Narratives of adaptation for future-oriented conservation

by

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Candidate's Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university. To the best of the author's knowledge, it contains no material previously published or written by another person, except where due reference is made in the text.

Claudia Munera-Roldan

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Positionality

My background in biological sciences and conservation biology influences this thesis.

Growing up and being educated in a biodiverse and multicultural country has influenced my career choices. Colombia's rich nature has been promoted as one of our main assets and, simultaneously, as the means to overcome poverty and achieve desires for economic development, a legacy of colonization in our region.

I see humans' life as totally interconnected with nature. That motivated me to gain more understanding and documenting the dynamic interlinks between humans and nature. While studying biology and later working as a biologist in Colombia, I saw the inequalities and poverty of people living in remote areas. I also learned about the deep connections local communities have with nature, the different names they assign to wildlife, how they link nature with some uses, benefits, beliefs, and creeds, and how their livelihoods rely on using natural resources.

I always have been interested in finding options to address the contradictory consequences of economic growth while exploring the social and livelihood impacts of environmental conservation and sustainable development initiatives, to work toward solutions that consider social realities and needs.

Living and working in Central America allowed me to gain in depth understanding about the cultural and social contexts associated with managing nature. Working in the Guatemalan National Protected Areas Council was the best school I ever had to learn about protected areas governance and the multiple complexities related to reconciling mandates of managing nature with Local and Indigenous rights. The multicultural lessons continued in Nicaragua. Working with local communities and small farmers in Nicaragua was significant to learn first-hand how these communities make sense of environmental and technical concepts and how the social and political issues affect their aspirations for the future.

I acknowledge the uneven and violent impacts of colonization on Indigenous groups and local communities, evident in the societies of the three countries addressed in this research. Issues of racism, inequality, dispossession, and violence have shaped societal relations and are guiding decisions now. But I also know about many examples of collaboration and willingness to overcome past injustices.

This thesis is written by a biologist who has transitioned to social sciences. As a biologist, I have used specific words and language to communicate ideas about conserving nature. And although we (biologists) might think the message is clear, I have learned that closing the gap across disciplines and sectors requires deliberation to clarify the message, outcomes, and proposed solutions.

There are still many lessons ahead, but my previous work, personal experiences, and curiosity have been fundamental to organising the ideas presented in this work.

Abstract

Adaptation is about those actions we can do today in response to observed changes or to prepare for future changes. However, the speed and rate of current global change trajectories call to examine how we understand and relate with nature and make decisions to adapt to future changes. Conservation managers are increasingly facing the difficult task of preserving nature under conditions of uncertainty and rapid change. The uncertainty associated with climate change challenges traditional conservation practices. Ecological systems are no longer assumed to be stable and predictable, making it more challenging to define thresholds of acceptable change and understand the implications of change.

This thesis contributes to climate adaptation research from the perspective of protected areas, a common and often preferred form of conservation. Protected areas are complex socio-ecological systems, where several stakeholders and institutions interact across multiple geographical and temporal scales. Although protected areas strategies aim to be long-term, policies, practices, and resource allocation are often short-term, creating a disconnect between management and ecological response time. This temporal disconnection opens questions about the aim of long-term conservation practices, especially as climate change and other drivers of change challenge protected areas' commitment to sustain certain values in the future.

This research looks to study existing narratives of adaptation in protected areas, to understand how and why individuals and institutions make sense of climate change impacts in biodiversity conservation, and how such interpretations influence choices for the future. For this, three research questions guide the enquiry: 1) what narratives of adaptation exist, 2) how do these narratives influence choices for managing climate-induced changes, and 3) how do the narratives facilitate future-oriented practices?

The methodological approach is based on the interdisciplinary field of futures studies. The analytical framework for the thesis is based on the Five Dimensions of Futures Consciousness, a conceptual model which helps to understand how individuals and institutions prepare for the future. I used mixed qualitative methods for data collection, including review of policy documents and empirical data collected through interviews with conservation practitioners and scientists conducted in Australia, Colombia, and South Africa.

As a thesis by compilation the results are presented in five papers. The papers illustrate how futures consciousness elements come into play when defining a system or parts of a system for management, and the implications for managing change or preventing changes in protected areas. I found a diversity of interpretations of what adaptation is, influencing how management is likely to accept change in conservation goals and its implications for defining adaptation options. The interviews demonstrate that the different interpretations of adaptation are context related. Adaptation actions often follow socially constructed discourses, which are then implemented in the form of policies and strategies.

This research elaborates on how and which characteristics of futures consciousness are involved in decision-making processes and reaffirms the relevance of examining how individuals mobilise and express desires for change at broader scales. The findings demonstrate how individuals' values influence the understanding and

acceptance of ecological change across temporal and spatial scales, which then can influence choices for adaptation. Shifting the paradigm of long-term conservation in the enclosed boundaries of protected areas requires rethinking assumptions of change, critical thinking about the limits of adaptation, understanding where the motivations to do conservation come from, what are the costs of sustaining adaptation, and the role of rules in shaping action.

Future-oriented strategies can be based within day-to-day management to enhance reflection on what has been done, what has worked or not, and identify how to move forward. It is also important to consider that people's mental models about a system and their expectations for the future will be different, which can be influenced by social and cultural contexts influencing action and planning. Exploring futures consciousness can encourage practitioners and scientists to critically examine existing assumptions about change, while unpacking potential contradictions between individual and collective aspirations about the future.

The futures consciousness model provided a structure to understand climate adaptation preferences, expectations, and motivations behind actions, while considering the diverse ontological and epistemological perspectives and relational approaches involved in managing protected areas. This research provides insights into how individuals and institutions anticipate and prepare for the future, offering a route to construct positive and desirable futures for conservation.

List of papers

As a thesis by compilation, a substantial part of the research is presented as standalone manuscripts which are already published or under review. Below is a list of the publications, their status, and details of my contributions:

Paper 1 (published)

Múnera-Roldán, C., Roux, D.J., Colloff, M. J., and van Kerkhoff, L. (2020) *Beyond Calendars and Maps: Rethinking Time and Space for Effective Knowledge Governance in Protected Areas*. Land, 9, 293; doi:10.3390/land9090293

This paper was conceived to explore concepts of time involved in knowledge-based approaches to protected areas management. I undertook the literature review, compiled the information to analyse the ideas, and prepared the manuscript. All co-authors helped in the analysis, writing, and editing. The section presenting the South African case study is mainly a contribution from Dirk Roux, but we held discussions about it while doing fieldwork in South Africa.

Paper 2 (published)

Múnera-Roldán, C., Colloff, M. J., Locatelli, B., and Wyborn, C. (2022) *Engaging with the future: framings of adaptation to climate change in conservation*. Ecosystems and People, 18:1, 174-188, DOI: 10.1080/26395916.2022.2043940

The conceptualisation, approach and research design for this paper was my idea. I conducted data collection, synthesis, and writing. The analysis was a collaboration with contributions from the co-authors, alongside reviewing and editing the final version.

Paper 3 (in review)

Múnera-Roldán, C., Colloff, M.J., Andrade, G.I., and van Kerkhoff, L. (in review). *Future orientation and adaptation narratives: towards sustainable management in protected areas*. Manuscript submitted to Sustainability Science.

The research design, data collection, analysis, and writing of Paper 3 was primarily my work. My co-authors provided feedback for the analysis and helped in writing, editing, and reviewing the manuscript.

Paper 4 (in review)

Múnera-Roldán, C., Colloff, M.J., van Kerkhoff, L., and Pittock, J. (in review). *Mismatches between beliefs and actions in adapting biodiversity to climate change*. Manuscript submitted to AMBIO.

I did the conceptualisation, research, data collection and analysis for Paper 4. The manuscript was collaboratively written after extensive discussions, edits, critiques, and suggestions from co-authors.

Paper 5 (in review)

Múnera-Roldán, C. (in review). *Futures consciousness as an operational framework for adaptation to global change in South Africa*. Manuscript submitted to Ecosystems and People.

I did the conceptualisation, research design, data collection, data analysis, and wrote this paper, which received feedback from supervisors.

Contribution to other publications

During the PhD, I had the opportunity to collaborate with other researchers and contribute to other publications. Although these publications do not contribute directly to addressing the research questions, these papers are complementary pieces. The book chapter led by fellow PhD student Carla Alexandra was valuable for discussing ideas and concepts on futures thinking. The article led by Emilia Pramova was essential to get more insights into how individuals make sense of the world and, therefore, was helpful for the futures consciousness analysis. The article on transformative adaptation helped in gaining more knowledge on transformative governance and transitions, similar to the opportunity of collaborating with Josie Chambers in the two articles on co-production.

Alexandra, C. Wyborn, C. Múnera-Roldán, C., van Kerkhoff, L. in review. Futures-thinking – concepts, methods and capacities for adaptive governance

Chambers J.M., Wyborn, C., Klenk, N.L., Ryan, M.E., Serban, A., Bennett, N.J., Brennan, R., Charli-Joseph, L., Fernández-Giménez, M.E., Galvin, K.A., Goldstein, B.E., Haller, T., Hill, R., Múnera-Roldán, C., et al. (2021) Co-productive agility and four collaborative pathways to sustainability transformations. Global Environmental Change https://doi.org/10.1016/j.gloenvcha.2021.102422.

Pramova, E., Locatelli, B., Valdivia-Díaz, M., Vallet, A., Quispe Conde, Y., Djoudi, H., Colloff, M.J., Bousquet, F., Tassin, J., Múnera-Roldán, C. (2021) Sensing, feeling, thinking: Relating to nature with the body, heart and mind. People and Nature 10.1002/pan3.10286. 10.1002/pan3.10286

Chambers, J.M., Wyborn, C., Ryan, M.E., Reid, R.S., Riechers, M., Serban, A., Bennett, N.J., Cvitanovic, C., Fernández-Giménez, M.E., Galvin, K.A., Goldstein, B.E., Klenk, N.L., Tengö, M., Brennan, R., Cockburn, J.J., Hill, R., Múnera-Roldán, C., et al. (2021) Six modes of co-production for sustainability. Nature Sustainability 4, 983–996. doi:10.1038/s41893-021-00755-x

Colloff, M.J., R. Gorddard, N. Abel, B. Locatelli, C. Wyborn, J.R.A. Butler, S. Lavorel, L. van Kerkhoff, S. Meharg, C. Múnera-Roldán, E. Bruley, G. Fedele, R.M. Wise, M. Dunlop (2021) Adapting transformation and transforming adaptation to climate change using a pathways approach. Environmental Science & Policy 2021 Vol. 124 Pages 163-174 https://doi.org/10.1016/j.envsci.2021.06.014

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Chapter 1. Introduction

A scientific collection can be a fascinating journey through history and knowledge. At first instance, it might just look like some dead animals, plants, or their parts. Looking beyond those pieces, one can understand and connect the data from the labels and the knowledge provided by the collectors. These specimens are there for a reason. They connect data from the past with our present to help plan the future. These items and their associated data represent symbolic objects, values, concepts, and beliefs that bind a group of people into communities of meaning. In this case, the scientific community represents a network of knowledge experts (biologists or ecologists), enabling them to engage in similar activities, share similar cognitive mechanisms, and use similar language and words (Yanow, 2000). I use this example of a scientific collection to illustrate one of the many ways natural scientists connect with nature to create meaning and knowledge, which is reflected in the language used to communicate ideas.

Collecting specimens for scientific purposes has not always had such noble objectives and has been linked with other aims such as wildlife trafficking. That was the case during the 19th and early 20th centuries in America. The “Bogota skins” is the name given to millions of birds’ skins sourced from tropical America as part of wildlife trafficking to North America or Europe for the millinery trade. However, a few also ended in museums. Although chaotic for science, as many specimens lacked the necessary information on identity or locality, this incident might have enabled the beginning of the first conservation strategies in Colombia and Latin America, with support from North American conservation groups (Quintero-Toro, 2012).

The common storylines of the Bogota skins are natural history and scientific knowledge. However, the interpretation and goals of North American and Colombian scientists was different: for Colombians, it was about creating a sense of nationalism based on the rich and diverse nature, while political economy interests were behind the North American motivations (Quintero-Toro, 2012). In any case, those diverse interpretations of the problem triggered action to change environmental politics at that time.

At first sight, the link between scientific collections and adaptation might not be obvious. However, I have seen how those approaches influenced conservation policies in Colombia, where I worked in scientific collections at the Humboldt Institute and the National Sciences Institute. Information from specimens from those collections has been used to justify the creation of national parks and conservation policies. The format for documenting and collecting information might have changed since then, but the outcomes of scientific activities still influence how conservation scientists think about and inform environmental policy and action, often without questioning the implications of those policies.

1.1. Overview and context

This thesis is about narratives, words, and meaning. In it, I explore how language and words in use help to create meaning about an issue, to communicate ideas, and how those ideas translate into action. The issue at stake in this thesis is climate adaptation.

Climate adaptation has a variety of interpretations, with different worldviews, disciplines, knowledge, and practices used to communicate meaning and action (Bassett and Fogelman, 2013; Goldman et al., 2018; Nalau and Verrall, 2021) and different ways to understand what adaptation success looks like (Singh et al., 2021). Making decisions and planning for the future under stable conditions is increasingly something from the past. Examining existing worldviews underpinning norms and structures used to make sense of the world, can help us make decisions and prepare for future changes despite the inherent uncertainty associated with climate change.

This thesis contributes to climate adaptation studies to better understand the challenges and barriers to implementing adaptation in specific contexts, in this case, within biodiversity conservation. The focus on protected areas allows me to contribute to my original disciplinary home of conservation biology, hopefully informing debates about how to restructure conservation approaches under changing climates. Protected areas represent ideals and efforts of the international conservation community to conserve biodiversity (Godet and Devictor, 2018; Maxwell et al., 2020), and in terms of the three case studies provided a comparable institutional goal and operational context. However, conservation science and practice are increasingly facing the difficult task of preserving biodiversity under conditions of uncertainty and rapid change.

I take two assumptions in framing my research questions and analysis. First, global climate change challenges our understanding of systems dynamics, processes, and responses to change. Second, ecological systems cannot longer assume conditions of stability and predictability. Climate-induced changes make it more challenging to define the limits of acceptable change and understand the implications of change in decision-making. Protected areas are complex socio-ecological systems where several stakeholders and institutions interact across multiple geographical and temporal scales (Cumming et al., 2015.; Cumming and Allen, 2017). Those cross-scale interactions respond to short-term policies, practices, and resource allocation. This temporal disconnection between management and ecological response time opens questions about the aim of long-term conservation practices under climate change.

Adaptation has a strong future orientation in that adaptation actions are typically concerned with preparing for expected future change; therefore, the thesis is also informed by futures studies, a transdisciplinary field of studies, with various theories and frameworks used to understand and explain how people engage with the future (Minkkinen 2020). In the case of protected areas, adaptation requires thinking critically about current adaptation frames of reference (Dewulf 2013), developing new skills for envisioning future scenarios, and creating awareness of how different actors perceive and construct the future (Nalau and Cobb 2022). In examining narratives of adaptation in protected areas, this thesis contributes to understanding preferences, expectations, and motivations behind adaptation, providing insights into how individuals and institutions anticipate change and prepare for the future.

The overall aim of this thesis is to **understand how individuals and institutions make sense of the concept of adaptation in the context of climate-induced changes to biodiversity, and how such interpretations influence choices for the future of conservation**. I am interested in understanding the attributes shaping adaptation preferences to prepare and respond to climate impacts on biodiversity conservation. My approach in this research is through studying narratives used to create meaning and communicate action. Applying a “futures” lens, the aim is to understand how and why individuals and institutions make sense of climate-induced changes in biodiversity

conservation, and how such interpretations influence choices for the future, as reflected in practice. The research questions (detailed further in Section 1.3) are:

1. What are the existing narratives of adaptation?
2. How do these narratives allow managing climate-induced changes?, and
3. How do the narratives facilitate future-oriented practices?

As adaptation is context specific (Wise et al., 2014), studying adaptation narratives requires documenting the different ways individuals and institutions anticipate and prepare for conservation under climate change. I compare adaptation narratives in different conservation governance contexts in Australia, Colombia, and South Africa. Exploring adaptation narratives and their relationship to how conservation actors construct the future in different contexts offers an opportunity to gain insights about governance transitions to deal with future impacts of climate change.

1.2. Why study narratives?

Words and language play an important role in human lives. Words help to communicate with others and, in some ways, influence our vision of the world, shaping cultures and even personal frameworks (Lakoff, 2004). Words have meaning because they represent something important for a person or a group. Words represent metaphorical depictions of values (e.g. freedom, love) or represent emblems or symbols of a larger whole (e.g. country, nature). Language conveys meaning, helping to communicate complex ideas and stories to other people, cultures, and societies. Stories created at the local level give meaning to collective representations and connections with landscapes, foods, or other symbols from the environment. Those stories are deeply linked with our individual identity and cultural backgrounds. But what is meaningful for an individual may have different significance for others.

Words and language are not static. They evolve and change according to circumstances, with specific uses reflecting how societies are engaging with the world, and are at the core of narratives used to communicate experiences or ideas (Souto-Manning, 2012). Narratives adopt different words according to new learnings and can have different interpretations at different levels. For example, global aspirational goals for sustainable development, to address biodiversity loss, or to mitigate climate change impacts, are made under the assumption of a global common understanding of the problem and how to solve it. But the reality can be different at different scales depending on the level of interest, or different interpretations of the problem.

International environmental governance – including climate change and biodiversity conservation – is a political context where a “global” terminology is used to facilitate understanding among a diverse set of languages and multicultural actors (Hulme et al., 2018; Turnhout et al., 2012; Turnhout et al., 2013). These high-level narratives influence thinking and action about nature and can ignore realities and practices at the local level. Defining biodiversity and approaches to conserve it has been a long and evolving debate (Borie and Hulme, 2015; Mace, 2014), as it is defining climate change adaptation (Bassett and Fogelman, 2013; Goldman et al., 2018; Nalau and Verrall, 2021). The different interpretations of climate change can influence how people anticipate, prepare for, and respond to the effects of changing climates on the environment and societies (Fløttum and Gjerstad, 2017).

The complex relations between nature and society require careful analysis of how

ideas are communicated, how policies are designed, and what happens in practice. Individuals interact with "particular phenomena" in specific contexts, shaping information and boundary objects to give meaning to words (Livholts and Tamboukou, 2015). Studying existing narratives can help to identify the different perceptions of climate adaptation and visions of the future implied and embedded in conservation policies. A narratives approach can help in understanding how a society understands the world and how that understanding is reflected in high-level political contexts. These narratives are framed on specific epistemologies, shaped by the interaction of cultural, political, geographical and historical contexts (Jasanoff, 2005).

According to Paul Sabatier, policies and programs represent belief systems, a reflection of people's values and perceptions of the world created and communicated in specific contexts (Sabatier, 1988). Such belief systems indicate communities of meaning, where knowledge and meaning are created though everyday practice and interaction with the world. The stories, metaphors, and words ("narratives") shared by these communities can shape group identity around a shared idea or concept. Communities of meaning are related to the concept of epistemic communities (Haas, 1992), or networks of knowledge-based experts sharing belief systems and preferences to verify and apply particular forms of knowledge, influencing policy and practice.

Biodiversity conservation is a social and political construction (Boisvert and Vivien, 2012; Forsyth, 2004) representing belief systems shared, created, and communicated by epistemic communities. Conservation science and practice should consider the different values attached to biodiversity and the different assumptions underpinning how we make sense of the world (Louder and Wyborn, 2020). However, biodiversity conservation has been criticised for ignoring certain voices and practices while reducing nature's dynamic complexities to certain functions, services, or instrumental values (Escobar, 1998; Woroniecki et al., 2020).

Although the United Nations conferences on the environment compiled global efforts to set a common language and shared aspirational goals for biodiversity conservation, researchers and practitioners are still debating between ecocentrism and anthropocentrism rationales for biodiversity conservation (Sandbrook et al., 2019; Taylor et al., 2020). In her work "Whose Conservation?", Georgina Mace describes four clear narratives framing biodiversity conservation approaches over time: nature for itself, nature despite people, nature for people, and finally people and nature (Mace, 2014). Her analysis reflects the evolution of conservation narratives with a trend towards accepting change and incorporating resilience as a key emergent idea in conservation.

Climate change is not exempt from a diversity of narratives, framings, and interpretations (Deswuld, 2013; Fløttum and Gjerstad, 2017; Goldman et al., 2018). Considering the different ways individuals make sense of the world, a diversity of narratives is to be expected. However, it is important to be aware of such pluralism, to understand potential contradictions and foresee consequences of loosely defining climate change as a problem or how climate risks are communicated, as it can reduce the complexity of climate change impacts across scales, and generate confusion about how to anticipate, prepare and act (Fløttum and Gjerstad, 2017).

Identifying existing narratives about adapting biodiversity conservation to climate change facilitates understanding adaptation concepts in use and how management prepares for potential future changes. I draw from the assumption that social realities influence positions and policies to define adaptation, to identify competing paradigms

of doing conservation under changing climates. A paradigm refers to the conceptual and methodological frameworks in which people operate, the "self-coherent repertoire of scientific theories, no exact models, tools and even styles of thought of a historical period, which delimit the set of concepts and methods which can provide the scientist to do his job" (Guerra et al., 2012, p. 20). Narratives can also help to identify possible tensions between different stakeholders when implementing climate adaptation. Addressing competing paradigms requires studying how the narratives – words and concepts – are used and communicated by communities of practice, in policy documents and academic literature.

Exploring the narratives requires addressing contextual issues influencing how science, policy, and practice interact to deal with "unknown" futures, and how historical, political, or social factors facilitate, or do not facilitate, adaptation. Such analysis can reflect knowledge biases defining what attributes of nature should be prioritised in conservation decisions, which indicators are used to assess change, how systems' boundaries and scale for management are determined, and who participates in decision making.

As science and practice, conservation biology has traditionally focused on protecting and restoring some attributes of biodiversity (e.g. threatened species) or the provision of ecosystems services from the impacts derived from human activities (Meine et al., 2006). Biodiversity conservation strategies are already facing new and inevitable social-ecological transformations as a consequence of global change impacts, where preserving, maintaining, and restoring to existing or earlier states may no longer be appropriate. This brings philosophical and practical implications to the need to adapt conservation strategies to climate change, which require revising existing assumptions about conservation, and dominant rules and values supporting conservation policy and practice (Massarella et al., 2021).

A narratives approach can help identify contradictions between aspirations of preserving ecological attributes (resisting change) and how such desires translate into action. It can also offer entry points, or transitions, to manage inevitable ecological transformation under climate change (van Kerkhoff et al., 2019). Such transitions might require acknowledging change as a fundamental part of complex systems as an important condition for environmental governance and management (Cilliers et al., 2013; Folke et al., 2004; Nelson et al., 2007).

1.3. Research questions

The process of rethinking biodiversity conservation under climate change invite to anticipate and address future ecological changes, a turn towards future-oriented conservation (Wyborn et al., 2016). Future-oriented conservation will be particularly relevant in protected areas, which are probably the most common conservation tool worldwide, designed to conserve natural assets and biodiversity over the long term (Dudley and Stolton, 2008; Godet and Devictor, 2018). Calls for transformational change in conservation strategies are increasing, looking for alternative approaches that enable conservation scientists and practitioners to accommodate different perspectives and practices and transform environmental debates (Colloff et al., 2017a; Colloff et al., 2017b; Massarella et al., 2021).

Understanding the narratives of adaptation and orientations towards the future can help to define such alternative approaches. But as explained above, defining climate

change adaptation is not straightforward. In adaptation science and practice it is common to find diverse understandings of what it is and how to do it, and even about who participates and gains benefits from adaptation initiatives (Bassett and Fogelman, 2013; Múnera-Roldán et al., 2022; Nalau and Verrall, 2021; Singh et al., 2021). In biodiversity conservation, a common approach to adaptation focuses on the technical aspects of climate change, without considering the legal and institutional barriers that might prevent conservation strategies being ready to deal with changing climates, and the implications for the future (Wyborn et al., 2016).

In this research I examine existing narratives, applying a futures framework to study the interpretations of adaptation as communicated and implemented in conservation policy and practice. Exploring adaptation in conservation strategies can help in understanding the level of awareness of future consequences of decisions made today and assess how existing governance approaches are ready to deal with future climate change.

To understand how individuals and institutions conceptualise adaptation in biodiversity conservation, three main research questions and two sub-questions underpin the thesis, including descriptive, analytical and evaluation questions:

Q1 – What narratives of adaptation exist?

Q1.a. – What is the decision-making context for adaptation policies in conservation?

Q2 – How do existing narratives allow or prevent managing climate induced changes?

Q2.a. – How is uncertainty about the future being addressed in the narratives?

Q3 – How much do current narratives facilitate future-oriented practices?

The methodological approach to address these questions is based on the interdisciplinary field of futures studies. More specifically, I use futures consciousness, which helps to understand how individuals and institutions anticipate and prepare for the future (Ahvenharju et al., 2018). I also draw from anticipatory governance perspectives, to explore how present-day governance approaches enable managers to address uncertain futures (Boyd et al., 2015; Muiderman et al., 2020).

I used a combination of approaches to examine the different conceptions, narratives, and framings used in climate adaptation and conservation strategies. For this, I engaged first in a conceptual exploration (Papers 1 and 2), which was then complemented with empirical research about adaptation narratives in protected areas (Papers 3, 4, 5), and a policy analysis to understand how existing rules facilitate adaptation or not (Paper 4). Table 1.1 links the research questions with the papers.

For those papers using empirical data, I considered two different thematic perspectives. For Paper 3 (and partly 4) I followed an interpretative analysis to understand the different conceptualisations and framings of adaptation, considering the language used to communicate experiences and create meaning (Souto-Manning, 2012). Paper 5 follows a relational approach to understand how meaning is created and therefore how adaptation action is mobilised (Lejano, 2019; Wagenaar, 2007, 2011).

Table 1.1. Overview of research questions and how the papers address each question

Research question	Themes covered	Paper
1. What narratives of adaptation exist?	What are the origins of the narratives? How is the future of biodiversity conservation perceived in the narratives? What attributes are framing the narratives?	Papers 2, 3, 4, 5
1.a. What is the decision-making context for adaptation policies in conservation?	How do existing values interact with current rules? What knowledge and expertise are relevant in the implementation of adaptation?	Papers 1, 3, 4, 5
2. Are the narratives allowing or preventing managing climate induced change?	How is ecological change perceived in conservation strategies? Are there approaches for cross-scale integration?	Papers 2, 3, 4, 5
2.a. How is uncertainty about the future being addressed in the narratives?	Are there any thresholds of change identified in the conservation strategies? What is the approach to deal with uncertain futures?	Papers 1, 2, 5
3. How much do current narratives facilitate future-oriented practices?	Are there entry points for transitioning to future-oriented approaches?	Papers 1, 3, 5

My initial intention for the thesis was to socialise the findings through workshops and other participatory approaches to identify options for future-oriented conservation with the stakeholders. However, COVID-19 related border closures and travel restrictions made this impossible, so I focused on desk review of policy documents and independent thematic analysis of the empirical data collected during the interviews.

1.4. Thesis structure

This thesis by compilation is structured in two sections. In section one I develop the main argument of the thesis and contextualise the research in four chapters, including this introduction, theoretical background, case studies, and methodology, to connect the concepts and research questions with the findings presented in the papers and in section two.

Throughout this document I will be using concepts like conservation, future, biodiversity, adaptation, and protected areas, which are defined in the theoretical background provided in Chapter 2. The case studies where the research was conducted are presented in Chapter 3, including an overview of the three countries and protected areas where data collection was done. Chapter 4 synthesises the methodological approach, describing the methods used to answer the research questions.

Table 1.2. Contribution of the papers to address the research questions

Paper	**Contributions to research questions**	**Contribution to overall aim**
Paper 1 Beyond Calendars and Maps: Rethinking Time and Space for Effective Knowledge Governance in Protected Areas	Research questions 2 and 3	Sets the basis to study how concepts of time influence decisions and translate into choices for the future
Paper 2 Engaging with the future: framings of adaptation to climate change in conservation	Research questions 1 and 2	Systematic review on adaptation narratives used by academic communities, helped understanding adaptation preferences and implications for management
Paper 3 Future orientation and adaptation narratives: towards sustainable management in protected areas	Research questions 1, 2, and 3	Adaptation narratives mapping in the case studies, to understand institutional contexts shaping preferences for the future
Paper 4: Mismatches between beliefs and actions in adapting biodiversity to climate change	Research questions 1 and 2	Analysis on how policies and institutional contexts shape adaptation narratives, and how those contexts facilitate or constrain managing change
Paper 5: Futures consciousness as an operational framework for adaptation to global change in South Africa	Research questions 1, 2, and 3	Analysis of narratives from the South African case study documenting elements of futures consciousness facilitating transitions toward future-oriented practices

Section two compiles the papers in Chapter 5, providing a summary of the papers, explaining how the papers connect with the research questions, and summarising the main findings for each paper, followed by the papers themselves (Table 1.2). A discussion and key findings from the research are then discussed in Chapter 6, summarising the contributions to the research and how the research questions were addressed, before presenting some future research directions and the conclusions in Chapter 7.

Chapter 2. Theoretical background

Climate change challenges traditional ways of designing, managing, and practicing biodiversity conservation. Environment and societal changes will increase in rate and magnitude due to climate change (IPCC, 2022a). Conservation research and practice can no longer focus solely on strategies that resist change. Likewise, conservation policies need broader interdisciplinary approaches to anticipate change and integrate cross-scale impacts and responses throughout the complex interactions between biological and social systems (Wyborn et al., 2016). However, adaptation decisions are also about how and whose values decide now on behalf of future generations. Deciding how, when, where, and why to intervene in conservation adaptation is not just a practical task but also a relational, emotionally laden, and political one (Tschakert 2020).

In this study, futures studies allow me to examine perspectives of conservation professionals in conceptualising and implementing climate adaptation in protected areas and how such interpretations influence future choices. The research contributes to the field of climate adaptation, providing insights into understanding individuals' and institutions' preferences for adapting conservation and how they anticipate and prepare for future changes (e.g. narratives, worldviews). The protected areas covered in this research represent a hierarchical, multi-scale governance model, which I consider in the analysis. However, I also recognise that park managers are also agents of change. Therefore understanding shared assumptions, beliefs, and aspirations for adaptation can inform reflexive practices and create options for institutional change.

Coming from the field of conservation biology, I understand the deep emotional attachments to place and related grief for potentially losing unique species of places. As a practitioner and researcher in adaptation, I have also learned that climate-induced change is happening and, in some cases, will be inevitable. Transitioning into social sciences helped me understand the importance of the context where decisions occur to pay attention to the barriers people face. As I am interested in understanding the motivations and rationale behind adaptation actions in conservation, the ontological positioning of my research takes a critical realism perspective. Critical realism suggests reality exists separately from our awareness or knowledge of it. Despite attempts to understand reality through observation and empirical data, we can't capture the real world in a whole, such observations give us confidence to try to understand it (Haigh et al. 2019). Understanding how people conceptualise adaptation can be a partial comprehension of reality. However, a critical realism perspective helps to understand where people are and where they come from while acknowledging that people's operational context has causal effects on their interpretation of the world.

As Fletcher (2017) proposed, reality is stratified into three domains: the empirical, the actual and the real. For the context of my thesis, the *empirical* is represented by how people communicate their beliefs and aspirations to adapt biodiversity strategies to climate change. The *actual* is what happens when actions in response to current climate impacts or in preparation for prospective impacts are enabling or constraining aspirations for the future. The *real* is the context and structures where people operate, the causal mechanisms and power structures influencing people's understanding of reality and their responses to climate-induced changes. In paying attention to context, I acknowledge the underlying social, political, and cultural structures shaping

motivations, beliefs, or aspirations to adapt protected areas strategies to climate change.

The three sections in this chapter describe the problem, central concepts, and theories underpinning the research. First, I contextualise the problem of biodiversity conservation and protected areas under climate change in subsection 2.1. Then, I synthesise adaptation-related concepts (subsection 2.2.). Both subsections 2.1 and 2.2. contextualise the research regarding academic discourses related with biodiversity conservation and climate adaptation. Finally, subsection 2.3. summarise future-related concepts underpinning the methodological framework to understand how futures perspectives can better inform adaptation.

2.1 Biodiversity conservation and climate change

> "C5: Climate change is projected to become increasingly important as a direct driver of changes in nature and its contributions to people in the next decades. Scenarios show that meeting the Sustainable Development Goals and the 2050 Vision for Biodiversity depends on taking into account climate change impacts in the definition of future goals and objectives" (Díaz et al., 2019, p. 7).

The Convention on Biological Diversity (CBD) defines biodiversity, or biological diversity, as "...the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems" (SCBD, 1992; p. 3). The CBD was created in response to a global call to address biodiversity loss worldwide and recognise the value of biodiversity for the wellbeing of humans. The CBD 2011–2020 strategic plan defined its overall vision: "by 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people" (SCBD, 2021. p. 4). This vision idealises nature, and in assigning attributes such as wild and pristine, nature needs to be preserved from industrialisation processes that see it as "an inanimate resource for exploration and investigation, human consumption and economic development" (Adam, 1998, p. 27).

Global biodiversity agendas are increasingly calling to integrate the multidimensional connections across climate change, biodiversity, and sustainable development, involving efforts to expand land-and-ocean conservation-based areas to 30% in the next decade (Pörtner et al., 2021). However, it is unclear how the aspirational goals of expanding conservation areas are going to be implemented. More clarity would be required to define which governance and rules will apply, what are the expected outcomes, and who will benefit from expanding or creating new protected areas, including considerations for nature-dependent people (Fedele et al., 2021).

Nature and benefits provided to society (e.g. ecosystem services) are facing a wide range of rapid changes as a consequence of direct and indirect drivers of change related to human activities (Díaz et al., 2019). Climate change is a direct driver of ecological change, and it can trigger other drivers of change, which can have consequences on ecosystems and for society. For example, it can bring a series of changes in the biology and ecology of species and populations, including species redistributions (Pecl et al., 2017), or bring changes at ecosystem level in and outside protected areas (Dunlop and Brown, 2008). These changes can have impacts on society at the local level (e.g. human livelihoods) and national levels (i.e. economies) as the

provision of ecosystem services is affected (IPCC, 2014, 2018, 2022a).

The high rate of nature degradation and biodiversity loss worldwide is making it harder for scientists and practitioners to respond to or minimise ecological change in a timely manner.

Biodiversity conservation is a mission-oriented discipline, involving the application of science to understand and manage ecosystems and biodiversity affected directly or indirectly by human activities (Soule, 1985). Conservation scientists and practitioners categorise conservation actions as *ex situ*, which means outside of the natural distribution of species (e.g. zoos, gene banks), or *in situ* which involves managing natural resources or elements of nature on-site, for example through forest management or establishing protected areas. Protected areas are probably the best example of in situ conservation action (Godet and Devictor, 2018; Maxwell et al., 2020). The next section provides a conceptual background of protected areas and the challenges to manage protected areas in a changing world.

2.1.1. Conserving biodiversity in protected areas

Protected areas represent the efforts of a global community, creating meaning around specific values framed on the preservation of nature. They represent core values of communities or nations: “values are fundamental to the concept of protected areas. They give meaning to and provide an impetus for protected areas establishment” (Worboys et al., 2015, p. 12).

