

Review

A Transformative Turn towards Sustainability in the Context of Urban-Related Studies? A Systematic Review from 1957 to 2016

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Abstract: This article evaluates if the increasing use of the term “urban transformations” in academic research and the widely acknowledged importance of cities in sustainability transformations has led to a transformative turn towards sustainability and Global Environmental Change (GEC) in urban-related studies. This is done through a systematic review of the scientific literature on urban transformations for the last six decades. This way, the multiplicity of uses of the term urban transformations is identified and a contextualization of the urban transformations to sustainability-debate within the wider sphere of urban-related studies is achieved. Our findings show that until now the term is very heterogeneously used in the scientific literature and that the number of articles referring to urban transformations to sustainability has significantly increased during the last five years. While first steps towards a transformative turn can be identified, empirical cases of successful urban transformations towards sustainability hardly appear in the articles. A gap between the theoretical concept and the empirical cases of urban transformations is clearly visible, which also has implications for future research on urban sustainability.

Keywords: cities; sustainability; urban transformations; literature review; transition

1. Introduction

Transformation has become an important paradigm not only in the scientific debates on sustainability [1–3] but also in the political agendas on Global Environmental Change (GEC). For example, the Sustainable Development Goals (SDGs) of the United Nations, adopted in 2015 by the UN member states as part of the Agenda 2030, have the ambition to transform our world [4,5]. Institutions such as the United Nations Economic Commission for Europe (UNECE) and the United Nations Development Program (UNDP) connect the term transformation with inclusive and sustainable development [6]. Accordingly, the German Advisory Council on Global Change (WBGU) also emphasizes the need for a “Great Transformation” [7].

In contemporary political debates, it is acknowledged that far-reaching, fundamental and non-linear changes (transformations) are needed in order to achieve a more sustainable world and that it is particularly cities that have to play an important role in these transformations [7]. Cities contribute to GEC, are at the same time affected but likewise show the potential to combat, adapt to or even mitigate GEC, if a wide alliance of politicians, scientists, NGOs as well as enterprises jointly takes up this challenge.

Despite the widespread use of the term urban transformations in the academic debate, a clear definition is still lacking and different research epistemologies concerning urban transformations to sustainability exist [8]. We added a conceptual approach towards urban transformations from

a socio-environmental science perspective, highlighting the three dimensions resource efficiency, quality of life and resilience as well as their interdependencies as key understanding [9,10]. Even though urban transformations and also urban transitions “have quickly become widely shared normative catch phrases in science and policy that evoke (radical) change for urban sustainability” [11] (p. 18), it is still a matter of discussion what is actually meant by these terms beyond a general understanding of transformation as change [11]. Nevertheless, this definitional blurriness reaches beyond the currently predominating urban transformations to sustainability debate: In other studies on urban areas, which do not have a focus on sustainability but on issues such as migration, the built environment, urban culture or urban economy, the term urban transformations is used with a variety of different meanings by different scientific disciplines and even within the same scientific communities (see for example the differences regarding the use of the terms urban transformation/transition between [12–15]). This indicates that urban transformations can be considered as a buzz word which is used in multiple ways in very different contexts and does not have a clear definition.

In order to reveal the different meanings of the urban transformations to sustainability debate, in this article a systematic review of the scientific literature on urban transformations was carried out for the last six decades. We demonstrate how the uptake of the concept of urban transformation in the scientific urban studies literature has evolved quantitatively over time and what content-related topics have been covered. An analysis of the scientific application of the term urban transformations helps to identify if it offers an appropriate framework for current and future research on urban sustainability. Our focus lies on academic literature only, which excludes other uses of the term urban transformation in political agendas, municipal planning or urban real estate development. This way, the article aims to shed light in the multiplicity of scientific uses of the term and tries to contextualize the urban transformations to sustainability-debate within the wider context of urban-related studies. We aim at evaluating if the increasing use of the term urban transformations in policy agendas on sustainability and GEC is reflected by academic research and if the widely acknowledged importance of cities in sustainability transformations has actually led to a transformative turn in urban-related studies. Stemming from a socio-environmental research perspective, the objective of this article is two-fold: First, we analyse the general distribution of the term urban transformations in scientific literature (starting from the first occurrence of the term in the year 1957) and identify the temporal, spatial and thematic patterns of its use, in order to better understand the plurality of meanings. Second, we evaluate how the term is integrated in existing debates of environmental and sustainability studies.

The article starts with a short introduction to the newly emerging research field of transformations to sustainability (so called “T2S-research”, [16]) and the increasing importance of cities as research objects within this field. We then describe the methods used for this systematic review, followed by a description of the main results. In the conclusions, we discuss the implications of our findings for urban-related and transformation studies.

2. Transformations to Sustainability: An Emerging, Yet Fuzzy Research Framework

Only recently, the term transformation has been introduced in sustainability science. This with the intention to widen the concept of sustainability and add with the term transformation(s) a more process- and implementation-oriented view on sustainability [17]. Furthermore, it is particularly urban transformations to sustainability that plea for far-reaching changes. Those are considered to be necessary in order to achieve a more sustainable world and which also require new forms of transformative research [18–20]. However, recent works that introduce the general concept of transformation related to sustainability and/or GEC have stated that the term is used in multiple ways and has multiple meanings [21]. Patterson et al. [22] differentiate between concepts referring to resilience and socio-ecological systems, social innovation and transition management, concepts denoting to navigating “planetary boundaries” and works which focus on learning processes and reflexive governance. They display the characteristics of these partly interrelated, partly opposing

concepts of transformation through describing the goals, mechanisms, the trajectory of change as well as the theoretical background used in the different concepts. In a similar approach, the German Environmental Agency reviewed different understandings of transformations used in academic literature and elaborated analytical categories to differentiate between the concepts [23].

