Planning for Urban Biodiversity in a Divided World

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Abstract: *Despite global efforts, biodiversity loss continues unabated at rates that test planetary equilibrium. New planning methods for biodiversity protection are needed to reduce this loss. But, biodiversity loss is extremely complicated. Its root causes bypass traditional societal divisions, spanning economic, cultural, and social factors. One area of potential at this time of urgency is to focus on nodes of society that have wide reaching influence outside of their borders: cities. This study examines urban biodiversity plans and related guidelines to see if these documents successfully weave together social, economic, and cultural factors with biodiversity. Within these documents, this study explores definitions of biodiversity, its strength as a concept, and its connection with social, cultural, and economic considerations.*

1 Introduction

Biodiversity is a foundational element crucial to humanity's ability to survive and to thrive. As primary confluence zones of human activities, cities are major nodes that can promote biodiversity protection or reinforce biodiversity loss over wide areas.[1] In light of this, it might be expected that biodiversity protection would be an integral part of urban planning to ensure the current and future viability of our civilization. On the contrary, city plans typically address biodiversity as a subcategory related to land conservation, if they mention it at all. To achieve a new hegemony of urban biodiversity planning, it is crucial that we, as planners, identify where the reach of biodiversity plans fall short of the full spectrum of the drivers of biodiversity loss.

So far, efforts have not resulted in widespread reduction of biodiversity loss. I believe this may be due in part to the fact that very few efforts have had sufficient time to measure their impact, but also because two false conceptions are largely followed by biodiversity conservationists: identifying humanity as inherently against nature and addressing the symptom of land use change rather than underlying socio-economic drivers. To address biodiversity loss in a meaningful way, each of these two false concepts must be replaced by their more holistic counterparts: humanity as an inextricable part of nature and a focus on drivers of biodiversity loss rather than its main symptom.

1.1 Research Questions

[1] Many attendees came away from Rio+20 feeling that local governments are the change drivers for finding solutions to global environmental problems (Ki-moon 2012, Tsay 2012, Llana 2012).

In this study I ask, "*Does urban biodiversity planning address the full spectrum of the drivers of biodiversity loss?"* To understand the reach of these drivers requires a systemic viewpoint uncommon in today's world of division and specialization. While planners embraced social issues in the 1960s, incorporating them across plans,[2] biodiversity remains a subcategory under land use planning. This lack of understanding is especially exacerbated by conflicting views and a lack of dialogue between environmental scientists, social activists, and economic leaders. Protection of biodiversity can be interpreted as something that would be "nice" but is not essential when other concerns are more pressing, rather than a factor, direct or indirect, in nearly every decision. Worse, it can be seen as a win/lose issue wherein biodiversity protection appears to be in opposition to other concerns rather than underpinning economic, social and cultural functions.

I seek to answer my hypothesis through three research questions:

1. How strong is biodiversity protection in practice as a concept? How broadly is it defined and discussed? Is it "baked in" per se, considered throughout and discussed in multiple sectors?
2. Do urban biodiversity plans promote biodiversity in the urban context in a way that integrates social, cultural, and economic drivers of biodiversity loss, or are they limited to land use factors?
3. Do guideline documents for biodiversity planning address an integrated perspective of biodiversity? Do they address social, cultural and economic drivers of biodiversity loss?

I look for the answers to these questions within urban biodiversity planning documents. The majority of urban biodiversity plans have been released in the last decade, so biodiversity actions are largely in the planning phase. Therefore, this study is limited to plans rather than outcomes.