Protected areas are an example of how values, rules and knowledge interact in decision-making processes (Gorddard et al., 2016): the intention to preserve some values motivates the establishment of management strategies and rules, and defines what information should be collected and used for monitoring. This interaction of values, rules, and knowledge will influence the different management objectives and classification of protected areas (Dudley and Stolton, 2008). Table 2.1 describes the different protected area categories following the International Union for the Conservation of Nature (IUCN) classification and its management objectives.

Global aspirations to set aside land and ocean areas as protected areas for conservation intend to halt biodiversity loss, while reducing threats that affect the provision of ecosystem services and a healthy environment (Maxwell et al., 2020). Setting new protected areas and expanding existing ones was one of the CBD’s Aichi targets (SCBD 2021) and is one goal in the recent Global Biodiversity Framework (SCBD 2022). Protected areas have been a response from nation-states to exercise sovereignty and align with modern global agendas, with little consideration of the implications of how these global conservation goals made by outsiders align with local realities.

Protected areas can have different governance arrangements, from formal state-managed areas to customary conservation-based territories managed by Indigenous peoples and local communities, or even private conservation initiatives (Maxwell et al., 2020). Designing and governing protected areas implies setting aside portions of land to be legally protected in the long term, while assigning resources for their management. These areas are justified by diverse narratives including political interests, economic considerations, or scientific theories to define what elements of nature should be conserved (Hardenberg et al., 2017; Wakild, 2018). These narratives define which actions can be performed there and who participates in decision making, potentially closing off options for the future to other stakeholders.

Table 2.1 Protected areas categories and brief description (Dudley and Stolton, 2008).

Category	Description
Ia – Strict Nature Reserve	Strictly protected areas set aside to protect biodiversity and possibly geological/geomorphic features where human visitation use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring
Ib – Wilderness Area	...usually large unmodified or slightly modified areas retaining their natural character and influence without permanent or significant human habitation which are protected and managed so as to preserve their natural condition
II – National Park	...large natural or near natural areas set aside to protect large-scale ecological processes along with the complement of species and ecosystems characteristic of the area which also provide a foundation for environmentally and culturally compatible scientific, educational, recreational, spiritual and visitor opportunities
III – Natural Monument or Feature	...protect a specific natural monument which can be a landform, sea mount, submarine cavern geological feature such as a cave or even a living feature such as an ancient grove. They are generally quite small, protected areas and often have high visitor value
IV – Habitat/Species Management Area	...to protect particular species or habitats and management reflects this priority. Many Category IV protected areas will need regular active interventions to address the requirements of particular species or to maintain habitats, but this is not a requirement of the category
V – Protected Landscape/ Seascape	protected area where the interaction of people and nature over time has produced an area of distinct character with significant ecological, biological, cultural, and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other value
VI – Protected area with sustainable use of natural resources	...conserve ecosystems and habitats together with associated cultural values and traditional natural resource management systems. They are generally large with most of the area in a natural condition where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area

Despite controversies, protected areas around the world continue to be an important tool for biodiversity conservation. The CBD Aichi goal No. 11 promoted the expansion of protected area coverage for both terrestrial and marine areas, so that "areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes" (Leadley et al., 2014, p. 259). To meet this goal, each country set its own targets adjusted to its needs, realities, and environmental policy frameworks. As a result, some countries are focusing on adjusting or improving management effectiveness tools, while others explicitly look to increase ecological connectivity, which reflects different levels of interest and capabilities to address the global goal. For example, Colombia and

Australia reported interest in increasing ecological connectivity, although through different approaches. Colombia's strategy has been to work outside the protected areas, taking advantage of the National Network of Protected Areas (SINAP) which includes wide land-use planning (DNP, 2010); in Australia the approach attempts to establish collaborative partnerships (Leadley et al., 2014).

For the purpose of this research, I approach protected areas as complex socio-ecological systems (SES), where multiple stakeholders and institutions interact in a variety of geographical scales through time (Cumming, 2016; Cumming et al., 2015). Precisely, the cross-scale context of protected areas has implications for management and decision making of natural resources or other values contained in specific geographic boundaries. This geographic limitation defines the frontiers for decision making, challenging planning and interaction with other actors. Conservation practitioners, managers and decision-makers are already facing the challenge of whether traditional conservation goals based on maintaining existing ecosystems, species and landscapes remain feasible in the face of inevitable ecological change related to climate change (Hannah, 2008; Hannah et al., 2007).

2.1.2. How climate change is affecting conservation practice

Protected areas aim to be in place for the long term, if not forever. However, policies, practices, and resource allocation are often short-term, creating a disconnect between management processes and the ability to understand how ecosystems respond and adjust to disturbances across temporal and spatial scales. This spatial and temporal disconnection open questions about the aim of long-term conservation practices, especially as climate change and other drivers of change challenge aspirations for protected areas to sustain certain values in the future.

Policies to address climate change impacts on ecosystems and biodiversity need consider local communities and their livelihoods. As SES, protected areas provide multiple benefits to humans. With the impacts of climate change, benefits and values of protected areas (e.g. water, food, or tourism) will be largely affected by climate change (IPCC, 2022a). Therefore, it is important to consider the human dimensions of a climate-transformed environment inside and outside protected areas. The effective implementation of adaptation depends on issues of governance, including addressing needs, values, and knowledge of local stakeholders.

Adaptation in protected areas management would need to consider potential future impacts of climate-related ecological changes on conservation goals beyond immediate planning timeframes. As climate and other drivers of change affect the functionality of natural ecosystems, human societies that depend on the provision of ecosystem services would need to adjust as well. The next section provides more details about adaptation concepts.

2.2. Adaptation

There is compelling evidence that future trajectories of climate change will bring ecological changes to natural and social systems worldwide (IPCC, 2014, 2022b; Pörtner et al., 2021). These changes can affect the way people interact with ecosystems, and the capacity of ecosystems to provide services to support human livelihoods or to sustain conservation goals and support adaptation in the future (Colloff et al., 2020).

Adaptation is defined by the Intergovernmental Panel on Climate Change (IPCC, 2014, 2022b) as a process of adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, including efforts to reduce current climate risks and vulnerabilities allowing systems to adjust to changes. Climate adaptation usually deals with technical responses to biophysical risks (e.g. floods, sea level rise) and environmental changes (e.g. phenological changes). The IPCC also emphasises the importance of identifying actual or expected impacts, considering social and place-based vulnerabilities, defining actions to reduce negative effects of climate change, learning from different sources and past experiences, and anticipating impacts from models.

There are three common terms in the climate change literature and practice: vulnerability, adaptation, and resilience. These words work as boundary objects facilitating communication, sharing information, and practice (Goldman et al., 2018). Adaptation in policy making contexts is related to human actions that can help to reduce negative impacts, while in ecology, adaptation does not imply human action and is often more related to the capacity of ecosystems to adjust or shift functionality or composition in response to stressors (Settele et al., 2014). Choices to prepare for, and respond to climate change, are largely context dependent and will be influenced by a set of values framing rules, and the selection of knowledge to inform decisions (Gorddard et al., 2016).

For the context of this research, adaptation is seen as processes of adjusting human responses to environmental changes (Colloff et al., 2017b) to differentiate from the natural processes of biodiversity to adjust to disturbances. In this sense, adaptation is used as the political decision points that can provide opportunities for transformation, incremental adjustment or resistance to change (Pelling et al., 2015). Table 2.2 summarises some terminology related to adaptation. This conceptual diversity sets the background to study how adaptation is conceptualised and implemented.

Table 2.2. Summary of adaptation and transformation concepts

Term	Definition	Source
Adaptability	The inherent capacity of people in a SES to learn, through combining experience and knowledge, in order to adjust its responses to changing external drivers and internal processes. It implies that actors in a system have the capacity to influence resilience	Folke et al. (2010); Walker (2006)
Adaptive governance	Existing social conditions and social contexts, that enable management of natural systems through the implementation of adaptive management (see below)	Chaffin et al. (2014)
Adaptive management	An iterative process where practitioners test hypotheses and adjust decisions and actions based on experience and actual changes	Stankey et al. (2005)
Adaptation pathways	Also known as route maps; decision-making processes to evaluate adaptation options, recognising the high levels of uncertainty and complexity around decisions that seeks to avoid maladaptation	Wise et al. (2014)
Incremental adjustments	"Marginal changes in infrastructure, institutions and practices that foster flexibility and fulfil capacity while not directly threatening systems integrity"	Pelling et al. (2015:117)

Intentional transformative adaptation	Co-produced responses to observed or anticipated changes in social-ecological systems leading towards irreversible changed structures and functions, including changes in norms, visions, values, rules and practices	Colloff et al. (2021)
Maladaptation	Actions that increase risk of adverse climate-related outcomes now or in the future, and often is an unintended consequence	IPCC (2022b)
Resilience of biodiversity	Considering three scales: - Species surviving environmental changes because they resist change or adapt - Landscapes maintaining ecosystems integrity, processes, and healthy ecosystems even when some attributes (ecosystems or species) change; ecosystems transformation from one type to another is not consider lack of resilience - Social-ecological systems, where the interaction of societal use and natural ecosystems persist even under climate change	Dunlop and Brown (2008)
Resilience thinking	Understanding and accepting change to investigate the complex interactions and dynamics of social-ecological systems for better management in the face of disturbances, surprises, and uncertainty	Folke et al. (2010); Walker (2006)
Resistance	"Increased and concentrated investment in existing development pathways, infrastructure, institutions and practices"	Pelling et al. (2015, p. 117)
Transformation	"Fundamental change to the functioning of systems"	Pelling et al. (2015, p. 117)
Transformation of ecosystems	Permanent shift of ecosystems to an alternative stable state. This include changes in the way an ecosystem is perceived from a decision context and by society. Related to "resilience thinking" (see below)	Colloff et al. (2017b)
Transformation of decision contexts	Recognising that ecosystems and their drivers are changing, decision contexts and governance arrangements evolve to adjust decisions as change happens. Related to incremental adjustments	
Transformation as developing the capacity for adaptive governance	A profound type of change, that require inherent capacity to develop adaptive governance	
Transformative	Seen as the opposite of adaptability (above), happens when ecological, economic, or social structures change so much that a new system is created	Folke et al. (2010); Walker (2006)
Transitions in conservation	An integral vision of conservation governance, that helps to identify opportunities to adjust decision-making to help navigate change and guide the development process from traditional conservation thinking and practices, towards future-oriented conservation	van Kerkhoff et al. (2019)

The concept of thresholds of potential concern (TPC) refers to operational goals to define the spatial and temporal boundaries for monitoring how much change is

acceptable in a system (Biggs and Rogers, 2003). TPC can help in defining the environmental, social, economic, and technological features that often set limits to adaptation (Adger et al., 2009), including other human-related conditions such as ethics, knowledge, perceptions of risk, and cultural factors that might affect the definition of how much change is acceptable. The failure or success of adaptation actions reflect societal values and preferences, are context specific and can evolve through time.

2.2.1. Resilience and adaptation in conservation

As mentioned above, the term resilience is often used interchangeably with adaptation as climate change resilience (Fisichelli et al., 2016; Goldman et al., 2018). Resilience is related to how a system, community or individual responds to disturbance, not necessarily bouncing back to an original state, but being able to change and reorganise while maintaining its key functions (Walker et al., 2004; Walker, 2020).

Resilience has been described as a boundary object in climate change discourse (Borie et al., 2019; Goldman et al., 2018; Olsson et al., 2015). Despite its common use, there has been little reflection about the assumptions and frames of reference used to define resilience. The term resilience conveys ideas of change, adaptation, and resistance, although it can be used to prevent transitions (Olsson et al., 2015). As a boundary object, the term resilience facilitates understanding and communication between diverse stakeholders and communities of practice. The positive connotation of resilience can have unintended consequences. For example, if resilience is used to imply a desired outcome it can lead to maladaptation if it prevents managers accepting inevitable climate-induced ecological change (Fisichelli et al., 2016).

Resilience thinking requires careful consideration of system boundaries and interrelations across scales, to help managers understand resistance to change, or transformation in SES (Folke et al., 2011) and define TPC to manage a system. However, it is important to acknowledge that if a system exceeds a tipping point its conditions and structure will fundamentally change (Walker et al., 2006). Resilience concepts, if clearly defined, can help protected area managers to adapt management to changing conditions, while identifying and monitoring drivers of change affecting the integrity of protected areas' values at different scales (Cumming et al., 2015, p. 316).

Regardless the approach, managers should consider the limits to adaptation, as ecosystems in protected areas might not have the capacity to adjust to climate-induced stress. Therefore, if the problem is rapid changes induced by climate change, protected areas management should shift from dealing with local stressors to taking more systemic approaches (Côté and Darling, 2010).

2.2.2. Ecosystem-based and nature-based adaptation

The role of nature and ecosystems to support sustainability agendas has gained more traction in recent years (Osaka et al., 2021). Using nature and ecosystems to support adaptation has been a central idea in a range of approaches such as Ecosystems-based Adaptation (EbA; SCBD, 2009), Ecosystem-based Disaster Risk Reduction (Eco-DRR; Klein et al., 2019), and recently through Nature-based Solutions (NbS; Nesshöver et al., 2017; Palomo et al., 2021). Other related approaches in conservation and sustainability practice include Climate-smart Conservation (Stein et al., 2013) and Pro-poor Conservation (Adams et al., 2004). EbA and NbS concepts and

their expected outcomes become aligned with conservation adaptation approaches through interventions such as ecosystem restoration, designating and managing protected areas, and creating connectivity corridors.

All these approaches emphasise the role of a healthy environment in supporting ecosystem services, conservation planning and reducing risks to address environmental, social and economic challenges, while helping societies to buffer climate change impacts (Nesshöver et al., 2017).

Climate change and global sustainability agendas increase efforts for integral and multidisciplinary approaches to ensure ecosystems can maintain functionality to provide ecosystem services, including carbon sequestration, reducing climate risks, and supporting coping capacities for human societies. Nature's contribution to adaptation (NCA) acknowledges the intrinsic properties of ecosystems to provide options for future livelihoods and adaptation, considering the social-ecological dynamics and interactions (Colloff et al., 2020).

NCA and the use of nature-based solutions to adapt to climate impacts requires transformative thinking, not only regarding development pathways, but also on the perception and relations of humans with natural ecosystems. In exploring how people make sense of the concept of adaptation, the aim is to help researchers and practitioners examine their assumptions about change (resist or accept) while examining feasibility of adaptation and conservation goals under climate change. However, assumptions about change and aspirations for the future are often linked with people's values underlying their perspectives about what adaptation is and how to implement it (O'Brien and Wolf 2010; Gorddard et al. 2016). In the next section I explain why and how a futures lens can help unpacking different perceptions of adaptation and what needs to happen to support desired conservation outcomes in the future.

2.3. Futures research

Adaptation is about those actions we can do today in response to observed changes or to prepare for future changes, which requires approaches to think about future changes. Thinking about the future has been deeply rooted in human societies in different ways, from shamans and oracles, to systems and cybernetics, or modelling the future, and acknowledging complexity and emergence in planning (Schultz, 2015).

The systematic study of the future through future-oriented theories and practices is known as futures research, which includes futures thinking, anticipatory governance, and strategic foresight, among others. The field has been applied to diverse sectors, including economic, social and natural sciences. Futures research is a transdisciplinary field of study and related methods, to help individuals and institutions strategically evaluate current contexts, problems, and frameworks in use, encouraging constructive shifts in practices and thinking towards alternative futures (Bengston et al., 2012; Hichert et al., 2021; Inayatullah, 2013).

Futures tools can include diverse methods including scenario planning, forecasting, prediction, and horizon scanning, among others (Bengston, 2019; Hichert et al., 2021), to prepare for a range of possible futures, while considering the diverse worldviews, beliefs systems, and ways of knowing underlying everyday actions and decisions. Futures studies and the multiple approaches to anticipate, represent, and achieve desired futures, should remain open to evaluate impacts and adapt across its multiple

theoretical fields (Minkkinen, 2020).

Futures research aims to scientifically address the future, while recognising the imprecisions and limitations of the future as an "illusion" of knowledge (Gabriel, 2013), of something that does not exist. In his book *The Art of Conjecture*, Bertrand de Jouvenel explains how past events (from the Latin *facta*) reflect real things, while future events (from the Latin *futura*) represent fantasies (Jouvenel, 2017). Physical, natural, and social sciences deal with facts, and build from events for which consistent information and data can be collected. But when talking about the future we are not building upon facts, but rather on cognitive products, ideas, expectations, or even emotions such as hopes or fears. Those emotions can facilitate planning toward a better future or can be a barrier to preparing for future changes.

In the context of biodiversity conservation, futures thinking is related to anticipating and accepting future ecological transformations, while allowing learning and critical reflection on the implications of ecological transformation to adjust governance processes (Wyborn et al., 2016). Anticipatory governance and futures thinking can encourage environmental policy makers, scientists, and managers to consider the complex interactions, processes, and responses across scales derived from social-ecological transformations and their implications for decision making towards the future (Boyd et al., 2015; Muiderman et al., 2020).

Future-oriented conservation is a collective term for management approaches aiming at preparing conservation strategies to accommodate future change and build capacities to support management decision-making under uncertainty (van Kerkhoff et al., 2019). Engaging in future-oriented practices requires rethinking existing assumptions about conservation goals and a critical examination of impacts of global change on those goals. Engagement in future-oriented approaches can enable governance systems to proactively anticipate and accept the inevitability of social-ecological transformation related to uncertain drivers of change (Pereira et al., 2021; van Kerkhoff et al., 2019) and identify contested views involved in adaptation and conservation (Bennett et al., 2017). Future-oriented conservation can help managers to overcome a sense of fear about change and loss, to embrace new and unclear situations with a sense of agency to identify solutions to create desired futures (van Kerkhoff et al., 2019).

My engagement in futures thinking is through exploring future consciousness, or level of awareness about what could, likely, and ideally occur in the future as part of an internalised (individual) and experienced (social) phenomenon (Ahvenharju et al. 2018). Future consciousness has been described as a shared capacity of being aware of the future potential of the present and being mindful about the consequences of today's decisions towards the future (Sharpe et al. 2016). Sanna Ahvenharju and co-authors define futures consciousness as a 'human capacity to understand, anticipate, prepare, and embrace the future' (Ahvenharju et al. 2021) This thesis uses the concept to understand individual and collective motivations shaping conservation planning and management actions in protected areas, and how the future of biodiversity conservation under climate change is articulated.

Addressing futures consciousness requires understanding ontological and epistemological framings involved in the creation of meaning and conceptualisation of the environment, affecting processes to anticipate and prepare for the future. The analytical framework for the thesis is based on the Five Dimensions of Futures Consciousness model (Ahvenharju et al., 2018). Their model is based on social

psychology, to study how individual cognitive processes are affected by social interactions, therefore influencing individuals' capabilities in defining collective futures, and helps to understand how people prepare for, and embrace the future; the five dimensions are *time perspective*, *agency beliefs*, *openness to alternatives*, *systems perception* and *concern for others* (more details below); these dimensions are not discrete, can be interrelated, and influence each other.

Futures and adaptation studies can cover different levels of analysis. Skrimizea et al. (2020) propose four levels for transformative adaptation including individual, relational, structural, and cultural. The *individual* implies changes in cognitive, emotional, perceptual, and spiritual dimensions, *relational* addresses changes at the relationship level between individuals questioning underlying issues, *structural* includes social, political, and economic structures and context, and *cultural* is the overarching collective identity, knowledge, and responses to drivers of change and conflict. Those levels of change are related to Piotr Sztompka's proposal of social change happening in two levels of social reality: the individual level, including people, groups, associations, or movements, and the totality, including societies, civilisations, and social systems (Sztompka, 1993, 1994). Matti Minkkinen describes three levels of analysis in futures theories and frameworks: the *micro* level focuses on studying how individuals make sense of the world and the future, the *meso* level covers institutional and organisational cultures to anticipate futures, and the *macro* level analyses options for societal transformation (Minkkinen, 2020).

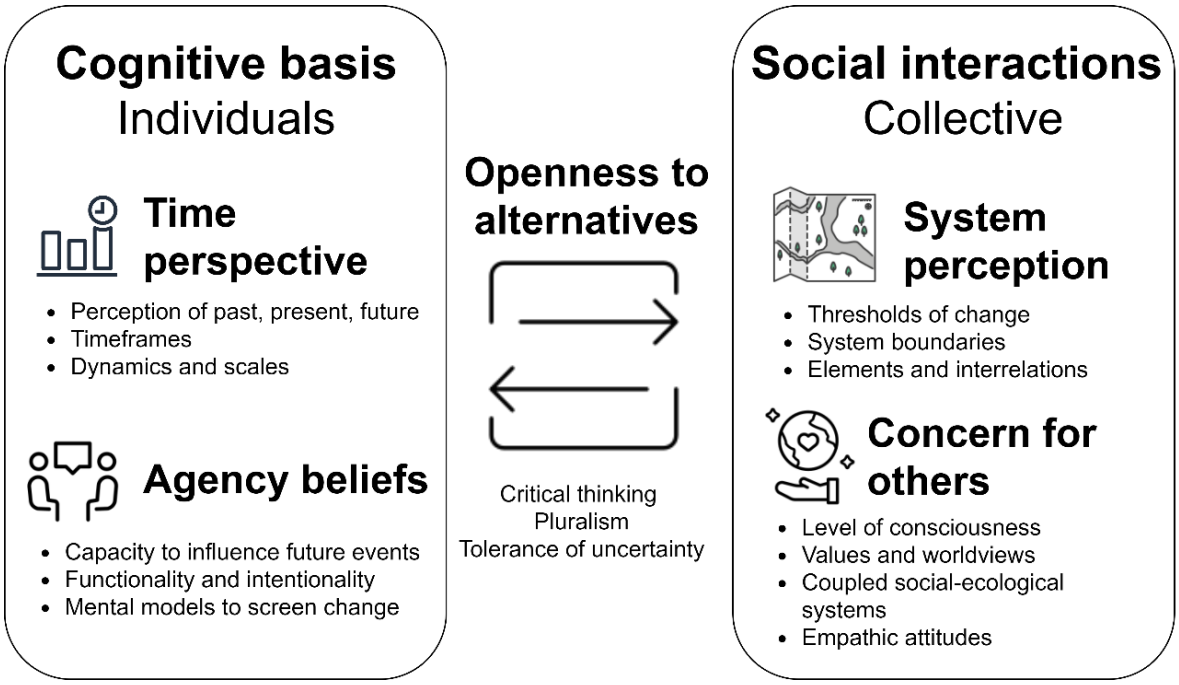

Figure 2.1. Conceptual framework to analyse adaptation concepts. Source: Figure 3.2. in Múnera-Roldán et al. (2022)

The Five Dimensions of Futures Consciousness involve three domains of analysis (Fig. 2.1), adding to Sztompka's and Minkkinnen's constructs. The first domain involves individuals' cognitive capacities to conceptualise time, and the ability to respond to change and influence future events. The second domain forms the basis for social, collective ways of understanding the system, and the level of care towards

others (human and non-human agents). The third domain brings together individual and collective capacities to critically think about current options to deal with change (Ahvenharju et al., 2021; Ahvenharju et al., 2018). The framework is complemented with theoretical perspectives of social change to understand social change processes including system model, form and temporal range, seat of causality, and social consciousness and outcome (Feola, 2015; Sztompka, 1993).

At the individual level, perceptions of change are related to issues of grief, solidarity, idealism, considerations of injustice, emotions, and temporal perspectives. The perception of change will influence individuals' willingness to participate in collective spheres (or refusal and resistance to be part of collective action). Some factors that enable individuals to engage in collective action include leadership, policy engagement, learning, and having structures in place that value people and relationships (Baum, 2019).

The next subsections provide more details about the Five Dimensions of Futures Consciousness.

2.3.1. Time perspective

A sense of time allows individuals to critically examine our understanding of the temporal contexts where humans operate, involved in how we assign timeframes to certain events and the solutions to manage the environment (i.e. short vs. long term) (MacKenzie, 2021). Different cultures and societies perceive and define time in different ways. Time can be perceived as unidirectional, cyclical, seasonal or linear, and is used to assign chores or mark events (Bell, 1997; Boroditsky and Gaby, 2010). Time perspective is an imagined logic of connection between temporal elements, affecting the understanding of system dynamics, perceptions of change, and is part of individuals' meaning-creating process.

Most of the modern conceptions of time (and space) follow a logical Newtonian mechanics model, where time is unidirectional and linear, a sequence of past-present-future events (Graham and Healey, 1999; Kolinjivadi et al., 2019). Indigenous peoples' conceptions of time may be circular and multidimensional, intuitive and lacking discrete units to categorise or schedule events, although prioritising events according to their relative importance for survival (Becker, 2009; Janca and Bullen, 2003). Individuals' temporal orientation towards the past, present, or future links with specific behaviours and is related to individuals' mental models of time and how personal experiences influence understanding of past, present and future times (Table 2.3; Przepiorka et al., 2016).

Time perspective links with emotional, cognitive, and experiential processes (Zimbardo and Boyd, 1999) influencing imaginary temporal distances assigned to events and systems. Imagined events happening in a distant future are represented in abstract terms and can be decontextualised from reality, while planning for events imagined in a near future are more concrete and contextualised (Fortunato and Furey, 2011). Time perspective explains how individuals can be predisposed towards a past-present-future temporal perspective, although characteristics from the three temporal perspectives can be assessed and used when interacting with the world and others.

Table 2.3. Summary of concepts related to time orientation

Dimensions and elements	Definition and practical application	References
Past-negative	Events in the past are traumatic, tending to prevent events that are felt as undesirable from becoming memories	Zimbardo and Boyd (2015)
Past-positive	Nostalgia for past events, desire to reconstruct the past	Zimbardo and Boyd (2015)
Past thinking	Thinking pattern drawing from past events and experiences (memories), characterised by thoughtful and cautious decision making, based on facts and information gathering, and tendency for a past time orientation	Fortunato and Furey (2011)
Present hedonistic	A "hedonistic, risk-taking… attitude toward time and life"	Zimbardo and Boyd (2015)
Present fatalistic	Conditioned by environmental issues where people operate, as often seen in people in poverty, or feelings of hopelessness	Przepiorka et al. (2016)
Present thinking	Ability to create concrete mental representations of events, characterised by a propensity to organise, control the environment, a desire for stability, practical decision making, and tendency to future time orientation	Fortunato and Furey (2011)
Expanded present (unfolding present)	Focus on day-to-day events, no links to past or future. The timing of events occurring in the environment gives meaning, order, and structure to life; it is characterised by detachment from clock times	Zimbardo and Boyd (2008)
Future	Future orientation towards goals and rewards	Zimbardo and Boyd (2015)
Future thinking	Ability to form abstract mental representations of the future, open to possibilities and able to create and recreate novel pathways. Characterised by visionary thinking, creative problem solving, perception of new opportunities, flexibility, and adaptability. Tendency for present time (hedonistic) orientation	Fortunato and Furey (2011)

Understanding differences in the conceptions of time can help explain how individuals understand causality (i.e. linear vs. nested; Bussey, 2014), assignment of function, and intentionality (Feola, 2015; Sztompka, 1994). This helps to explain individuals' mental interpretations of climatic stimuli and events and their consequences. Such perceptions of rapid or slow change have implications in defining action and mobilising – or not – transformation in normative structures to deal with changes (de la Sablonnière, 2017). Time perspective not only address the timeframes used in conservation management, but also how prospective decisions are made (Kolinjivadi et al., 2019).

2.3.2. Agency beliefs

Agency beliefs refer to individual capacities to make choices and influence the future (Ahvenharju et al., 2018). Agency can be examined as internal or external processes influencing choices. Internal agency refers to cognitive and affective

processes where individuals visualise future goals and aspirations, while external agency links to socialising and influencing collective goals, and changing current contexts (Benessaiah and Eakin, 2021). Oberlack (2017) describes agency as the rules and procedures that shape adaptation decision-making. Such rules respond to an interaction of values and knowledge preferences framing adaptation choices (Gorddard et al. 2016), influencing individuals' agency. Agency beliefs are related to how much individuals or collectives are optimistic and confident of having the capacity and capabilities to influence future events, and therefore how responsibility towards the future is addressed and how much individuals feel empowered or disempowered to act. Agency beliefs invite individuals to reflect on how passively or actively they are shaping the future (Sztompka, 1993).

Agency opens options to explore relationality between human and non-human agents (Neely, 2021), and the role of emotions or political ideologies in decision-making. The emotional relations mobilising action and politics in adaptation encourage addressing affective and relational aspects that influence decision making (Nightingale et al., 2021). Emotions originate at the individual level, but are also socialised, shared and co-created in specific cultural contexts (van Kleef et al., 2016). The relational, affective aspect of agency helps to start connecting the individual and collective domains explored in this thesis.

The imagined temporal extension of how ecological processes respond to disturbances and change links with individuals' mental models of causality. Causality can be explained as linear, discreet, distinctive steps, with predictable consequences. However, this linear perception of causality can constrain imagination and agency. Mental models constructing causality as part of a layered, complex system allow individuals to imagine the interconnections and consequences of actions at different scales, opening future options to act (Bussey, 2014). Understanding causality as linear limits understanding systems complexity and the dynamic interplays of its parts (Juarrero, 2008).

2.3.3. System perception

Systems perception focus on how individuals understand the complex relationships of systems they live in (Ahvenharju et al., 2018; 2021). Understanding how people (e.g. conservation managers) perceive systems requires acknowledging the diverse views and ontological basis where the conceptualisation of systems occurs. Are ecosystems the main ontological lens to define a system? Is the system understood as institutions, or as social-ecological systems?

The notion of a system is essential in resilience studies, ecological, and social sciences (Olsson et al., 2015). In SES studies and protected areas, a system is often linked with resilience (Cumming and Allen, 2017; Cumming et al., 2015) to help understanding the complex and dynamic interrelation of elements and responses across scales. In defining a system, it is important to explore its boundaries. System boundaries can be metaphorically represented by the interaction of rules, values and knowledge (Gorddard et al., 2016) at different scales, with specific time-related characteristics interacting and shaping options (Adam, 1998). Across space and time, a system can have socially defined boundaries (e.g. protected areas or customary lands), and boundaries can be environmental or geographic (e.g. watersheds), or can be political (e.g. provinces, or municipalities). Understanding a system structure, its parts and arrangements, the skeleton where SES operate, is fundamental to understanding change and its dynamics (Sztompka, 1993), with implications for how others (nature

and human communities) are considered in adaptation.

Defining a spatial or temporal dimension can help individuals to set system boundaries and determine a level of interest and responsibility in response to social or ecological processes. In futures consciousness, the level of interest is related to being mindful on behalf of "something", while realising how consequences of decisions can have impacts at different levels of a system (Ahvenharju et al., 2018). In protected areas, a system perception can help to understand ecosystems' responses to drivers of change, or specific dynamics inside the system boundary (e.g. how species respond to climate change), or human responses and actions in response to those changes (e.g. how local communities adjust harvest times). A system perception in adaptation relates to how individuals understand who can be affected by climate impacts across geographic scales, connecting with the following dimension, 'concern for others'.

2.3.4. Concern for others

The dimension concern for others has a strong basis in values, morality, and ethical thinking. It assumes that decisions for a better future should consider others (Ahvenharju et al., 2018). As discussed above, a systemic perception opens possibilities to think about the cross-scale implications of climate change. Then, in defining desired futures, institutions looking to define adaptation strategies should consider the plurality and dynamic nature of knowledge and values involved in decision contexts while recognising the welfare of future generations. Future-conscious individuals should avoid institutionalising or legitimising the future by patterning strategies and practices (Sztompka, 1993). Concern for others enables options for multiple values and worldviews to be reflected in adaptation actions.

In conservation practice, the level of consciousness refers to contemplating ecological processes and responses to drivers of change at different spatial and temporal scales, considering the multiple ways societies respond to change, and how decisions will affect the different elements in the system. This requires acknowledging other belief systems, and differences in values and epistemologies, while deliberating on the purpose, and potential outcomes of conservation strategies across the system for present and future generations. For example, by considering options to incorporate voices marginalised by power relations (Stirling, 2008), and issues of justice for nature and humans (Tschakert, 2020; Tschakert et al., 2020), to envision inclusive and pluralistic views to meet social challenges.

2.3.5. Openness to alternatives

Openness to alternatives represents the final domain. It involves critical thinking and questioning commonly accepted views of systems changes, while exploring options to use and apply new knowledge and options, instead of looking for, and sticking to, predictions and plans (Ahvenharju et al., 2018). Being open to alternatives can occur at the individual or collective level, through processes that allow perceiving and evaluating change in the conditions and social reality of a system within which individuals and society operate, enabling societal capacity of self-transformation, to rearrange, modify or develop structures and praxis (Alexander and Sztompka, 1990).

Having critical thinking, tolerance to uncertainty and being open to experience are important characteristics to enable consciousness towards the future, with implications for transforming individual and institutional capacity to learn from past successes, and being able to critically examine existing contexts and politics behind

past failures when exploring new options (Catalano et al., 2021; Chambers et al., 2022). Critical thinking is therefore an essential ability to understand the complex characteristics of SES and imagine different possible futures.

2.4. Futures consciousness and adaptation

The Five Dimensions of Futures Consciousness model is not an adaptation framework. But the five dimensions model offers a structure to examine how protected areas managers make sense of the concept of adaptation to anticipate and prepare for future climate-induced changes. In doing so, it allows exploring which and whose futures are dominant and examining how and why specific adaptation actions occur.

Ahvenharju et al. (2018)' Five Dimensions of Futures Consciousness model provides a meta-synthesis of practical concepts relevant to adaptation, including resilience, complexity, social and ecological systems, systems thinking, and values. All five dimensions are relevant to adaptation (Nalau and Cobb, 2022). Future consciousness has been proposed in social-ecological systems and sustainability studies as a preliminary step for reflexivity (Sharpe et al. 2016; Preiser et al. 2021). However, the attributes of the 5DFC model has not been explored in adaptation or biodiversity conservation before. Other adaptation frameworks primarily focus on the content of adaptation, or what adaptation actions need to be taken, without addressing an important prerequisite, which is understanding how people may differ in their capacities to think and act about change and adaptation. In summary, the 5DFC is a model for exploring fundamental capacities for how people and institutions incorporate a sense of the future in their present -day decision-making.

Relevant adaptation frameworks that complement the five dimensions model include the values-rules-knowledge (VRK) framework (Gorddard et al. 2016), and Oberlack's (2017) taxonomy of institutional attributes for adaptation. Both, the VRK framework and the taxonomy address adaptation from the perspective of institutions and decision contexts, which is not directly addressed by Ahvenharju and co-authors multidimensional model. However, Gorddard et al. (2016) and Oberlack (2017) refer to the importance of understanding how people's values influence adaptation choices. The 5DFC model expands this concept of values into a more comprehensive set of potential influences.

The multidimensional futures consciousness model also complements conservation adaptation frameworks like the Resist-Adapt-Direct (RAD; Clifford et al. 2021; Lynch et al. 2021; Schuurman et al. 2021) and the resistance-resilience-transformation (RRT; Peterson-St Laurent et al. 2021), by providing an explicit future-orientation and situating managers' perspectives about change and their preferences for the future. Then, it can help to comprehend the outcomes and impacts of today's decisions in the future, including who participates and who will be affected by decisions.

In exploring to what degree adaptation approaches and the people implementing them in the case studies have attributes of futures consciousness or not, the thesis covers a gap in the adaptation research field and informs future-oriented conservation practices. The case studies are described in the next chapter.