In order to show that the different urban transformations to sustainability approaches are not only based on different theoretical foundations but even use the same words in opposing meanings, we exemplarily highlight two influential works on transformations to sustainability: The work of Andy Stirling [24] and of Derk Loorbach [25]. Those two authors have been selected because of their original contributions to transformation studies which are, amongst others, references for the Future Earth community and the Sustainability Transitions Research Network. Furthermore, Stirling and Loorbach are representatives of two important transformation research institutions. Stirling is based at the STEPS (Social, Technological and Environmental Pathways to Sustainability) Centre of the University of Sussex which has a transdisciplinary and policy-driven orientation towards transformation and Loorbach is head of the DRIFT (The Dutch Research Institute for Transitions) at the University of Rotterdam which has a strong focus on technological and social innovation and transitions to sustainability.

- While some authors argue that the necessary transformations to deal with challenges of GEC and social justice are too deep, urgent and pervasive to be achieved by democratic means and democracy is sometimes queried to be the enemy of nature, Stirling [24] differentiates between two ideal types of political replies to the aforementioned urgent challenges. He differentiates 1. *Societal transitions*, in his understanding technological innovation towards a pre-defined end as for example global transitions to nuclear power in energy production; and 2. *Social transformations*, which are more plural, emergent and unruly political-re-alignments, involving social and technical interactions and with no clear-defined end. Contrary to other authors, it is repeatedly the unruly, bottom-up transformations which are based on active democracy rather than top-down structured transitions that achieve the most profound radically progressive social changes. Stirling thereby makes a crucial point concerning the general politics and the specific political instruments of transformations to sustainability.
- The work of Loorbach refers to transition management approaches such as Grin et al. [26] and aims to explain the shift from one regime to another. In a more general way the approach aims to understand how societal changes emerge. In contrast to Stirling, Loorbach sees transformations and transitions as interrelated and not opposing concepts. Transitions are defined as a “non-linear shift from one equilibrium to another” [25] (p. 45) and will lead to the long-term process of a “New Transformation” towards sustainability, which is characterized as a power shift away from powerful elites controlling resources money and power. Loorbach understands incremental changes in so-called niches of markets as the starting point for paradigm change that can pave the way towards more profound changes.

While it is not our aim to discuss the differences and commonalities between the two approaches, we can state that both authors refer to a similar analysis of current societal and environmental conditions as a starting point and that both conclude that paradigm changes towards sustainability are needed. What is interesting from a semantic point of view is the fact that even though both authors are prominent representatives of the emerging field of T2S-research they use the terms transformation(s) and transition(s), in very different, even opposing ways.

This messiness concerning the general use of the terms transformation(s) and transition(s) can also be stated for research on transformations to sustainability in urban areas. Synthesis research has shown that works on urban transformations to sustainability frequently make reference to prominent transformations research strands such as the multi-level-perspective and socio-technical systems (STS) [8,11]. Also, here, different definitions of urban transformations and transitions exist. This makes it difficult to evaluate if unintended ongoing urban changes or rather explicitly intended changes

towards sustainability can be coined as (a) transformations; (b) transitions or as (c) sustainable urban development in general and what actually are the differences among the three. Even though only work which uses urban transformations in connection with systemic change towards sustainability was evaluated in that synthesis ([8,11]), divergent uses of objective, character and process described by the term urban transformations were identified. As a consequence, the concept of urban transformations to sustainability remains vague and it is still not clearly defined, what is actually meant if someone uses the term urban transformations.

This allows for two future scenarios for urban transformations to sustainability research:

- (1) Research determines clear definitions on transformations/transitions to sustainability and also specifically for cities through combining the different research strands of sustainability transformations. This could finally lead to a theory of urban sustainability transformations and the emergence of new debates.
- (2) Future research considers transformations as generic term which covers all processes, steps and policies which try to achieve sustainability and which is used in different contexts with different meanings, however lacking scientific clarity and being very close to a catch-all term such as sustainability.

While both scenarios seem plausible, current research somehow fishtails between both options. In order to link the research to the understanding of transformations in political agendas as far-reaching changes and to avoid that transformations becomes another buzz word for sustainability, we argue that clear definitions are necessary.

In order to narrow this ambitious target down, we propose as a first step for this, a systematic, criteria-based look on current uses and meanings of urban transformations. We argue that such an analysis needs to go beyond the transformations to sustainability perspective and evaluate urban transformations in a wider context, e.g., in lights of political frameworks or the debates on rural-urban migration. Thus, the analysis and the evaluation are following other approaches used in the urban studies and sustainability research sphere (see Section 3). While this may sound as an effective instrument to increase the complexity and fuzziness of the term urban transformations, we aim to achieve the contrary. We argue that evaluating the genesis of the term will help to conceptualize urban transformations to sustainability and reveal potential links to existing urban-related studies as well as to evaluate its empirical implementation. The overall aim is to identify, this way, the specifics of urban transformations to sustainability, particularly in regard to other not-sustainability related work on transformations. Thereby, we aim at contributing to achieving more clarity with regards to the terms and concepts and to reveal potential gaps between the transformative goals mentioned in the political agendas and their implementation in cities.

3. Methods

Literature reviews have become an important instrument in research that focuses on sustainability at an urban level, for example as a tool to capture the emergence of concepts such as human-environment interactions in urban green spaces [27] or ecosystem disservices [28].

Furthermore, reviews on the literature on sustainability transformations/transitions, concerning for example changes of socio-technical systems, or on transdisciplinary research in sustainability science exist [3,29,30]. Besides the thematic variation, the methods used in all of these works are fairly similar and in general based on a keyword-based search and analysis of Web of Science WoS and/or Scopus articles in a certain time period. This way, literature reviews can be understood as part of the knowledge synthesis method of *systematic reviews*, which are described for example in the context of science-policy related biodiversity research [31,32]. Literature reviews do not refer to a specific theoretical approach or theoretical foundation but do consist of clearly defined methodological steps and an analytical framework, which makes the search criteria and search process transparent.

Qualitative reviews on articles published on transitions and transformations in connection with spatial categories and system change towards sustainability exist [8,11]. In contrast to these works, our approach targets to display particularly the relation between urban sustainability transformations and other aspects of urban transformations (for example rural-urban migration or changes in the built environment). Reflecting the above-mentioned challenges with regards to the different uses of transformations and transitions and in order to grasp all relevant literature, our review follows a qualitative approach, complemented with quantitative elements and includes both terms “urban transitions” and “urban transformations” (as well as the singular forms “urban transition” and “urban transformation”). The Databases Web of Science WoS and Scopus were systematically searched for articles which refer to the above mentioned terms, acknowledging potential biases and neglect of field specific and national citation indexes [33]. Articles which were classified as pure book reviews as well as articles written in other languages than English were excluded from the review as the terms under analysis may have another connotation in different languages. Also, books and book chapters have been excluded from the search, acknowledging that this may influence our results. Nevertheless, in order to achieve comparability to other reviews in our field of interest we decided to focus only on articles.