Planning for the protection of biodiversity occurs in isolation from, and even in opposition to, other administrative units and viewpoints. This is despite the fact that improvements in biodiversity contribute to many other priority areas in health, resource management, food security, ecosystem services, economic sustainability, and cultural preservation.[3] Ecologists, biologists, and environmental scientists prepare biodiversity plans from a preservationist mindset that focuses on particular species or target areas of land and the removal of human use. The plans suffer from a lack of understanding of the social and political dynamic of resource consumption and marketplace activity. As a result, biodiversity planning activities are self-limiting.[4] The good news is that by opening up the biodiversity protection planning process to address the greater network of socio-political influences on biodiversity loss, biodiversity planners can build new alliances and can tap into a much larger toolbox of solutions for urban biodiversity. More importantly, the new solutions can address the causes of biodiversity loss, rather than just the symptoms.

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[2] At least in the U.S. (Clavel, 1986)
[3] CBD (2010); UNEP (1999); Posey (1999)
[4] Tidball and Weinstein discuss resistance to using a systems-based approach to planning in spite of "substantial lip service to the contrary" (2011, p. 371).

2 Materials and methods

This concurrent mixed models/mixed methods study aims to better understand the research problem by analyzing biodiversity documents. I grouped the documents into three categories: (1) biodiversity plans that are local government plans with "biodiversity" in the title, (2) non-biodiversity plans that are the same but have biodiversity only in the body, not the title, and (3) associated guideline systems used by local governments to develop such plans. In this study, document analysis with both quantitative and qualitative aspects provides an overall picture of urban biodiversity plans. Some initial unstructured interviews and a workshop supplement the document analysis.

The methodology uses qualitative and quantitative analysis across all three research questions. The first question, regarding biodiversity as a concept, uses interviews and both manual and unsupervised lexical analysis. The second question, regarding whether plans integrate social, cultural, and economic aspects of biodiversity, uses manual and unsupervised analysis of documents. The third question, regarding the guideline documents, uses the results of the lexical analysis with a review of current models to look back and explore the underpinnings to the development of the plans.

The unbiased lexical analysis is supported by manual analysis to obtain reliable and useful results. I follow the triangulation method of mixed methods mixed models, developed by Tashakkori.[5] Mixing both qualitative and quantitative analysis across all phases provides results that are highly valid.[6] In this case, I develop my theories based on the initial unstructured interviews that are then enhanced and informed by unbiased lexical analysis to come to a combined, new starting point. From there, I develop further reasoned arguments for manual analysis and compare them with existing biodiversity protection planning frameworks that will challenge me to question the previous results iteratively.

2.1 Methods

I selected an unsupervised content analysis approach to review 48 biodiversity plans and 17 non-biodiversity plans. I chose Leximancer software because it allows me to analyze large amounts of text in a pseudo-quantitative and unbiased method that can be repeated.[7] By contrast, in a supervised analysis, the researcher introduces bias through his or her own framework of codes and themes. Leximancer automatically generates themes using an algorithm that is unbiased. After investigating the use of concept maps generated automatically by Leximancer, I found that the maps themselves were not stable enough to produce a repeatable result, but that the theme strength and concept co-occurrence data was consistent and could be exported for additional statistical analysis. Therefore, I chose to utilize the theme strength identification and co-occurrence raw data generated by Leximancer for my analysis. I supported this data with my own manual search and categorization.

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[5] Tidball (2012), Tashakkori and Teddlie (2003),
[6] Greene, *et al.* (1989)
[7] Smith and Humphreys (2006); Penn-Edwards (2010).

The plans that were analyzed include: 48 biodiversity plans; 4 climate change plans, 4 comprehensive plans, 1 wetland plan, and 8 sustainability plans that each contain the term biodiversity. The plans are not limited geographically nor in scale, but I did limit them to only those places which average at least 1,150 people per square kilometer[8] to ensure an urban context. The plans cover city-states, cities, regions, counties, and provinces. I analyzed each type of plan in aggregate, grouped by commonality, and individually. I found individual analysis to be the most useful because it was unbiased by the variability in the size of the documents.