Chapter 3. Case studies and context of the research

My approach to explore future orientation in relation to conservation and climate change follows a multiple case study research methodology (Yin 2009). I looked for case studies where science – practice – policy interactions are addressing the implications of conserving biodiversity under climate change, to identify existing narratives of adaptation, and how those narratives influence choices for the future. I wanted to explore the role of institutional structures and governance systems in shaping adaptation narratives and its implementation. The hierarchical, multi-scale governance of protected areas provides a rich basis to explore how high-level narratives (e.g. policies) derived from international agreements translate into narratives and policies at the local scale.

The case studies are protected areas in Australia, Colombia, and South Africa. The justification for selecting these nations has different reasons but allowed an empirical and analytical lens to compare adaptation narratives in various political, historical, and social contexts, thus allowing me to examine to what degree adaptation narratives differ across different governance systems.

In selecting these countries, I knew that each country has different approaches to address climate change and biodiversity conservation. I wanted to examine to what degree those different governance approaches result in different adaptation narratives, ways of implementation, and expected outcomes.

The three countries share similarities: all are megadiverse countries with rich and unique biodiversity; all have well-established protected areas systems; climate change has been identified as a major driver of ecological change and are working towards climate adaptation and conservation. The three countries are post-colonial societies, with complex social, governmental, multicultural and plural systems shaping knowledge creation and perceptions of reality, providing an interesting background to identify and compare adaptation narratives. Finally, their economies rely on resource intensive extractive industries, including fossil fuel production.

Protected areas management strategies aim to be long-term. However, policies, practices, and resource allocation are often short-term, creating a disconnect between management and ecological response time. This temporal disconnection opens questions about the aim of long-term conservation practices, especially as climate change and other drivers of change challenge protected areas' commitment to sustain certain values in the future.

To address the research questions, protected areas within the selected countries were chosen following these criteria:

- Formally designated as a protected area, including a landscape with more than one protected area. Setting protected areas includes mapping some portions of land or ocean and the assignment of legal, human, and economic resources to protect biodiversity in the long term. This is the starting point to understand what perceptions of time, agency, and systems frame the narratives.
- There is some level of cross-scale management, as for example sites with international designation (e.g., Ramsar sites, UNESCO World Heritage Sites). As explained in the previous chapter, protected areas are complex SES, where several stakeholders and institutions interact across multiple geographical

scales. Such interactions can imply trade-offs and feedback at different levels and have different implications for management and planning.

- Key drivers of global change have been identified and are being addressed in management planning; examples of drivers of change could include the water balance changing because deforestation or climate variability. This criterion helps in understanding ecological change and how are they addressing those drivers of change.

A summary of the protected areas selected for the research and the criteria is provided in Table 3.1.

Table 3.1. Selected protected areas, explaining the selection criteria in the three countries. NP: National Park; SFF: Flora and Fauna Sanctuary

	Australia	**Colombia**	**South Africa**
Protected area	Australian Alps corridor (Kosciuszko NP and Namadgi NP)	SFF Otun-Quimbaya, Alto-Fragua Inti-Wasi NP; SFF Los Colorados	Garden Route NP
Cross-scale management	Both parks include a Ramsar site, and are part of an interstate protected area network	Otun-Quimbaya includes a Ramsar site, and belongs to the UNESCO WHS Cultural Coffee landscape; Alto-Fragua is part of a regional protected landscape	The park includes a Ramsar site, and is part of the UNESCO WHS Cape Floral Region Protected Areas
Climate adaptation strategies for conservation	Not explicitly, but climate change is mentioned in the plan of management in both parks	Institutional guidelines to incorporate climate change in management plans	Plan of management has a program on climate change
Values identified in the management plans	Mainly natural values (water, endangered species), and cultural values (tourism, i.e. skiing)	Natural values (water, permanent glaciers, endangered species), and cultural values (tourism, and Indigenous lands)	Natural values (unique ecosystems – Fynbos, water, endangered species coastal/marine resources), cultural values (tourism)
Drivers of change identified	Changes in water quantity and water quality, changes in snow, fire, invasive species, increase in temperatures	Extreme weather, invasive species, changes in water quantity and quality	Changes in water quantity quality or water quality, fire, invasive species, sea level rise and coastal erosion

The next section provides more details about the social, economic, and historical context of each country, also describing the protected areas where interviews were conducted, which helps to give more context about how the narratives have been produced and communicated.

3.1. Australia

A young country in a complex, big, and ancient continent. Australian landscapes are unique and extreme, from arid deserts to snowy mountains, tropical rainforests and

savannas, and with a rich and distinct biodiversity. Australia is also home to one of the oldest continuous human cultures in the world, with at least 65,000 years of Aboriginal history that was deeply transformed with the British invasion and colonisation, which started a process of dispossession of Indigenous Peoples from 1788, followed by the emergence of a post-colonial, multicultural and multi-ethnic society (Mcintyre, 2016). The new settlers created a sense of identity based on a new landscape with distinctive species and ecosystems (Trigger et al., 2010). Natural landscapes have been transformed into agricultural lands under visions of prosperity, labour, survival, and wealth accumulation (Butzer and Helgren, 2005; Colloff, 2020).

The government model in Australia is federal, comprising Commonwealth, state and territory governments, with each level having different roles, responsibilities and plans which are not necessarily integrated under a national guiding goal (Ross and Dovers, 2008). This government model and the division of responsibilities create different interpretations of leadership, affecting accountability, policy integration, implementation, and coordination between government levels (Pittock et al., 2015; Samnakay, 2021).

The Australian constitution (from 1900) does not provide specific mandates for states or territories, and each state has its own constitution and other institutional frameworks. The federal constitution does not set national targets for the environment or climate change, except in regard to international obligations (Commonwealth of Australia, 1977). Aboriginal and Torres Strait Islander peoples are not explicitly recognised in the constitution, despite proposals to recognise their rights (Burney, 2018; Hobbs, 2018). This lack of recognition limits Aboriginal participation and voices, their traditional knowledge and connections with country. Lack of recognition constrains the implementation of Indigenous perspectives in environmental governance. Self-designation of Indigenous Protected Areas (IPAs) by Indigenous nations has been a step toward recognising Indigenous rights, reconciliation and justice (Finegan, 2018). However, institutional and political transformation is still required for full recognition of “Indigenous peoplehood” as part of a pluralistic, multicultural Australian identity beyond colonial approaches (Hobbs, 2018).

Climate change policy initiatives can be tracked as far as 1989, when Senator Graham Richardson submitted a proposal to Cabinet to reduce greenhouse gas emissions levels (Talberg et al., 2016). However, since signing and ratifying the UNFCCC in 1992, Australia’s climate change policies have had different momentums, ideologies, and priorities (Crowley, 2017; Talberg et al., 2016). Dealing with climate change has been approached mainly as an emissions mitigation problem, and adaptation is loosely approached as “building resilience” (Commonwealth of Australia, 2015). **Paper 4** presents more details on Australia’s policy approaches to climate change and conservation.

The Australian National Reserve System (NRS) was a critical step to addressing biodiversity conservation and ecosystems resilience by establishing a more representative network of protected areas, with an overarching aspirational goal to guarantee “native species, ecosystems and associated cultural values will be protected in perpetuity” (Commonwealth of Australia, 2010, p. 2). By 2020, the NRS covered an impressive 152 million hectares of land protected (representing about 19.75%) under different governance schemes, including State, private, and IPAs (Davison et al., 2022). However, the long-term goal of protecting Australia’s biodiversity has not been achieved (Pressey et al., 2021). Conservation preferences in Australian protected areas are biased towards protecting species and ecosystems over social and recreational

values (Hernandez et al., 2021), which aligns with public preferences for conservation to prevent species extinction (Zander et al., 2021).

Climate change has been identified as a major driver for conserving biodiversity in Australian protected areas (Dunlop and Brown, 2008). However, conservation goals documented in strategies are not clearly defined, or do not differentiate between accepting change or preventing loss, as observed in an analysis to evaluate the climate-readiness of Australian conservation strategies (Dunlop et al., 2013). Such a lack of clarity about conservation goals and ecological change has implications for future management of protected areas under climate change.

Addressing the negative effects of climate change on the environment and protected sites has been highly contested politically, as observed in Commonwealth government efforts to prevent recognition of climate change as a reason for designating sites on the list of UNESCO World Heritage Sites in danger (UNESCO, 2021), particularly regarding coral bleaching on the Great Barrier Reef (Cheung et al., 2021). These actions contradict not only the statement by the Great Barrier Reef Marine Park Authority (which is a Commonwealth government agency) that climate change is the greatest threat to the Great Barrier Reef (GBRMPA, 2019) but also the perceptions of local stakeholders that climate has caused coral bleaching (Thiault et al., 2021).

3.1.1. The Australian Alps

The case study in Australia is a mountain landscape known as the Australian Alps (Fig. 3.1). Located in the southeast of the continent, the Australian Alps represent a complex of connected parks covering over 1.6 million hectares spread over three jurisdictions: Victoria, New South Wales and the Australian Capital Territory (Crabb and Dovers, 2007). The region covers highland ecosystems and the only portion of mainland Australia with seasonal snow. This area has important conservation values, provides ecosystem services and economic benefits, and is the traditional lands of many Indigenous nations (Morrison and Pickering, 2013; Worboys and Good, 2011). The Alps provides important economic benefits to Australia's economy, with an estimated provision of 9600 GL of water annually to the Murray and Murrumbidgee rivers (Worboys and Good, 2011).

The research focuses on Namadgi National Park in the Australian Capital Territory (ACT), and Kosciuszko National Park in New South Wales (NSW). Although a Memorandum of Understanding for the Australian Alps provides some guidance for cross-jurisdictional collaboration (Crabb and Dovers, 2007) each park is managed under different plans of management and rules: Namadgi is managed by the ACT Government (ACT Government, 2010), and Kosciuszko by NSW National Parks and Wildlife Services (NSW Department of Environment and Conservation, 2006).

Namadgi is the smallest park of the Australian Alps, and includes one Ramsar site, the Ginini flats. Namadgi is an Aboriginal name for the Brindabella mountains where part of the park is located (Slattery, 2015). Part of the area was reserved in 1908 to protect a catchment for drinking water supply to Canberra, the future capital of Australia (ACT Government, 2010). Water remains the main conservation goal for the park, alongside natural and cultural heritage, recreation, and fire, among others (*ibid*). In 1944 the first efforts to reserve areas for conservation in Kosciuszko commenced, to protect nature and reduce the then rampant soil erosion driven by overgrazing of livestock (*ibid*). The Blue Lake Ramsar site is part of Kosciuszko National Park.

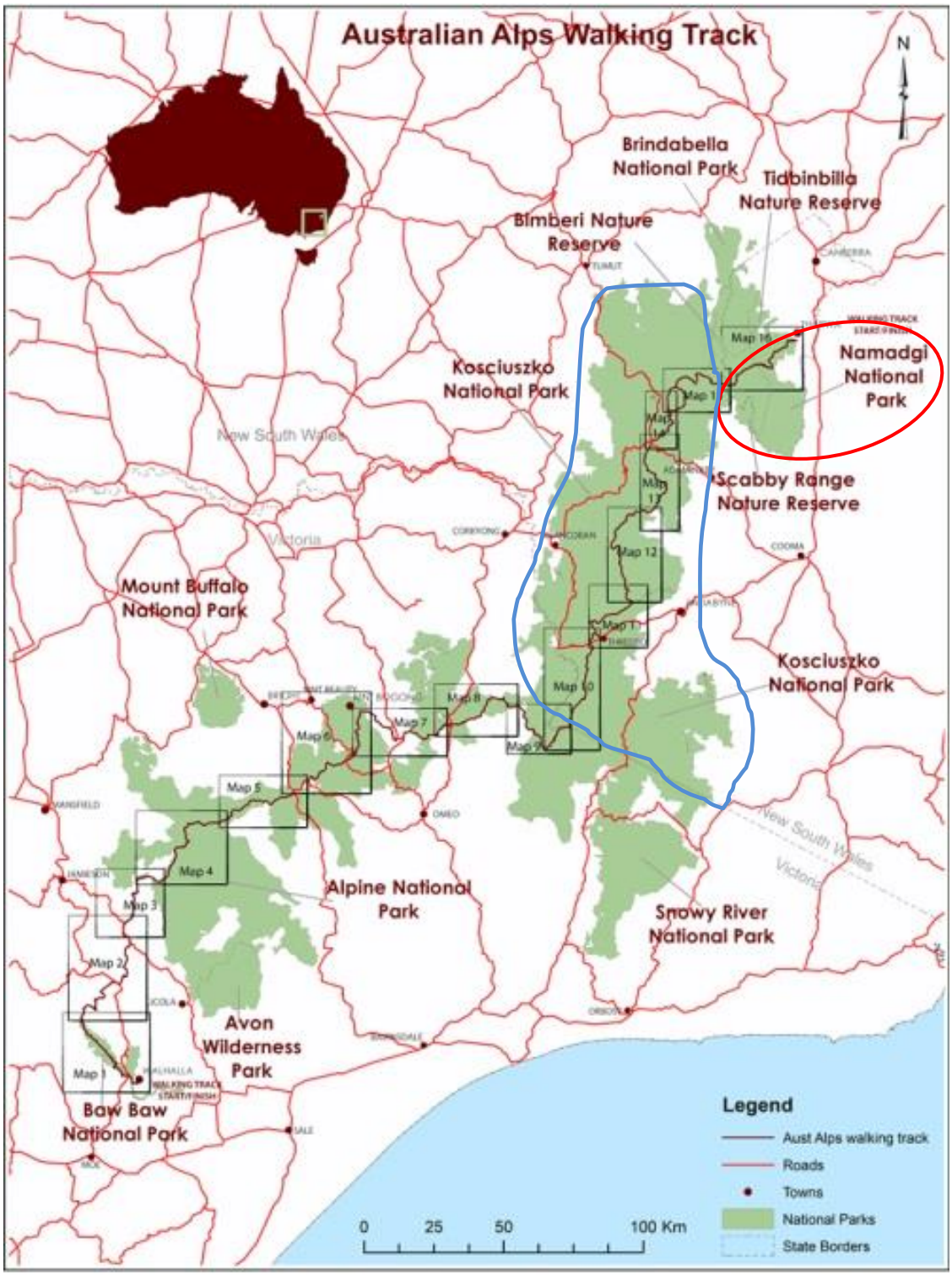

Figure 3.1. Australian Alps map. Namadgi National Park is circled in red, and the blue scribble indicates the approximate location of Kosciuszko National Park. Source: https://theaustralianalpsnationalparks.org/experience/aawt/maps/

The Australian Alps has been deeply transformed with the arrival of new settlers, and their intensive logging, mining and grazing practices, the building of hydro infrastructure, tourism infrastructure, and the establishment of national parks. The creation of protected areas has been and remains a contested issue, especially in NSW (Wyborn, 2009).

The Australian Alps is characterised by extreme local weather. Climate change has been identified as a major driver of change for both parks, with potential impacts cascading across ecological processes and scales. Some of the impacts are related to observed and expected reductions in snow cover (Morrison and Pickering, 2013; Whetton et al., 1996) and its consequences for water provision, impacts on the tourism industry, and shifts in animal and plant distribution (Dunlop and Brown, 2008; Morrison and Pickering, 2013). An additional impact is the increase in wildfires frequency and intensity, as observed in the 2019–20 Black Summer bushfires, which burnt as much as 71% of native forests in protected areas in the ACT (mainly in Namadgi) and nearly 50% of multi-use and public conserved native forests in NSW (Davey and Sarre, 2020).

3.2. Colombia

With a complex geography and variety of ecosystems, Colombia is recognised as one of the most biodiverse countries in the world. With more than 63300 species recorded in the territory, Colombia hosts about 10% of known species on Earth despite covering only 0.7% of the global land area (SiB-Colombia, 2022). The narrative of rich biodiversity has been also a political construction of nationalism and identity, which started during the early 20th century, as part of international collaborations between Colombian and North American naturalists, enabling the beginning of conservation strategies in Colombia including setting the first protected areas (Quintero-Toro, 2012). Multilateral institutions also had a significant role in putting nature at the core of the nation's goal of creating a modern state (Leal, 2017) and the beginning of environmental policies and institutions to protect natural resources. The first national parks system was created in the 1970s (under the Natural Resources Code of 1974), which focused on preserving biotic communities, biogeographic units, genetic resources, and endangered species.

But for many Colombians, nature has been also a resource for economic development to be used, managed, and extracted. Colombia has a complex social-historical context where legacies from the Spanish colonisation have shaped aspirations of economic development and contested views of nation (Carrizosa Umaña, 2014). With one of the highest deforestation rates in Latin America (Armenteras et al., 2017), Colombia is listed as the country with the 12th highest deforestation rates globally (Global Forest Watch, 2022). Although having relatively egalitarian landholding policies, land distribution has been a contested issue and issues of political power are shaping modern concentration of land ownership (Faguet et al., 2020), influencing the already complex socio-political context.

Colombia has been affected historically by social change and civil war, including violent actions against humans and nature. A 50 year long civil war ended in 2016 with a peace process between the government and the insurgent group, the Revolutionary Armed Forces of Colombia (FARC) (Karl, 2017). The "internal conflict", as it is known in Colombia, caused intense human displacement from rural to urban areas. With the peace process, post-conflict Colombia has opened opportunities to reimagine alternative futures, and reconcile nature and society through low impact economic activities (Maldonado et al., 2018). At the same time, it has also led to illegal deforestation in or adjacent to protected areas (Clerici et al., 2020; Murillo-Sandoval et al., 2021).

A new constitution in 1991 was a major step away from colonial legacies (Republica

de Colombia, 1991). The new constitution acknowledges the pluralism and multiculturalism of Colombian society, gives responsibility to the state to protect natural resources, and recognises territorial rights of Indigenous and Black communities. Policies for environmental management, including biodiversity conservation and climate change, are framed under the constitution. Since the 1990s, Colombia has been actively engaged in climate change policies, and working to understand the hazards and impacts related to climate change. The three national communications (NC) submitted to the United Nations Framework Convention on Climate Change (UNFCCC) aim to include climate change in policies across sectors and levels of government. Emerging policy initiatives facilitate adaptation for management of natural resources, including protected areas, as part of the solutions to climate change in the country's national adaptation plan and strategies. Colombian National Parks has seen this as an opportunity for integrating climate adaptation into protected areas planning and management (more details in **Papers 3 and 4**).

National parks in Colombia are managed by the government agency Parques Nacionales Naturales de Colombia, which has autonomy from the Ministry of Environment. The National System of Protected Areas (SINAP), created formally in 2010, defines management categories and responsibilities (including national, subregional, and private lands) while allowing the creation of subregional protected areas systems (DNP, 2010). The SINAP is the set of protected areas, social actors and management strategies and instruments that articulate them, to contribute to the fulfilment of the country's conservation objectives. It includes all protected areas of public, private or community governance, and of national, regional or local management. PNN has the legal mandate to manage the 59 state-owned protected areas (PNN, Fig. 3.2), including areas of the National Natural Park System in the categories of National Natural Park (PNN); Fauna and Flora Sanctuary (SFF); Unique Natural Area (ANU); National Natural Reserve (RNN) and Vía Parque (park way). It also has a mandate to contribute to the consolidation of the SINAP, and coordinate and implement policies, plans, programs, norms, and procedures related to the SINAP.

3.2.1. From the Amazon to the Caribbean

Although with different levels of progress, the three protected areas selected as case studies in Colombia are trying to incorporate climate adaptation into their management plans. Defining conservation goals in plans of management has been a process of learning and slowly moving from a species focus to broad ecosystem services. The management plans define two filters for monitoring management effectiveness and conservation. A coarse filter defines ecosystems or landscapes, aiming to protect social benefits and provision of ecosystem services, and the fine filter defines monitoring actions for focal species.

The first park is Otun-Quimbaya Flora and Fauna Sanctuary. This park is located in the Central Andes in the area known as the Coffee Growing Region (Eje Cafetero in Spanish). The area has a diverse social-ecological context, with active and ongoing work on territorial planning, protected areas management and climate adaptation action (Múnera-Roldán and van Kerkhoff, 2019). This protected area includes the Ramsar site Laguna de Otun and is part of a UNESCO Coffee Cultural Landscape, a World Heritage Site. Management of natural resources is focused on the protection of ecosystem services (such as water provision) and conservation of threatened species populations (Parques Nacionales Naturales de Colombia, 2016).

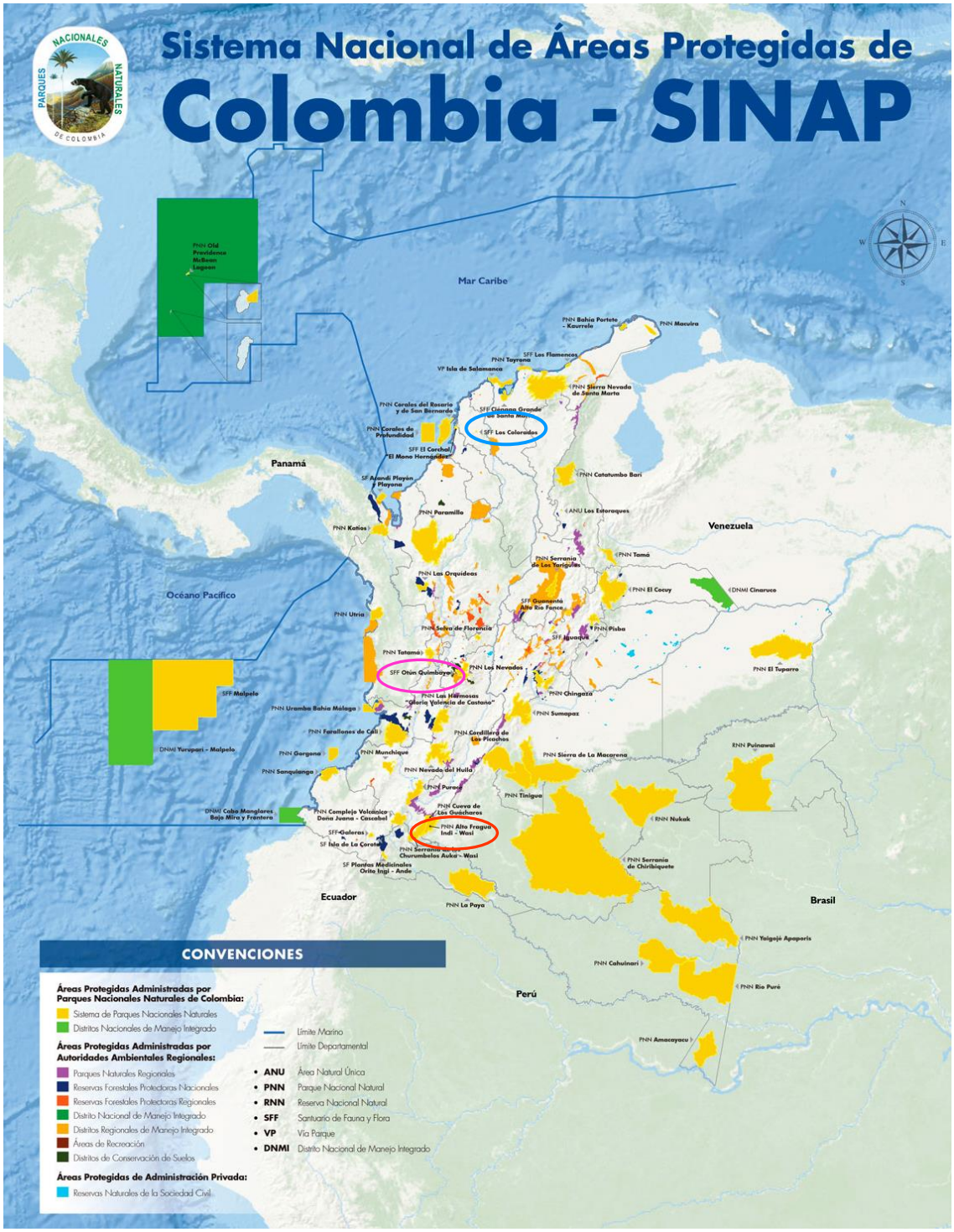

Figure 3.2. Map of Colombian protected areas managed by Parques Nacionales Naturales de Colombia (PNN); blue circle: Los Colorados Flora and Fauna Sanctuary, pink circle: Otun Quimbaya Flora and Fauna Sanctuary, and red circle: Alto-Fragua National Park (source: https://www.parquesnacionales.gov.co/portal/es/)

The second park, Alto-Fragua Indi Wasi National Park, is in the Amazon Piedmont and was established to protect biodiversity, environmental services, and cultural values. The park is located in a transition between Andean and Amazon forests in the Eastern Andes and overlaps with Indigenous lands (Inga Kuna people); the Inga Kuna people were an important stakeholder supporting the declaration of the area as a

National Park (Parques Nacionales Naturales de Colombia, 2012). Being a national park, its management is the responsibility of the Colombian Government, but as it overlaps with Indigenous territory, they participate in defining conservation goals and management actions. This has brought some tensions between two different worldviews and governance systems, which are continually under negotiation. The Amazon Piedmont region has seen an increase in settlers migrating from other regions of Colombia. Consequently, the park has illegal and legal settlers inside the protected area and in its buffer zone.

Los Colorados Flora and Fauna Sanctuary is the third park. Located in the Caribbean region, it is a small area protecting tropical dry forest relicts. The area is immersed in a matrix of agricultural lands and human settlements around the park, creating a complex socio-ecological context, where climate and land-use change are the main drivers of change (Parques Nacionales Naturales de Colombia, 2018). The area witnessed some of the most violent chapters during the civil war in Colombia. In the post-conflict era, the park is integrating local communities into conservation efforts as part of territorial planning with a landscape lens, using climate adaptation as a management approach to promote connectivity (Parques Nacionales Naturales de Colombia, 2018).

3.3. South Africa

South Africa is a biologically rich country, with unique ecoregions distributed across a dynamic landscape, and is home to an entire floral kingdom: the fynbos biome. The country has a complex social and political context, shaped by legacies from British and Dutch colonisation, and a war in the 19th century during the beginning of mining for gold, coal, and diamonds. It is a multicultural country, where the past has a strong voice, and the environment has been central in the process of nation building and in overcoming the legacies of colonisation and apartheid (Carruthers, 2006).

Protected areas in South Africa have been associated with issues of racism. Black people were fundamentally excluded from conservation or prevented from accessing resources (Musavengane and Leonard, 2019) through “fortress-style” protected areas. Racial segregation under the apartheid regime (1948–1993) had profound effects on society and for environmental management. Under apartheid, nature was to be controlled and managed in game reserves for wealthy Whites, while Blacks were dispossessed of their traditional lands and became labourers on reserves, farms and in mines (Thakholi, 2021). Up to the end of the apartheid era, national parks built a sense of identity and unity among Whites, but Blacks were still segregated, creating a physical and psychological barrier between Blacks and the natural environment (Carruthers, 2014; Mabunda et al., 2003).

The transition to democracy opened opportunities to reimagine the nation, especially to overcome the inequitable legacies of colonialism and apartheid. In regaining the right and voice to create the post-apartheid country, South Africans took note of the international environmental political movement of the time (Carruthers, 2006), ideas that are expressed in the new country’s constitution (Musavengane and Leonard, 2019). However, weak policy implementation remains the main challenge to achieve the egalitarian vision of social justice declared in the constitution (Plagerson et al., 2019). Although the South African economy is increasingly dominated by the manufacturing and service sectors, mining has been, and still is, important in the country. Tourism – especially eco-tourism – is an important economic activity in

private and national protected areas.

Despite the challenges, South Africa has a well-developed natural and social sciences research program (Ziervogel et al., 2014) and robust environmental policy frameworks (Taljaard et al., 2019). Climate change was initially framed as a scientific problem, but is now recognised as a development problem presenting a challenge to reduce the impacts of climate on society and interaction with drivers of vulnerability such as poverty and health (Shackleton and Shackleton, 2012; Ziervogel et al., 2014). The recent COVID-19 pandemic brought management challenges for protected areas including barriers to monitoring and controlling access and use of resources by local communities (Smith et al., 2021). These challenges have implications for environmental justice and fair access to natural resources.

Parks in South Africa had an original focus on protecting game populations. Those game reserves set the basis to form the South African National Parks (SANParks) reserve system after the 1920s. The majority of national protected areas in the country are fenced, managed inside static borders as part of wildlife management strategies, or to control tourism. SANParks implements long-term monitoring in almost all its parks. Management of protected areas is supported by strong knowledge-based structures where scientists and managers constantly interact under the same governance structure (Roux et al., 2019). The management approach under Strategic Adaptive Management (SAM) acknowledges systems complexity and associated uncertainties (Freitag et al., 2014; Roux et al., 2021; SANParks, 2020).

3.3.1. The Garden Route

The case study in South Africa is the Garden Route National Park (GRNP). The park is located on the southern coastline of South Africa, spanning Eastern and Western Cape provinces. GRNP is a fragmented matrix of landscapes including mountain ranges, forest, lakes, estuaries and marine ecosystems, agricultural lands and urban areas; this complex of ecosystems is managed as a single unit by SANParks. The GRNP was officially created in 2009, after merging existing protected areas: Wilderness and Tsitsikama National Parks, with the Knysna National Lake Area (Fig. 3.2).

The diversity of landscapes and uses in the area is reflected in the complex and diverse stakeholder relations, and co-operative governance. GRNP is one of the few unfenced parks in South Africa.

It has rich biodiversity and special ecosystems. It includes a Ramsar site (Wilderness Lakes), which supports an important waterbird assemblage in South Africa (Russell et al., 2014). Portions of the park are included in the Cape Floristic Region World Heritage Site. The GRNP is an important watershed, with about 60% of the park overlapping with South Africa's Strategic Water Source Areas, of which 28.8% are protected in the GRNP (Nel et al., 2017). A large portion of the rivers in the area has been designated as a Freshwater Ecosystem Priority Area (Nel et al., 2016).

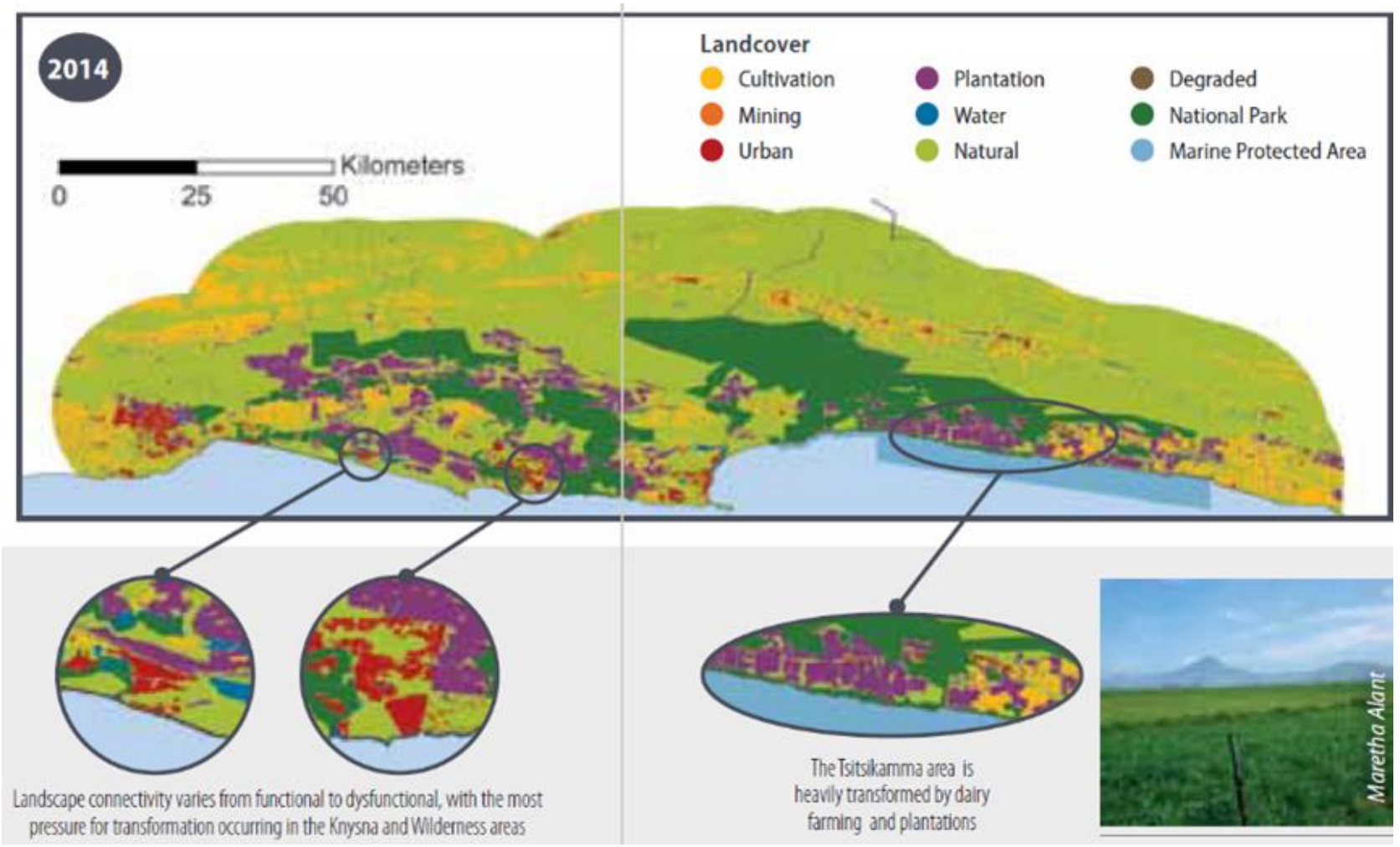

Figure 3.3. The Garden Route National Park, on the south coast of South Africa, comprises a matrix of land use and conservation areas. Source: van Wilgen and Herbst (2017)

Climate change has been identified as the most significant emerging challenge for the park, experienced through extreme events including flooding, storm surges, and fires (van Wilgen and Herbst, 2017).

The social context of the park is diverse and contrasting. The levels of poverty and unemployment are high (Quinn et al., 2019) and there are informal settlements around the urban and sub-urban centres (Roux et al., 2021). GRNP is implementing participatory processes to define the collective vision and integrate the diversity of local perspectives and their aspirations for the future (Roux et al., 2021; SANParks, 2020).

Chapter 4. Approach

Sustainability scientists and practitioners are increasingly facing more complex scenarios, including the need to make decisions under high levels of uncertainty, rapid social and environmental change, and within a diversity of views to address such changes (Sardar, 2019a, b). This thesis aims to understand how individuals and institutions understand the concept of adaptation in the context of climate-induced changes to biodiversity. I do this by exploring narratives used to communicate biodiversity conservation management under climate change.

As explained by Suoto-Manning, narrative analysis aims to gain insights into how individuals make sense of their experiences as part of social interactions through exploring language used to communicate within the context of institutional discourses (2014). Discourses also reflect a shared language that gives meaning to phenomena through ideas or concepts created and reproduced in specific contexts (Hajer and Versteeg 2005). Analytically, discourses and narratives inform each other: discourses represent power and language as expressed in high-level texts (e.g. policies), while narratives are concerned with people's everyday stories and experiences (Suoto-Manning 2014). Perceptions about change, and responses to address it, can be framed by socially constructed discourses which are then implemented in the form of policies and strategies. Identifying adaptation narratives involved in management of natural resources under climate change requires an approach that acknowledges and allows the capture of diverse knowledge and practices from multiple disciplines.

