2018 (data for this review were retrieved up to February 2018). It is observed that a steep change happens in 2015, when also News mentions start to be present in a more consistent way. The number of mentions in Policy documents is rather limited ($n = 11$); they all refer to two publishing institutions: The National Academies Press, in the United States, and the Publications Office

of the European Union, in Luxembourg. The research items referred by the American institution mostly relate to the management of US National Parks soundscapes [35], while the documents referred by the EU institution have a stronger focus on transportation noise and urban acoustic environments [36,37].

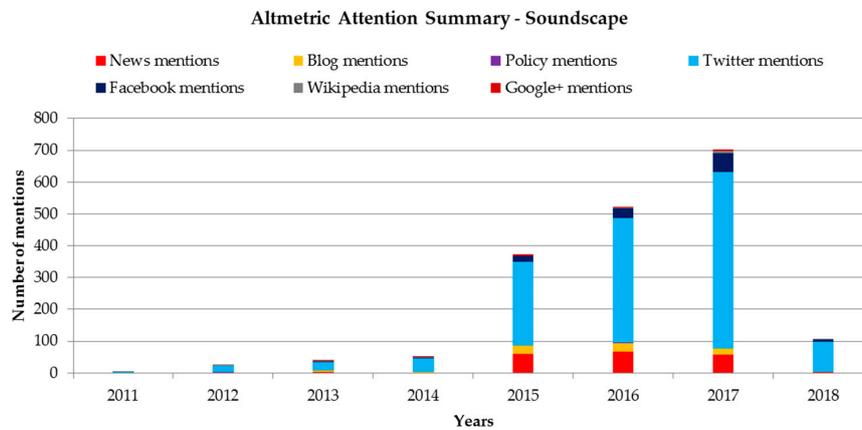


Figure 2. Number of mentions retrieved in the full Altmetric database for the selected sources of attention (“soundscape” as keyword).

4.2. Geographical Spread of the Mentions

In order to get further insights into the world regions where soundscape research gets most attention, the geographical spread of the Altmetric mentions was considered. It is worth pointing out that not all Altmetric mentions are necessarily associated to geographic information; this is either because the source of attention does not include it (e.g., Wikipedia pages), or because the information is not publicly disclosed (e.g., Twitter users might not always report their location). Consequently, only 1117 mentions were found to be associated to a specific country, with 58 countries represented around the world. Figure 3 reports the number of mentions for the countries with at least 10 mentions. The United States ($n = 406$) and the United Kingdom ($n = 292$) lead this ranking, followed by a number of European countries, the only non-European ones being Australia, Canada, New Zealand and Japan. It is noted that most of the countries listed in this context are also those more active in international networks and scientific communities about soundscape standardization [10,13,38].

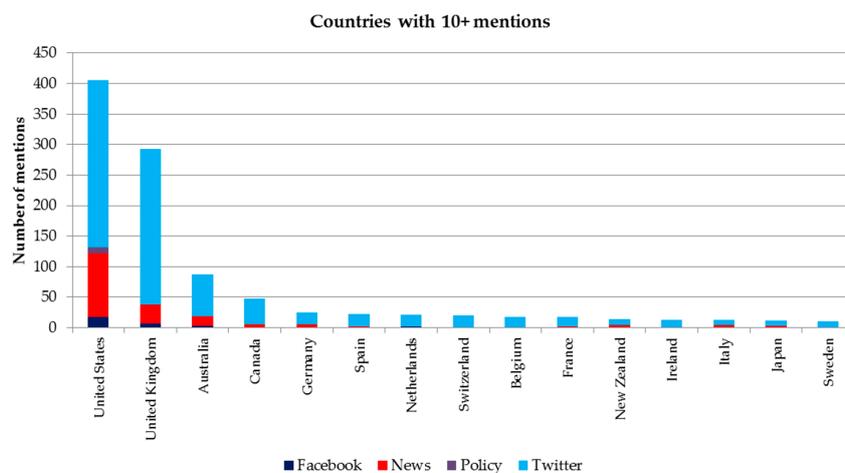


Figure 3. Number of Altmetric mentions of “soundscape” in countries with at least 10 mentions, sorted by source of attention.