I addressed each of the three research questions in the following ways:

1. In the non-biodiversity plans, I reviewed how biodiversity is expressed as a concept generated by Leximancer. I looked at whether or not and how strongly it manifests as a concept or a theme, and how it relates to other identified themes. I manually counted the frequency of the biodiversity term. I also generated frequency diagrams of the co-occurrence of biodiversity[9] with other concepts as compared to other terms in the same document. I compared this with a sampling of other common terms to determine whether "biodiversity" had a more or less consistent co-occurrence pattern as other concepts.
2. I investigated the themes of the biodiversity and non-biodiversity plans and identified concepts and themes that are social, cultural, or economic, rather than nature or land-based. Using the Leximancer concept outputs, I classified the concepts according to six categories: (1) social, (2) cultural, (3) economic, (4) land use/ecological, (5) educational, and (6) other terms. I then developed an index for the degree of integration that accounts for the quantity and frequency of categories 1-5. From these analyses, I could order and categorize the plans according to their degree of integration.
3. I repeated the process from question 2 on documents describing the four selected frameworks. I then used retroductive reasoning to compare the plan documents with the biodiversity planning conceptual frameworks.

The selection of documents is biased in three ways: (1) towards groups that keep information on their biodiversity plans on the web in a searchable format, (2) towards English speaking areas and (3) by lacking a control dataset of documents that do not mention biodiversity. I made every attempt to gather all the biodiversity plans and frameworks that met the density criteria and contained at least one instance of the term "biodiversity" or its derivatives.

3 Results

[8] I use density instead of population numbers to ensure an urban context without the need to worry about particular boundary areas, such as metro area versus city boundaries. The resultant plan areas include entire cities, city-states, areas within larger cities, local regional areas and provinces (states). The density limit serves to ensure that all included plans are working within a dense, urban context.
[9] I extracted these data from Leximancer for further analysis in spreadsheet form.

3.1 Non-Biodiversity Plans

Biodiversity is not a strong concept when compared to other concepts in the non-biodiversity plans. Aggregating all of the non-biodiversity plans, "biodiversity" occurs in 187 text blocks, and ranks 66th among themes, with 5% relevance relative to the most common theme, “city” (see Fig. 1). Analyzing each plan individually, and then averaging the results, the percent relevance jumps to 10%. By comparing the frequency of biodiversity, both as a term[10] and as a theme, between the plans, I obtained a more nuanced picture that was consistent around the 10% figure. This analysis also indicated a much higher incidence in the sustainability plans and the wetland plan (see Table 1).

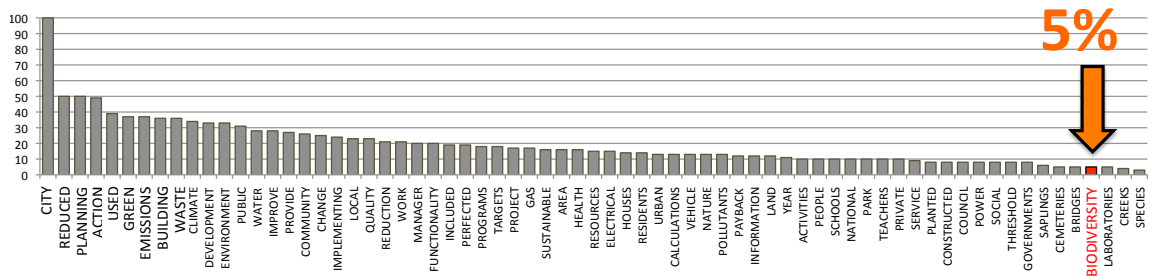

Fig 1. Theme relevance for the top concepts of all non-biodiversity plans, an average.

Table 1. Average incidence of "biodiversity" term in non-biodiversity plans by plan type.