4.1. Methodological framework

Adaptation is about dealing with existing impacts and preparing management for future changes. Futures thinking provides a variety of analytical approaches to address the ontological, epistemological, and methodological challenges of preparing for desired futures (Bengston et al., 2012; Hichert et al., 2021). As described in Chapter 2, my approach to futures thinking is through futures consciousness, or how individuals and collectives are aware of different possible futures, and about the consequences of decisions made today. Futures consciousness is an action-oriented perspective of the future (Ahvenharju et al., 2018), offering a framework to explore how belief systems translate into action, and how much the process considers the consequences of such actions into the future.

The Five Dimensions of Futures Consciousness (hereafter 5DFC; Ahvenharju et al., 2021; Ahvenharju et al., 2018) was used in this study to examine how individuals and institutions understand, prepare for, and accept the future including the capacity to understand different timeframes and having long-term thinking (time perspective, see section 2.3.1), individuals' or institutional capabilities to influence future events (agency beliefs, section 2.3.2), being able to critically think about current contexts and assumptions (openness to alternatives, section 2.3.3), seeing and understanding social and natural systems interconnections (systems perception, section 2.3.4), and being aware of others, including humans and non-humans, when planning for the future (concern for others, section 2.3.5).

Futures consciousness provides a basis for understanding preferences to adopt future-oriented practices in protected areas and can be explored via narratives. These narratives are created in specific contexts and shaped by collective discourses used by

protected area managers to communicate and interact with nature, local communities, and other stakeholders. Futures consciousness has been applied to analyse acceptance of policies (Ahvenharju, 2021) and of COVID-19 pandemic rules (Lalot et al. 2021) using surveys and psychometric tools to measure it at the individual level, also to analyse regulations on the protection of data privacy (Minkkinen, 2019) and framings of adaptation concepts in conservation (Múnera-Roldán et al., 2022) through narrative analyses. Ahvenharju et al. (2018) propose multiple research options and applications of their model, including qualitative analysis of how humans approach the future through interviews or document analysis.

I started exploring concepts related to futures consciousness and specifically the 5DFC in relation to decision contexts dealing with preparing protected areas planning for future climate change. The starting point was to explore concepts of time, or the interaction of different "times" (past, present, future) to gain understanding about how concepts of time are applied in conservation practice, and how individuals and institutions think and act in relation to necessary policy shifts that acknowledge climate change and related future ecological transformations.

Paper 1 is a conceptual paper to explore concepts of time in relation to applying knowledge-based approaches used in managing protected areas, which helped in grounding the application of the 5DFC in the context of protected areas. This paper connected concepts of time with knowledge governance, proposing a framework to facilitate addressing concern for others, systems perceptions, and openness to alternatives, with the aim of enabling agency. The conceptual model described in Fig. 2.1 was used to analyse the findings for **Papers 2, 3,** and **5**. Although **Paper 4** does not explicitly apply the conceptual model, it provides an interpretative analysis of the policy contexts where the narratives emerge. Table 4.1 summarises the analytical approach and methods used to address the research questions in each paper.

In the results (Chapter 5), I illustrate the application of futures consciousness to understand motivations and preferences for adapting protected areas, exploring mismatches between individuals' interpretations of SES and change, and whether governance arrangements empower managers to navigate climate change.

4.2. Methods of data collection

The research design for data collection follows a multiple case study research structure (Yin, 2009). At the broad level, my focus is an integrated approach to case studies demonstrating some aspects of science–governance interaction in the context of adaptation (case study selection criteria were described in Chapter 3). The multiple case study approach allowed me to compare how adaptation is conceptualised and to study similarities and differences according to each context. The protected areas in the three countries represent conservation communities managing or planning for a range of climate adaptation strategies for biodiversity, offering an opportunity to connect the place-based experience of managers with broader institutions across multiple scales.

To answer the research questions, I have used mixed qualitative methods for data collection, including content analysis of policy documents and a systematic literature review. The cross-scale approach covers the local scale (protected area), subnational, and national scales. For **Paper 4** I also included the international agendas in conservation and climate change. Again, the criteria for selecting case studies described in Chapter 3 was the basis to identify commonalities and differences in adaptation across countries.

Table 4.1. Analytical approach and methods for data collection used in each paper

Paper	Analytical modes to explore meaning and belief systems		Methods for data collection	Approach	Scale of analysis
	Narratives articulation	Futures consciousness			
Paper 1: Beyond Calendars and Maps: Rethinking Time and Space for Effective Knowledge Governance in Protected Areas		✓	Case study and literature review (desk analysis)	Conceptual approach to explore time and knowledge-based processes (science / practice interaction)	National, subnational level
Paper 2: Engaging with the future: framings of adaptation to climate change in conservation	✓	✓	Systematic review with thematic analysis	Conceptual approach and thematic analysis (how science inform practice)	Academic literature
Paper 3: Future orientation and adaptation narratives: towards sustainable management in protected areas	✓	✓	Semi-structured interviews	Case study approach; dialogical and discursive approach (science/policy/practice interaction)	National, subnational level
Paper 4: Mismatches between beliefs and actions in adapting biodiversity to climate change	✓	✓	Literature review and semi-structured interviews	Discursive analysis of legislative and policy context (policy/practice interaction)	International, national, subnational
Paper 5: Futures consciousness as an operational framework for adaptation to global change in South Africa	✓	✓	Semi-structured interviews	Relational, dialogical approach and individual worldviews (science/practice interaction)	National, subnational

4.2.1. Semi-structured interviews

I collected empirical data through 51 semi-structured interviews conducted in the three case studies covering three national parks in Colombia (n = 15), one in South Africa (n = 20), and two parks in Australia (n = 16). The same interview guide was used in all countries, except for one question that was specific to South Africa (Appendix A, Table 1A). All parks in the three countries are managed by government organisations under each country's legislation and policies.

The interviews were conducted using a purposive sampling strategy (Palinkas et al., 2015). I looked for stakeholders involved in managing natural resources and climate adaptation, including managers, scientists, and policy makers. The sample in Colombia also included external collaborating organisations, which despite not being directly involved in managing a park, provide advice on conservation or climate adaptation (Appendix A, Table 1B). The interviews helped to document the visions people hold for conservation governance, whose knowledge and expertise counts in the development of adaptation strategies, and how participants conceptualise adaptation in biodiversity conservation. Results presented in **Papers 3** and **4** cover data collected from interviews in the three case studies, while **Paper 5** focuses only on data from South Africa.

4.2.2. Literature review

For **Paper 2**, I applied a systematic literature review using a thematic focus, looking for trends in narratives and key themes in the academic literature on conservation. A thematic review is a qualitative method to identify concepts or themes and elicit how terms are applied in different situations (Thomas and Harden, 2008), adapting the thematic synthesis process outlined in Haddaway et al. (2018). This method helped in analysing patterns of meaning within concepts used in specific contexts, as well as common approaches used by communities of practice. This review helped to identify how narratives used by the academic conservation community informs practice.

The review of legislative and policy documents on climate change, adaptation, and biodiversity conservation helped in examining the socio-political context of the case studies. In **Paper 4**, I used an interpretative analysis of policy discourses (Phillips and Hardy, 2002; Yanow, 2000) to examine the metaphors, key topics, and common concepts shared by epistemic communities as presented in policy documents, which helped in understanding how these discourses make adaptation actions feasible and legitimate, and therefore how social-ecological realities have been constructed. In summary, this approach helped to set the operational context where managers are implementing actions, grounding the results collected during the interviews (**Papers 3, 4, 5**).

The management plans for the parks and the environmental and climate legislative and policy frameworks were reviewed to examine the different framings of climate adaptation in conservation-related policies as presented in official forms. This was useful to establish key components of the operating context of the case studies, for example, to identify existing barriers, issues, and topics that influence the governance of protected areas, adaptation preferences, and to explore relations between knowledge-based processes and adaptation.

4.3. Collecting and analysing data

Data from interviews was covered by Ethics protocol approved by the Australian National University Human Research Ethics Committee 2019/226, and written consent for the interviews was obtained (Appendix B). Although I intended to conduct all interviews in person, this was only possible for South Africa as just after finishing my fieldwork in South Africa, the pandemic and consequent border closures and travel restrictions started. Fieldwork in South Africa was conducted in February and March 2020. Data collection for Australia was largely through online interviews (six interviews were conducted in person in Australia), and all the interviews with Colombia were conducted online. Although sample size was not predetermined, difficulties in collecting data during the pandemic influenced the final sample size for each country.

Interviews in Australia and South Africa were conducted in English, and those in Colombia were in Spanish. The interviews were audio recorded, and later transcribed for analysis using qualitative interpretation with NVivo 12 Software (QSR, 2020). Data collected in Spanish were not translated for analysis as I am a native Spanish speaker but were analysed using English language themes. Quotes in Spanish were translated into English for the purposes of presentation.

The analysis followed a deductive coding approach. The initial codes followed 5DFC themes and conceptualisation of adaptation. The coding was extended to include other qualitative data including strategies for coordination and participation (rules), relevant expertise (knowledge in use) and visions of the future. These codes were used to understand institutional arrangements across climate change and protected areas policies, and science-practice interactions. Empirical data coded from the interviews helped to map the narratives shared by managers in the three case studies (**Paper 3**), to document policy discourse mismatches between national and local levels (**Paper 4**), and to examine the role of futures consciousness in strengthening decision making and open options for adaptation (**Paper 5**).

For **Paper 4**, I applied an interpretative discourse analysis (Phillips and Hardy, 2002; Yanow, 2000) of legislative and policy documents, to extract aspirational goals, values and belief systems shaping socially accepted practices to manage, regulate or solve environmental problems (Hajer, 1995; Sabatier, 1988). The policy and legislative documents were categorised based on the policy hierarchy model of Samnakay (2017, 2021) covering international conventions, national/subnational policies, regulations, and protected area management plans. Documents were screened to identify words and phrases used to communicate aspirations, approaches and expected outcomes. The analysis looked to identify how those documents mentioned biodiversity conservation or climate change, and the overall context (as explained by the documents) shaping options and choices to address the problem (e.g. institutions, or other stakeholders mentioned). The analysis helped to identify policy drivers, logics and expected outcomes, analysing metaphors and phrases used to communicate the problem and connections between drivers of change.

To understand science-practice interactions, specifically, how climate adaptation is understood and applied in conservation (**Paper 2**), I used a thematic synthesis (Haddaway et al., 2018) to identify key messages and themes as communicated in academic papers. This qualitative analysis allowed me to explore commonalities or differences between themes and define a broad conceptual framework of how adaptation is used in the biodiversity conservation community. A thematic review is a

method to identify key concepts or themes from qualitative studies and “translating them into one another” (Thomas and Harden, 2008, p. 3) to identify how different terms are used in different approaches. I started with a broad search to collate literature from a bibliographic database (Scopus, using access from ANU services), followed by article screening to narrow the sample using Revtools (Westgate, 2019). Revtools is an R Package to help article screening in evidence synthesis projects. This tool can help to visualise the main topics (themes) in a big sample to start filtering the less relevant papers before manual screening and synthesis, and then the systematic review. After several attempts and combinations, I performed a search in the academic database Scopus searching for title and abstract, using a basic search string that covers climate change, ecological transformation and conservation, with potential derivatives:

"conservation" AND (“climat* chang*” OR “eco* transform*”)

The initial sample was 7252 papers. Using Revtools I was able to narrow down the sample and select the relevant documents for the synthesis. After several iterations a sub-sample of 441 articles was obtained. The sub-sample was manually screened to obtain a final sample of 150 articles. Then, I used a questionnaire template for meta-data extraction (descriptive information) and to code the data, through analysing the full text of the selected papers (150). Data analysis had two stages. First, a focus on identifying articles providing an explicit definition of adaptation to critically assess key narratives and themes. Those definitions and themes were tabulated in MS Excel (**Paper 2**, Appendix A), to define a list of grouped themes (clusters). The final number of themes and clusters emerged using an inductive coding approach while screening the 150 articles. Coded themes were examined using a cluster analysis of word similarity with NVivo 12 (QSR, 2020). The themes extracted from the definitions were subsequently analysed using the 5DFC framework (Chapter 2, Fig. 2.1) to explore how change is framed in the definitions and how the framings influence adaptation options.

The other part of the analysis for **Paper 2** was to assign ontological, epistemological, and theoretical perspectives to the grouped themes (Moon and Blackman, 2014). Data extracted from the 150 articles included conceptual background and integration, definitions of adaptation, key ideas and topics, underpinning discipline/science, common themes, outcomes of adaptation, motivations, and recommendations to adapt conservation practices to climate change. **Paper 2** focuses only on the thematic analysis from the 36 articles providing a definition. However, other data extracted from the 150 articles was useful to identify narratives of adaptation from the academic literature and understand science-policy interactions. A summary is presented in Chapter 5, section 5.2.

4.4. Research ethics

Fieldwork procedures for this research was approved by the Australian National University Human Research Ethics Committee 2019/226. Ethics procedures included:

- Recruitment or invitation letter for participants, describing the project in plain language and providing contact details (Appendix B1),
- An information sheet with more details about the project, implications for participation and data handling (Appendix B2), and,
- A consent sheet requesting that participants provide written consent to participate and record the interview, and indicating how to address their inputs

in the research (anonymous or full attribution, Appendix B3).

All participants were provided with the above documents before the interviews were conducted. Although some interviewees agreed to full attribution, all quotes from the interviews were handled as anonymous.

4.5. Personal reflections on collecting qualitative data during a pandemic

A PhD journey (as happens in any other research or project) always faces uncertain and challenging moments. However, as it was for many people, I wasn't prepared for navigating the challenges of a pandemic. Although I was able to travel to South Africa for the first phase of fieldwork, to finish collecting data for the research I had to modify the tools to comply with COVID-19 restrictions, from in-person to online interview methods.

Yes, you can collect data and do virtual interviews. But the differences between virtual vs. in person data collection are massive, in my experience. I am glad that I was able to finish fieldwork and data collection virtually, but I don't think virtual interviews can ever replace the first-hand experience and interaction with interviewees and getting to know the context. For example, while I was in South Africa, I was able to attend and observe a range of meetings with managers and scientists, and even observe fieldwork activities with local stakeholders, allowing me to better understand SANParks' operational framework, how meaning is created, shared, and implemented in actions. I am aware this was not the case for Colombia and Australia. For Colombia I relied on my previous experience and knowledge gained through work done in previous years (and being Colombian and knowing the political, cultural and environmental background of the country). Ironically, although I was based in Australia while collecting data (mainly virtually), understanding the Australian context proved to be more challenging. My approach then involved relying on extensive reading, and informal conversations with experts when possible.

Chapter 5. Results

Chapter 5 presents the papers, providing an introductory summary to explain how each paper contributes to addressing the research questions.

5.1. Beyond calendar and maps: rethinking time and space for effective knowledge governance in protected areas (Paper 1)

This paper is foundational to understanding how concepts of time influence narratives and preferences for managing change in protected areas, providing a preliminary conceptual exploration of futures consciousness. The paper explores how different temporal horizons and ideas of "time" (past, present, future) connect with conservation practice, influencing decision-making to allow or prevent managing change in protected areas (sub-question 2a). The paper draws from a literature review of concepts of time to describe how those concepts influence protected areas management. The conceptual review helps in understanding the role of time in addressing ecological change and how such perceptions influence choices for knowledge-based processes to deal with uncertain futures (sub-question 1a).

Although concepts of time are subjective, they can be socially mediated through communities of practice. Existing social and cultural contexts can influence processes governing how and whose knowledge is used in conservation and climate change decision making. Although the 5DFC does not explicitly address knowledge-based processes, it includes recognition of the role of knowledge as a transversal issue for anticipating futures (Ahvenharju et al., 2018). The paper contains a discussion of how concepts of time used in conservation link with knowledge-based processes, influencing preferences for certain forms of knowledge (e.g. scientific, technical, Indigenous Knowledge). Preferred forms of knowledge affect perceptions of risk, and imaginaries of climate change problems and solutions, with implications for whose concepts and worldviews are mobilised in setting conservation and adaptation agendas, and ethical implications about who benefits or is affected.

The paper contributes to understanding some options to transition towards future-oriented practices to facilitate management changes and reconcile management calendar times with unfolding changes in social-ecological systems (research question 3). The paper offers a heuristic to aid in the process of reflexivity and learning from everyday practice, encouraging managers and scientists to address multidimensional knowledge-based processes, rethink assumptions, and envision desired futures. The reflexivity process can help in addressing other dimensions of futures consciousness (agency beliefs, concern for others, systems perceptions, and openness to alternatives). With examples from South Africa and Colombia, the paper illustrates what a reflexive practice looks like in reality and reflects on implications for future management. The supplementary material presented in **Paper 1** provides guiding questions and options for managers and scientists interested in exploring steps toward a reflexive practice.

Paper 1 set the basis to study how existing narratives and communities of practice deal with ecological change, which is later explored in subsequent papers (**Papers 2, 3,** and **5)**.

Australian National University

Statement of Contribution

This thesis is submitted as a Thesis by Compilation in accordance with https://policies.anu.edu.au/ppl/document/ANUP_003405

I declare that the research presented in this Thesis represents original work that I carried out during my candidature at the Australian National University, except for contributions to multi-author papers incorporated in the Thesis where my contributions are specified in this Statement of Contribution.

Title: Beyond Calendar and Maps: Rethinking Time and Space for Effective Knowledge Governance in Protected Areas

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agreed to the published version of the manuscript.

Senior author or collaborating authors endorsement: _____

Dirk J. Roux	Signature		Date	21 June 2022
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Lorrae van Kerkhoff	Signature		Date	17.6.2022.

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Article

Beyond Calendars and Maps: Rethinking Time and Space for Effective Knowledge Governance in Protected Areas

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Abstract: Protected area managers rely on relevant, credible, and legitimate knowledge. However, an increase in the rate, extent, severity, and magnitude of the impacts of drivers of change (e.g., climate change, altered land use, and demand for natural resources) is affecting the response capacity of managers and their agencies. We address temporal aspects of knowledge governance by exploring time-related characteristics of information and decision-making processes in protected areas. These areas represent artefacts where the past (e.g., geological periods and evolutionary processes), the present (e.g., biodiversity richness), and the future (e.g., protection of ecosystem services for future generations) are intimately connected and integrated. However, temporal horizons linked with spatial scales are often neglected or misinterpreted in environmental management plans and monitoring programs. In this paper, we present a framework to address multi-dimensional understandings of knowledge-based processes for managing protected areas to guide researchers, managers, and practitioners to consider temporal horizons, spatial scales, different knowledge systems, and future decisions. We propose that dealing with uncertain futures starts with understanding the knowledge governance context that shapes decision-making processes, explicitly embracing temporal dimensions of information in decision-making at different scales. We present examples from South Africa and Colombia to illustrate the concepts. This framework can help to enable a reflexive practice, identify pathways or transitions to enable actions and connect knowledge for effective conservation of protected areas.

Keywords: protected areas; knowledge governance; cross-scale management; knowledge systems; temporal dimensions; time

1. Introduction

Protected areas are artefacts where the past, present, and future are connected and integrated. As public assets, these designated conservation areas are boundary objects—spaces where multiple actors share information and interact [1], connecting diverse social-ecological elements, each with specific temporalities. Elements from the past are represented by landscapes, geological and ecological processes, refuges as sites and symbols of Pleistocene extinctions and historical climates [2], or the deep time evidence of the unfolding relationships between people and nature. Through time, human societies have evolved narratives that reflect different ways of conceptualizing, interpreting, and interacting with nature, justifying what is considered important or of value (including tangible and intangible values) and how to manage nature. In this context, protected areas represent the stage on which particular

societal interpretations of nature are played out [3]. Human agency is expressed in conceiving and deciding what, why, and how nature in these protected areas needs to be conserved.

As complex social-ecological systems, protected areas comprise multiple temporal and spatial scales where human and non-human actors connect [4], although not necessarily at the same pace. Time-related characteristics in ecological systems include ecological and evolutionary processes including variables such as seasonality, frequency, and duration of interacting biotic and abiotic processes that are organized hierarchically [5,6]. For human societies, time provides the cues for specific practices, for instance, traditional local and Aboriginal communities organize their activities according to natural, seasonal tempos (i.e., harvesting, ceremonies, fishing), using customary and experiential knowledge that comes from memories and stories transmitted from one generation to the next. In this perspective, knowledge is active, rather than static and processed [7]; memories represent information from the environment that has been filtered and interpreted by human agents [8]. For modern human societies, time is entrained to deal with administrative issues, the creation of daily routines embedded in time-related metaphors like calendars, clocks, diaries, and time zones. In the case of protected areas, time is related with management and operational plans to meet conservation goals, with specific timeframes for implementation measured in months or years.

Managing and planning biodiversity conservation is complex, with inherent uncertainties and contested interests affecting decision-making [9]. In managing for environmental sustainability—including protected areas—practitioners rely on relevant, credible, and legitimate information for their decision-making processes [10]. Although advances have been made to better integrate information for managing natural resources, two issues are still evident: the constant call for better, more effective science indicates a persistent frustration and perceived lag between science and action [11], and there remain many cultural and institutional barriers to effectively use scientific information [12,13].

Unpredictable change is inherent to managing protected areas as complex systems and managers often are prepared to deal with it [14]. However, the increase in frequency and severity of impacts of drivers of change [15] affects institutional and individual capacity to respond to such events and use information for decision-making; in part, because of the inherent tensions managers face in reconciling management timescales and ecological timescales. For example, the speed and rate of extreme climate events and their impacts can extend beyond both the timeframe of a management plan and boundaries of a protected area or a country; its effects overlapping different temporal and spatial scales and cascading across biophysical systems [16]. Such events limit the ability of managers to identify and use climate information for decision-making processes [17,18], design monitoring systems, and comprehend ecological transformations and how people and nature respond to climate change [19,20]. In short, the additional complexity of climate variability limits the capacity of managers to design conservation strategies that effectively address adaptation to climate change.

What does time mean for managing protected areas under uncertain changing conditions, and how can people plan for, and select the best information to deal with unexpected changes? To help answer these questions, we propose that careful consideration of temporal and spatial aspects could provide benefits for knowledge creation and its application for managing natural resources in times of high uncertainty and rapid change. We argue that the linear conceptualization of temporal dimensions, implemented and reinforced through the use of modern calendars and clocks (as well as timetables, diaries and agendas), might be constraining our capacity to understand complex interactions in social-ecological systems at multiple spatial and temporal scales. Land managers operate in at least two spatio-temporal scales: the here and now and day-to-day of their responsibilities, as well as the scale at which social-ecological processes play out in the longer term at a landscape or regional scale [21,22]. However, managers are often constrained by the need to respond to specific timeframes mandated by the tools for management or urgent responses to meet administrative or political objectives, rather than operating at more extensive spatio-temporal scales beyond administrative constraints and maps [23].

To facilitate a multi-dimensional understanding of knowledge-based processes, we propose that dealing with uncertain futures starts with a better understanding of the knowledge governance context

and decision-making processes involved in adapting protected areas management to climate change. Drawing primarily from civic epistemologies studies [24], the manuscript is divided in four sections. In the first section we present concepts related to time, presenting the idea of the "eternally unfolding present" [25,26] to enable actionable knowledge and practice under uncertain futures. The second section focuses on knowledge governance, and the implications for decision-making in the context of protected areas management. In the third section we propose a framework that can help understand time-related issues in relation to identifying, accessing, and using knowledge in ways that reflect the multi-dimensional scales within which protected areas operate. In the fourth section we illustrate our concepts with practical examples from the South African National Parks (SANParks) experience with Strategic Adaptive Management, and interviews performed during a study of knowledge governance under climate change in Colombia [18]. In the concluding section, we highlight the importance of understanding time related processes in planning and practice, to facilitate addressing multidimensional processes where protected areas managers operate.

2. Timescapes and Time Perspective

2.1. Understanding Time: Connecting Past, Present, and Future

Time helps human societies, individuals, and institutions to plan and organize activities, connect with specific moments in history, and, in separating the past from the future, it facilitates the making of prospective decisions [27,28]. In every society, different conceptions and perceptions of time coexist. A key assumption in planning for the future is that time is "continuous, linear, unidirectional and irreversible" [28] (p. 140); time is continuous in that it keeps moving on and does not comprise discrete units, unidirectional in that one event follows the other, even if repeated in cycles, and irreversible in that it cannot go backwards. The perception of time as linear or circular is not only a subjective construction but also a cultural one [28].

In modern industrial societies, and the management of natural resources, time is the " ... disciplining coordination metrics of modern clocks and calendar ... by which modern society measures and responds to change and categorically distinguishes the 'past' from the 'future'" [27] (p. 3). Ecological processes and ecological responses to external variables (including human disturbances) operate in longer spatial and temporal scales. This inherent mismatch between human planning and the rhythms of nature constrains the capacity to recognize, access, and use alternative tempos from Indigenous and Local Knowledge (ILK); such knowledge comprises individual and collective memories, their relation to and interpretation of territory, and environmental change [29].

From a temporal perspective, the duality of nature and society that is inherent in natural resource management does not exist in Indigenous societies [27,30]. For example, a landscape represents both abstract and physical aspects, where time and space are intrinsically related and evident (i.e., in geological eras, evolutionary processes, and human habitation). A landscape is created in the eyes and mind of the observer, so its boundaries depend, in part, on the observer's capability for interpretation and imagination [30] and represent both tangible and intangible elements of cultural relationships between people and nature. From landscapes, we can move to the idea of *timescapes* as described by Adam [30], to acknowledge complex environmental phenomena and inherent temporalities relevant to social-ecological systems. Timescapes encompass time-related characteristics (seasons, rhythms, pace, cycles, environmental change, memories) linked to the natural environment. The concept acknowledges change and how past events and memories influence the present while offering options for the future: "A timescape perspective enables us to integrate scientific and everyday knowledge and the constitutive cultural Self with the workings of nature" [30] (p. 55).

In protected areas and in the context of climate change, timescapes can help integrate diverse forms of knowledge to understand how climate change-related impacts cascade across scales [16] and levels of governance, including different temporal and spatial scales that go beyond the boundaries of protected areas. A timescape includes the complex responses to changes in social-ecological systems,

the different interpretations of risk, and the urgency to act. It implies active learning from past events and diverse actors, crafting new knowledge in the present, and envisioning future scenarios under climate change.

2.2. Temporal Dynamics and Conservation Goals

This interaction of different timelines (past, present, future) is common in biodiversity conservation and climate adaptation studies. However, sometimes knowledge-related work does not explicitly consider temporalities. Knowledge baselines for managing protected areas are often based on species inventories, which are limited to a specific location and time. Long-term monitoring can address temporal coverage from single inventories [31]. Defining indicators of the conservation goals, alongside Thresholds of Potential Concern (TPC) can help managers and scientists to identify levels of unacceptable change in the system under management [32,33]. Ecological responses have specific temporal hierarchies, representing long-term system variability [6]. Understanding the differences between individual ecological responses (events) and processes can facilitate the identification of information needs and the design of monitoring systems. Monitoring ecological processes and responses—not just particular biotic groups—can provide a better understanding of the complex, non-linear processes of ecological responses through time, and help to understand patterns and trajectories across scales (see e.g., [5] for a watershed case covering multiple protected areas, and [34] for long term elephant and fire savannah management in Kruger National Park).

As drivers of change and their impacts operate at multiple scales, monitoring systems might consider units beyond the protected area boundaries to facilitate an understanding of the complex dynamics of social-ecological systems. Tools for forecasting and prediction can help to visualize scenarios for the future and identify information needs for conservation goals [35,36]. These prediction tools have an important temporal basis enabling time perspective: being aware of how events follow each other over time, and the role of past events in shaping the choices made today for the future [37]. It emphasizes the role of everyday practice, experience and learning, placing an actor (individuals and institutions) in an "eternally unfolding present" [25,26].

Memory is an important element of time-related perspectives. In "The importance of a certain slowness", Cilliers [8] describes the relevance of knowledge and memory, and its role to help anticipation of what is to come as complex systems unfold over time. He points out that memory is the "persistence of certain states of the system, of carrying something from the past over into the future". This does not mean to glorify the past, but allowing past events to linger in the present is how we can process information, interpret new events to help inform anticipation of the future, and counter the illusion that "if we live quickly and efficiently in the present we are somehow closer to reality" [8] (p. 108). Knowledge creation is a social process that requires learning, reflection, and dialogue, all of which take time. Integrating diverse forms of knowledge and memories provide a means to interpret the changes and evaluate the rhythm, impacts, and extent of drivers of change.

As different stakeholders in protected areas usually hold a diversity of beliefs, values, and knowledge, and different interpretations of time and change, exploring knowledge governance arrangements can help to identify potential political, cultural or customary tensions when selecting and applying knowledge for planning [38]. In the next section, we discuss how these temporal dimensions connect with knowledge-based processes.

3. Knowledge Governance: Accessing, Using, and Sharing Information

3.1. Creating Meaning, Crafting Knowledge

Words and stories shared by a group shape its identity and create meaning for mutual ideas and concepts. Meaning is produced through interactions with the world and reinforced by the selected choice of words, language, and metaphors used in everyday interactions [39]. This collective creation of meaning is closely connected with knowledge creation. Knowledge-based processes are

context-dependent: institutions, rules, geographies, as well as individual and collective preferences, shape how knowledge is created, shared, and applied. A variety of cultural and political settings frame how people perceive, understand, and respond to natural phenomena and processes, including the 'how', 'what', and 'whose' of knowledge and its use [40].

Acknowledging the complexity and varied forms of knowledge, in this paper we consider two domains: scientific knowledge, and ILK [41]; ILK evokes the strong, long-standing linkages of Indigenous people, but also of more 'recent' communities (e.g., pastoralists or farmers) to their natural environments, and their specific interpretations of environmental change. Protected areas provide a good example of the interplay (or lack thereof) between knowledge and action produced by different actors operating at different spatial and temporal scales. As a 'community of practice' [39], protected area managers reinforce meaning through maps, regulations, and management plans, the implementation of which is measured in calendar time. In contrast, Indigenous communities create meaning and make sense of their world through dreams, stories, ceremonies, and traditional practices, where calendars and clocks are less relevant [42]. As explained by Cuvi [43] (p. 81), ILK[1] is created through practice, learning, and openness to experiment. These individual and collective interpretations of the world, with different understandings of risk and future climates, can lead to different environmental rules and standards, which can then enable or constrain adaptation options [29]. In managing complex social-ecological systems, it is important to acknowledge the plurality of visions and human dimensions shaping science-policy relationships [44].

In doing their work, protected area managers are expected to find, produce, and use information to connect management objectives with specific time horizons for their implementation, monitoring and evaluation [45]. In deciding what knowledge to use for planning and making decisions to deal with changing environments, protected area managers are conditioned by their decision contexts. Gorddard et al. [46] explain the decision-context as a societal construction whereby held human values (such as the motivation to conserve nature), societal and institutional rules (formal and informal actions, norms and practices for managing and planning), and knowledge (the diverse ways used by people to make sense and understand the world) influence how people make decisions. When certain values or rules predominate it affects how certain forms of knowledge are included or excluded, depending on what values, rules and knowledge the decision makers consider credible, legitimate and important (see examples of values, rules, and knowledge interactions from Australia in [46,47]; for Colombian examples, see [48]). In the next section, we provide details of this knowledge-practice interaction.

3.2. *Producing, Co-producing and Governing Knowledge*

In linking science with management decisions, there is a trend to move from the knowledge deficit model [11] to co-production as a way to promote actionable science while considering the complexity of challenges in managing natural resources under climate change [49]. Although co-production has different definitions, we follow Wyborn et al. [50] (p, 3.2): "processes that iteratively unite ways of knowing and acting—including ideas, norms, practices, and discourses leading to mutual reinforcement and reciprocal transformation of societal outcomes". This definition addresses context-related aspects of producing and applying knowledge and the governance of knowledge-based processes in situations where there are different interpretations and ways of creating meaning in the setting of goals, as is the case for protected areas.

Knowledge exchange, understood as processes of creating, sharing, interpreting, accessing and using knowledge, is one way of understanding the interplay that is required for co-production, and is not straightforward [13]. Understanding contexts and barriers can facilitate the identification of options to enable knowledge exchange for more efficient decision-making and management. Such an approach requires an understanding of the governance of knowledge: the overarching rules of how

[1] Here ILK is inferred by the authors; in Cuvi (2019) Indigenous knowledge is mentioned, but does not refer explicitly to ILK.

societies engage in knowledge creation (including the preferred types of knowledge for making decisions) and how to share, protect, use, or access that knowledge [38]. Knowledge governance "can help to understand the role of knowledge and learning in the governance of complex societal issues" [51], including knowledge-based arrangements (formal and informal rules) for decision making, and facilitate more effective interactions between knowledge and practice. Knowledge governance is often confused with knowledge management, however the latter involves the day-to-day practice of organization along with accessing and using information and is not considered here.

Understanding knowledge governance can help to address temporal mismatches when deciding how to address conflicts of interests, identify ways to move beyond traditional practices and embrace innovative options for managing natural resources. A first step is to identify existing knowledge governance systems, for example the so-called 'loading dock' model [50,52], as well as institutional arrangements in use, for example boundary organizations, knowledge exchange, and embedded researchers [13,53]. These models are often framed by high-level processes and complex arrangements that shape the way society governs knowledge-based processes (known as civic epistemology), which therefore influence knowledge systems (such as institutional arrangements for science-policy interaction), as well as interventions and knowledge management responses for the application and translation of knowledge into action [38].

Knowledge-based processes (including co-production) might benefit from explicitly embracing different temporal dimensions. In collaborative interdisciplinary research, different perceptions of the urgency to solve problems, and the different paces to create knowledge by different disciplines and communities of practice, influence how we define timeframes for action [54]. In the next section, we present alternatives to explicitly explore the diverse conceptions of time, how it is conveyed in knowledge-based processes, to open opportunities for productive collaboration and dialogue with multiple stakeholders in and around the protected area, rather than mismatched understandings based on preconceptions or assumptions of time.

4. Framework for Multidimensional Knowledge-based Processes

> "*Some years ago, we started reflecting on fragile ecosystems and climate change, and we realized, what are we going to do with the glaciers? Who is working on that? What management actions are needed?*"
>
> Manager, Colombian National Parks, 2016

In its conception and implementation, management of natural assets often neglects or misinterprets temporal horizons when designing environmental monitoring programs and decision-making processes. To facilitate an understanding of time in relation to knowledge processes and decision making, we propose a framework to evaluate current knowledge-based processes in protected areas management and planning, as a guide to understanding the timescapes in which managers operate. Acknowledging that management of conservation goals operates within spatial and temporal limits, the framework is a guide to addressing the complex interactions of multidimensional management in a practical way while identifying options to move beyond constrained and utilitarian concepts of time (such as calendars) in relation to knowledge selection, usage, and the implementation of policies. Each protected area context is different, and it is likely that some managers are already applying some of these ideas. The framework aims to enable managers to navigate options for integrating practice (e.g., management effectiveness), applying science and technical knowledge (e.g., monitoring systems), and connecting diverse knowledge systems and memories to understand social-ecological processes and responses to drivers of change. For example, ILK can provide a richer vision of social-ecological processes, based on multigenerational observations and practice [55].