The analysis was done in several steps.

- Firstly, all Web of Science and/or Scopus articles that use the terms urban transformation(s) or transition(s) either in the title, in the abstract or in the keywords were identified, starting with the first occurrence in 1957 until 2016. A total of 902 articles has been found. Some (few) discrepancies occurred in the databases as the same article appeared several times but with different publication years, or book reviews and editorials were classified as research articles, etc. However, those problems were solved on a case-to case base.
- All selected articles were then, in a second step, classified along the following categories: 1. Year of publication; 2. Geographical focus; 3. Journal of publication. The geographical focus of the paper refers to the national level and was (if not already displayed in the title of the article) identified through the abstract. In cases where this did not lead to a result, the geographical focus was classified as “not known.”
- As one of our aims was to evaluate the environmental perspective of urban transformations, we selected in the third step those articles which clearly show a relation to GEC. Based on the abstract, we selected those articles dealing with the use of nature in cities, climate issues, environmental degradation in and caused by cities, urban health- and risk and disaster issues if related to nature and the environment (articles such as [34–36] or [37]). 226 articles were selected this way.
- In a subsequent fourth step those 226 articles were then evaluated whether they apply a normative understanding in the sense of urban transformations to sustainability. This means that in this step those articles were selected which understand urban transformations as fundamental, systemic changes causing sustainability shifts in for example infrastructure, behaviour or mobility patterns or cross-sectoral changes in a city and as something which is required to achieve sustainability. All 78 articles identified in step 4 have therefore an explicit normative approach. The difference between the 226 articles which show a relation to environmental aspects (selected in step 3) and the 78 articles which were selected in step 4 is the normative perspective: All the articles of step 4 define as objective of transformation a more sustainable urban environment. In contrast, the articles in step 3 analyse the impact of urban transformations (understood for example as rural-urban migration or as post-socialist transformation) on the environment. The distinction between the articles identified in step 3 and in step 4 is decisive to understand the novelty of T2S research: All articles identified in step 4 have an explicit normative approach which is process-oriented and aims to contribute to the overarching goal of sustainability.

- As a fifth step, we had a detailed look at the 78 articles with a normative understanding of urban transformations. Firstly, we analysed how often these articles have been cited. This was then compared with the number of citations which other articles on urban transformations received. While the number of citations does not necessarily show the impact of the respective article and it is not clear in which context the article has been cited (if this was directly related to urban transformations), this number can serve as an approximation on how the academic community perceived the article. This methodology follows [3], who analysed citations of articles on transformations to sustainability in a similar way.
- Subsequently, the content of the articles has been analysed in order to identify the thematic fields and the empirical cases used in the articles. This, in order to get a deeper understanding of the articles which use urban transformation(s)/transition(s) in a normative way. We differentiated between empirical articles (using one or few case studies) and more theoretical/conceptually oriented articles. From the total of 78 articles, 23 have a theoretical/conceptual focus, while a majority of 55 are based on empirical case studies. This allows us to evaluate how the goal of urban transformations to sustainability has been applied.

4. Results

Our first finding stems from step one and two and evolves from the 902 articles which use the terms urban transformation(s)/transition(s) either in the title, abstract or key words and underpins the unequal annual distribution of the articles since the year 1957 until present (see Figure 1). For readability reasons, in the following, we do not differentiate between those terms but use only the term urban transformations referring at the same time also to urban transitions as well as the singular form of both terms. Seemingly, urban transformations have gained continuously in importance especially since the year 2010, reaching the highest level in 2016 with 117 articles. This reflects on the one hand the increasing scientific production in terms of articles in general, especially since the 2000s [38,39]. On the other hand, it shows how topical the term urban transformations is in current research articles, with a clear increase in the last five years. The main underlying factor might be that the share of people living in cities has highly increased, reflecting that we are living in the urban age today [40] (for a critical view on the urban age see [41]) and therefore the importance of cities also rose.

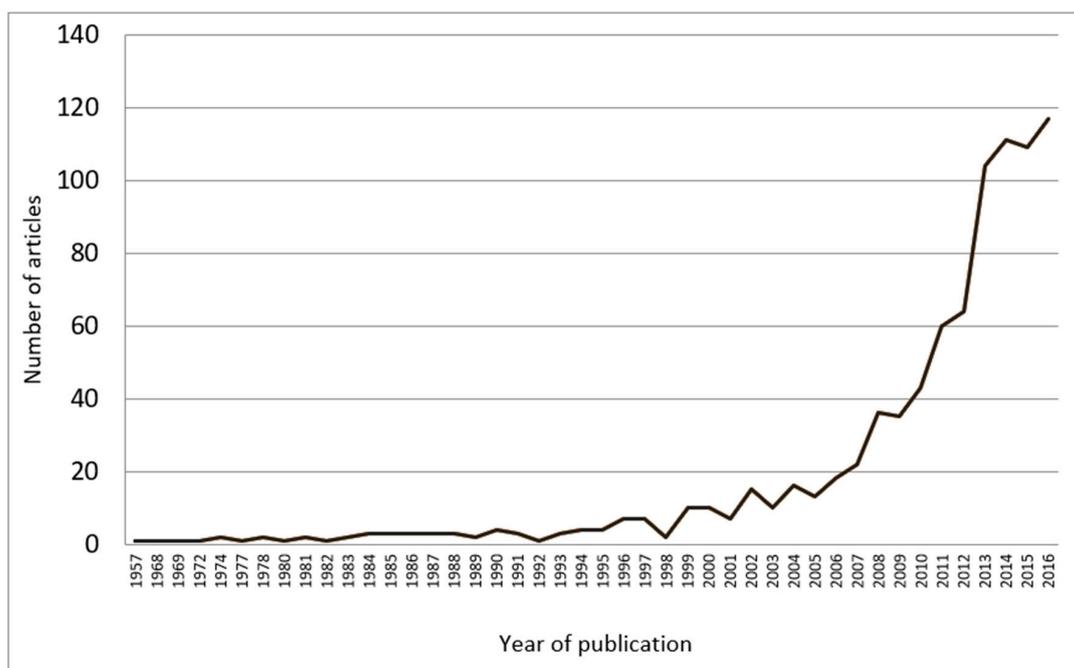


Figure 1. Annual distribution of articles using the term urban transformations.