Plan Type	Biodiversity Concept Relevance	Pages Containing “Biodiversity” term	“Biodiversity” term average occurrence per 1,000 words
Sustainability/Greening Plans	13%	17%	1.7
Wetland Plan	9%	37%	2.3
Climate Change Plan	7%	2%	0.3
Comprehensive/Development Plans	5%	5%	0.3
All Non-Biodiversity Plans	**10%**	**12%**	**1.1**

To further understand how biodiversity relates in the text to other concepts, I used the co-occurrence percentage between biodiversity and other concepts (see Fig. 2). A frequency distribution of these co-occurrence percentages reveals that biodiversity has a weak connection to other concepts, and that it is connected to a higher number of concepts overall when compared with “development,” “green,” “community,” and “area.” The frequency distribution in Fig. 2 shows that “biodiversity” has a frequency diagram with a high peak skewed farthest to the right. The shoulders are the smallest, with the tail at nearly zero. The other terms have small bumps in the tail, indicating concepts that have a more robust bidirectional correlation with the comparative concepts.

[10] This manual search also counted “bio-diversity” and “diversity” that were in reference to species or habitats rather than social or economic issues.

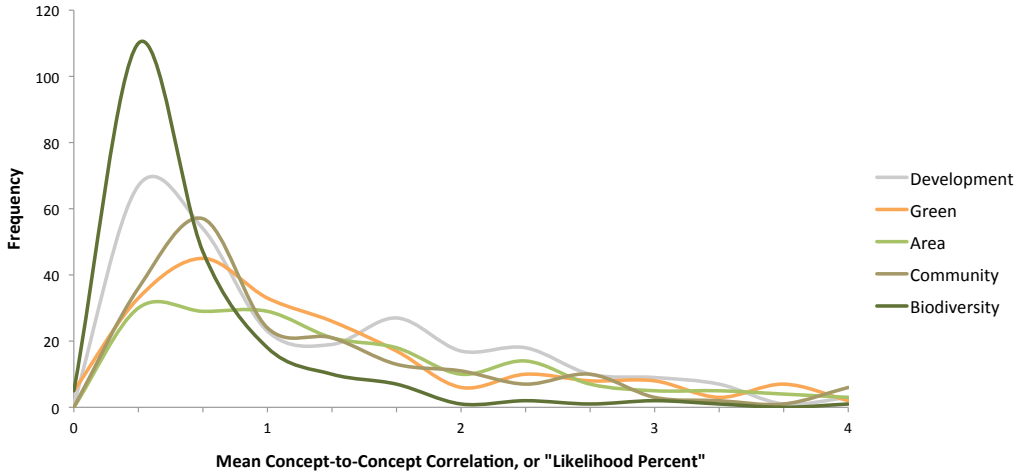

Fig 2. Frequency distribution of select concept-to-concept correlations in non-biodiversity plans.