The framework is based on the idea of ecological reflexivity [56], involving *recognition* (monitoring impacts and system changes while anticipating future conditions), *reflection* (learning from past events, rethinking values and practices and envisioning), and *response* (reviewing objectives and

values and reconfiguration of processes and practices). We integrate these elements into a simplified version of protected areas decision making (Figure 1). The framework includes the idea of the here-and-now that protected area managers face every day in their jobs. The present represents the living memory (including previous learning) gained by practice, anticipation of what is going to happen, and careful observation of the outcomes. We present some guidance questions (Figure 2 and Appendix A) intended to facilitate the reflexive process, guide discussions, and help managers exploring multidimensional knowledge-based processes in their current practice. These questions can happen as part of a deliberative process to update management plans or monitoring systems and can guide managers navigate and understand how current knowledge systems address time across scales. The framework and suggested options are not prescriptive, but aim to guide the discussion to identify what information is useful, whose knowledge is relevant, and elements to consider in designing monitoring systems that allow managers to capture systems dynamics in space and time.

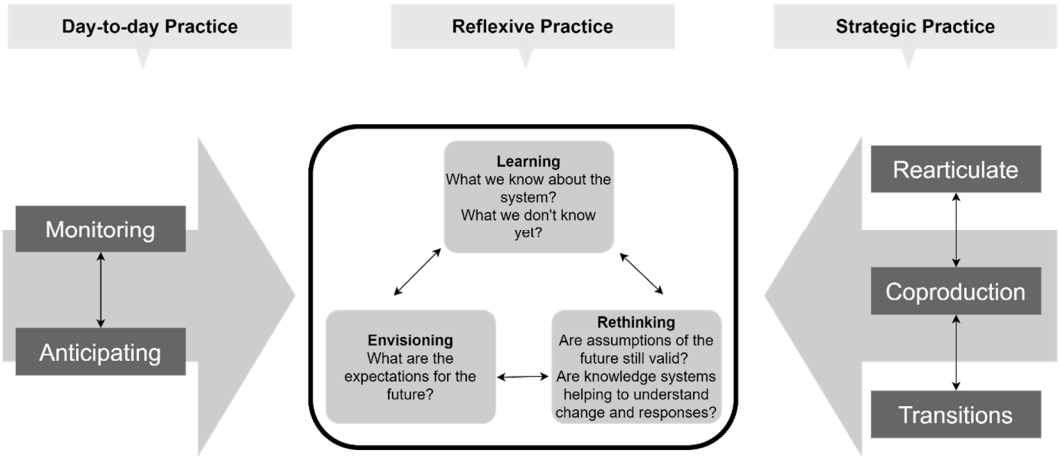

Figure 1. A framework to address multi-dimensional knowledge-based processes for management of protected areas. The day-to-day practice on the left focuses on monitoring social-ecological processes and anticipating or thinking about future conditions of the system. The reflexive practice (center) emphasizes learning from previous knowledge-based processes, rethinking assumptions and knowledge systems, and envisioning expectations. To the right, the strategic practice level focuses on how to rearticulate or transition to alternative forms of knowledge and management. Modified from Dryzek and Pickering [56].

The first category is the *day-to-day practice*, or operational level, which represents the activities to meet the strategic objectives, including anticipating changes and monitoring current conditions. This level is critical to provide feedback to strategic decisions and update planning. Then, an intermediate level of *reflexive practice*, to allow learning about past projects, planning and activities, rethinking the effectiveness of knowledge systems used to understand change, and envisioning expectations for the future. Finally, the *strategic level* corresponds with decisions related to broad, overarching, long-term goals that span geographical and temporal scales. These can include setting collective visions for a protected area and surrounding landscapes, align management plans with Indigenous Plans of Life (a participatory planning instrument to reimagine Indigenous futures), developing and managing a network of protected areas, or complying with international conventions.

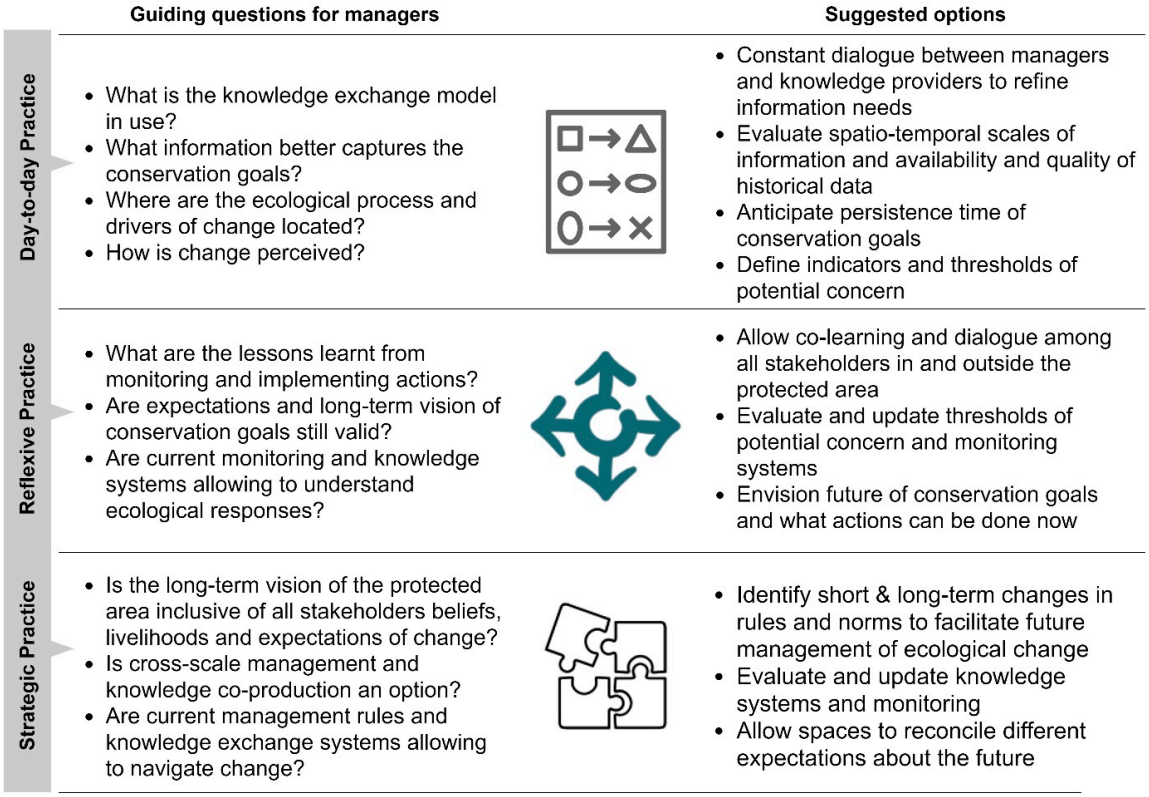

Figure 2. Illustrative example of the guiding questions and options for managers, to guide the discussion about multidimensional knowledge-based processes. Tables A1–A3 expand the questions at each level.

The information required to understand changes in ecological functions and the cascade effects of disturbances across scales require more than data collected over narrow temporal and spatial scales [57]. The relationship between information needs and decision-making timeframes might have different interpretations in management and planning [18] (p. 45), affecting how information is produced, selected, and used. Moreover, our lack of clear knowledge about the type, speed, and extent of ecosystem transformation as consequence of climate change challenges how we make decisions, our interpretation of time, affecting knowledge-based processes for managing protected areas. For example, when designing monitoring systems, scientists and managers often omit the response timeframes of ecological processes, or use incomplete datasets that do not reflect the interconnectedness of ecosystem processes at different spatial and temporal scales [5] or the underlying complexity of ecosystem services and the processes that provide them. In this sense, we understand ecosystem services as biophysically and socially co-created; their use and interpretation evolve over time according to societal preferences [58]. As ecosystems, biodiversity and social processes are structured hierarchically across temporal and spatial scales, protected area managers can benefit from explicitly addressing temporal scales, territorial dynamics and ecological processes when using knowledge and information.

Careful linking of management effectiveness times, with long-term monitoring results can help visualize changes and responses while allowing learning, testing of management options, the effectiveness of information collected and evaluation of thresholds of change. At the strategic level, the rethinking of information and knowledge needs involves a process of collective reflexivity on how to adjust knowledge systems for managing change and understanding that management of future ecological transformation requires dynamic management, learning and eventually rethinking and changing practices, structures and conservation approaches consistent with what has been learnt and observed. Although this re-articulation is not straightforward, it can occur as small transitions in

current approaches that facilitate reframing knowledge governance processes and incorporating other forms of knowledge (e.g., see four conceptual transitions to enable future adaptation in [48]).

The example illustrated in Figure 3 shows how ecological processes and information needs on conservation goals distribute across spatio-temporal scales to support predictions of ecological responses and change over the longer term. Anticipatory processes can benefit in setting TPCs, and reflecting on the observed responses of biota to climate and other drivers of change, managers and researchers will be able to better understand the mechanisms of climate impacts, the sensitivity of natural systems and implications for transformation in the protected area. Human needs and their dependence on ecosystem services play an important role in defining conservation goals, but also as underlying drivers of environmental change. Social TPCs can complement ecological ones to allow an integral understanding of processes and responses of the social-ecological system [59].

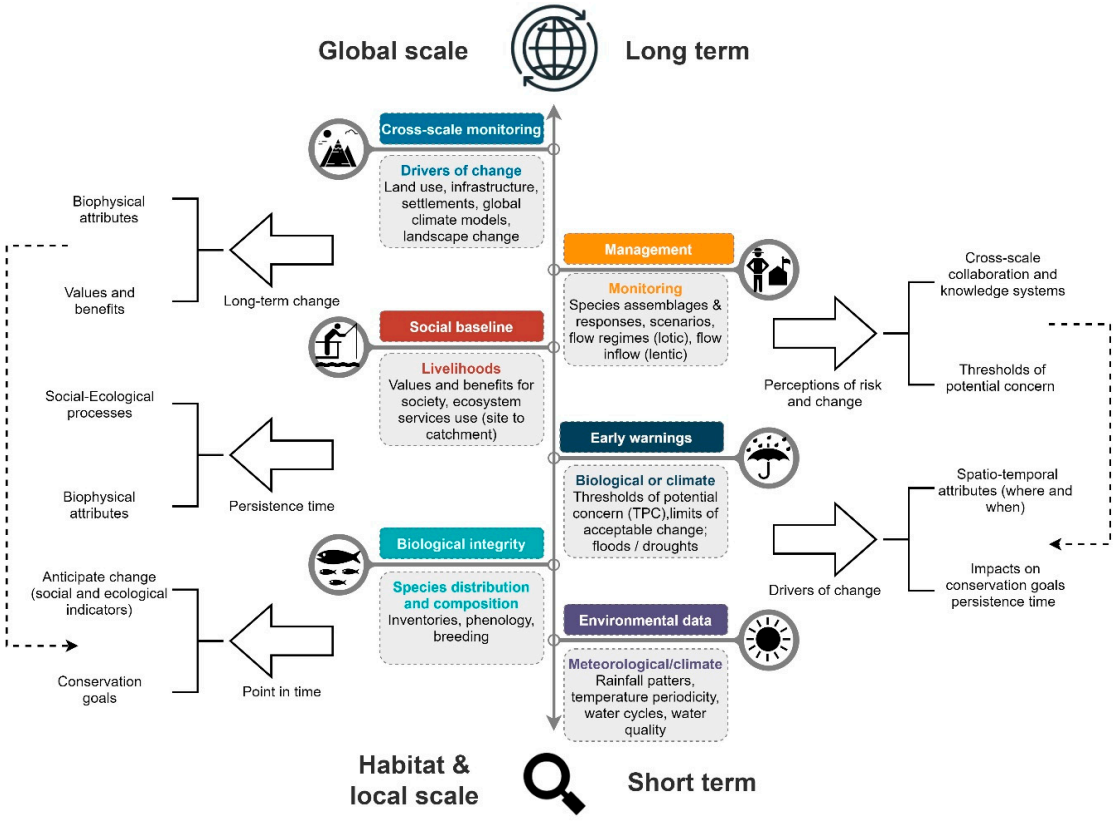

Figure 3. Overview of social-ecological processes and information needs on conservation goals for managing protected areas across spatio-temporal scales, from the short-term and local scale (bottom) to the long-term, large scale (top). Information from local level can help to understand conservation goals and social-ecological responses across scales, and the overall performance of ecological processes and functions. Data collected at the local scale (e.g., inventories) are limited to a moment in time and space; long-term monitoring can address temporal coverage from single inventories. Identifying early warnings like Thresholds of Potential Concern (TPC) facilitates an understanding of systems responses to drivers of change. Drivers of change can be events at local level/small temporal scales, or located at larger spatiotemporal scales, even outside the protected area, their impacts cascading across biophysical systems.

Human responses to environmental change play an important role in the dynamic nature of knowledge production. These responses can include changes in agricultural practices, reforestation and restoration efforts, human migrations or shifts in use of natural resources [20]. Observing and recognizing these responses within and outside the protected area can facilitate learning and experiential

management, which is essential to enabling adaptive practices, while adjusting information needs, timeframes, and planning, which is essential for moving into the strategic practice level.

Finally, it is important to recognize the knowledge governance and decision-making context in the protected area. Each case is different and human perceptions and interpretations of the conservation values influence the creation of knowledge for managing these areas. An open dialogue with relevant stakeholders might allow agreement about objectives and desired future goals as well as identify the most relevant socio-ecological processes that require monitoring and management, while defining the thresholds of potential concern and limits of acceptable change [9,59]. In understanding the type of information available, including the timeframes for which climate information exists, managers can reflect on current practices and management questions, update planning tools, and improve decision making processes.

5. Reconciling Calendar Time with Reflexive Practice

So far, we have considered a framework for multidimensional knowledge-based processes for protected areas management. We emphasize that recognizing temporal dynamics related to production of knowledge is essential to support decision making and planning of social-ecological systems. It can help in understanding complex temporal patterns, the interaction at different geographical scales, and biotic responses to different drivers of change [6]. However, some questions remain outstanding. Environmental managers in the Anthropocene need to be more aware of driver-response dynamics through time and rethink temporal horizons and spatial scales, given the complex context under which multiple actors interact and make decisions [4]. We suggest this framework can help reconcile the different motivations for protecting natural assets when defining and implementing management and adaptation options under uncertain and changing conditions.

Calendar timeframes are useful when dealing with administrative issues, assessing changes in the conditions and guiding future management [60]. Independent on the knowledge model in use, applying a reflexivity process for the management of protected areas can facilitate a time perspective approach and identify relevant information from past events, while observing, documenting, and learning from previous practices, and investing that knowledge in new meaning in the present and into the future. This approach includes thinking about what information is available now or what information might be relevant to understand socio-ecological processes and responses in relation to the conservation goals, while reflecting on the biophysical characteristics that span through space and time and can support an understanding of ecological responses to climate change. In this context, the time perspective can help design monitoring systems with a more systemic vision and facilitate adaptation to a changing climate.

We present examples from South Africa and Colombia to illustrate how calendar times can be reconciled with reflexive practice. An ongoing collaboration between the authors helped to infer how this is happening in each country. The different governance models and knowledge systems of these countries allowed the authors to explore—through an inductive process—the assumptions for the framework. The example from South Africa comes from SANParks extensive experience with adaptive management; for Colombia, we used data collected through a co-production and knowledge governance study [18].

5.1. South African Approach: Strategic Adaptive Management and Reflexivity

How different is the framework presented here (Figure 1) from adaptive management? Adaptive management has become a foundation of effective environmental management in contexts characterized by high levels of ecological uncertainty [61]. It stems from acknowledging that ecological (and social-ecological) systems are complex, that understanding of such systems is imperfect and partial, and that the responsible way to proceed with management in these contexts is to learn by doing, and to adapt actions as new understanding emerges. It achieves this by integrating research, planning, management, and monitoring in repeated cycles of learning [62]. Adaptive management

is a systematic approach to improving the management process by purposefully learning from the outcomes of management actions.

Strategic Adaptive Management (SAM) is a version of adaptive management that has been iteratively developed and implemented by SANParks for more than 20 years [9,63]. SAM has been applied to a variety of social-ecological challenges, from relatively narrow (e.g., management of elephant populations [64]) to extremely broad (e.g., management of a national park; for more information, see Roux et al. in review) application contexts. Regardless of the context, SAM consists of four interlinked and dynamic sub-processes [65]: adaptive governance (co-producing the 'rules of the game' at a range of levels, from national legislation to park policy to local rules shaped by stakeholder norms and values); adaptive planning (co-creating a vision and management objectives for addressing a specific social-ecological challenge); adaptive implementation (designing and implementing management measures, research experiments and monitoring programs to action the above objectives and enable learning from their outcomes); and adaptive evaluation (assessing and reflecting on the outcomes of implementation against the vision and objectives, to inform ongoing learning and adaptation).

During adaptive planning, diverse stakeholders participate in face-to-face dialogues during which they deliberate the social values, changing contexts (social, technological, economic, environmental, and political) and vital attributes (special or unique features) of the social-ecological system of concern that should guide future decision making. These dialogues provide the basis for jointly articulating a vision and setting management objectives. The tacit knowledge of participants, which reflects past experiences, converges into an explicit vision statement and objectives for directing management in the future.

During adaptive implementation, ongoing engagement between agency scientists, park management, and stakeholder groups enables the consideration of multiple knowledge sources, including experiential and tacit understanding as well as science-based information, to inform decision options. Selected management actions are implemented in conjunction with complementary research projects and monitoring programs, to enable purposeful learning by doing. Monitoring of key indicators, and setting TPCs for these indicators, serve as forms of feedback to stimulate reflection, especially when thresholds are being approached or exceeded.

Adaptive evaluation refers to formal and informal assessment of and reflection on progress towards achieving the vision and set objectives, in line with the reflexive level. Lessons learned through these processes provide forms of feedback to, at least in theory, update or adapt the rules of the game (adaptive governance), the vision and objectives (adaptive planning) and management actions, research agendas, and monitoring programs (adaptive implementation). The SAM process incorporates memories and prior knowledge of stakeholders to anticipate and articulate a desired future state, which in turn guides sense-making in the present through combined actions, monitoring, learning, and research.

The SAM approach aligns to some degree with the framework. However, even SAM, with its strong emphasis on getting "consensus on a desired future state across a range of value systems" [62], has shortcomings. Park management plans are embedded in national legislation, which render their planning, implementation, and evaluation processes less flexible, responsive, and adaptive to natural social-ecological cycles than ideal [62] (e.g., policy determines when a plan gets revised, and not necessarily readiness of the social-ecological system; compliance culture stifles experimentation; and resource constraints limits dialogue with stakeholders). However, there are opportunities to rearticulate the rules. For example, where management plans include a program on climate change, ongoing learning about, and improved understanding of, climate as a driver of social and ecological change will help to update the normative rules of the game, to better understand information needs for climate adaptation, update monitoring systems, facilitate envisioning options, and rethinking assumptions.

5.2. Colombian Protected Areas: Linking Knowledge and Management Beyond the Calendar

The Colombian protected areas national agency has been actively working to understand the hazards and impacts related to climate change and their implications for managing protected areas. The Future-proofing Conservation project worked with protected area managers to rethink management options in the context of climate change and uncertainty about future socio-ecological transformation [48]. Using semi-structured interviews, the quotes below were documented by C.M. during the project to identify the different forms of knowledge related to climate and ecosystem services that are used for long-term planning and management, and how knowledge governance can be enhanced for strategic thinking and decision making. Full details on the methodological approach and methods are presented in Munera and van Kerkhoff [18]. The quotes in this manuscript have not been published previously.

Knowledge creation is an evolving process of past experiences and everyday interaction with the world, in which reflection is encouraged and learning is incorporated into practice. In Colombia, managers recognize these attributes, and are in the process of implementing reflexive practice: "we have [scientific] information; [now] is a moment to stop, review and analyse what we have, looking at the future, to identify gaps, reflect on other issues we would need to cover and to develop a long-term vision for managing protected areas" (Int. 3). This quote demonstrates the relevance of practices of learning, collaboration, and openness to change. In applying long-term thinking, it is important to consider choices and decisions made today, while being open to accepting and using alternative knowledges to understand territorial processes to support implementation of conservation strategies and connect with different concepts of time and knowledge.

For Colombian protected areas the learning process is allowing reflection on current practices to integrate risk into management and better connect with territory: "we are working on understanding if restoration is an adaptation action or not, what criteria we need to consider and how to apply it in practice to decide if we need to update zoning in the management plan. Managing risk is helping to better understand the territory and identify places where landslides can affect indigenous communities or farmers" (Int. 4). This process is facilitating managers to integrate other forms of knowledge alongside scientific information, enabling the strategic thinking necessary to manage uncertain futures and planning for climate adaptation [18].

Climate change and uncertainty of climate-related information have been reported as a major barrier for making decisions [66], so is the poor understanding of climate change impacts and mechanisms of climate sensitivity for species and ecological processes [17]. These limitations, plus a sense of urgency in trying to avoid ecological change, might prevent managers from fully considering social-ecological dynamics and potential mismatches in the information available to them. Climate change is opening the door to update current practice: "climate change is forcing us to look beyond the boundaries of the protected area and have more integral planning" (Int. 12). Although this openness to incorporating new knowledge was in response to a technical deficit (a lack of instruments for monitoring climate variables), it demonstrates that it is possible to rethink practice [18]. Instead of a reactive use of information, when a climate event triggers a response [66], managers can benefit from careful consideration of how past events have shaped present-day ecosystems, and cross-scale ecological responses of the conservation goals. Such considerations include the identification of conditions that may trigger other responses and can give managers agency to identify the most relevant information to act as the future unfolds.

A diversity of worldviews in a context of managing protected areas and knowledge-based processes can facilitate the reconfiguration and rethinking of managing multidimensional protected areas systems. Indigenous communities have specific timescapes, intrinsically linked with their interpretation of the environment across temporal and spatial scales. In their view, life and nature are not seen as discrete units, but as processes that have specific cycles linked with belief systems and cosmology. For Indigenous groups, decisions on their land requires revisiting their ancestral history [42,55], a view that demonstrates a deep time perspective and connectedness with the territory. Some Colombian

protected areas that are co-managed by indigenous groups are in the process of adjusting modern administrative timeframes to local tempos, set by nature and people's connection with it [42,67], and, when setting meetings, managers need to consider environmental rhythms (e.g., river flows), customs (e.g., funerals, wakes, and dreams) and their timing with nature. Although these parks are managed under State rules, local practices have been influencing the way the National Protected Areas agency interprets their role and governance in areas inhabited by Indigenous communities [42].

5.3. Implications for Future Management

As we started developing the ideas for this manuscript, an unprecedented bushfire season ravaged parts of Australia. Although bushfires are expected every summer, their severity and extent had enormous impacts on National Parks, wildlife, and livelihoods, challenging the response capacity to deal with them and questioning how to integrate Aboriginal customary practices of fire management. Fire regimes in Australia are well documented, especially in relation with the human practices and Aboriginal knowledge [68]. Aboriginal customary practices to manage the land using fire have been proven to reduce the density of shrubby understory plants and fuel loads, thereby reducing the intensity of bushfires [69,70]. Incorporating Indigenous fire management into Australian protected areas can be regarded as a direct adaptation measure to manage dynamic ecosystems under a changing climate or as an indirect adaptation measure, which aims to maintain ecosystems in their current configuration, depending on context and perspective [71]. Integrating ILK with modern technology and science can be beneficial, but requires changes in knowledge governance hierarchies, reflection on future expectations of conservation goals, and defining how much change managers and local communities are willing to accept to facilitate system monitoring, management, and action [72].

Understanding and accepting change (ecological change, change in practice, change in knowledge, and change in the territory) is a first step to rethink management of biodiversity under changing environmental conditions and climate. This perspective constitutes a shift in the way we conceptualize nature and management, and therefore the epistemic context and responses. In documenting dynamics of change and adaptation in epistemic communities (specifically practitioners and researchers working in ecological restoration), Hirsch and Long [73] found that when practitioners move their expectations from stable climates and ecological models to recognize the possibility that historic conditions and preconceived assumptions of nature might no longer exist, they were able to reorient practice and goals. This shift in thinking and practice might bring new paradigms, concepts, perspectives, and ideas, enabling the integration of new information and knowledge for strategic adaptive management.

Through a reflexive practice, managers, local communities, and other relevant stakeholders (information providers included) can discuss and identify TPCs and limits of acceptable change and identify management responses in relation to change, while adapting information needs. This shift in the science-practice paradigm is reported in Kruger National Park [9], where SAM was a response from managers who realized that instead of avoiding change, it would be better to understand and anticipate it, while working to identify conservation goals and thresholds of potential concern. This re-framing allows a transition from business-as-usual management to an approach where the complexity of social-ecological dynamics is recognized. Rapid change is embraced to allow room for co-learning, to understand change and the multiple values, knowledge, and interpretations of nature.

The interaction between different epistemic communities can help to update knowledge-based processes, as reported for Colombian protected areas [18]. This interaction demonstrates that biodiversity conservation planning processes can accommodate a range of different outcomes and worldviews, while recognizing how environmental decisions connect or impact other sectors. Anticipating the future is not about speculating, but being able to consider future consequences of decisions made today, having agency and willingness to change and take action, question current alternatives, being able to connect with other forms of knowledge, disciplines, and stakeholders, and being aware of others (nature or society) when making decisions [37].

6. Conclusions

The framework we present provides some guidance to connect multiple dimensions where knowledge and decision-making interact in the management of protected areas. We consider it is adaptable to specific context and circumstances, considering the knowledge governance model in use, and taking advantage of managers' experience and daily interaction with social-ecological systems to facilitate learning and co-production. Also, the framework incorporates a recognition that social-ecological processes and drivers of change have different time horizons and operate at different spatial scales. Rethinking and changing knowledge systems in use can take advantage of the diverse ways people make sense of the present and envision the future.

The custodianship of the present for future generations is augmented by an appreciation of the past and the acknowledgement of the plurality of knowledge systems. Use of diverse knowledge systems takes advantage of a richer set of memories, facilitating the process of anticipation and adaptation to new conditions, dealing with surprises, and reconciling collective agendas and expectations [8,74]. In a context of climate change, governance determines how we respond to new and uncertain climate impacts, and influences whether and how strategies are implemented [75]. Considering the challenges posed by climate change, and other drivers, we need more flexible management of biodiversity and ecosystem services while incorporating multiple visions, temporalities, processes, and interpretations of the world. The concept of timescapes [30], can help managers to understand time related processes in their areas, rethink assumptions, and explicitly consider and integrate multidimensional knowledge-based processes in mental models and practice. For example, because timescapes encompass seasons, natural rhythms and cycles, and memories of natural events, they can be used in TPC thinking and SAM by paying greater attention to changes in the return interval and seasonal shifts in events related to drivers of change, such as bushfires, floods, droughts, and cyclones. The effects of such changes on the integrity of protected areas and surrounding landscapes, and the consequences for achievability of management objectives then form a basis for a more reflexive approach to management.

Reconciling calendar management times with reflexive practice is possible, as we have presented here. South Africa National Parks is working on it, while Colombian protected areas have been accommodating diverse knowledge systems to complement technical knowledge and transitioning to adjust practices and rules. Although we probably will not find an ultimate suitable and cost-effective solution to deal with complex problems in a rapidly changing world, as Fernández [11] (p. 172) points out, we need to remember "new circumstances and context, including past solutions, require ongoing work because we are dealing with co-evolving systems". Accepting this challenge requires for us to stop, contemplate, and understand the moment, as well as to be conscious about how our actions and knowledge are connected and can impact future social, political, and ecological outcomes. Embracing a bit of slowness is important to better identify, evaluate, and deploy the knowledge required to deal with future changes, beyond just responding to "efficient" calendar times. We finish quoting an old Italian proverb: *chi va piano, va sano e va lontano* (whoever goes slowly, goes safely and goes far).

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Appendix A

Table A1. Guiding questions for protected area managers to facilitate the reflexivity process in multidimensional knowledge-based processes, and options to consider for the *day-to-day practice* level. **Words highlighted in bold** represent some key ideas and issues to consider.

Guiding Questions	Options	References
What is the current model of knowledge governance in use?	**Constant dialogue** between managers, practitioners and scientists to follow up system responses and 'novelties. Even under a loading dock knowledge transfer model, managers can have a dialogue with scientists to refine information needs. **Co-production**, interdisciplinarity and socio-cultural diversity to integrate local knowledge can facilitate understanding of different needs, expectations, and social-ecological responses. Evaluate **costs and needs** for data collection, including where to host the data, funding, and capacity to analyse and interpret it in the long term	[12,13,50,52,53]
What is the main conservation goal (e.g., biophysical attributes, ecosystems services, ecological processes) and what information better capture conservation goals responses to drivers of change?	**Inventories** and surveys provide a first glimpse of conservation goals status but are limited to **narrow spatio-temporal scales**. Evaluate survey characteristics, frequency of data collected, and applicability of results. Historical data can be useful to understand the system and anticipate responses, important to **evaluate availability and quality** (e.g., gaps in time or space) of datasets. Identify indicators that can help understand climate change as a factor influencing **ecological integrity** (e.g., early warnings systems-floods and droughts)	[5,31,76,77]
Where are the ecological processes and drivers of change located?	**Conservation objectives** can have a narrow or broad **spatio-temporal scale**; drivers of change can be inside, or outside the protected area. Evaluate which **methods** for data collection best captures processes and drivers of change at **different scales**. Identify the **quality and origin** of the drivers of change (e.g., endogenous change, exogenous-agriculture, anthropogenic climate change-related)	[5,31,78,79]
What temporal and spatial scales are more relevant to monitor conservation goals and social-ecological processes?	Information about social-ecological responses at **smaller spatial scales** (and over short periods) can help, over time, to **connect to broader scales** (even if this is not the original objective) but requires **consistency to avoid information gaps**. Consider establishing **long-term monitoring** systems of ecological processes and **monitoring impacts of external drivers of change**. Understand **persistence time** of conservation goals to improve design of monitoring systems and observe **responses and trends to anticipate future changes**	[5,78]
How much change are managers and stakeholders willing to accept in relation of social-ecological systems?	Define indicators and **thresholds of potential concern** of these indicators, co-produced with managers, scientists, and communities to track social-ecological responses, define future expectations, **limits of acceptable change** and decide when to intervene. Complementary to quantitative tools, **qualitative tools** can help predict **system responses and cascade effects** of disturbances	[32,57,59,80,81]

Table A2. Guiding questions for protected area managers to facilitate the reflexivity process in multidimensional knowledge-based processes at the *reflexive practice* level. **Words highlighted in bold** represent some key ideas and issues to consider.

Guiding Questions	Options	References
Are managers and scientists understanding response times and social-ecological systems responses?	**Evaluate if current information** systems and **data quality** allow managers and other relevant stakeholders to understand ecological processes, functions, and responses to disturbances. **Conceptual models** and mental maps can help design monitoring, understand system dynamics, **connect knowledge systems**, and identify management options	[9,31,82–84]
What was learnt from the previous practice and monitoring?	Allow time for **co-learning and evaluate social-ecological responses** in deciding if, and when to intervene, including understanding and learning from human responses to ecological transformation through time	[48,85]
Are current monitoring systems and management effectiveness processes adequately capturing responses and changes of socio-ecological systems across temporal and spatial scales?	**Review and update** monitoring systems to capture knowledge and learning from different actors and facilitate future decisions. Evaluate if **monitoring system timeframes** are adequate to follow social-ecological responses, inform decision-making processes, communicate risks, and facilitate stakeholder engagement. Evaluate if management effectiveness results can help to understand changes in social-ecological systems	[78,86]
Can observations from stakeholders outside the protected area and local knowledge, help to understand human and nature responses to drivers of change?	Evaluate and **update thresholds of potential concern** to ensure monitoring systems are capturing ecological responses across scales and enabling action. **Identify potential collaborators** for monitoring ecological processes outside the protected area	[18,59]
Are future expectations for the conservation goals in the still valid and relevant?	Under conditions of uncertainty and complex systems, **envisioning and futures thinking** approaches can help visualize future scenarios and identify actions that can be done in the present	[35,36,48]

Table A3. Guiding questions for protected area managers to facilitate the reflexivity process in multidimensional knowledge-based processes at the *strategic planning* level. **Words highlighted in bold** represent some key ideas and issues to consider.

Guiding Questions	Options	References
Under scenarios of ecological change, is the long-term vision of the protected area inclusive of the beliefs, livelihoods, and expectations of different stakeholder groups?	Identify **complementary management and adaptation options** (e.g., stewardship programs, corridors, community conservation). Evaluate if conservations goals are still relevant or need to be reframed to address stakeholder visions while addressing future climate change. Participatory workshops, face-to-face **dialogues**, or **co-production** to reconcile different expectations about the future. Evaluate **changes in perception of values** about the protected area and identify how to allow access to conservation benefits without compromising ecological integrity.	[48,78]
How do we improve and update monitoring systems and knowledge governance models to facilitate strategic planning in a context of high uncertainty?	**Update standards and rules** (including funding) to improve monitoring systems and enable action; evaluate adequacy of **funding**. Co-design strategies for knowledge co-production can help identify options to **rearticulate knowledge governance models** to deal with uncertain futures. Evaluate management options, identify new alternatives and barriers that constrain adaptive management	[12,48,87]
Are there options for cross-scale management and knowledge co-production in and outside protected area boundaries?	Consider the **voices and expertise** from diverse **stakeholders in and outside the protected area** to enable a dialogue and participatory strategic planning. This can help evaluate responses and **rethink current practices** while finding a balance between the requirement of protected area management and the social-ecological context.	[48]
Are decision-making processes and knowledge systems still valid to deal with new conditions and navigate ecological change?	Evaluate **strategic alliances** between different groups for collecting, analysing, and sharing information (e.g., private sector, academia, local communities). Identify which **rules and norms** might need to change to facilitate integrating diverse knowledge systems to facilitate adaptation in the short and long-term	[46]

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5.2. Engaging with the future: framings of adaptation to climate change in conservation (Paper 2)

Given the multiple definitions, frameworks, and approaches for adaptation, this paper aims to understand how adaptation is used by the academic community to inform its implementation in conservation practice. Studying how climate adaptation is used by communities of practice can help to identify patterns and concepts (narratives) used by epistemic communities addressing research question 1. Identifying these narratives helps in understanding how adaptation concepts are enabling conservation science and practice to reflect on ecological transformation and identify options to facilitate management changes (research question 2 and sub-question 2a).

Applying a systematic thematic review (150 papers screened), with my co-authors we mapped key themes from academic literature (peer-reviewed papers) to identify how the concept of adaptation and related themes are translated and used in different conservation approaches. The results were analysed using the 5DFC, to understand how change is framed in the definitions, and how such framings influence adaptation preferences, which helped me to address research question 2. I found that adaptation in conservation contexts is used as a boundary object and can have different meanings and interpretations. There is a plurality of adaptation approaches, visions, and expectations of what adaptation is, how to implement it, and what are its expected outcomes (e.g. resisting or accommodating change). Despite this pluralism, there is rarely reflection to consider what adaptation entails, who benefits from it, and whose knowledge informs decision making. Scientific/technical approaches are the preferred way to address uncertainty. These findings helped me to address research questions 1 and 2.

Paper 2 also proposes a model to help scientists and practitioners unpack existing assumptions about change and expected adaptation outcomes. The paper provides a discussion about the implications for management and what managers should consider when defining adaptation options while considering existing arrangements for managing protected areas (sub-question 2a). In this paper we provide recommendations to foster collaborative dialogues to consider changing current management approaches, evaluating whether decisions made today are adequate for the future in a rapidly changing world. The findings from Paper 2 help to understand the emergence of the adaptation narratives presented in **Papers 3** and **5**.