The analysis of the journals where those 902 articles were published is displayed in Figure 2. It includes all journals which at least contained five or more articles on urban transformations. What comes apparent is that while some journals, which have a strong urban focus such as *Urban Studies*, *Cities*, or *International Journal of Urban and Regional Research* are very prominent, articles on urban transformations are also published in other journals which have no explicit focus on cities, e.g., *Journal of Cleaner Production*, *Sustainability*, or *Pacific Affairs*. This again underpins that the term urban transformations is used in a variety of different framings; not only in specific urban-related journals but also in journals which are rooted in environmental or sustainability sciences, in politics, economics and architecture or disaster studies. A complete list of the name of all journals in which at least five articles using the term urban transformations were published, can be found in Appendix A.

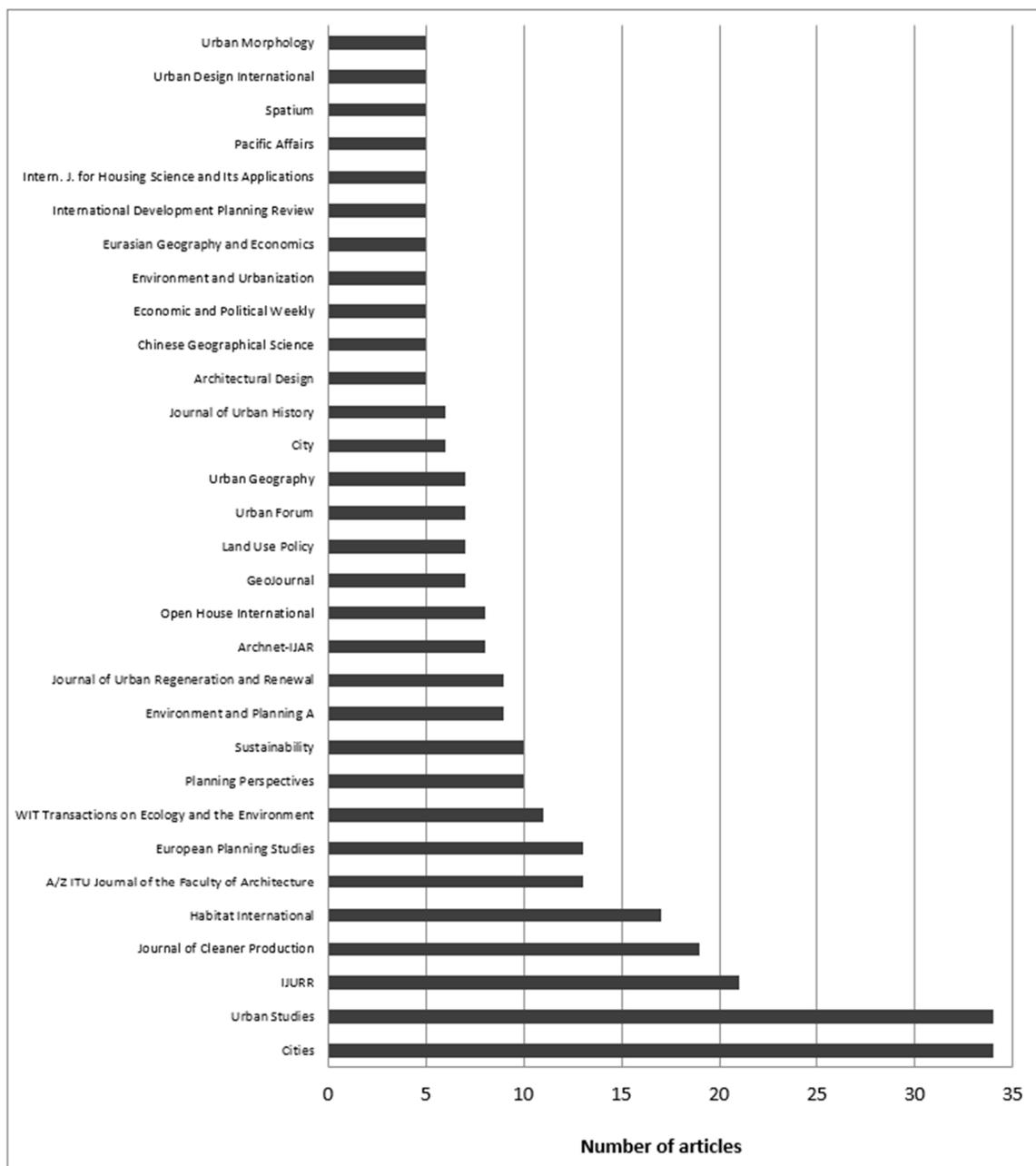


Figure 2. Distribution of articles using the term urban transformations in different scientific journals (only journals with five and more entries).

Figure 3 shows the geographical range of papers. China, Turkey, the United States, Italy and the UK are the five most frequently addressed geographical foci when focusing on urban transformations. The size of China and the enormous growth of Chinese cities as well as the dynamic rural-urban migration may explain its prominent position in the scientific literature on urban transformations. The frequent focus of papers on the United States and the UK might be a result of the general predominance of US and UK case studies in urban studies [42]. However, there is no clear reason why so much work on urban transformations refers to Italy. One explanation might be the existence of specific national urban policies and practices. The predominance of Turkey can be explained with large so called ‘urban transformation projects’ (UTPs) that are comparable to urban renewal projects, aiming to achieve physical and demographic ‘upgrading’ of particular areas within the city. Although highly contested and with a totally different meaning than our understanding of urban transformations, they are today one of the main mechanisms through which a neo-liberal system is instituted in incompletely commodified urban areas in Turkey [43].