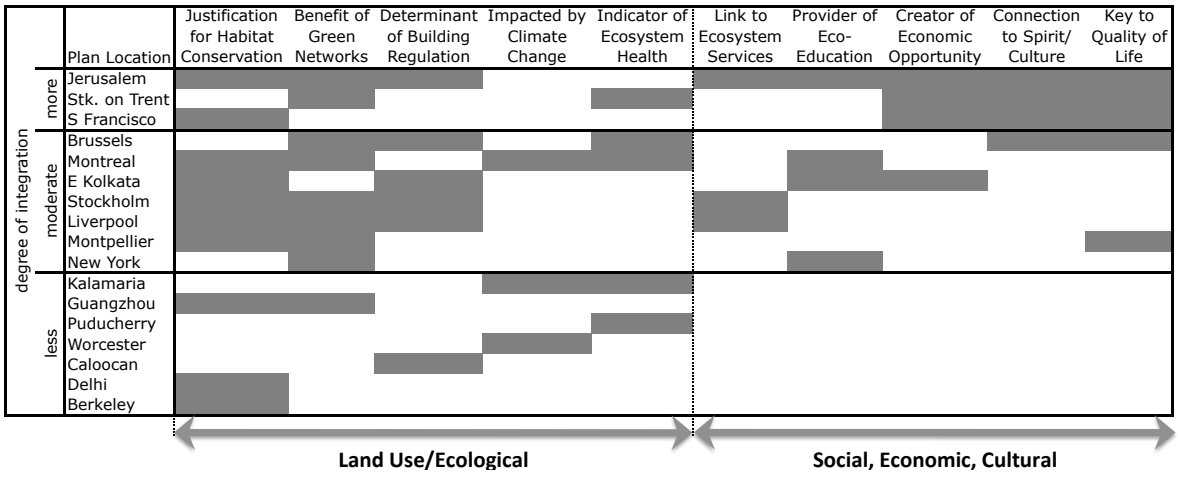

Fig. 3. Categorization of occurrences of "biodiversity" in non-biodiversity plans; positive results shown in grey.

To understand how non-biodiversity plans refer to biodiversity, I looked at each instance of the term in context and established ten categories of how biodiversity is conceived in the non-biodiversity plans. In Fig. 3, I indicate under which categories each plan refers to biodiversity.[11]

The three most common biodiversity references in the plans relate to green areas and land use. Nearly half of the plans refer to biodiversity solely in terms of land use or ecological ideas. These plans are not only the least integrated, but also have the least total number of references to biodiversity each, ranging from just one reference to three. The moderately integrated plans primarily refer to biodiversity in terms of land use and ecological issues, but also include at least one reference in another category. The more integrated plans refer to biodiversity primarily in non-ecologically focused ways.

[11] A minority of the references did not have a category, such as when biodiversity appears in a long list of things to be considered. In cases like this, I did not count the reference as being in any category, rather than arbitrarily assign one.

3.2 Biodiversity Plans

I identified 48 biodiversity plans meeting the density criteria. An additional 7 plans were not analyzed due to language barriers. Of the 48 plans, 26 are from locations in the United Kingdom. I analyzed the *degree of integration* each of these plans exhibit in terms of to what degree they include social, cultural, educational, and economic concepts as well as land use and ecological concepts. Then I ranked them according to an integration index developed for this study.

To determine how integrated each plan is conceptually, I exported the concept relevance output from Leximancer for each plan and then categorized the resulting numbers according to these categories: land use/ecology, social, cultural, education, and economics. From these categorizations of the relevancy percentages, I calculated an overall percentage for each category in each plan.