Complementary information not included in Paper 2:

During article screening I also extracted details (if provided in the article) about stakeholders involved in adaptation, the scale of adaptation approaches, governance arrangements, timeframes, summary of recommendations or outcomes. This was useful to understand how the academic literature is informing adaptation practice and helped me to address research questions 1, 2, and sub-question 2a. Those findings are not presented in Paper 2, but I elaborate on additional results here, as it was fundamental for the research to understand how adaptation is conceptualised in conservation.

After screening the 150 articles, I categorised how they described the biophysical or social system elements that need to adapt to climate change (e.g. biophysical or social

attributes; Table 5.1).

Table 5.1. Qualitative attributes of adaptation extracted after screening and coding 150 articles. Count per node (in brackets) extracted from NVivo. Source: author.

Questions (node)	Common qualitative attributes
Adaptation by whom?	Managers (72)
(Agents mentioned)	Scientists (26)
Adaptation of what?	Biophysical attributes (80)
(System elements)	Social attributes (strategies, laws, policies) (67)
Which scales are mentioned?	Political (99)
(Analytical focus)	Protected areas (47)
	Country (40)
	Biophysical (93)
	Species (50)
	Ecosystems (36)
Key words	Climate [change] (114)
	Management (62)
	Planning (37)

From 150 articles, only 22 described adaptation in terms of socio-ecological systems (addressing both biophysical and social elements), but the majority focus on ecological attributes. Eight articles mentioned the need to recognise societal values in adaptation. The scale of adaptation was often expressed in biophysical terms (e.g. landscapes), but the articles also covered the political scale at which adaptation occurs (e.g. protected areas).

The most common adaptation recommendations made in the articles are summarised in Fig. 5.1.

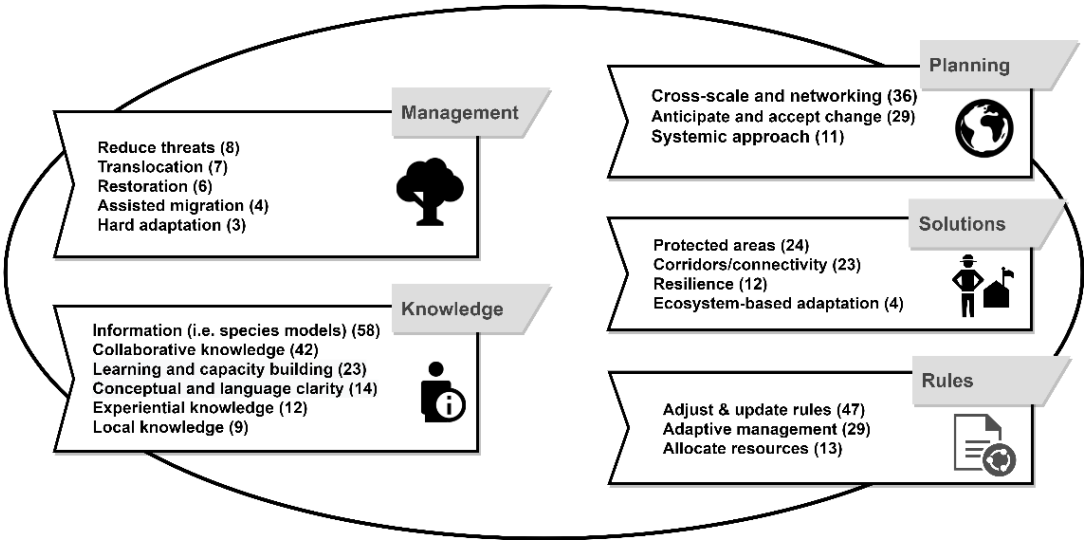

Figure 5.1. Themes covered in the recommendations for adaptation after screening 150 articles. The numbers of articles addressing each theme are in brackets. Source: author.

These recommendations include knowledge-based (scientific information, n = 58; learning and capacity building, n = 23). Collaborative approaches such as integrating technical and scientific knowledge with experiential knowledge of protected area

managers were frequent (n = 42), but few (n = 9) involved including Local and Indigenous Knowledge. Some articles (n = 14) called for clarity in communicating climate information and concepts to different audiences. Management recommendations included designating and managing protected areas (n = 24), landscape connectivity and corridors (n = 23), reducing threats (n = 8), translocation (n = 7), restoration (n = 6), assisted migration (n = 4), and infrastructure adaptation options (n = 3). The most frequent planning recommendation was for incorporating diverse stakeholder perceptions and knowledge across spatio-temporal scales (n =36). Rules-based recommendations focused on updating rules (n = 47), or managing adaptively, proactively, and flexibly (n = 29).

Australian National University

Statement of Contribution

This thesis is submitted as a Thesis by Compilation in accordance with https://policies.anu.edu.au/ppl/document/ANUP_003405

I declare that the research presented in this Thesis represents original work that I carried out during my candidature at the Australian National University, except for contributions to multi-author papers incorporated in the Thesis where my contributions are specified in this Statement of Contribution.

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REVIEW

Engaging with the future: framings of adaptation to climate change in conservation

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ABSTRACT

The term 'adaptation' is commonplace in conservation research and practice, but often without a reflection on the assumptions, expectations, or frames of reference used to define goals and actions. Communities of practice (e.g. conservation researchers, protected areas managers) have different interpretations of climate change impacts on biodiversity and different ways of defining, operationalizing and implementing adaptation. Their cognitive and motivational expectations for the future are associated with different paths to reach such desired futures. To understand how adaptation is framed in conservation, we undertook a systematic review with a thematic synthesis of the definitions of the term as used in the academic conservation literature. From a sample of 150 articles, only 36 provided a definition of adaptation. We critically appraised the explicit definitions to identify emergent themes that represent particular adaptation approaches. Themes were then grouped, and each group was assigned to a scholarly tradition, onto-epistemological approach and theoretical perspective. Based on theoretical perspectives on social change, we propose a framework (including individual cognitive basis, social interactions, and openness to alternatives) to analyse how change is framed in the definitions and how the framings influence adaptation options. The grouped themes represent passive, active, or indirect adaptation approaches. We used these themes to generate a conceptual model to guide conservation researchers and practitioners engaged in climate adaptation research, policy and management to aid reflection and understanding of the options available to design adaptation agendas and allow negotiation of diverse interests, views and expectations about the future.

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1. Introduction

Global biodiversity agendas are calling for novel conservation approaches and increased actions to address climate change effects on biodiversity and society while supporting 'habitable climate, self-sustaining biodiversity and a good quality of life for all' Pörtner et al. (2021). Adapting to climate change is and will continue to be an imperative for social-ecological systems (SES) through strong and innovative efforts. By SES we refer to the interconnected systems of people and nature, 'characterised by strong connections and feedbacks within and between social and ecological components that determine their overall dynamics' (Biggs et al. 2021, p. 5). Actions to prepare for and respond to actual or expected global environmental change are influenced by individual and collective framings of reality (Castree et al. 2021), previous knowledge, experiences, and expectations for the future. For example, adaptation in biodiversity conservation contexts usually concerns technical responses to known biophysical risks (e.g. floods, bushfires) or environmental changes (e.g. phenological shifts) through the evaluation of impacts and vulnerability, identification of options and implementation of responses (Noble et al. 2014). These responses represent visions or aspirations for the future, defining what elements are to be conserved and influencing social and political agendas.

As researchers and practitioners in climate adaptation integrate knowledge and practice among disciplines and across sectors (Nalau and Verrall 2021), different adaptation interpretations have emerged in the literature (Bassett and Fogelman 2013). Conceptualization and implementation of the adaptation concept involve contestation among adaptation stakeholders with diverse world views, knowledge, values, rules and preferences (Wise et al. 2014) and different ways of addressing uncertainty and social-ecological change (Wyborn et al. 2016). Accordingly, there are multiple interpretations of what adaptation is and what adaptation success looks like (Singh et al. 2021). Understanding adaptation concepts requires revising existing assumptions and expectations, and recognizing the diversity in framings of risk, time,

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and space to identify adaptation opportunities and diversify available options to address current change and prepare for the future (Morchain 2018).

The effects of climate change on biodiversity are well documented, as are the options to respond to it. Several articles detail adaptation options for protected areas (e.g. Hannah 2010; Gross et al. 2016), at species level (e.g. Foden et al. 2018) and SES (e.g. Colloff et al. 2020; Fedele et al. 2020). Working with nature and ecosystems to support adaptation to climate change is central to Ecosystem-based Adaptation (EbA; CDB 2009), Ecosystem-based Disaster Risk Reduction (Klein et al. 2019) and Nature-based Solutions (Seddon et al. 2019; Palomo et al. 2021). Other approaches in conservation practice include Climate-smart Conservation (Stein et al. 2013) and Pro-poor Conservation (Adams et al. 2004). All these approaches reflect a plurality of paradigms and frameworks, but rarely with a reflection on what or whose frames of reference are informing choices, what is deemed desirable, and how to deal with change (Osaka et al. 2021).

The lack of clarity in conceptual framings of adaptation and transformation can impede action (Feola 2015). Exploring the plurality of narratives, concepts and frameworks in use can stimulate discussions about the problem and approaches to find common ground in research and practice. Uncovering how climate adaptation is used in biodiversity conservation helps identify how epistemic communities (Haas 1992) frame and translate adaptation to communities of practice. In this paper, we explore future-orientation characteristics of the definitions and concepts of adaptation used in the academic literature to examine the ontological and epistemological origins that frame perceptions of change and concepts of adaptation. To foster reflexivity about these concepts and framings, we propose a model to guide biodiversity conservation practitioners and researchers dealing with climate change to critically think about future adaptation outcomes.

As far as we are aware, there is no published analysis exploring characteristics of future-orientation in relation to adaptation concepts, as used in conservation research. We explored: 1) how adaptation is defined; 2) emergent themes and concepts and 3) similarities and differences between adaptation concepts. We used a systematic review with a thematic synthesis of the literature by analysing themes and concepts to evaluate how the definitions are enabling an understanding of climate change impacts and preparation for the future. From this review, we developed a conceptual framework for conservation researchers and practitioners engaged in the interface between adaptation research, policy, and practice. We do not advocate a specific definition or approach but provide a critical perspective to think *about what adaptation is* and prepare strategies to deal with changing futures.

2. Methods

A thematic review is a qualitative method to identify concepts or themes and elicit how terms are applied in different situations (Thomas and Harden 2008). By analysing patterns of meaning within concepts used in particular contexts, boundary objects can be identified as well as common approaches used by communities of practice. We adapted the thematic synthesis procedure of Haddaway et al. (2018) to the following sequence: 1) select relevant literature on adaptation in conservation; 2) screen articles; 3) map and extract themes; 4) identify concepts, and 5) analyse concepts.

2.1. Literature selection, screening, and theme mapping

The literature was selected by running a broad query in the database Scopus using the search string:

> 'conservation' AND ('climat* chang*' OR 'eco* transform*')

Using the term (adapt*) returned too many results, in different disciplines, so we abandoned it. We selected articles in English (2010–2019), in peer-reviewed journals. The search was restricted to title, keywords, and abstract. The search generated 7,252 papers. We used revtools, an R Package to screen articles for similar topics or themes to identify relevant papers for synthesis (Westgate 2019). After several iterations we obtained a sub-sample of 441 articles. Manual screening of texts gave a final sample of 150 articles (Figure 1 and Appendix A). We excluded articles that: 1) described climate change impacts on ecosystems and/or biodiversity but did not address adaptation; 2) were about adaptive management but did not address climate change; 3) did not contain an explanation of, or approach to, climate adaptation; 4) reported sectoral vulnerability (e.g. forestry, fisheries or water resources) but which did not address biodiversity conservation (i.e. actions directed to preserve biodiversity or some elements thereof).

Each article conveying an adaptation concept was appraised as providing an explicit definition of adaptation. Those articles with a definition were critically assessed for key narratives and themes, which were then tabulated in MS Excel. Duplicate or overlapping themes were combined or clarified to obtain a list of grouped themes (clusters) by manual screening of articles that contained a definition of adaptation. The final number of themes and clusters emerged using an inductive coding approach while screening the 150 articles. Themes were coded using a cluster

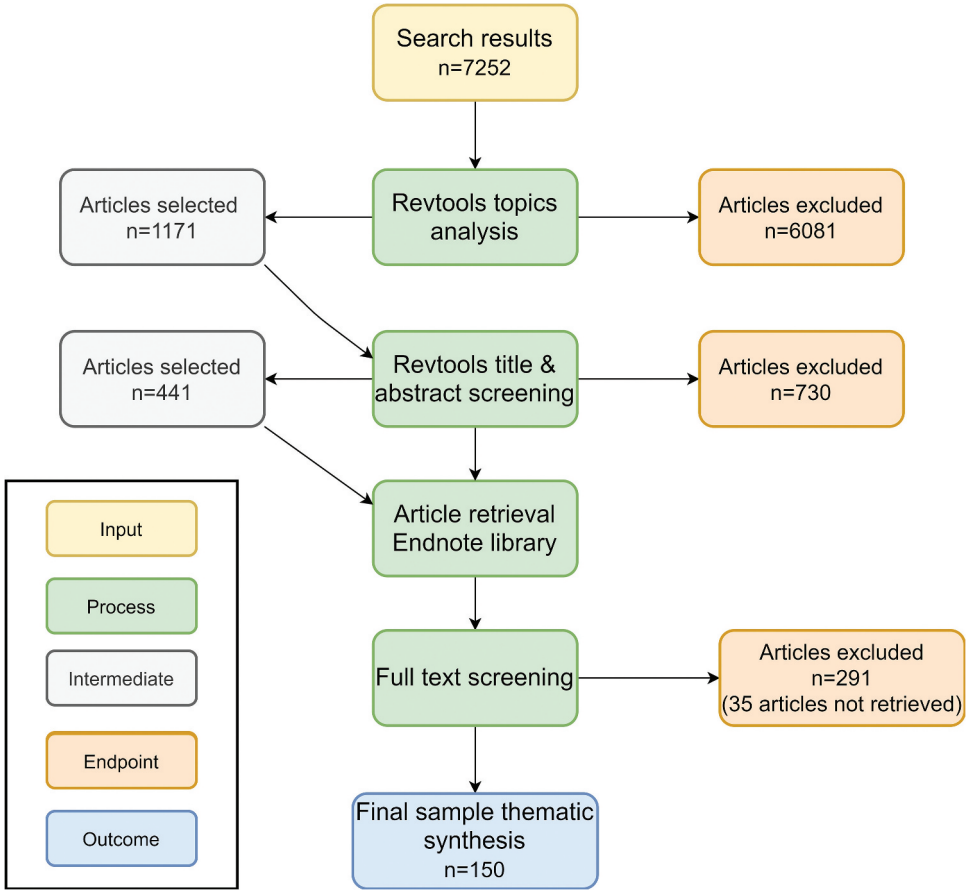

Figure 1. Flow diagram showing the stages of the systematic review process.

analysis of word similarity using qualitative data analysis software NVivo 12 (QSR International 2020).

2.2. An analytical framework for adaptation concepts

Understanding the epistemological and ontological diversity of adaptation concepts can help identify contestation between stakeholders engaged in adaptation activities (Bennett et al. 2017). Ontology concerns 'what is' the nature of reality to be explained, while epistemology is the knowledge choices used to understand the world (Moon and Blackman 2014). Different disciplinary traditions are grounded in different ontologies and epistemologies influencing what aspects of reality are studied, and which types of research methods are deployed to understand that reality.

Using an interdisciplinary basis to construct an analytical framework for adaptation concepts, we use elements from the Five Dimensions of Futures Consciousness (Ahvenharju et al. 2018) and components from the review of transformation by Feola (2015). Both frameworks are based on theoretical perspectives on social change. That of Feola (2015) is based on social theory and uses the criteria of Sztompka (1993) to classify social change processes: system model, awareness of time scales, understanding of causality, awareness of change and its outcomes. The framework of Ahvenharju et al. (2018) is based on social psychology and how people understand, prepare for and embrace the future. A primary assumption in our analysis is that nature and social orders (social institutions, structures, relationships) interact and are produced together (Jasanoff 2004). A simplified summary of these frameworks is explained in Figure 2 covering three broad domains to analyze the definitions.

The first domain is the cognitive basis on which individuals contemplate future consequences (Ahvenharju et al. 2018). This cognition includes 'time perspective'; an imagined logic between temporal elements in a system, such as patterns of decline or stability: 'the form and time span the change process takes' (Feola 2015, p. 379). Time perspective is linked with causality, assignment of function and intentionality: how an understanding of sequences of events and their consequences influences the capacity of actors to respond to change. Agency beliefs in this domain address how individuals and collectives have confidence in their capacity to influence future events.

The second domain involves systems-based and social-collective features of adaptation, involving system perception and the relatedness of system elements, including concern for nature and other people. SES are multi-dimensional, non-linear and involve interactions among their components

(resources, ecosystems, actors, communities) under a range of environmental, social, economic, and institutional conditions. Concern for others implies an understanding of how systems responses to drivers of change affect human and non-human agents (Dunlop and Brown 2008).

The third domain is openness to alternatives, involving critical thinking and questioning commonly accepted views of systems changes. Openness to alternatives implies exploring, using and applying new knowledge and options instead of looking for and sticking to predictions and plans (Ahvenharju et al. 2018). This domain brings together the previous ones.

After coding the themes extracted from the definitions, we aggregated similar themes in groups. We then used the three domains explained above (Figure 2) to explore how change is framed in the definitions and how the framings influence adaptation options. Table 1 describes the concepts used to assign ontological, epistemological, and theoretical perspectives to the grouped themes, following Moon and Blackman (2014).

3. Results

3.1. Thematic synthesis

Some 36 of the 150 articles screened provided an explicit definition of adaptation. Adaptation definitions were diverse, with a total of 83 themes across the 36 definitions, from maintaining conditions to accommodating change. These themes were aggregated into nine clusters based on overlap in scope (see examples in Table 2). Some themes appeared in more than one definition of adaptation and were therefore shared among clusters. (See Appendix A for details of which articles, themes and clusters were collated.) The thematic analysis reflected the conceptual diversity informing adaptation and how issues of visibility, authority and legitimacy influence the conceptualization of adaptation. For example, at least 12 definitions followed the IPCC definition of adaptation (IPCC 2007, 2014).

Each cluster represented a set of ideas, approaches, and expectations of adaptation. The nine clusters were: 1) Nature by Itself (evolutionary and autonomous adaptation); 2) Resilience (ability of systems and its elements to absorb change and recover from disturbance), 3) Managing Nature (active manipulation to prevent, or control perceived environmental crises); 4) Caring for Nature (non-manipulative management actions based on care and empathy); 5) Ecosystems (approaches promoting conservation and sustainable use of ecosystems, with ecosystem properties providing a basis for adaptation); 6) Opportunities (existing options to facilitate and implement adaptation); 7) Learning and Understanding (active processes involving collective production of knowledge on climate change, impacts and adaptation); 8) Institutional Processes

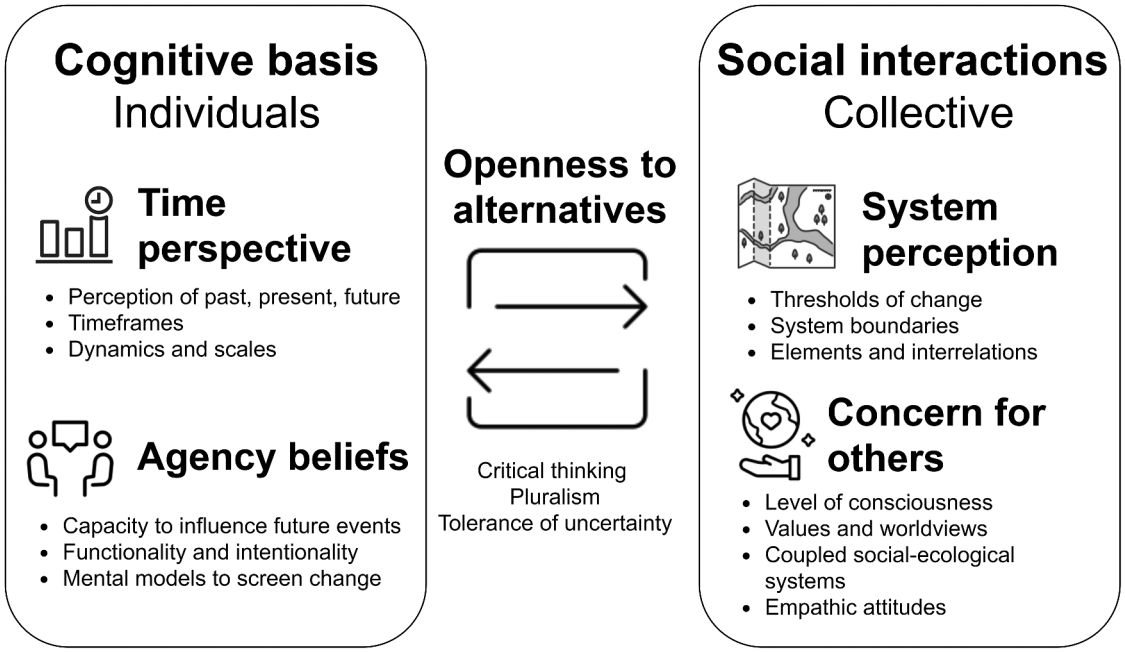

Figure 2. Analytical framework for adaptation concepts. The first domain (left) represents individuals' cognitive capacity to understand temporal characteristics of social-ecological processes and ability to respond to change and influence future events. This domain shapes the social, collective ways of understanding the system (right), its elements, boundaries, and the level of concern towards others. Openness to alternatives (center) or the individual and collective capacity to critically think about current options to deal with change helps to connect these domains. Based on Ahvenharju et al. (2018) and Feola (2015)

Table 1. Summary of concepts used in the analyses, explaining the ontological basis, epistemological approach, and theoretical perspective assigned to grouped themes from the adaptation concepts. Adapted from Moon and Blackman (2014, p. 1169).

	Elements	Definition
Ontology ('what is' the nature of reality to be explained)	Realism	One reality exist. Reality can be explained through appropriate methods (naïve realism). Defining reality remains uncertain because the structures affecting reality can change (structural realism). Understanding nature requires critical examination (critical realism).
	Relativism	Multiple realities exist. Reality has a unique construction in people's mind (relativism), or is constructed and shared by a group, but multiple realities are constructed across groups (bounded relativism).
Epistemology (Knowledge choices used to understand the world)	Objectivism	Knowledge is created by observing and documenting reality
	Subjectivism	Knowledge is influenced by people's interpretations of reality
	Constructivism	Knowledge is created through people's interactions with reality
Theoretical perspective (Systems of values guiding action)	Positivism	Knowledge from natural science methods can be applied to predict the social world
	Structuralism	Knowledge comes from understanding formal structures, ideas, and concepts in use, and can be applied to predict all aspects of human culture
	Critical theory	Question and challenge existing truths
	Feminism	Understanding power relations and behaviours to enable change
	Post-structuralism	Deconstruct language and discourses in use to understand a problem and its causes
	Pragmatism	Any method should be used to understand a problem

(governance options to facilitate adaptation) and 9) Anticipating (envisioning actions and responses).

We identified three emergent adaptation approaches from the clusters: 1) Passive (letting nature work); 2) Active (intervening); and 3) Indirect (creating the right conditions) (Figure 3). Proximity between clusters indicates the multiple concepts informing adaptation in conservation (representing a scholarly tradition) and the related onto-epistemological and theoretical perspective from which they are derived (Table 3).

3.2. Analysis of concepts

Below, we explore similarities and differences among the adaptation themes, following the three domains in the analytical framework for adaptation concepts (subsection 2.2.).

3.2.1. Time perspective and agency

Adaptation approaches connecting past, present and future through anticipation are embedded in the clusters Anticipating, Learning and Understanding, Opportunities and Managing Nature. Although the definitions of adaptation generally do not address time (32 of 36), we identified three temporal perspectives in the clusters. First, adaptation processes related to continuous, unidirectional perceptions of time attempt to prevent or minimise change (e.g. maintenance of ecosystems processes and functions), as in Nature by Itself, Caring for Nature and Managing Nature. In clusters such Institutional Processes and Anticipating, linear events (e.g. adaptive management, adaptation pathways) can have different directions, acknowledging options for alternatives to accommodate change. In the second perspective, cyclical natural processes allow adjustments under some degree of human intervention, as in Ecosystems, Resilience, Anticipation, Learning and Understanding and, in part, Caring for Nature. The third perspective lies between the former two and reveals the dual temporality of resilience thinking. The capacity of a system to self-organise following disturbance and maintain itself within critical thresholds denotes a cycle (Holling and Gunderson 2002, p. 34), but transformational change at small scales, which enables resilience at large scales (Folke et al. 2010) denotes non-linear, continuous change. Resilience as used in the definitions of adaptation means either maintenance of current conditions, facilitation of change, or support for system recovery.

Climate change is an exogenous force in all clusters. Exogenous drivers involve external pressures (e.g. effects of climate change and globalization) and the adaptation responses to those pressures, while endogenous drivers are properties of the system and its elements (e.g. phenology, consumption of natural resources). However, endogenous forces are evident in Nature by Itself and Resilience clusters, whereby ecosystems have inherent capacity to persist, adapt, or transform. In the clusters Caring for Nature and Managing Nature, adaptation responses to exogenous drivers are related to ideas of 'efficiency', thus justifying interventions. The cluster Ecosystems incorporates both endogenous and exogenous forces playing out over time.

The Caring for Nature and Ecosystems clusters entail maintenance of ecosystem functions as part of adaptation (e.g. Groves et al. 2012), while the functional role of rules and social processes is embedded in Managing Nature, Institutional Processes, Anticipating, Opportunities and Learning and Understanding.

Deliberation, planning and action for conservation adaptation are underpinned by our ability to explain facts in relation to perceptions of cause and effect. Concepts of causality and change may be objective or subjective, depending on the mental models used by different individuals and collectives (Moon et al. 2019). The nine clusters outlined above show contrasting approaches to time perspectives and agency

Table 2. Examples of definitions extracted from the articles containing definitions of adaptation and the emergent themes and clusters extracted from the definition. Clusters follow Full set in Appendix A.

Citation	Definition	Emergent themes	Clusters
Groves et al. (2012)	'Climate change adaptation refers to the adjustment of natural or anthropogenic systems to a changing climate for the purpose of moderating impacts or capitalizing on novel opportunities (IPCC 2007). We argue that integrating adaptation into systematic conservation planning is imperative … '.; 'we describe five explicit adaptation approaches that can be incorporated into regional scale conservation plans, trade-offs involved in their application, assumptions implicit in their use and additional data that may be required for their implementation: (1) conserving the geophysical stage, (2) protecting climatic refugia, (3) enhancing regional connectivity, (4) sustaining ecosystem process and function and (5) capitalizing on conservation opportunities emerging in response to climate change (e.g. Reducing Emissions from Deforestation and Forest Degradation [REDD])'.	Adjustments in natural systems Adjustments in human systems Identify and exploit opportunities Conserve geophysical stage Protect climate refugia Corridors and connectivity Maintain ecosystems processes and functions Mitigation *n* = 8	Anticipating Learning and understanding Opportunities Ecosystems Caring for nature Nature by itself *n* = 6
Lukasiewicz et al. (2016)	'Climate change adaptation refers to the actions that people take in response to projected or actual climate change' (Parry et al. 2007; p.27). A related but as yet lesser known concept is that of 'maladaptation', which refers to actions that seek to avoid or reduce vulnerability to climate change, but end up increasing it in other systems, sectors or social groups (Barnett and O'Neill 2010); 'Our research drew on an ecosystem-based approach to climate change adaptation which advocates strategies that improve environmental health as a way of ameliorating climate change impacts' (The World Bank 2009). Such strategies include the use of protected areas (Dudley et al. 2010), protection, maintenance and restoration of resilient, connected ecosystems (Cottingham et al. 2005) and conservation of biodiversity 'hotspots' (Catford et al. 2012)."	Human actions in response to climate change Avoid maladaptation Ecosystem-based adaptation Improve environmental health to reduce impacts Protected areas Resilient, connected ecosystems Protect biodiversity hotspots *n* = 7	Anticipating Managing nature Ecosystems Caring for nature Resilience *n* = 5

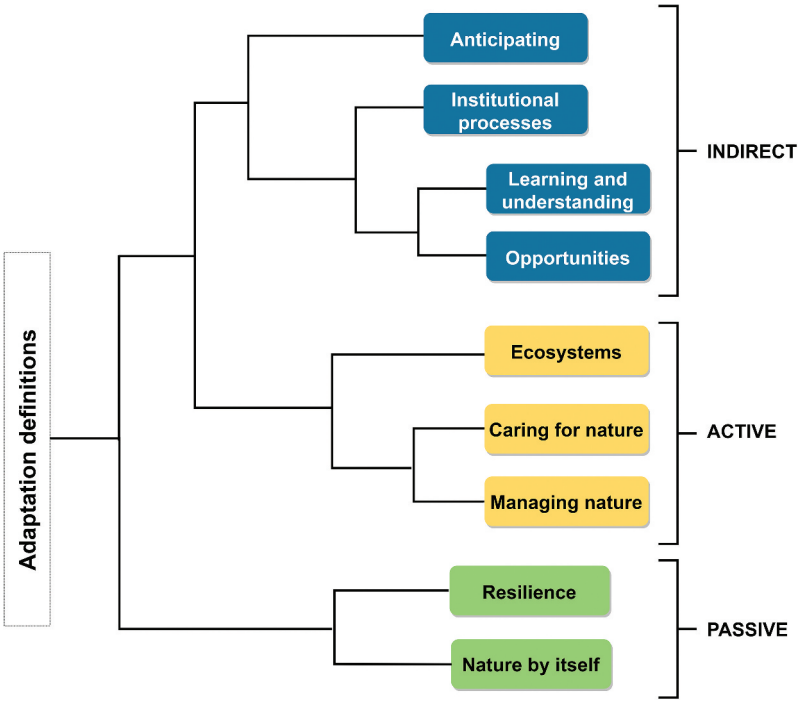

Figure 3. Cluster analysis by word similarity of the themes within the clusters and definitions. Clusters in blue represent *Indirect* mechanisms to create the right conditions; clusters in yellow are *Active* interventions and in green *Passive* interventions.

in relation to how, when, where and why human intervention may be required in conservation adaptation.

3.2.2. System perception and concern for others

The adaptation definitions and themes acknowledge the complex interactions between nature and people within SES but differ in concepts of what constitutes the system. Nature by Itself, Caring for Nature and Managing Nature mostly focus on natural systems and components, such as vulnerable species or biotic communities. Some definitions address 'complex social-ecological systems' (e.g. Jacobs et al. 2019) and take a systems approach to 'managing for ecosystem processes and function rather than for particular species' (Jantarasami et al. 2010). Ecosystems

Table 3. Emerging clusters (grouped themes) of adaptation in biodiversity conservation. Each concept was analysed to establish the scholarly tradition, concepts, and theories informing adaptation (ST), ontological basis (OB), epistemological approach (EA), and theoretical perspective (TP); OB, EA, and TP follows Moon and Blackman (2014).

Grouped theme	Description	References	Scholarly tradition, onto-epistemological & theoretical basis
Nature by Itself	Adaptation linked with evolutionary & autonomous adaptation, indicating natural processes that lack conscious or directed actions & responses: species & ecosystems have intrinsic capacity to adapt to change. Conservation thinking before the 1960s was broadly of the 'nature for itself' type, which prioritizes wilderness and intact natural habitats, generally without people and has scientific underpinnings from wildlife ecology, natural history and theoretical ecology	Metzger et al. (2006); Mace (2014)	ST: Biological/evolutionary sciences OB: Naïve realism EA: Objectivism TP: Positivist
Caring for Nature	'Caring is not only an attitude of concern for the well-being of another, but also … a practice that seeks to tend to another's needs'. Empathy as a driver for conserving nature (feelings of connectedness, grieving loss of ecosystems/species) and 'the constituting role of (re)productive activities and "sustaining services"'. Nature conservation is mobilized by human agency, where humans are care-givers' & 'care-receivers '. The practice of care can occur on a 'non-interference' vs. 'manipulating interventions' gradient.	Jax et al. (2018)	ST: Feminist philosophy OB: Structural realism EA: Subjectivism TP: Feminism & post-structuralism
Ecosystems	'Ecosystem-based adaptation uses biodiversity and ecosystem services in an overall adaptation strategy. It includes the sustainable management, conservation and restoration of ecosystems to provide services that help people adapt to the adverse effects of climate change'. EbA 'may require managing ecosystems to provide particular services at the expense of others'.	CDB (2009)	ST: various, mainly ecology OB: Critical realism EA: Constructionism TP: Structuralism
Resilience	' … resilience … is a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables'. 'Resilient forests are those that not only accommodate gradual changes related to climate but tend to return toward a prior condition after disturbance either naturally or with management assistance'.	Holling (1973); Millar et al. (2007)	ST: Ecological resilience OB: Structural realism EA: Objectivism TP: Positivism
Managing Nature	Conservation biology as a response to environmental crisis 'shaped the relations between ecological science, natural resource management and environmental politics'. Conservation management actions are interventions undertaken by individuals to reach predetermined conservation goals (e.g. prevent, ameliorate, or accommodate change), for example restoration aims to repair or improve some conditions assumed to be malfunctioning.	Robin (2011); Prober et al. (2019)	ST: various, mainly ecology OB: Critical realism EA: Constructionism TP: Structuralism
Opportunities	'Factors that make it easier to plan and implement adaptation actions, that expand adaptation options, or that provide ancillary co-benefits'.	Klein et al. (2014)	ST: multiple traditions OB: Relativism EA: Subjectivism TP: Structuralism
Learning and Understanding	'The processes that are in place to enable learning and how to strengthen them'. 'Enabling adaptive processes of improving management goals, policies and practices through learning are adopted to help bridge the science-policy gap'. 'A systematic understanding of climate change adaptation by local natural resource managers is needed, not only to characterize the current status of adaptation, but also to enhance future efforts to track adaptation at scales relevant to state agencies or regional organizations'	Wyborn et al. (2016); Wise et al. (2014); Adger et al. (2009)	ST: multiple traditions OB: Bounded relativism EA: Constructionism TP: Constructivism
Anticipating	'Adaptation needs arise when the anticipated risks or experienced impacts of climate change require action to ensure the safety of populations and the security of assets, including ecosystems and their services'.; 'All efforts to "know the future" in the sense of thinking about and using the future are forms of anticipation. Equally the future is incorporated into all phenomena, conscious or unconscious, physical or ideational, as anticipation'.	Noble et al. (2014); Miller et al. (2013)	ST: multiple traditions OB: Relativism EA: Subjectivism/Objectivism TP: Constructivism/Positivism
Institutional Processes	Options to facilitate transitions or transformation of governance arrangements to accommodate change while acknowledging scientific uncertainty, considering social values and the cross-scale and systemic nature of climate impacts (vertical and horizontal integration).	Wyborn et al. (2016); Wise et al. (2014)	ST: multiple traditions OB: Bounded relativism EA: Constructionism TP: Critical theory/pragmatism

and Resilience clusters regard systems as dynamic human-nature interactions; Resilience approaches address the complexity of biodiversity as a systems property that contributes to resilience (Peterson et al. 1998).