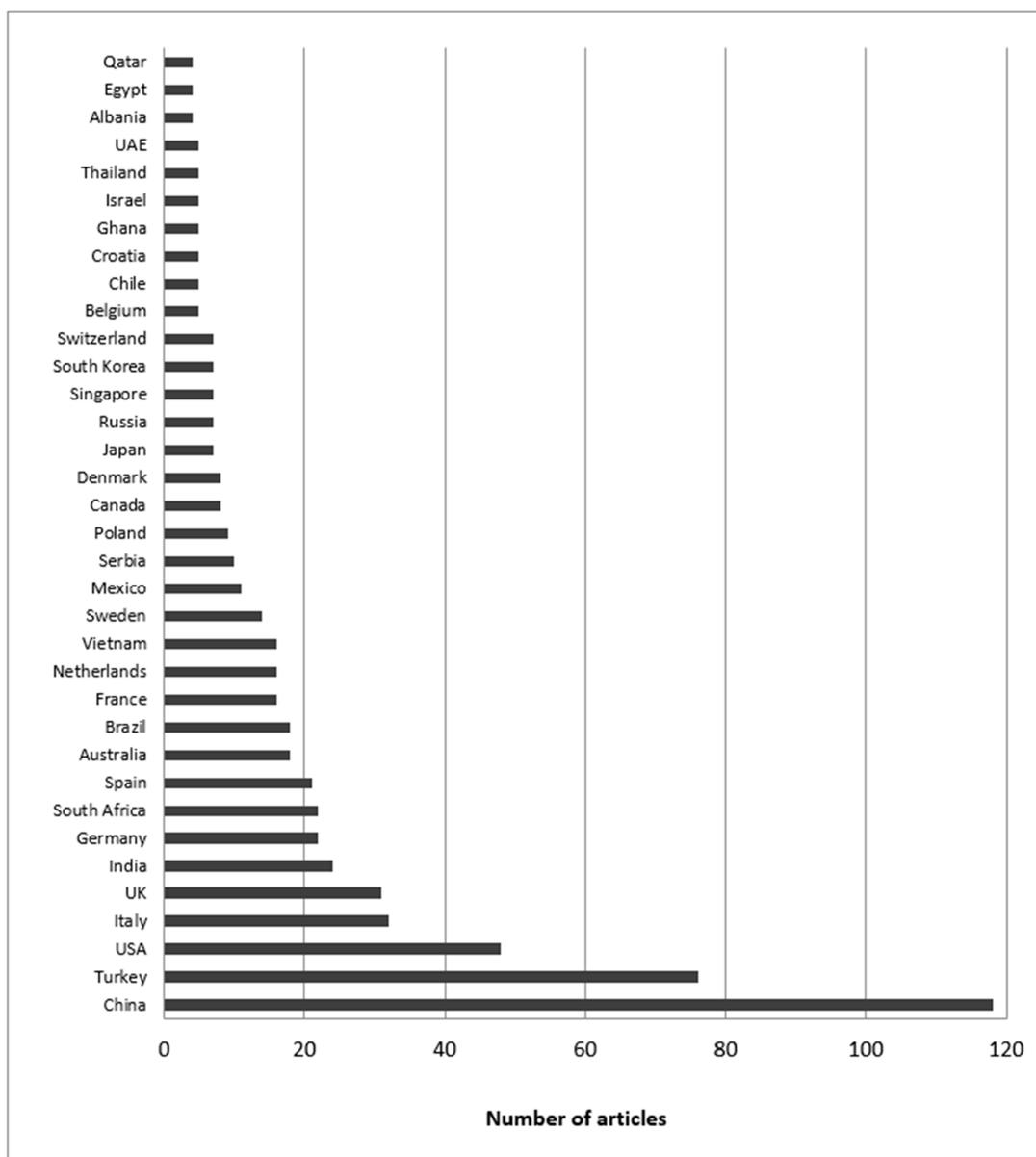


Figure 3. Distribution of the most frequently addressed geographical foci of articles using the term urban transformation.

In step 3, only those articles which use urban transformations in relation to GEC issues were analysed. Figure 4 demonstrates that this is a more recent phenomenon (columns in dark grey). The first article using transformations in relation to GEC was published in 1999. Until the end of 2016, a total of 226 articles emerged.

Even more recently, the use of the term urban transformations evolved in a normative way (urban transformations towards sustainability, in light grey), the main result of step 4 of our analysis. The first articles that understand urban transformations as fundamental, systemic changes which are needed in order to achieve sustainability shifts were published in 2010, with a first peak in 2013 and increasing up to 23 articles in 2016 (light grey). In 78 of the 226 articles which use the term urban transformations in the context of GEC, a socially accepted and/or needed normatively used pathway to sustainability stems out.

The first significant increase between 2011 and 2013 might be explained with the high involvement of social scientists in climate change research, with a focus on adaptation (e.g., [44,45]). The first peak in 2013 is related to a Special Issue on urban transformations to sustainability in the Journal for Cleaner Production (cf. Figure 5). Trigger for this special issue was the fact, that “despite increased awareness of the urgency to respond to climate change and to promote sustainable development, there are few powerful initiatives that are decisively shifting urban development in a sustainable, resilient and low-carbon direction” [46] (p. 1). Therefore, the editors of the special issues see a need to explore sustainable urban transformations focusing on multi-dimensional structural transformation processes. After this peak, the number of articles decreased in 2014. The numbers increased again in the year 2015 and 2016, which might be the response to the negotiations and finally adoption of the UN Agenda 2030 and other documents and developments that led to an increase of also research activities in the context of cities, transformations and sustainability.