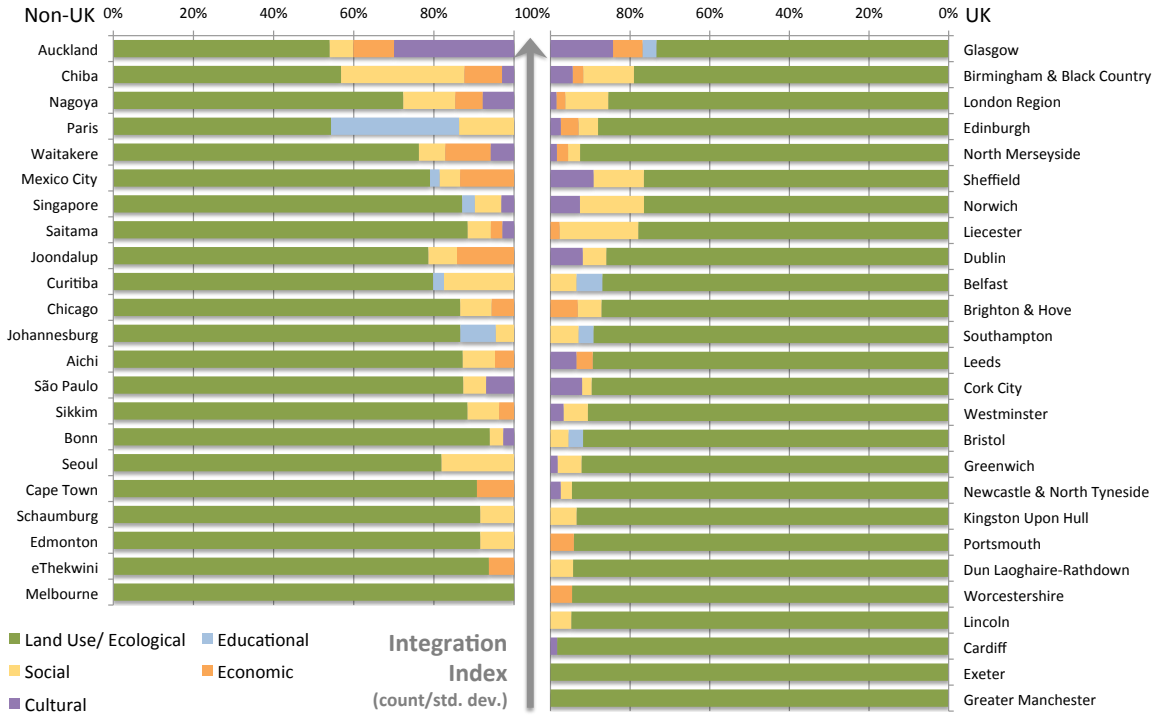

Fig. 4. Categorization chart for each biodiversity plan in order by integration index.

In order to rank the plans according to their level of integration within each category, I devised an integration index that would provide a higher number as plans approached an even spread among all five categories, and zero if only one category is used. The index weights the number of categories included, as well as the evenness of the distribution. The calculation is as follows:

$$\text{Integration Index} = (\text{count} / \text{SD}) - 2.236, \text{ where SD} > 0$$

Where count is the quantity of concept categories above 0% of the categorized content and SD is the standard deviation of each of all 5 categories' percentages. For example, Auckland has 4 categories of co-occurring concepts and the standard deviation of (54%, 5.9%, 10.2%, and 29.9%) equals .221. So, the integration index for Auckland is (4/.221) – 2.236 which equals 15.87, the highest integration

index of all the plans. I repeated this process for each plan to derive a comparable integration index. I then graphed each plans' concept categorization distribution from most to least integrated according to the index, separating the United Kingdom (UK) plans from non-UK plans (see Fig. 4).

3.3 Biodiversity Guideline Systems

The four guidelines analyzed in this study are all currently in use by many cities around the world. They all focus on the urban condition and on biodiversity. Some offer certification or official membership, and all of them have a step-by-step process or scoring system that they recommend for biodiversity planning.

Each one has its own emphasis. ICLEI's Local Action for Biodiversity (LAB) Pioneer Program provides flexibility in terms of the specific actions taken by the cities and focuses more on political commitment to biodiversity. The Cities Biodiversity Index, by the Singapore National Parks Board, focuses on conservation activities and outcomes. The Economics of Ecosystems & Biodiversity (TEEB) for Local and Regional Policy Makers stresses human-centric benefits of ecosystem services and how to assess their value economically. Lastly, the Urban Biosphere Initiative (URBIS), also suggests a more human-centric approach, but this time with a focus on rights and equity. Respectively, they emphasize the political, ecological, economic, and social aspects of urban biodiversity planning.