4.3. Most Mentioned Journals and Collections

An additional aim of the present review was checking which scientific journals or collections publish soundscape studies receiving most attention. The journals cover a relatively broad range of scientific disciplines, such as biology, acoustic ecology, landscape and urban planning and social sciences. Overall, research items from 134 different journals were found, with 228 mentioned outputs and 1678 total mentions. Figure 4 shows the number of mentioned outputs and mentions each output received in the retrieved journals. Thus, on average, there would be 1.7 mentioned outputs for each journal, with a mean of 7.4 mentions for each output, across all journals and disciplines. However, Figure 4 shows that the linear relationship between the number of mentioned outputs and the number of mentions received by each item is relatively weak, with the former explaining only a limited amount of variance (9.3%) for the latter.

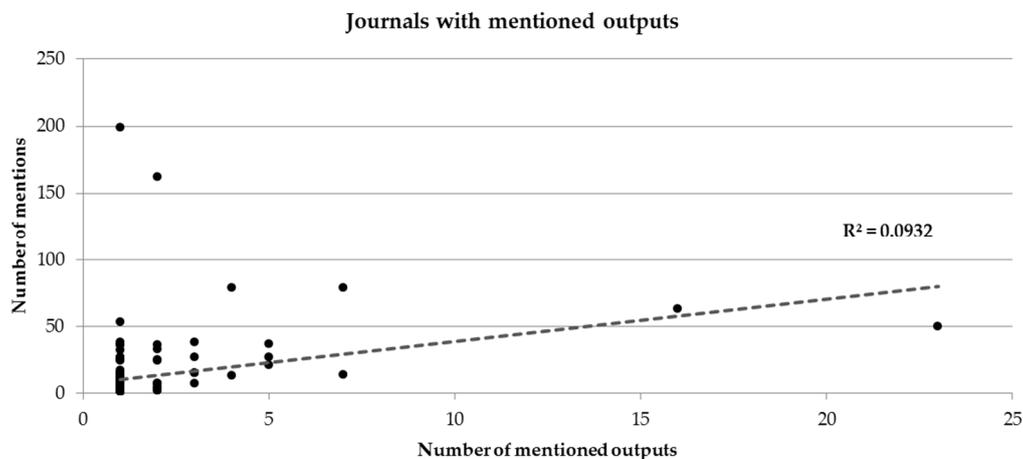


Figure 4. Number of mentions received by each output in the journals and collections publishing items having “soundscape” as keyword.

Figure 5 reports both the number of mentions and mentioned outputs for the journal and collections with at least 10 mentions in the Altmetric database. It can be observed that in some cases (e.g., Current Biology, The Conversation, Landscape Ecology, and Scientific Reports) a relatively small number of research outputs account for large number of mentions, with ratios ranging from 20:1 to 200:1. Thus, few articles received a lot of attention. On the other hand, there are journals with more mentioned outputs and fewer mentions per item (e.g., Journal of the Acoustical Society of America and Applied Acoustics, with ratios of 2:1 and 4:1, accordingly). When looking deeper into these cases, it can be observed that the mentions are often related to the corporate social media accounts of the journals/publishers themselves, or personal accounts of the authors of the scientific items (e.g., journals/authors “re-tweeting” the link of their own published work). This suggests that these stakeholders are having a more “active” role in promoting their research outputs, using social media as part of a broader outreach (or marketing?) strategy.