Adaptation occurs at different scales within a system and depends on how system boundaries are defined. Caring for Nature, Ecosystems and Managing Nature contain an explicit focus on the physical boundaries of protected areas, whereas Institutional Processes address the fuzzier boundaries of protected area governance. In Ecosystems, Caring for Nature, Resilience, and Institutional Processes clusters, human-nature interactions are central to adaptation. However, Resilience has broad framings in the definitions, sharing with Nature by Itself the theoretical perspective that nature has an intrinsic capacity to adapt to change. Thus, the scale at which autonomous adaptation is expected to occur defines system boundaries and the limits of acceptable change. Some articles address the spatial scale of adaptation in terms of ecological connectivity: interactions of system components (genes, individuals, populations, and species) across scales drives ecosystem processes such as dispersal, colonisation and recruitment, as in the Ecosystems and Resilience clusters.

Managing Nature and Caring for Nature are both action-oriented but differ in process and systemic perception. Managing Nature involves active management intervention to resist change in some biophysical elements (e.g. species translocation), while Caring for Nature involves actions to ameliorate impacts and can include landscape approaches (e.g. restoration, facilitating autonomous adaptation). Opportunities, Anticipating, Learning and Understanding, and Institutional Processes involve actions by individuals and collectives to prepare for, and respond to, exogenous drivers of change.

The diversity of system perceptions highlights differences between approaches of preventing versus accommodating change. The capacity to reframe responses to change is examined below.

3.2.3. Openness to alternatives

This domain connects the individual domain (time perspective and agency beliefs), with the collective (system perception and concern for others), where perceptions of change affect adaptation actions (sub-subsection 2.2).

The adaptation concepts differ in whether change is to be avoided or embraced. Themes range between maintaining the status quo (Nature by Itself), or accepting change, as in Resilience. Both clusters have a theoretical basis in biological sciences whereby species and ecosystems have an intrinsic capacity to adapt to change. However, Resilience addresses change via systems absorbing shocks and maintaining integrity. Thus Resilience-related themes acknowledge the dynamic nature of systems (Bernazzani et al. 2012), but the goal of maintaining integrity may prevent adaptation and change.

Themes in Managing Nature include options to use non-native species to maintain or restore ecosystem services, contrary to traditional conservation approaches that focus on protecting native species through eradicating alien species. Maintaining ecosystem functions is more important than the origin of the organisms that deliver them, enabling alternative adaptation approaches and constructs of novel and modified ecosystems (Hobbs et al. 2014).

Openness to alternatives implies that agents understand and examine the temporal contexts of the strategies available to them (MacKenzie 2021). Visioning helps agents anticipate change and its consequences, thus guiding action (e.g. Bernazzani et al. 2012; Brazier et al. 2012; Watson et al. 2012). Adaptiveness, including adaptive management, adaptation pathways and building adaptive capacity (e.g. Fuentes et al. 2011; Weisshuhn et al. 2018), enables reframing decision contexts in response to anticipated or unexpected changes (Gorddard et al. 2016). These processes, involving human agency in adaptation, occur in Institutional Processes, Learning and Understanding, Opportunities, and Anticipating.

Adaptation may be driven by emotions (e.g. solastalgia – grieving for degradation and loss of ecosystems; Albrecht et al. 2007), symbolism (terms and metaphors to communicate meaning), or rely on scientific explanations (based on biological, social and economic theories). In studies of social change, the role of trauma has been explored in the willingness to accept change and new approaches. Trauma is linked to negative memories of loss and pessimistic imaginaries of the future (Alexander et al. 2004). Caring for Nature and Managing Nature reflect this perceived sense of loss, while Ecosystems, Anticipating, Learning and Understanding, and Institutional Processes help identify actions to minimise damage, reduce threats and accommodate change.

Opportunities, Anticipating, Institutional Processes, Learning and Understanding use reflexivity to understand and rationalise cause-and-effect events into actions. The concepts address issues of trauma and loss grounded in ontological positions, belief systems, held values that frame people's expectations for the future (Alexander et al. 2004), influencing their capacity to deal with uncertainty.

4. Discussion

The term adaptation functions as a boundary object in conservation research and practice, with different meanings linked to a range of expectations and

adaptation approaches. Experts and communities of practice use adaptation-related terms indistinctly, enabling 'acceptance across groups despite different meanings attached to them' (Goldman et al. 2018). However, repeated use of concepts without careful consideration of meaning, interpretation and application, can constrain options to address complex ecological dynamics under uncertain change (Johnson and Lidström 2018), including adaptation governance and socio-economic aspects (Rubio Scarano 2017).

The themes and clusters differ in terms of how a system is described (natural vs. societal), temporal perspectives (linear vs. cyclical) and openness to change, representing specific characteristics to anticipate and prepare for the future. These differences are explained by the diverse scholarly traditions, ontologies and epistemologies from whence the clusters emerge. The definitions represent a spectrum of approaches from realism to relativism that reflect variation in the acceptance of uncertainty and openness to change. The epistemological and theoretical space in which scientists and managers operate can enable or constrain participation of stakeholders and adaptation options. Below, we explain these findings in relation to what future consciousness means (Ahvenharju et al. 2018).

The negative impacts on biodiversity caused by climate change can engender urgency to explore options for adaptation (Loorbach et al. 2017). This sense of urgency is related to rates of biophysical change and how time is conceptualized (linear vs. cyclical, fast vs. slow) which, in turn, influences the nature and pace of responses (e.g. reactive or anticipatory; Múnera-Roldán et al. 2020). The rate and magnitude of biophysical change influences how social change and adaptation occurs under conditions of stability, incremental, or transformative change (Colloff et al. 2020, Figure 2 therein), conditioning the nature of changes to institutional structures and processes, including cultural identity (Sablonnière 2017). Addressing long-term thinking starts acknowledging that urgent issues requiring immediate action (e.g. epidemics, bushfires) will always occur in parallel to and compete with, considerations of how to address long-term consequences of present actions in decision making and management (MacKenzie 2021).

A long-term perspective helps identify adaptation options, connecting everyday knowledge with expectations for the future. Conservation using climate change refugia is one example of adaptation considering long temporal perspectives (Morelli et al. 2020). However, only one of the articles providing a definition recommended protecting climate refugia and, among the 150 screened articles, only four mentioned it. Spatial planning and climate refugia are promoted globally as an adaptation option, but these efforts have not been successful (Carrasco et al. 2021). This might suggest that, in defining adaptation options, decision makers might not be addressing spatial and temporal perspectives of conservation actions in relation with pace and rate of transformation, and social-ecological systems responses to change.

Time perspective is linked with characteristics of agency as causality, assignment of function and intentionality. People assign function to system elements based on their mental models of what that element is, does and how it changes, affecting how drivers of change are classed as endogenous or exogenous (Sztompka 1993). Awareness of change and its consequences prompts a sense of agency, by connecting knowledge and understanding to the intent to act and then to current or future adaptation actions.

Agency beliefs are instituted through 'mainstreaming adaptation'; the translation of awareness of the need to respond to climate change into policies and frameworks for adaptation (Burch et al. 2014). Agency involves the capacity for transformation, reorganizing and developing structures and processes to learn about and respond to systems changes (Alexander and Sztompka 1990), and is central to identify options towards transformative change as suggested by Palomo et al. (2021). Questioning current approaches and rules and being open to alternatives can enable learning to respond to ecological change. Critical thinking and learning processes can help to address power imbalances by including other voices and forms of knowledge, thus creating options to identify unconventional solutions.

A utilitarian, instrumental approach to ecosystem functions and services in some conservation approaches (e.g. EbA, environmental peacebuilding) privileges scientific positivist approaches, marginalising other world views and knowledge (Woroniecki et al. 2020). The recommendations in the articles often focus on strengthening scientific and technical knowledge for adaptation. Accordingly, adapting conservation to climate change may be missing opportunities for knowledge co-production and addressing power imbalances. Part of what is missing is the importance of empathy to nature; humans and nature are not decoupled (Kiik 2018). Acknowledging the inseparability of human-nature interactions helps address power imbalances and re-draws the boundaries of social and natural systems.

Scientific and technical knowledge is usually preferred to inform decisions in adaptation. Although this desire for predictive certainty via empirical testing of reality (e.g. species models, vulnerability analyses) is valid, it is important to recognise that approaches advocating only scientific knowledge to anticipate change, reduce uncertainty and exercise control can exclude other perspectives and ways of doing (Borie et al. 2019). This can create an

assumption that adaptation to climate change is a problem to be solved only by science and technology, rather than an issue to be addressed through pluralism and changes in societal values and rules.

Applying pluralistic adaptation approaches involves developing a holistic, systems perspective to planning and action to address the complex dynamics of SES and understanding how climate change and other drivers create cascade effects through the system, its elements (Dunlop and Brown 2008) and also how humans respond to climate change (Watson 2014). Identification of tipping points, thresholds of potential concern and limits of acceptable change then provides a basis to translate understanding of system cascades into adaptation actions (Biggs et al. 2011; Freitag et al. 2014). Addressing tipping points and thresholds to avoid maladaptation is a fundamental principle of the adaptation pathways approach (Wise et al. 2014; Fedele et al. 2019).

5. A conceptual model for adaptation in conservation

We consider there are three basic types of adaptation, whereby perceptions of change and the conservation goals guide adaptation options and mechanisms (Figure 4): 1) incremental adaptation; 2) a continuum of resistance, resilience and transformation, and 3) adaptation as transformation.

Adaptation as an incremental process, separate from transformation. For conservation goals aiming at preserving system structure and functions, as in Caring for Nature, adaptation options are framed as responses to maintain current prevailing societal objectives through reducing climate-related risks (Dow et al. 2013). Adaptation is mainly through coping actions and incremental short-term responses (Adger et al. 2009) through active (e.g. preventing change by controlling invasive species; Peterson St-Laurent et al. (2021), or passive approaches (e.g. climate refugia; Morelli et al. 2020). If ecological change is not prevented, then 'limits to adaptation' have been reached (Dow et al. 2013; Barnett et al. 2015) and transformation is necessary.

Adaptation as a continuum of resistance, resilience and transformation. This form of adaptation aligns most closely with Managing Nature. Conservation goals aiming to build resilience would need to explore epistemologies and frames of reference under which resilience is defined and decisions are made (Peterson St-Laurent et al. 2021). These include defining the current regime, system boundaries, tipping points, effects of driver variables across spatial-temporal scales (Smit et al. 2020) and exploring alternative states under scenarios of change. Resilience is not about systems 'bouncing back' to an original state, but 'the ability to adapt and change, to reorganize, while coping with disturbance' (Walker 2020, p. 1). If the system is likely to transform to an alternative stable state, then new structures and functions arise, creating new options and priorities for conservation adaptation. Resilience can also include the capacity for incremental change.

Transformation as an integral and necessary part of adaptation. For conservation goals accepting systems are dynamic and unpredictable, adaptation involves accepting, anticipating and accommodating change to achieve transformation (Rickards 2013). This approach, which aligns with Ecosystems cluster, enables dynamic adaptive management, constant updating of rules and practices and consideration of novel ecosystems. Adaptation occurs via a mix of incremental and transformative actions, whereby 'windows of opportunity' created by changes in decision contexts for adaptation enable successful implementation (Lavorel et al. 2019). Anticipatory responses can also lead to transformative adaptation (Freitag et al. 2014) while exploring options to update current conservation decision contexts and adaptation processes (Colloff et al. 2017).

All three adaptation types require careful attention to governance issues (i.e. responsibilities, rules, resources). Some adaptation actions might not have leverage under current regulations (McCormack 2018), or resources may be insufficient to implement management and deal with unfolding changes, restricting individual and institutional capabilities to shape future events (agency).

Adaptation actions are likely to benefit from critically examining current values, norms, and frames of reference guiding conservation actions while identifying transitions towards practices that support flexible and proactive implementation in response to global environmental changes (Colloff et al. 2021). Similar models to understand adaptation options have been proposed recently, as the Resist-Adapt-Direct framework (Lynch et al. 2021), or Peterson St-Laurent et al. (2021) resistance-resilience-transformation typology. Our proposed model complements such frameworks and can help researchers and practitioners unpack what and whose frames of reference are used to address socio-ecological change, and thus shape the development and implementation of conservation and adaptation agendas. But more importantly, the model can help foster dialogue and reflexivity over whether decisions made today are adequate for the future in a rapidly changing world.

6. Conclusions

The themes in the definitions of adaptation reflect diverse narratives of what adaptation is, how to implement it, perceptions of change, and expectations for the future. This lack of clarity is persistent and has

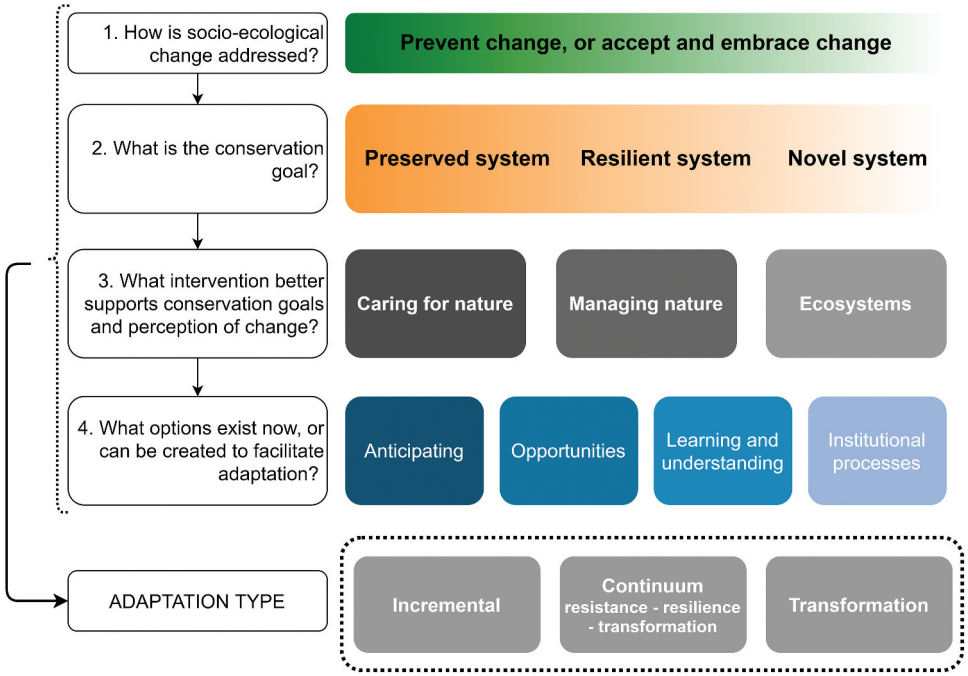

Figure 4. A conceptual model for adaptation in conservation. Depending on the perception of change (1) and the desired goals (2), the interventions (3) can differ. The options (4) for adaptation represent indirect underlying basis for all adaptation types, which can be an *incremental* process and separate from transformation, a *continuum* of resistance, resilience and transformation, or occur via *transformation* as an integral and necessary part of adaptation.

made it difficult to operationalise adaptation frameworks (Peterson St-Laurent et al. 2021). Conservation biology is a subject in constant evolution, where different concepts have been applied over time (Mace 2014). Our findings reflect this plurality. To aid scholars and practitioners seeking to navigate this potentially confusing terrain, we offer a heuristic to enable critical reflection on current options, revise assumptions, question established truths and negotiate contested views of climate-related change.

We found different concepts and approaches to deal with change, including the capacity to recognize system conditions, elements, and their dynamic interactions at different spatial-temporal scales. Adaptation approaches shape current and future options to address change, including what needs to be done differently, what elements should be maintained, and acceptance of when a system transformation is inevitable. Defining conservation adaptation goals (either by preserving current conditions, building resilience, or accepting novel systems) is highly context-dependent, a result of how values, rules and knowledge frame adaptation decision-making for conservation (Gorddard et al. 2016), shaping how we prepare for the future.

Adaptation approaches are enabled by flexibility, diverse values and knowledge. Processes of reflexivity can help reconcile different expectations and forms of knowledge to facilitate managing change (Múnera-Roldán et al. 2020). Such facilitation then aids the understanding of responses by SES as they unfold in the present, enabling options for alternative management under rapid ecological change. Open dialogue and critical reflection about expected conservation goals, options, concepts, and onto-epistemological foundations of adaptation and conservation science and practice (Moon and Blackman 2014) can help clarify what adaptation means in a specific context. In this way, those involved in adaptation can learn and build from this conceptual diversity to create a common, pluralistic ground to better understand current options and implement adaptation while opening up future options and choices.

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5.3. Future orientation and adaptation narratives: towards sustainable management in protected areas (Paper 3)

Paper 3 presents the results of mapping narratives of adaptation shared by managers and practitioners interviewed in six protected areas in Australia, Colombia, and South Africa (see Chapter 4 for more details). Each country has different approaches to address climate change and biodiversity conservation, which then influences concepts of adaptation, its implementation, and expected outcomes. The 5DFC guided the analysis to understand how individuals and institutions understand and prepare for future transformations. The analysis examines the role of futures consciousness in defining adaptation narratives in the three countries, addressing research questions 1 and 2. Participants in the three countries reflected on how current management is helping, or not helping, to address adaptation and provided examples of opportunities (Colombia and South Africa) or barriers (Australia) to adaptation (sub-question 1a).

The results from the interviews demonstrate that the different interpretations of adaptation are context related. I extracted a total of nine narratives, three in each country. The narratives are framed in specific socio-political contexts, and represent different aspirations for the future and different priorities for management. There are different levels of acceptance about ecological change and different ways to manage transformation. Although there are similarities across the countries, the narratives identified are distinctive of each country and reflect the environmental governance arrangements in use (top-down or bottom-up), stakeholders involved, and expectations of adaptation. Table 5.2 summarises the contextual characteristics shaping the narratives, including different governance modes, actors involved, and related visions of the future (not presented in Paper 3).

Adaptation outcomes are between preserving ecosystems integrity accepting the dynamic nature of systems, and reconnecting with nature. In Australia, the main focus is on preserving ecological attributes (resist change). Colombia and South Africa are more focused on adaptation options to guarantee social benefits from the parks under scenarios of change. Existing rules for managing protected areas are mainly top-down, but Colombia and South Africa have more participatory approaches to include other stakeholders, allowing more systemic management beyond ecological attributes. In Colombia, management allows recognising and integrating Indigenous and Local Knowledge in adaptation. In South Africa, managers do not discuss climate change issues with local stakeholders, but they integrate local aspirations for the future in the management plan. In Australia there is no integration of Indigenous knowledge systems or local stakeholders' perceptions of change when defining adaptation. The findings indicate that when management allows the participation of other stakeholders, it facilitates thinking differently about how social-ecological values can be affected by drivers of change at different scales and beyond the boundaries of the protected area.

In Colombia, adaptation offers opportunities to implement the peace process, support territorial planning and collaboration with other stakeholders, and reduce climate risks for local communities; adaptation is perceived as a transversal theme that intersects with other sectors. For South Africa, adaptation opens opportunities to address environmental and social justice through considering local stakeholders' expectations in collective envisioning exercises. In Australia, despite the strong focus

on preserving threatened species and ecosystems, the findings indicate desires toward accepting change as a key element for future management.

Table 5.2. Contextual and operational characteristics of the narratives. C: Colombia; SA: South Africa; A: Australia; PNN: Colombian National Parks Agency; SINA: National Environmental System; SANParks: South African National Parks; NSW: New South Wales

Narrative	Governance mode	Main actors	Climate change and visions of the future
A1- Circle of life	Top-down; bottom-up	NSW, ACT conservation agencies; local communities	Climate change impacts acknowledged, reactive approaches to reduce vulnerability and allow systems recovery
A2- Recovering country	Top-down; bottom-up	NSW, ACT conservation agencies; local communities; Aboriginal Rangers being engaged (ACT)	Climate change envisioned and anticipated, partially included in strategies
A2- Political dogmatism	Top-down	Federal government; NSW and ACT conservation agencies	Climate change impacts acknowledge (focus on species), no clear instruments to prepare for and respond to climate change
C1- Territorial solutions	Top-down & bottom-up, with participatory approaches	PNN (central, regional, local); local governments; local communities; SINA	Climate change impacts anticipated and included in strategies
C2- Risk reduction	Top-down	PNN (central, regional, local); local governments; SINA	Climate change as hazards and vulnerability to extreme events, reactive approaches
C3-Institutional	Top-down; some participatory approaches	PNN (central, regional, local); local governments; SINA	Climate change institutionalised in rules and policies
SA1- Resilient systems	Top-down & bottom-up, with participatory approaches	SANParks (scientific services, management)	Climate change not prioritised in management, but incorporated in learning processes
SA2- Environmental justice	Participatory approaches	SANParks (scientific services, management); local communities	Concerns about social & environmental justice, adaptation should consider park benefits for society
SA3- Command and control	Top-down	SANParks (scientific services, management); provincial and local governments	Managing non-climate threats, to maintain ecosystems integrity and functionality under climate change

The findings indicate that specific contexts can hold both competing and complementary adaptation narratives, which can inform each other or can constrain action towards the future (research question 2 and 3). Adaptation narratives in each country are socially constructed and shaped by specific institutional settings in which managers operate. The findings also demonstrate the role of having clear rules to facilitate cross-scale, cross-sectoral integration of adaptation as part of each country's aspirational goals for long-term sustainability. The diversity of narratives should not be a problem, providing there is reflexivity about expected outcomes and about assumptions of conservation goals.

Australian National University

Statement of Contribution

This thesis is submitted as a Thesis by Compilation in accordance with https://policies.anu.edu.au/ppl/document/ANUP_003405

I declare that the research presented in this Thesis represents original work that I carried out during my candidature at the Australian National University, except for contributions to multi-author papers incorporated in the Thesis where my contributions are specified in this Statement of Contribution.

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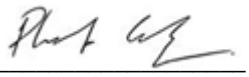
Philip Gibbons  20/7/2022

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Future orientation and adaptation narratives: towards sustainable management in protected areas

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Abstract

Addressing climate change and biodiversity loss is critical for long-term sustainability. Global climate and biodiversity agendas are setting ambitious goals to expand protected areas in the next decade and identify adaptation options to address future climate change impacts on biodiversity and nature's contributions to people. Protected areas aim to be long-term, but management and resource allocation are short-term, creating a disconnection between management and ecological response time that becomes more evident under rapid climate change. This paper shows how adapting biodiversity conservation under climate change is conceptualised in different ways of thinking and acting in different social-ecological contexts. We analysed adaptation narratives extracted from 51 semi-structured interviews with protected area managers from Australia, Colombia, and South Africa. We examined how contextual characteristics and collective constructions of the future come together to make sense of the concept of adaptation. We applied the Five Dimensions of Futures Consciousness framework to explore conceptualisation of time, systems perception, concern for others, engendering agency, and capacity to question existing truths to create new options for the future. Our analysis revealed a diversity of adaptation narratives with different characteristics of futures consciousness that define preferences and actions in response to ecological change. The findings provide a starting point to negotiate future adaptation and conservation agendas, considering how and which characteristics of futures consciousness are involved in decision-making processes and understanding barriers and options to adaptation.

Keywords: biodiversity conservation; climate adaptation; policy and practice; futures thinking; narratives

Introduction

Post-2020 global agendas for biodiversity conservation are setting goals to increase the protection of areas of 'particular importance for biodiversity, and its contributions to people' (SCBD 2021, p. 6). Achieving these ambitious goals under a changing climate requires consideration of the complexity of dynamics and responses of social-ecological systems across temporal and spatial scales. It also requires examining whether current biodiversity policies are fit to respond to a changing climate and

to what degree decisions and responses to global change enable adaptation, including who benefits from such actions and what it means for the long-term conservation of biodiversity (Bhola et al. 2021).

Protected areas are one of the most recognised approaches for conservation (Godet and Devictor 2018; Maxwell et al. 2020), representing ideals and efforts from the international community to preserve specific biodiversity values. The design and governance of protected areas imply setting aside portions of land or oceans to be legally protected in the long-term. This approach is supported by diverse narratives, including political and economic interests and scientific assessments of which elements of nature should be conserved (Hagerman et al. 2010; von Hardenberg et al. 2017; Wakild 2018). Such narratives define what actions are allowed, and which voices can participate in decision making potentially closing off future options for some stakeholders (Fairbanks et al. 2018; Jaramillo and Carmona 2022).

The diverse interpretations and narratives of what biodiversity is, what conservation aims to achieve, and who benefits from it has been a long, evolving debate (Escobar 1998; Mace 2014; Borie and Hulme 2015). Since its modern conception by the Convention of Biological Diversity, biodiversity conservation has been a social and political construction criticized for ignoring certain voices and practices and for reducing nature's dynamic complexities to some functions, services, and instrumental values (Escobar 1998; Woroniecki et al. 2020) without considering the moral, social, and practical implications (Piccolo et al. 2022). Climate change is also the subject of a diversity of narratives, framings, and interpretations that influence how people anticipate, prepare and respond to the effects of changing climates on environments and societies (Fløttum and Gjerstad 2017; Goldman et al. 2018).

Such pluralism is normal. The challenge lies in understanding potential contradictions and evaluating the implications of how adaptation problems and solutions are addressed. In the case of biodiversity conservation and protected areas, the concepts and frames of reference for adapting protected areas and biodiversity cover a diverse range of worldviews, disciplines, and epistemologies, as well as expectations for the future, which then translate in multiple approaches to implementation (Peterson St-Laurent et al. 2021; Múnera-Roldán et al. 2022).

Protected areas are complex social-ecological systems (SES) in which stakeholders, institutions, and elements from nature interact across multiple spatial and temporal scales (Cumming et al. 2015; Cumming and Allen 2017). Despite aspirations for long-term conservation, policies, practices, and resource allocation to manage these areas are often short-term, creating a temporal disconnection between management and ecological response time. This temporal disconnection open questions about long-term conservation practices and the suitability of existing environmental governance frameworks under changing climates (McDonald et al. 2018). Climate change and other drivers affect

whether protected areas can provide co-benefits such as mitigating climate change impacts and providing adaptation options (Colloff et al. 2020).

Despite increased acceptance of the reality of ecosystem change and complexity in conservation policy, defining and operationalising complexity remains poorly understood. Many adaptation efforts in conservation continue to focus on preserving some ecological attributes such as threatened species or unique ecosystems (Hagerman et al. 2010; Hagerman and Satterfield 2014; Foden et al. 2018; Gregory et al. 2021). Less attention is paid to the concern of supply of ecosystem services across spatio-temporal scales (Winkler et al. 2021) or how SES structures and processes respond and reorganize after disturbance inside and outside the boundaries of protected areas (Bengtsson et al. 2003). Moreover, adapting conservation policy and practice is mainly reactive, through low-regrets options (avoiding change or ameliorating negative impacts) which may not address the magnitude, extent and rate of transformations caused by climate change (Prober et al. 2019). Anticipatory governance (Boyd et al. 2015; Muiderman et al. 2020) and future-oriented approaches (Wyborn et al. 2016; van Kerkhoff et al. 2019) can facilitate conservation planning under uncertainty. A recent review on conservation and climate change indicates an increased appetite for anticipatory adaptation, but the authors note a bias towards North America and Europe and an overall lack of practical recommendations (McLaughlin et al. 2022).

In this paper we identify existing narratives about adapting biodiversity strategies to climate change to understand how adaptation is conceptualised and implemented in protected management and planning. We aim to understand: 1) how stakeholders involved in the governance of protected areas make sense of ecological change and adaptation; 2) how are such interpretations reflected in practice and 3) how conservation strategies enable transitions towards future-oriented practices, whereby managers have to make decisions under complex and uncertain conditions. To address these issues, we explored elements of futures consciousness, as articulated by conservation practitioners and decision-makers in Australia, Colombia, and South Africa, to understand how narratives of adaptation used in conservation science and practice are used and communicated to legitimise concepts and preferences for adapting protected areas under climate change. We illustrate the application of futures consciousness to developing an understanding of the motivations and preferences for adapting protected areas, exploring mismatches between individuals' interpretations of SES and change, and whether governance arrangements empower managers and local communities to navigate climate change. Our analysis can help inform future-oriented conservation approaches so that managers and scientists tasked with adapting protected areas to climate change can better prepare for future transformations (van Kerkhoff et al. 2019).

Futures consciousness

Adaptation is about those actions we can do today in response to observed changes and to prepare for future changes. Addressing climate change impacts on biodiversity conservation requires acknowledging change as fundamental to SES and central to environmental governance and management (Folke et al. 2004; Cilliers et al. 2013). Muiderman et al. (2020) summarize the diverse approaches, aims, and actions related to anticipatory governance, to facilitate an understanding of the different ways to imagine and engage with the future in sustainability research and practice. Future-oriented conservation requires anticipating and preparing for future changes in SES (van Kerkhoff et al. 2019). It also requires critically questioning current assumptions and rules, recognising that complex and interacting drivers of social-ecological change affect protected areas, and implementing flexible approaches to adapt management under changing conditions.

Implementing future-oriented approaches emerges from the collective construction of shared visions for the future (Inayatullah 2013; Bengston 2019). Futures thinking encourages policy makers, scientists, and managers to proactively consider the complex, cross-scale interactions and responses of social-ecological transformations and the implications for decision making (Pereira et al. 2021). Such approaches can help to identify contested views on adaptation for conservation (Bennett et al. 2017). Our approach to futures thinking is through exploring futures consciousness. Futures consciousness helps explain individuals' awareness of the consequences of their actions, their degree of acceptance of established truths and their ability to evaluate alternative options for the future (Ahvenharju et al. 2018).

We applied a framework, based on theoretical perspectives on social change, to analyse how social-ecological transformation is framed and influences adaptation options. We adapted the Five Dimensions of Futures Consciousness conceptual model (hereafter 5DFC; Ahvenharju et al. 2018), which characterises the ability 'to understand, anticipate, prepare for and embrace the future' (Ahvenharju et al. 2021) and an understanding of the future consequences of decisions made today (Ahvenharju et al. 2018). The 5DFC includes: 1) time perspective 2) agency beliefs 3) openness to alternatives 4) systems perception, and 5) concern for others (Ahvenharju et al. 2018). These dimensions are not discrete and can influence each other, as outlined below.

The multiple spatio-temporal scales involved in protected areas management require careful considerations of the cross-scale implications of decisions made in response to drivers of change, including beyond the boundaries of a park. Perceptions about time can influence motivations and actions to resist or accept and manage change (Hanusch and Meisch 2022). The 5DFC framework helps to understand how individuals and collectives consider future consequences in relation to timeframes in use for planning and management. Individuals' mental models of time, as oriented towards the past, present, or future, are influenced by experiential, emotional and cognitive processes. Such processes can affect how expectations and imaginary scenarios of systems in response to stressors are conceptualised and evaluated (Zimbardo and Boyd 1999; Przepiorka et al. 2016).

Agency beliefs explain the capacity of individuals and collectives to influence future events and feel empowered to act. Agency influences how individuals construct future goals and aspirations and how these are socialised to influence collective goals and achieve change (Benessaiah and Eakin 2021).

A systems perception requires acknowledging diverse ontologies and world views of how systems and their boundaries are conceptualised and defined: are ecosystem concepts the main ontological lens used to define the system or is it understood in terms of its institutions as a social-ecological system? Boundaries may be socially defined (e.g. customary lands), environmental and geographic (e.g. watersheds), or political (e.g. provinces or municipalities). Different perspectives on system boundaries can be thought of as the interaction of different sets of values, rules and knowledge (Gorddard et al. 2016) at different scales, with specific time characteristics interacting and shaping options (Adam 1998).

Concern for others is based on values, morals and ethics: decisions about the future should be inclusive considering other people's aims for a better future (Ahvenharju et al. 2018). In conservation practice, concern for others invites consideration of the multiple ways societies respond to change, the implications of decisions across scales, acknowledging differences in values and livelihoods, and deliberation on the purpose and potential outcomes of conservation strategies for current and future generations.

Openness to alternatives occurs, individually and collectively, through processes for evaluating change in the conditions of a system that enable adaptation, including the capacity of reorganizing, modifying or developing new structures and practices to address change (Alexander and Sztompka 1990). It involves critical thinking, questioning dominant views and approaches and exploring new knowledge and practices, not just adhering to predictions and plans (Ahvenharju et al. 2018).

Futures consciousness provides a basis to understand individuals' preferences to adopt future-oriented practices in protected areas. Futures consciousness can be explored via narratives: the stories individuals use to communicate their realities, everyday actions, understandings of drivers of change and response and expectations for the future. These narratives are influenced by societal contexts and collective discourses framed within the intricate relations protected areas managers create via their interactions with nature, local communities, and other stakeholders at different scales. Futures consciousness has been applied to policy studies (Minkkinen et al. 2019; Ahvenharju 2021), rules on protection of data privacy (Minkkinen 2019), and the use of adaptation concepts in conservation (Múnera-Roldán et al. 2022).

Methods

Case studies

We used a multiple-case study research approach to compare different decision-making processes and contexts (Yin 2009). We selected protected areas in Australia, Colombia, and South Africa where science-policy-practice interactions are considering the effects of climate change on parks management. Each case study had: 1) some degree of cross-scale management, for example via international designation and conservation obligations (e.g. Ramsar sites); 2) climate change and other drivers of change and their consequences identified and addressed in the management plans (e.g. changing water balance due to climate change and deforestation); 3) managed by government organisations (Supplementary Material A, Table S1). The case studies offer comparable and contrasting socio-political and historical contexts in which to study how futures consciousness shapes adaptation options.

The three countries are similar in that they represent multicultural post-colonial societies and have rich and unique biodiversity with well-established protected areas networks, climate change is a major driver of ecological change, and their economies are supported by extensive fossil fuel industries. The main difference is in legal obligations. Mandates to protect the environment and Indigenous peoples are defined in the constitution of Colombia and South Africa (Republica de Colombia 1991; Republic of South Africa 1996), while Australia's constitution does not contain obligations to the environment or to Indigenous peoples (Commonwealth of Australia 1977).

Under Australia's federal system, biodiversity conservation legislation, policies and responsibilities are fragmented among Commonwealth, State and Territory governments (Ross and Dovers 2008). At the national level, biodiversity conservation is institutionalised through the Federal Environment Protection and Biodiversity Conservation Act (EPBC; Commonwealth of Australia 1999) and associated policies that focus on preserving threatened species and ecological communities. Each state and territory has its own agencies, objectives, and regulations for protected areas.

Preserving ecosystem services is a central objective for Parques Nacionales Naturales (PNN), the national agency responsible for protected areas in Colombia. In recent years, PNN has sought to address the impacts of climate change on parks management and seek opportunities to integrate protected areas into nationwide planning processes (van Kerkhoff et al. 2019, Munera and van Kerkhoff 2019). Tensions persist over the establishment of parks and the social consequences of over 50 years of civil war (Leal 2019). In 2016 a peace process between the government and the Revolutionary Armed Forces of Colombia (FARC) is attempting to overcome the impacts of civil unrest, including the extensive displacement of people and disruption of livelihoods.

With a complex but relatively strong environmental governance framework (Taljaard et al. 2019), South Africa's transition to democracy attempts to overcome the legacies of colonialism and the apartheid era, which had major negative impacts on environmental justice and fair access to natural resources. South Africa National Parks (SANParks) is the national agency responsible for protected

areas. Its philosophy is based on Strategic Adaptive Management (SAM) which acknowledges systems complexity and uncertainty (Freitag et al. 2014; Roux et al. 2021). SANParks uses a knowledge governance structure whereby scientists and managers constantly interact (Roux et al. 2019). The case study in South Africa (Garden Route National Park) is one of the few unfenced protected areas in the country.