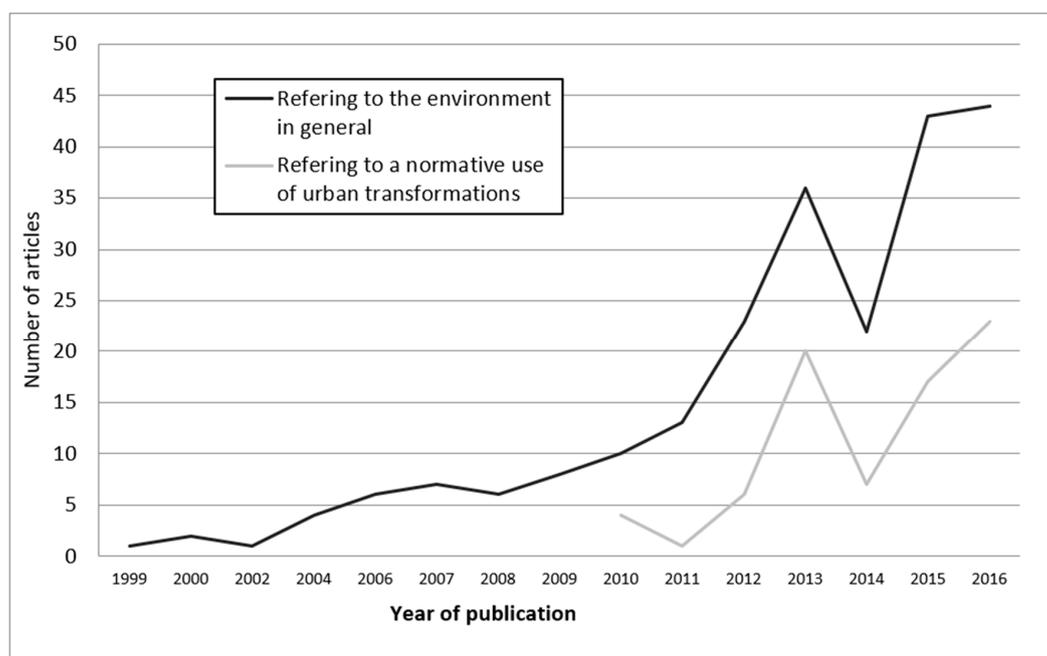


Figure 4. Yearly distribution of articles using the term urban transformations in the context of GEC in general ($n = 226$) and sustainability (normative use) ($n = 78$).

Figure 5 shows the scope of articles which are related to GEC (in dark grey, $n = 226$) and the share of the articles out of those GEC focused ones which uses transformations in a normative way (in light grey, $n = 78$). What can be stated is that the use of urban transformations in a normative sense as a pathway to sustainability takes place mainly in three journals (Journal of Cleaner Production, Sustainability and

Urban Studies), with only one of them (Urban Studies) being a specific urban-orientated journal. It is also interesting that other journals with high numbers of articles on urban transformations in general (International Journal of Urban and Regional Research and Cities) have not yet published articles that focus on urban sustainability transformations in a normative way. This shows that the current discussions on urban transformations to sustainability are only partly linked to other urban-related research communities.

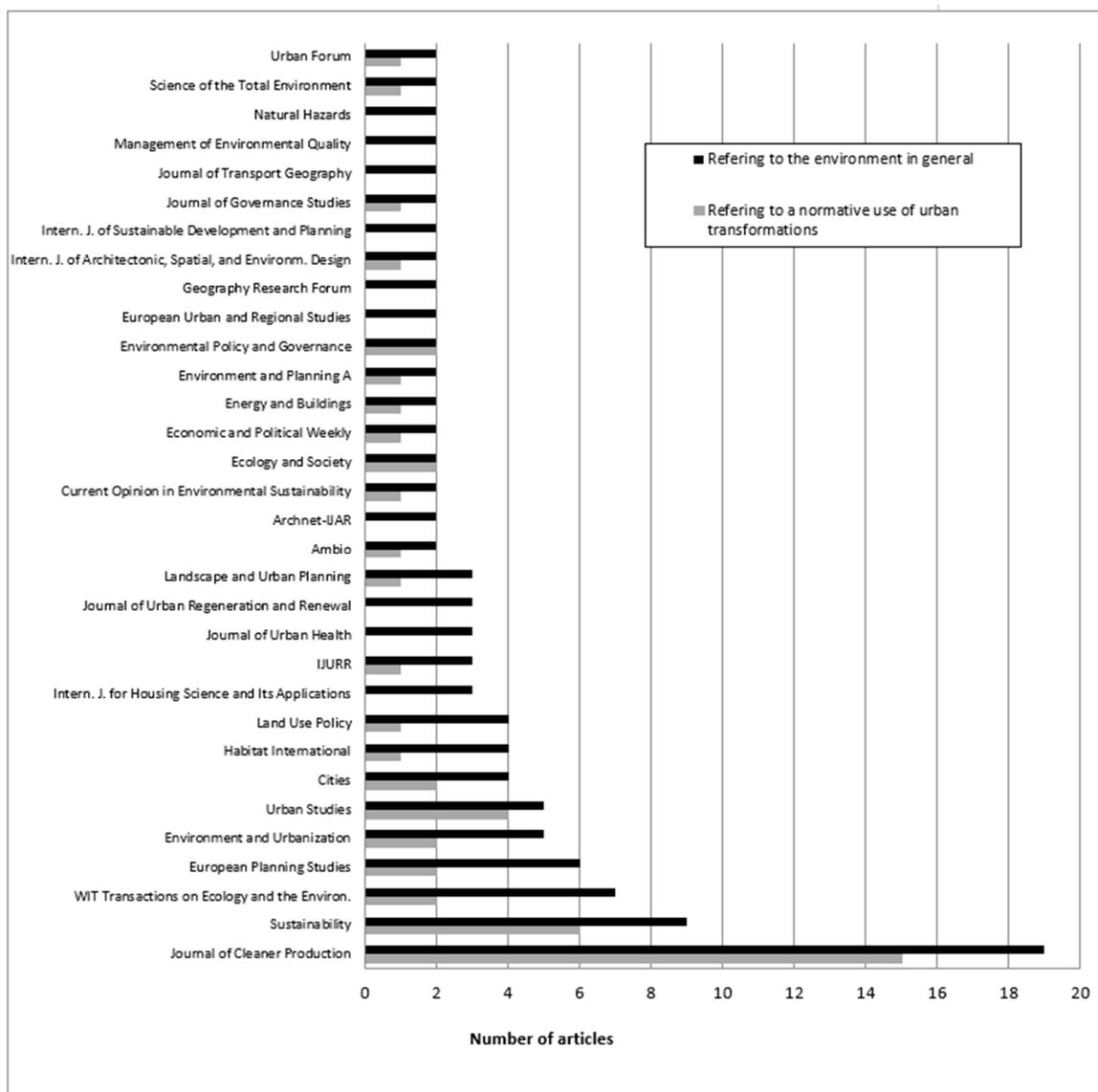


Figure 5. Journal distribution of articles using the term urban transformations in regard to GEC issues ($n = 226$) and a normative use of urban transformations ($n = 78$).