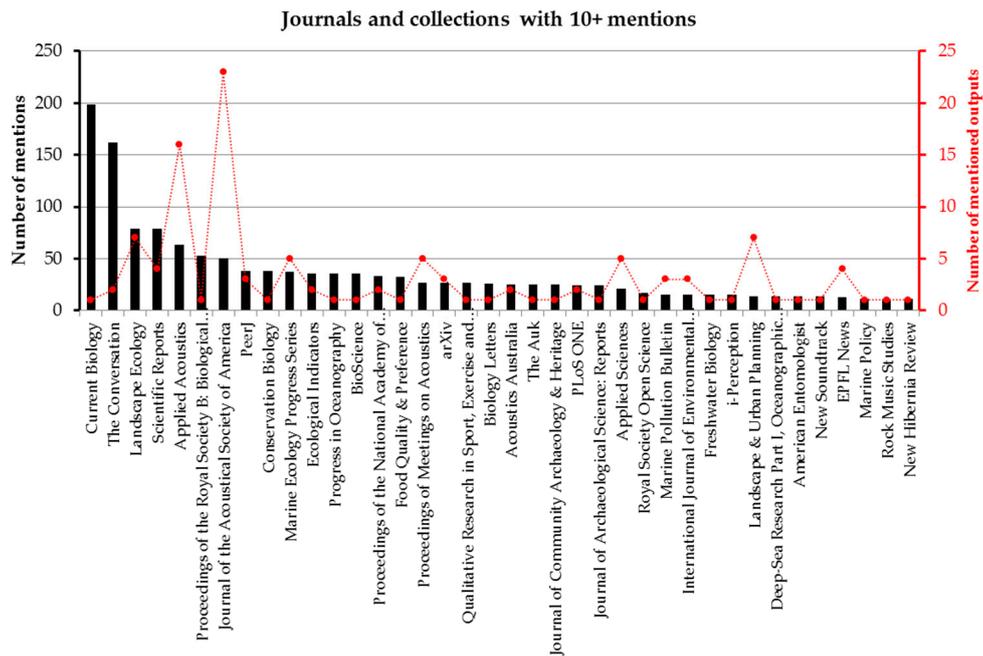


Figure 5. Number of mentions (black bars) and mentioned outputs (red dots) having “soundscape” as keyword in journals and collections with at least 10 mentions.

5. Concluding Remarks and Discussions

This paper aimed at providing a general framework to better position the soundscape discipline in the context of applied sciences. The framework included five main dimensions: Understanding and exchanging, Collecting and documenting, Harmonizing and standardizing, Creating and designing, and Outreach. Focusing on the last dimension (Outreach), this study briefly reviewed the attention gathered by soundscape studies in segments of society going beyond the mere academic context. The main conclusions of this review are:

- The amount of attention received by soundscape studies from a non-academic audience is increasing with time, especially since 2015, with most mentions in Twitter posts and News outlets.
- In terms of geographical distribution of the Altmetric mentions, the United States and the United Kingdom alone account for more than 60% of the total world-wide mentions of soundscape studies, across all sources of attention, keeping in mind that the keyword “soundscape” in English was used.
- From the point of view of journals publishing mentioned articles, a lot of attention is driven by few isolated articles dealing with hot topics, but some publishers and journals are possibly trying to adopt more structured impact and outreach strategies by taking an active role in promoting their own articles.

A limitation of this study is that it is not possible to assume that the Altmetric database will cover the “whole” attention soundscape-related studies receive in the online social realm. Like every database, Altmetric is selective. For instance, important social networks like LinkedIn and Pinterest, (which currently gather 460+ million members and 150+ million members, accordingly) are not tracked since they are “closed” networks and are not reachable by Altmetric tracking tools. To a great extent, this also applies to conventional scientific databases like Scopus or Web of Science, relying on bibliometric indicators: if the database does not include a specific journal, citations to an article originating from that journal will not be counted. To the best of the authors’ knowledge Altmetric is the only database of its kind, tracking mentions of scientific work in non-scientific outlets. While its

coverage may not be total, it does reveal trends over time and across different geographical regions about when and where soundscape research is being “noticed”.

It is also important to highlight that regarding the measures of “actual” societal impact of soundscape studies, the outcomes of this review are promising, but not exhaustive. This is mainly because, even if Altmetric data seem able to indicate which papers are more likely to have larger outreach [6], it is not clear what kind of impact they are actually reflecting (e.g., social, cultural, environmental and/or economic impact, etc.) [30]. Due to the high interdisciplinarity of soundscape research, it is not always easy to frame it into a single segment of society and more empirical studies would be desirable in this direction.

Finally, this review did not take into account the Altmetric Attention Score, mentioned in Section 3, as a criterion for analysis. The score is derived from an algorithm of the company to represent a weighted count of the mentions for a research output and to reflect the relative reach of each type of source. Altmetric does this so that it can then “rank” the importance of the items it tracks. However, the scope of this review was not establishing the relative importance of different soundscape studies, but just providing an overview of how the discipline is performing “as a whole” in finding its spot in the public debate.

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