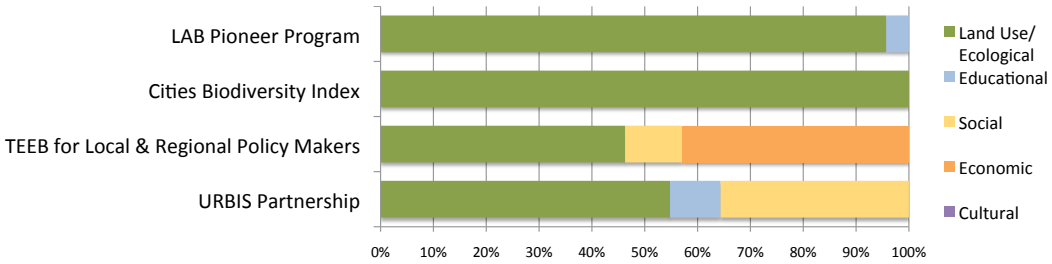

Fig. 5. Concepts Assessment of Frameworks

The concept assessment of each framework, using the same method as with the plans, reveals that each one covers land use issues, but only some cover the other categories (see fig. 5). LAB concentrates on political issues, building support, obtaining commitments, etc. The CBI focuses on ecological issues, and particularly on native biodiversity. TEEB concentrates on the economic viewpoint and offers many options for users, including some that touch on other issues like vulnerability. URBIS takes the social perspective and discusses rights and equity, though major parts of their program have not yet launched. None of the guidelines have a large cultural component, though TEEB's discussion of traditional livelihoods comes the closest.

4 Discussion

4.1 Strength of Biodiversity as a Concept

The low frequency of the term "biodiversity" in non-biodiversity plans indicates that these plans either have a low level of interest in or a low capacity for discussing biodiversity issues. The low frequency of the term biodiversity is even more dire when considering that the plans in this study are only a fraction of the many plans worldwide which discuss sustainability. These plans are, as far as I know, the only plans that mention biodiversity. For the others, the term may not appear at all.

In addition to low frequency, biodiversity also suffers from an inconsistent definition and lack of correlated concepts. For non-biodiversity plans, practitioners are still wrestling with the idea of what biodiversity means in cities and how to communicate it to a wider audience. Sustainability plans use a wide array of categories for biodiversity though the land use category is still over half of the references, at 57%. Something interesting happens between Comprehensive Plans and Climate Change Plans. Other than the first and most common category, “justice for habitat conservation,” they do not share a single other category in common. Climate change plans include “impacted by climate change” - obviously - and “indicator of ecosystem health.” But, comprehensive plans talk about biodiversity in terms of green networks, building regulations, eco-education and quality of life. Why is there such an extreme difference between them? With climate change plans having such lower overall occurrences of biodiversity, and being focused on climate change, the categories indicated make sense. The odd part is that the comprehensive plans, which should be the most broad, skip over those same issues. It is unclear why this is the case, but this is an area where increased consistency is needed between plan types so that the public is not confused by the plan documents.

In the biodiversity plans, the frequency distribution analysis of co-occurring concepts for biodiversity and other similar terms reinforced the idea that plans lack a clear and consistent way to refer to biodiversity, even when compared to such loose terms as “green.” Overall, biodiversity loss can be connected to many things in various contexts. Its ambiguity is reflected in both the text itself and the text analysis.

4.2 Integration of Socio-economic Aspects of Biodiversity in Plans and Guidelines

Among the non-biodiversity plans, the sustainability plans were the most integrated and had the most frequent references to biodiversity. The small sample size of non-biodiversity plans makes any conclusions difficult to apply to a broader population.

Some of the biodiversity plans had particularly high integration indices, and each has its own method for communicating biodiversity. Some plans clarify this ambiguity by pairing biodiversity with other words. Auckland Council’s Indigenous Biodiversity Strategy links the term “indigenous” with biodiversity and refers throughout to cultural aspects of biodiversity, particularly related to the

indigenous Maori. Nagoya's biodiversity plan changes scale throughout to illustrate global impacts of local ways of life.

No one guideline offers a fully integrated package, but combining aspects of various frameworks could give something close. New frameworks are needed that would guide future biodiversity plans to consider a wider array of biodiversity loss drivers. This would establish a discourse that links socio-economic issues with biodiversity questions instead of treating them as separate.

5 Summary

In conclusion, biodiversity plans and their guidelines have thus far focused primarily on the symptom of land use change. By expanding further to consider social, ecological, and cultural issues, the possibilities of biodiversity protection will expand as they relate to a broader array of goals and address root causes of loss rather than symptoms.

Acknowledgements

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