Urban transformations papers which refer to GEC issues frequently focus on Chinese, Turkish or Italian cities (see Figure 6)—a similar result as in the analysis of urban transformations in general (Figure 3). However, if only those papers are considered which are related to the normative dimension of urban transformations in relation to GEC issues, countries such as Australia, Germany, Denmark, Sweden, the UK and South Africa are most prominent (three and more articles). An imbalance towards highly industrialized, rich countries can be stated (with the exception of South Africa). The reason for this geographical bias might be related to the fact that the theoretical foundation of T2S research mainly emerged in those countries.

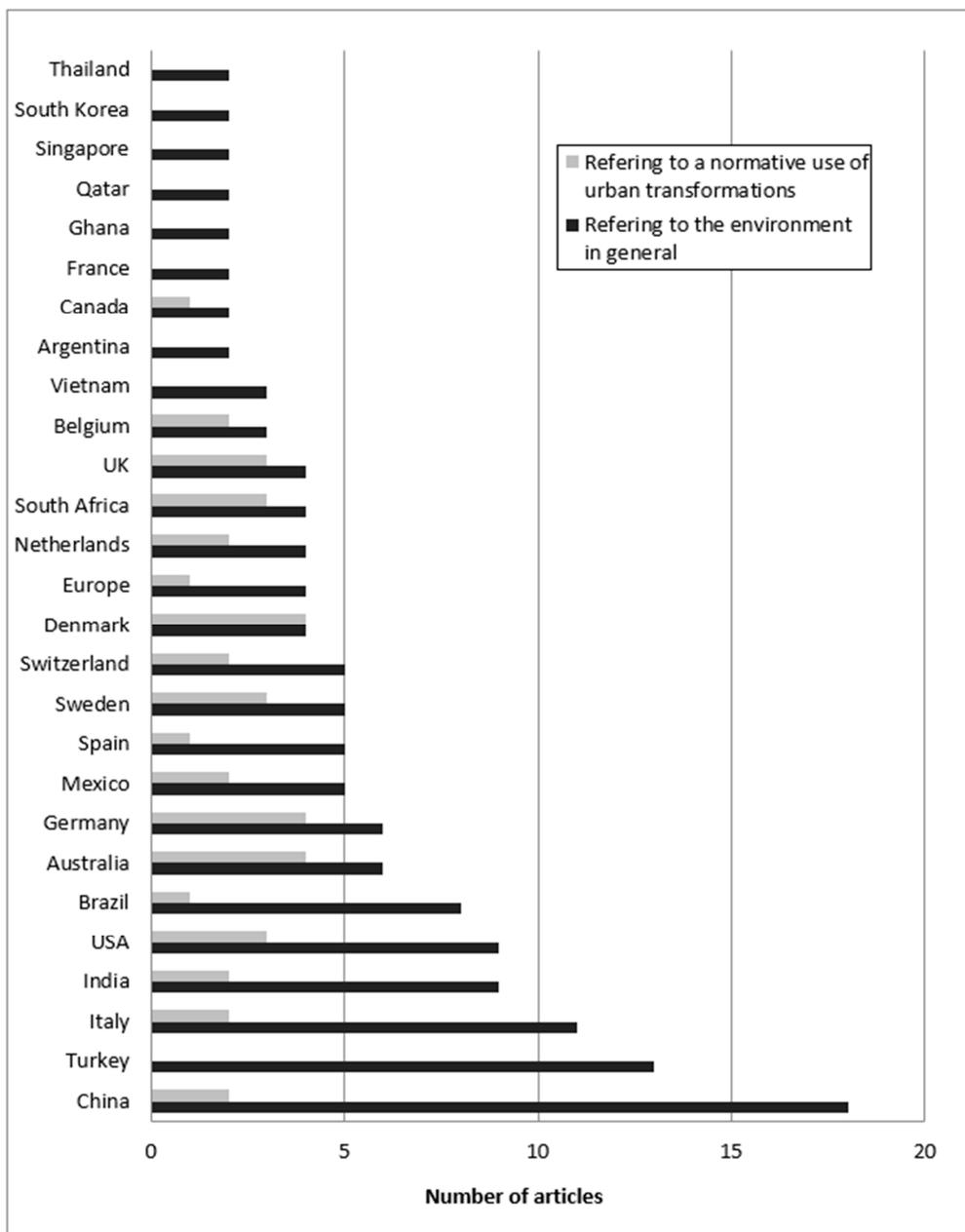


Figure 6. Geographical distribution of articles using the term urban transformations.

In a subsequent step 5, we analysed which of the articles ($n = 78$) were most frequently cited and therefore can be considered as key publications in the field of urban transformations, acknowledging the before mentioned limits of such an approach (see Section 3). This was done by using the number of citations in the Scopus database, which includes more journals than the Web of Science and therefore gives a better overview on how articles have been adopted in the scientific community. Seven articles which refer to urban transformations in a normative sense range among the 50 most cited articles: [46–52]. One has to consider that urban T2S-research is a quite recent phenomenon and therefore articles, which have been published earlier with another understanding of transformations might have more citation. However, we can state that those seven articles standing out could have a certain influence on the general debates on urban transformations. Although it is premature to speak of a general transformative turn in the T2S understanding in urban-related studies, some first steps toward this can be identified.

In the final step, we differentiated 23 articles out of the normative ones with a theoretical/conceptual focus, while a majority of 55 are based on empirical case studies. The case studies focus on different sustainability goals such as transformations for low-carbon or carbon-free cities, innovations in urban water or energy infrastructures, changes in traffic systems, adaptation to climate change or the role of green space in urban planning. Only few articles refer to various objectives or different dimensions of sustainability and pursued a more integrative, cross-sectoral view of urban transformations. For example, Haldrup and Snällfot [51] analysed how the objectives climate change mitigation, energy efficiency and human wellbeing were implemented in the refurbishment of multi-family houses. Nevens et al. [53] presented Urban Transition Labs as a co-creation method which has the potential to widen the goals relating to climate change and carbon neutrality to a broader sustainability perspective. In contrast to the limited number of empirical articles with an integrative perspective, most of the conceptual articles highlight the need to consider urban transformations as cross-sectoral, far reaching process, which can be characterized through synergies and interactions between different thematic fields: Sectoral approaches to the challenges of sustainable development are considered to fail [46] and transformations of behaviour, systems, cultures and institutions are at the same time necessary, in order to achieve urban transformations to sustainability [54].

The reason for the lack of a more integrative perspective in the empirical papers might be that the urban transformation processes described in the case studies did not apply such a cross-sectoral perspective and no “multidimensional and radical changes” [55] (p. 478) resulted. In this sense, the high standards described in the conceptual papers towards urban transformations (cross- and multi-sectoral, far-reaching and radical change processes) seem not to be reflected in the empirical cases. Rather, changes in one sector (energy, water, mobility infrastructures) are in the focus of most of the empirical papers on urban transformations.

A discrepancy between theory and practice of urban transformations, which can be labelled as implementation gap is also visible in the evaluation of the empirical cases. Many of the empirical papers have a rather sceptical view on the results of the urban transformation processes: It is argued that not very much tangible results are visible for the case of climate neutrality in Ghent [56], cities are not prepared to implement development paths which are not oil dependent was the judgement of Páez for Mexican cities [57] and in the case of carbon control management in London and Hong Kong, the authors conclude that “even though both cities paint reasonably good stories, the overall situation is stagnant: No radical changes are seen” [58] (p. 66). In the same way Newton [59] (p. 98) argues that “current metropolitan planning systems and political-institutional-community structures in high-income western democratic societies appear incapable of the longer-term transformational decision-making and implementation process.” For the case of climate adaptation Wamsler [60] identifies gaps between theory and practice: Climate adaptation takes place but is not really transformative. In this sense, a lot of the empirical articles are rather disillusioned about implementing urban transformations to sustainability and transformative changes are until now not a widespread empirical phenomenon.

5. Conclusions

Coming back to our initial question if a transformative turn towards sustainability and GEC in urban-related studies can be indicated, our results first of all point to an increase of articles referring to urban transformations during the last five years. The term urban transformations is very heterogeneously used in the scientific literature. Articles deal with various issues such as rural-urban migration, post-socialist transformation, changes in the build environment or in urban cultures, referring all to the term urban transformation. Therefore, the term describes a variety of different phenomena and is not based on a common understanding of what transformations on an urban scale actually stand for. The reference to sustainability and/or GEC is only one of a variety of different contexts in which urban transformations is actually applied.

Secondly, we can resume that the number of articles which refer to urban transformations to sustainability in a normative sense has also increased in the last years, standing out with a normative framework. Those acknowledge that transformations are needed in order to achieve the desired state of sustainability. This means that the final objective is already defined and the processes of how to achieve this final state need to be investigated. We assume that this relates to the use of transformations in political agendas on GEC, such as UN's Agenda 2030 [4] or the climate commitments. In articles focusing on rural-urban migration, post-socialist transformation, changes in the build environment or on urban cultures such a normative perspective does not exist or is at least less explicitly expressed.

Even though it seems premature to speak of a transformative turn in urban-related studies, the dynamic growth of articles using a normative understanding and the high number of citations of some of these articles, allows us to speak about first steps towards such a turn. Urban T2S research seems to become an established research field of urban transformations nowadays. However, it needs to be clarified that the discussion on a normative understanding of transformations currently takes place mainly in three journals and is still far from being a mainstream perspective in urban-related studies.

The third point is the geographic bias of the term: Current urban transformations research focuses almost exclusively on cities in developed countries. Therefore, it needs to be further analysed how the enormous challenges related to urbanization in developing countries can be combined with the T2S ambitions. As a first attempt towards such a more general application of urban T2S research the choice of case studies in the recent report of the German Advisory Council on Global Change (WBGU) [61] can be considered.

A fourth point is the discrepancy between the theoretical claim about the nature of urban transformations to sustainability (far-reaching, radical changes) and its practical performance. Only few empirical examples of urban transformations to sustainability, in which a cross-sectoral change actually took place, can be identified. High ambitions on what urban transformations to sustainability actually are, have been mainly expressed in political and conceptual papers but do not apply for empirical papers. This means that these ambitions have not been met in practice, neither by mechanisms to reach these ambitions nor by appropriate results and the empirical papers are very cautious about the questions, whether transformative change actually took place.

This leads us to some final reflections on research on urban transformations to sustainability: While the normative understanding of urban transformations has gained considerably importance in urban-related studies and even first steps towards a transformative turn can be identified, this is not reflected in current development processes in cities (at least in academic papers reflecting on those). An implementation gap between the theoretical concept and the empirical cases is clearly visible. Potential reasons for this gap are inertia, a lack of political will and/or instruments, obstacles to change existing behavioural patterns but also economic forces which try to maintain existing systems [10,62]. This gap has also implications for future urban T2S research: If the difference between theory and practice of urban transformations to sustainability becomes irreconcilable, the concept is in danger to become a meaningless wish-list. This way, we see a need for better combining the conceptual ideas on how transformative change *should* look with the practical urban experiences on how transformative change *can* look and even more importantly become reality. This might lead to uncomfortable insights but it will certainly help to evaluate realistically what cities can actually contribute to transformations to sustainability—and what not.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Distribution of articles using the terms urban transformation, urban transformations, urban transition and urban transitions in different scientific journals (only journals with five and more entries).

Cities	34
Urban Studies	34
International Journal for Urban and Regional Research IJURR	21
Journal of Cleaner Production	19
Habitat International	17
A/Z ITU Journal of the Faculty of Architecture	13
European Planning Studies	13
WIT Transactions on Ecology and the Environment	11
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