Narrative analysis

Narrative analysis focuses on understanding how individuals communicate their experiences and how language is used to create meaning (Souto-Manning 2012). Narratives studies can help evaluate how individuals and collectives make decisions in the present for the future, re-frame current paradigms and realities (Paschen and Ison 2014), shape new relationships with nature (Jepson 2019) and explore future scenarios under high uncertainty (Seymour et al. 2020). Exploring narratives in use by scientists and practitioners involved in protected areas management can reveal how adaptation is conceptualized, how interpretations about change shape science-practice-policy interactions, and how current contexts enable or constrain action.

The methodological process is summarized in Figure 1. We used empirical data collected through 51 semi-structured interviews (Supplementary Material A, Table S2) covering three national parks in Colombia (n = 15; Otún Quimbaya, Los Colorados, and Alto Fragua), one in South Africa (n = 20; Garden Route National Park – GRNP), and two in Australia (n = 16; Kosciusko – KNP, and Namadgi – NNP). Using a purposive sampling strategy (Palinkas et al. 2015), we recruited respondents with in-depth knowledge and experience in protected areas management and planning. We also invited actors from external collaborating organisations who are experts on protected areas or adaptation. The number of interviews was not predetermined as we were interested in actors from government agencies willing to share their experience in managing protected areas under climate change. We consider our sample size adequate for identifying futures consciousness characteristics that frame the adaptation narratives in the case studies. Interviews in South Africa were conducted in person (Feb.-Mar. 2020); data collection in Colombia and Australia was online due COVID restrictions.

The interview questions were intended to understand how respondents conceptualize climate adaptation, perceived climate change impacts on the park conservation goals, their perceptions about long-term conservation inside static boundaries of a protected area, expected adaptation outcomes, and what actions can facilitate conservation actions under climate change in the future (Supplementary Material B). All interviews were audio recorded and transcribed, and transcripts were analysed using qualitative interpretation with NVivo (QSR 2020). The analysis focused on 5DFC themes to identify concepts in use and quotations used to communicate perspectives on doing conservation under climate change and gain insights into individuals' positions about adaptation from their everyday experiences (Souto-Manning 2012).

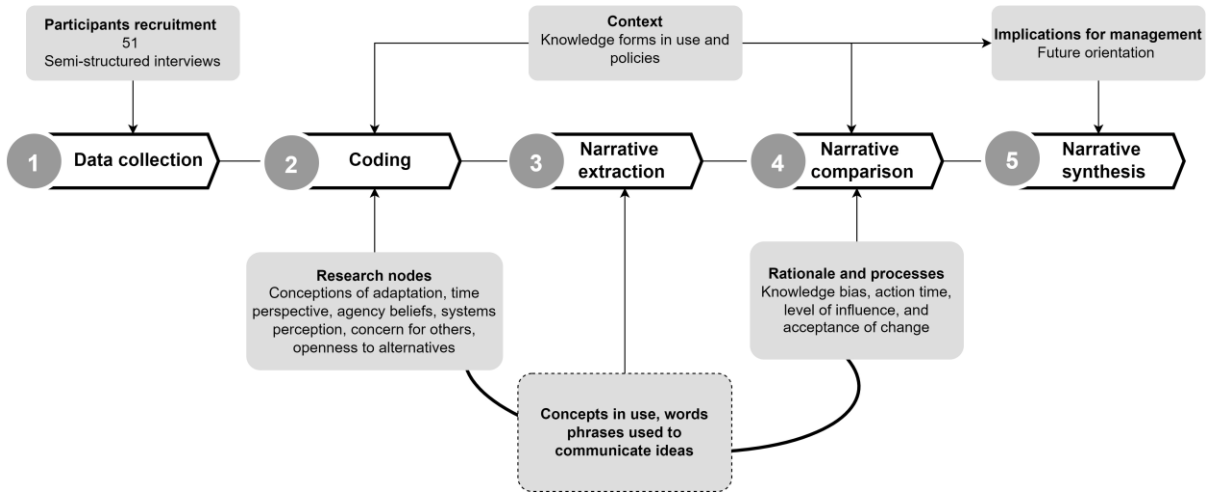

Figure 1. Overview of methodological and analytical process. Interviewees were selected using purposive sampling (1), then interviews were transcribed and coded (2) following the research nodes and contextual factors such as rules and knowledge in use. After extracting narratives (3) they were then compared for analysis (4, 5) according with the rationale and processes described.

After extracting the narratives, we evaluated each to identify similarities and differences according to the underlying adaptation rationale (covering knowledge bias and action time) and adaptation processes (including level of influence and acceptance towards change; Table 1). We also identified rules and knowledge-in-use shaping practice (Step 3 in Figure 1) including policy documents and management plans to gain a deeper understanding of the operating contexts of respondents and connect individual perceptions with collective shared meanings of adaptation.

Table 1. Framework for analysing adaptation rationale and processes.

Theme of analysis	**Description**	**Futures consciousness dimension**
Knowledge bias (Social-ecological > vs < Ecological systems)	Strategies can address the interconnectedness between natural and social systems, considering how cross scale dynamics (threats and response time) affect the system (+5), or can focus on local level management of some ecological features (-5)	• Time perspective • Systems perception • Concern for others • Agency beliefs
Action Time (Proactive > vs < reactive)	Strategies can have proactive time perspectives under timeframes that allow understanding of systems responses to change (+5), or can reactively respond to calendar/management timeframes (-5)	
Influence Level (participatory / bottom-up > vs < top-down)	Strategies empower actors through clear rules and enabling participation to integrate other stakeholders and local communities perceptions and needs (+5), or can be top-down approaches (-5)	• Concern for others • Agency beliefs • Systems perception • Openness to alternatives
Acceptance level (transformative > vs < resistance)	Strategies that accept complexity and dynamic social ecological systems accepting change (5) or strategies that look to prevent change and reduce uncertainty (-5)	

The narrative analysis is ontologically based on social constructivism (Hay 2016) regarding how futures consciousness is created and communicated, connecting individual perceptions and sense-making with collective meanings of adaptation. This project was approved by the Australian National University Human Research Ethics Committee 2019/226. Written consent for the interviews was obtained, and quotes are presented without attribution, referenced with country abbreviation and number: Colombia: C-#; Australia: A-#; South Africa: SA-#.

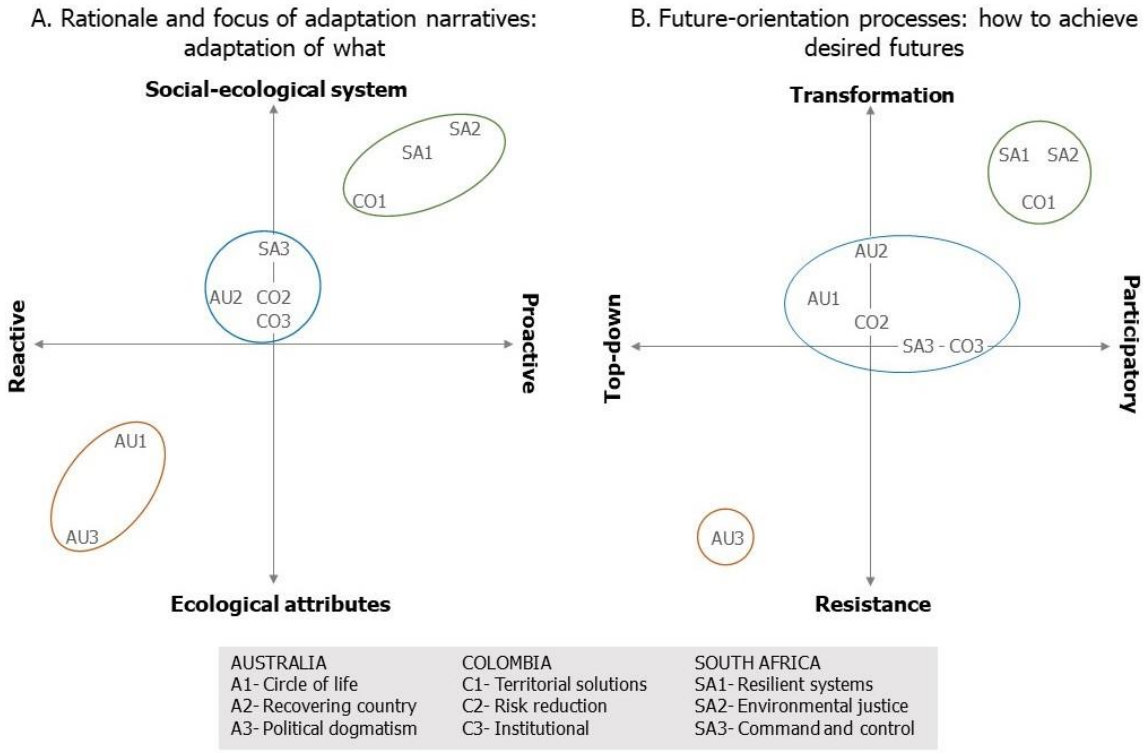

Figure 2. Adaptation narratives in Australia, Colombia, and South Africa. Figure 2A compares the adaptation rationale (adaptation of what vs. action time); Figure 2B compares the processes (acceptance of change vs. level of influence).

The plots in Figure 2 were produced after applying the analytical framework in Table 1 to visualize similarities and differences and identify futures consciousness elements underpinning the narratives. Narratives in Figure 2A represent the motivations for adaptation, ranging from adaptation of SES to ecological attributes, and different action time - reactive or proactive responses. In Figure 2B the narratives are grouped in relation to processes to achieve desired futures, indicating level of acceptance of change – resistance to transformation – and the level of influence, differentiating between participatory or top-down approaches.

Results

The results are organised to illustrate how futures consciousness come into play when defining adaptation, the levels of acceptance of ecological change across temporal and spatial scales and the implications for managing change in the enclosed boundaries of protected areas. We extracted a total

of nine narratives, three for each country (Table 2). Although some narratives share similarities across the countries, the narratives are distinctive, reflecting the environmental governance arrangements in use (top-down or participatory), stakeholders involved, expectations of adaptation, different levels of acceptance about ecological change, and different ways to manage transformation. Action time tends to be more proactive in narratives with a systemic approach, as are those narratives aligned with accepting change as part of managing SES.

Table 2. Overview of narratives describing rationale and processes. A: Australia: C: Colombia: SA: South Africa

Rationale	
A1 – Circle of life	Reactive and short-term adaptation to reduce threats and preserve ecosystems integrity and threatened species
A2 – Recovering country	Accepts ecological change, but aims to preserve ecosystems integrity and prevent species loss; questioning current focus on species in favour of wide systemic adaptation considering benefits for society; aspirations for long-term approaches
A3 – Dogmatic adaptation	Preventing ecological loss and protect threatened ecological attributes; adaptation is reactive under short-term approaches
C1 – Territorial solutions	Adaptation to support provision of benefits for society and nature at landscape level
C2 – Risk reduction	Prevent environmental change, maintain ecological integrity, and reduce climate change risks on society; reactive and short-term approaches
C3 – Institutional adaptation	Protected areas are tools to support aspirational goals of conserving biodiversity and provide benefits for society
SA1 – Resilient systems	Recognise dynamic relations of social-ecological systems; proactive approaches observing social-ecological responses to drivers of change but responding to calendar time management
SA2 – Environmental justice	Adaptation to climate change aims at maintaining provision of values and benefits for society; long-term envisioning guides management plan
SA3- Command and control	Adaptation aims to reduce threats on ecological elements but also to maintain benefits for society; short-term approaches under management calendar times
Process	
A1 – Circle of life	Adaptation as cyclical approaches to maintain conditions, but climate change is reducing opportunities to respond; no stakeholder engagement
A2 – Recovering country	Aspirations for landscape approaches and transformation of rules, but the lack of participatory processes constrains integrating different governing bodies and stakeholders across scales
A3 – Dogmatic adaptation	Hierarchical governance and unclear rules to prepare for, and respond to climate change
C1 – Territorial solutions	Parks are part of a complex territory therefore needs to integrate and negotiate stakeholders perspectives and aspirations through participatory approaches
C2 – Risk reduction	Maintain ecological integrity in parks incorporated into territorial/municipality land use planning using top-down approaches
C3 – Institutional adaptation	Aspirations that adaptation should address transformative change and cross-scale / cross-sectoral issues but strategies are short-term and preventing change
SA1 – Resilient systems	Adaptation through building resilience, and dynamic management to accommodate change while considering stakeholders concerns in management
SA2 – Environmental justice	Adaptation as building resilience at a landscape level, engaging stakeholder views and needs, and reconnecting society with nature
SA3- Command and control	Adaptation as connecting landscapes through corridors and ecosystem restoration, some participation through providing jobs to local communities

We found a diversity of understandings about what adaption is. Participants in the three countries reflected on how current management is helping or not to address adaptation. Participants shared examples from their perspectives about climate-induced changes and their impacts inside or outside the park boundaries. In Australia, the main focus is on preserving ecological attributes. Colombia and South Africa are more focused on adaptation options to guarantee social benefits from the park under scenarios of change. In Colombia provision of ecosystem services (mainly water) is the main focus for adaptation in the three parks studied. Climate change adaptation is not a priority for management in South Africa, although participants describe adaptation actions in terms of ecosystems-based adaptation, restoration, and building resilience. The term resilience is used interchangeably with adaptation in Australia and South Africa. In South Africa resilience is part of the philosophical thinking behind management plans alongside with complex systems, as part of SAM used by SANParks. Such philosophical underpinning of resilience is not used in Australia. From the examples shared by participants in Australia, resilience is used as a boundary object, with no clear consideration about its implications. Colombia does not include the concept of resilience as part of management or adaptation.

Adaptation of what and for whom?

Conservation strategies in the three countries included species and unique ecosystems, but there are clear differences in the knowledge bias guiding decisions towards managing SES or ecological attributes (Figure 2A).

The narratives indicate that managers are rethinking the intention of doing conservation inside static boundaries of the protected area. Such rethinking draws on building relationships and negotiating with local stakeholders inside and outside the protected area, which enable thinking differently about how social ecological values can be affected by drivers of change in the park, and beyond the boundaries of the protected area as illustrated by this quote from South Africa: *Conservation cannot rely on protected areas. Conservation has to be outside of protected areas. And climate change adaptation can't be in protected areas* (SA-13). Managers in Colombia also stated their understanding about conservation and adaptation as part of bigger planning processes and engagement with other stakeholders: *Our biggest aspiration in PNN is that other sectors and institutions understand the role of protected areas in providing ecosystem services for society and for ecosystem-based adaptation…[for that] we need to learn, to understand the needs from the farmer, from the tourism operator, but work with them so they understand that the park is not a museum, but that we can work together* (C-15).

The focus on SES is linked with adaptation narratives based on landscape approaches, where managers perceive the park as part of a larger territory, focusing on connectivity to guarantee the provision of ecosystem services for communities. South African narratives (and at least one from

Colombia, green circles in Figures 2A and 2B) are influenced by aspirations of social and environmental justice, not just desires for conserving biophysical elements of nature. In Colombia, respondents mentioned the 2016 peace agreement as an opportunity to support territorial planning and resolve conflicts with local communities: *[the peace agreement] covers a comprehensive rural reform providing an opportunity for managing land occupation and tenure conflicts in the park while improving the livelihoods of those people* (C-10). In South Africa protected areas are a means to address social problems, engaging with knowledge held by local communities and reconnecting people with nature. This perspective is based on responsibilities to attend to community needs for adaptation while recognising existing tensions between conservation and society: *the park can serve as a catalyst to resolve some of the societal problems and issues that the country is actually struggling with at the moment* (SA-16).

Despite aspirations for adaptation as part of a landscape approach in Australia, the findings illustrate negative feelings grounded on the perceptions of the politicisation of responding to climate change, managing feral animals and bushfires, which is a barrier for managers to engage with local communities: *…then we've got certain political parties disagreeing, it's awfully hard to get traction with the community when the issues become so politicized* (A- 6). Another interviewee indicated how the increased land clearing in private properties is constraining landscape approaches in Australia, and how future connectivity programs should consider the long-term effects of climate change: *[the landscape approach] It's never going to happen. But there is opportunity…we can be smarter about it, we can try and look at strategically linking things, connectivity strategies are already there. But the difference in connectivity strategies for the adaptation stuff is around transitional planting [you need] planting what you expect to survive in 50 years time or 30 years time* (A-2).

Climate change engenders questions of ethics, responsibility, and future management. In Colombia managers understand adaptation as part of observing local dynamics to prepare management for future changes: *adaptation is knowing the changes and interactions of different elements in a system, how climate change and other issues at the landscape will interact, acknowledging what are your responsibilities and goals, and how we prepare to deal with potential changes there* (C-5). Responses from South Africa indicate that when adaptation decisions are made considering local communities concerns, and that management is aware of SES responses though time, foreseeing future environmental responses to global drivers of change: *[climate adaptation] are those things we need to be doing to cope with the changes coming our way, so how are we going to do things differently in order to survive, as humanity. And humanity requires ecological functionality, so we need to be thinking about how the entire ecological system is going to persist over time and what we need to do to ensure that happens* (SA-20).

The temporal disconnect between management times and climate change is recognised as part of restructuring current short-term approaches. Managers would like to better understand climate change

impacts and define adaptation options through engagement with local communities and reconciling conservation practices with the social context of the park: *the challenge for us will be, how do we actually translate [climate change] into real learning on the ground with stakeholders, and how do we pull it together* (SA-15). Management in Australia respond to policies that prioritize threatened species, but managers are questioning the current focus on species conservation and discourses of species loss that affect accepting change: *Mentally we have to accept that change is going to happen and not try and keep fighting against it. And that doesn't mean give up on the issue* (A-4).

Systemic and participatory approaches, as observed in South Africa and Colombia, indicate that relying on technical aspects of climate change like models and climate information is becoming less relevant for future planning. In South Africa, existing participatory processes take stock of different stakeholder groups to negotiate and incorporate their visions about the park into the management plan, which has facilitated managing systems with high levels of variability, such as the case of estuaries and coastal wetlands: *the discussion is now how the estuarine systems operate in different phases. And one is not better or worse than the other. The closed phase can be very beneficial when the mouth opens, because you are different algae growing, you've got different food sources in there that are very important for recruiting fish that come in when it does open. And that has certainly had an influence over the dialogue around the mouth and also the expectations and the frustration around the mouth management. At the same time, SANParks has implemented more strategies to try and warn us about potential floods (SA-13).*

Parks in the three countries mentioned climate change as a critical topic for management. However, as highlighted by one interviewee, climate adaptation is highly contextual, and responding to climate change will be prioritised by parks differently. Then, adaptation will often rely on individual preferences or priorities to address adaptation as part of management: *[in Colombia] we have 59 national parks, each managed by different Chief Rangers, so there is so much diversity on thinking and visions, for some parks adaptation will be a priority depending on the context but for others there will be other urgent matters* (C-8).

Empowering

Empowering is about agency. Agency is enabled by managers questioning if existing approaches facilitate achieving desired conservation goals under climate change and reflecting on their assumptions while examining the opportunities to act.

Existing environmental frameworks and the participatory approaches used in South Africa and Colombia enable managers to pay more attention to the legal and institutional arrangements that prevent or facilitate dealing with changing climates and negotiate agendas with other stakeholders. In South Africa and Colombia, adaptation narratives aiming for corridors, landscape, and ecosystem-based approaches, draw from existing territorial planning or watershed regulations, empowering

managers to prepare for future changes and collaborate with stakeholders beyond the park's boundaries. Climate change has been key to aligning management goals and strategies with local stakeholders: *[Our] planning instruments must be harmonized with the local development plan, the Department one, the watershed plan, it's very complex but climate change has been transversal to integrate those many planning instruments* (C-5).

Rigid institutional mandates constrain learning and reflexivity about observed changes to inform future planning. When climate change is part of institutional strategies (e.g. a program in the management plan), it is harder for managers to manage the disconnection between management times and SES responses, constraining aspirations for accepting change as part of management: *We got so hung up about the measurable and actionable objectives, that we get almost blinded for, are we achieving the broader thing…we lose sight of the forest and we focus too much on the leaves* (SA-18). In Australia, the lack of clear rules to prepare for change, the perceived politicization of climate change, and narrow policy mandates to preserve ecological attributes over management of SES make adaptation reactive and short-term. Responses indicated frustration over current short-term programs focusing on managing system attributes such as feral species, threatened species, or prescribed fire management. Such approaches are implemented by external agencies and not integrated adequately in management: *The role of plans of management is changing. It used to be that it used to guide everything right, but now we go into a programmes phase…governments want outcomes, how do you get outcomes, you do it through a programme* (A-8).

Respondents in the three countries indicated desires to rearticulate existing practices and integrate other ways of knowing and aspirations for the future. Colombia is already doing it, South Africa not yet, and only one narrative in Australia indicated efforts to include different knowledge systems in management, which reflects transitional adaptation to change current top-down approaches by connecting Aboriginal interests with management: *A lot of work in the Australian Capital Territory is actually about Aboriginal people finding their way back, or getting an opportunity to be on country, rather than them providing knowledge, because a lot of it has been lost in this area* (AU-Int. 9). By recognising the history of Aboriginal dispossession and disruption of connections with country, this approach enables First Nations engagement, legitimises their voices, and re-connects their knowledge to Country.

Rethinking conservation under climate change is aligned with participatory approaches and accepting change as a fundamental part of SES. For example, when adaptation actions are presented as preserving some ecological attributes (e.g. species), respondents from South Africa indicated conflicting feelings as their preference is towards systemic approaches which are more aligned towards accepting and accommodating change rather than preventing it: *Do we fight it? Or do we live with it? Probably a bit of both. We try and prevent it obviously…but [there] are going to be radical changes…a lot of changes that are beyond our control* (SA-12). While in Australia, managers are

recognising the limitations of exiting practices under climate change focusing on static maps: *that change in composition across the landscape is something you would expect to see with climate change, but it's not something we conceptually can deal with in our traditional conservation models. So, for instance, something as simple as coming up with vegetation types for a vegetation map. Well, that's a static view of a whole lot of plant associations, which was never static in real, but it's going to be really changeable in the future* (A-12).

In Colombia, remote sensing technology is used for monitoring land cover changes to protect natural resources and Indigenous agricultural practices (chagras) and managers recognise that existing institutional framings facilitate to integrate local voices in planning: *we expect to harmonize [Indigenous] cultural protocols with the park's management plan, looking for a co-management approach. That's we would like to see not only with the Indigenous groups but also with local peasants so we can integrate their knowledge when making decisions* (C-10). Top-down approaches are not a barrier for adaptation in Colombia, as managers use those platforms to participate in cross-scale and cross-sectoral planning processes and to prepare for climate change: *[PNN] participated in the regional and departmental climate change node, supporting the implementation of the national climate change policy…also in the update of Colombia's 2030 National Determined Contribution, creating planning routes with the different organizations and the Ministry to see how the Amazon region can contribute* (C- 9); yet, a critique from respondents in Colombia was about the risk of potentially institutionalise climate change discourses through strategies and forums without reflexivity to connect high-level discourses with the realities of implementing climate change at different scales.

Discussion

The 5DFC model enabled elicitation of the rich plurality and contextuality of narratives from the three countries. These narratives represent diverse worldviews of systems and causality, shaping preferences, policies and approaches, the values, rules and knowledge of adaptation (Gorddard et al. 2016). Futures consciousness helps us understand these narratives in the specific contexts under which they are created and communicated. Below, we examine aspects of futures consciousness framing these narratives and discuss the implications for management and future-oriented conservation.

Cross-scale aspects of adaptation: time perspective and system perception

The time perspective in futures consciousness addresses how people orient themselves toward the future and how they use the past and present to plan for future consequences (Ahvenharju et al. 2018), including considering systems responses and how management actions influence change (Múnera-Roldán et al. 2020). Adaptation re-framed as 'pathways of change and response' (Wise et al. 2014), entails a strong temporal dimension. Yet, the past is often poorly integrated with the present and future in adaptation research and practice (Adamson et al. 2018). Diversifying knowledge systems can

help managers address complexity, uncertainty, and accept change in social-ecological systems. Colombia is in the process of integrating Indigenous and local knowledge (ILK) with scientific knowledge (Múnera-Roldán and van Kerkhoff 2019), which can help connect deep past perspectives of ecological change and response with the present and future (Ogar et al. 2020).

Managers in the three countries use vulnerability assessments and monitoring to connect past and present events with day-to-day management. However, only South Africa applies an integrated approach for planning, adaptive monitoring, learning, and reflexivity as part of the SAM approach. SAM builds on resilience theory and practice, where ecosystem responses occur across spatio-temporal scales (Roux and Foxcroft 2011). Understanding cross-scale interactions of drivers of change for parks and local communities has been central to parks management in South Africa (Freitag et al. 2014) and part of a constant rearticulation of practice (Roux et al. 2021; Roux et al. 2022).

The landscape approach used in Colombia helps managers conceptualise cross-scale interactions, negotiate conservation and land-use planning with local stakeholders and complement the ecosystem services focus, whereby parks can also provide benefits to local communities (Moros et al. 2020). However, the social benefits of ecosystem services are not addressed in monitoring systems, which focus on quantitative targets (Burgos-Ayala et al. 2020). This situation risks promoting reactive, short-term approaches to respond to stressors to define limits of change, which disregard the slow ecological responses of SES to new conditions (Gladstone-Gallagher 2022). Conservation discourses focusing on threatened species instead of social benefits, are a persistent tension between environmental, economic, and political agendas. Such approaches perpetuate the disconnection management-systems response time, as observed in the short-term policies in Australia based on species outcomes and programme performance may prove maladaptive under climate change, especially if environmental policies are not aligned across governance scales (Samnakay 2021).

Ecological integrity and functionality are aspirational goals in narratives from the three countries. The concept of ecological integrity is rooted in visions from the past, aiming to preserve the essence of a system through incremental adaptation actions to prevent change (Lavorel et al. 2020; Peterson St-Laurent et al. 2021). Managing for ecosystem functionality requires addressing alternative futures, exploring if management wants to avoid or to accommodate change (e.g. novel ecosystems) while maintaining functional properties and provision of benefits under conditions of change and climate variability (Colloff et al. 2020). Deliberations about expectations under climate change across scales and jurisdictions can enable individuals and institutions to be agents of change, as discussed below.

Doing is believing: agency, openness to alternatives and strategic planning

Agency beliefs represent how individuals can exercise their power and influence towards shaping desired futures. Assumptions and aspirations about the future are created and recreated in socio-

technical imaginaries that frame policies and actions to address change (Jasanoff and Kim 2013). Reflecting on desired goals helps remove temporal barriers between the imagined future and what people can do now, opening options and enabling agency (Maeckelbergh 2011).

In Colombia, PNN staff actively discuss cross-scale climate change impacts to identify adaptation options, questioning if current management approaches are adequate, and have started to include climate change considerations in plans to designate new protected areas (Rodríguez 2017; Ospina Moreno et al. 2020). Colombian parks managers take advantage of existing rules to participate in national and regional forums, making the case for benefits from the park to be relevant at different scales. However, PNN approaches still do not transcend high-level deliberations about biodiversity conservation and climate change with other National Environmental System (SINA) institutions. Strong policy frameworks are an opportunity for strategic planning beyond mobilising science. Still, institutionalising conservation in strategies and policies is not enough to prevent environmental degradation and requires cross-scale synthesis and integration of knowledge, inclusiveness and deliberation over goals and activities (Murcia et al. 2016; Sierra et al. 2017). Although the Colombian Constitution promotes societal participation in conservation and climate change policies through decentralised environmental governance arrangements, planning is mainly centralised and top-down, with no functional relationship between global spaces and local processes, representing a missed opportunity for adaptation.

In South Africa, implementing SAM has facilitated critical thinking, questioning, and discussion on climate change as a management issue, opening up options for adaptation (Múnera-Roldán et al. 2020). Co-production of conservation objectives with stakeholders helps to address complexity and uncertainty (Roux et al. 2021), integrate climate change into management, and reconcile tensions about future expectations of the park's benefits to local communities. As in Colombia, strong environmental frameworks enable agency by parks managers. However, there are still multiple challenges to properly integrating climate change in management, across sectors and scales (Taljaard et al. 2019).

In Australia, rules favouring threatened species and resisting change constrain adaptation (McDonald et al. 2018), which translates into preferences for creating protected areas with a focus on protecting species instead of social benefits (Hernandez et al. 2021). The result is evident in the politicisation of climate change and land uses (Wyborn 2009; Crowley 2021). There is also a perception of unclear roles and responsibilities, and a lack of guidance on cross-scale integration of climate change into management which impedes planning and implementation of adaptation strategies.

Adaptation pathways represent a practical expression of agency beliefs by helping managers deliberate, decide and act on options under uncertain scenarios of change (Wise et al. 2014). In

Colombia, adaptation pathways were not mentioned explicitly but might be deemed implicit in the decennial high-level strategic plans and actions to consolidate the National System of Protected Areas (DNP 2010). Defining thresholds of potential concern for monitoring systems' change stimulate thinking about management options in South Africa (Freitag et al. 2014). In Australia, the New South Wales National Parks and Wildlife Service use adaptation pathways to enable action under uncertainty (Jacobs et al. 2018), but management plans do not include it.

Agency can be constrained by institutional rules, or structural issues of poverty and inequality. In South Africa, bureaucracy is a barrier to including climate change in management plans, together with addressing changing climates within fixed boundaries of parks. In Colombia, agency is constrained by socio-political contexts that encourage deforestation in and around parks (Clerici et al. 2020; Rodríguez et al. 2020) affecting aspirations for adaptation and conservation.

Concern for others: adaptation for whom?

Adaptation involves considering who is affected by climate change and who benefits from adaptation actions. Adaptation presents an opportunity to overcome the dichotomy between human use and conservation by shifting from preserving ecological attributes to protecting benefits for society and local communities (van Kerkhoff et al. 2019). Provision of benefits from protected areas as part of the social-environmental justice of adaptation is seldom recognised (Rincón-Ruiz et al. 2019) or addressed as a critical element for conflict resolution and justice at the local level beyond utilitarian views of parks (Sene-Harper et al. 2019). While environmental justice is far from being addressed in the three countries, approaches in Colombia and South Africa indicate moves toward transforming biodiversity conservation practices (Massarella et al. 2021) by focusing on benefits for local communities and enabling their participation. However, narratives that aim for environmental justice should carefully consider the definition of justice, and the indicators used to evaluate how benefits from protected areas address equity and justice (Friedman et al. 2022).

Colombian narratives address interdisciplinary approaches but are not yet co-producing shared goals. However, in the post-conflict era in Colombia, the narratives highlight the role of parks in addressing structural violence affecting local communities and park managers (Leal 2019; Guasca et al. 2021). Colombian narratives also emphasize the strong relationships parks managers create with communities through respecting local values and rules (Ungar and Premauer 2019) and enabling the continuation of traditional livelihoods and the development of nature-based economic activities. In South Africa, respondents recognise tensions between conservation and society as part of the inherited parks model from the apartheid (Musavengane and Leonard 2019). But managers are building opportunities to renegotiate the aims of conservation as communicated in the interviews and documented in the participatory visioning for the GRNP management plan (SANParks 2020).

Extreme events and natural hazards framed as concerns for livelihoods and economic development, have permeated conservation discourses. However, it remains uncertain whether risk narratives enable holistic thinking and strategies or perpetuate top-down, technocratic approaches (Borie et al. 2019). In Australia, the consequences of unpreparedness for climate change impacts were highlighted by the 2019-20 'Black Summer' bushfires that burned through many parks (Davey and Sarre 2020). Yet, responses to increasing threats from bushfires still call for more knowledge on impacts, prevention, and recovery rather than adaptation (Celermajer et al. 2021). Indigenous Australians have made a case for threat mitigation through the use of cultural burning practices and their knowledge and experience of surviving 65,000 years of climate change are starting to be recognised and valued (Tran et al. 2020).

Implications for adaptation

Shifting the paradigm of long-term conservation in the enclosed boundaries of protected areas requires rethinking our assumptions of change, understanding where the motivations to do conservation come from, the costs of sustaining adaptation, and the role of rules in shaping action. The main implication of the multiple ways of addressing adaptation is related to how management addresses change which means defining how much park managers are willing to accept change, as this will influence conservation goals and adaptation options (Múnera-Roldán et al. 2022). Defining adaptation actions in protected areas also requires critical thinking about the limits of adaptation, or the point when adaptation actions are no longer effective, too costly, or socially unacceptable (Adger et al. 2009; Barnett et al. 2015).

The multiple adaptation framings can also have consequences on what knowledge is used to anticipate the future (Ahvenharju et al. 2018), how people understand climate change and risks (Simpson et al. 2021), and the use of indicators to assess adaptation effectiveness (Seddon et al. 2020; Singh et al. 2021). Futures consciousness can help explore how management understands and evaluates external stressors affecting the park's attributes and beyond its boundaries. South African narratives and their application of SAM provide an example of the benefits of using long-term and systemic approaches to understand the complex interrelations of stressors across scales to enable adaptation and learning.

Concluding remarks

The 5DFC model provides a structure for understanding contextual attributes of adaptation, expectations, and perspectives involved in managing protected areas under climate change in Australia, Colombia, and South Africa. Colombian and South African narratives represent attempts to overcome the past and move forward, while Australia is just beginning to explore such options.

We found a plurality of adaptation concepts and approaches, which is not unusual. Each protected area has different contexts, and managers will face different problems and choices. Exploring futures

consciousness can help understand the characteristics that enable or constrain future-oriented conservation. We suggest that future-oriented strategies should be based on day-to-day management to facilitate reflection and learning on past experiences and identify options to change maladaptive practices. Futures consciousness can help understand how intolerance of uncertainty impedes deliberations towards accepting change and evaluating the long-term consequences of decisions across scales. Engaging in future-oriented practices should consider that people's mental models about a system and their expectations for the future will be different, influenced by social and cultural contexts that affect action and planning.

Countries aiming to commit to global targets of expanding protected areas to address climate change and biodiversity loss would need to negotiate different constructions of the future in conservation research and practice and with local communities affected by conservation planning. The narratives presented here can be a starting point to understanding such differences and facilitate the implementation of reflexivity processes and methods to reframe adaptation.

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5.4. Mismatches between beliefs and actions in adapting biodiversity to climate change (Paper 4)

This paper addresses the policy context of each country to expand on the understanding of the socio-political contexts from which the adaptation narratives presented in **Paper 3** are created and communicated, helping to address research question 1 and sub-question 1a. This paper does not explicitly address the 5DFC but focuses on content analysis of policy documents.

Paper 4 explains how each country addresses high-level goals and their commitments to global climate change and biodiversity agendas, as observed in implementation at the local scale in defining and managing protected areas. The results illustrate the distinct discourses used by each country in their environmental governance arrangements. Despite differences, the discourses share similar metaphors to justify economic development. The three countries have contradictions between aspirational goals for sustainability and economic development, which align and explain the diverse narratives presented in **Paper 3**, helping to answer research question 1. The discourses also differ in how environmental governance at the national and subnational scale allows or constrains the implementation of adaptation (research question 2).

The findings demonstrate existing contradictions between high-level aspirations for sustainability, and how such discourses enable or constrain action to deal with uncertain futures at the local scale (sub-question 1a). In the paper, we discuss how beliefs and identities influence each country's social construction of adaptation discourses, influencing options to adapt biodiversity and protected areas to climate change (research questions 1 and 2). Aligning with the findings discussed in **Paper 3**, this paper demonstrates the relevance of having clear rules to address climate change, as it enables managers to identify options to negotiate agendas at different scales.

Environmental discourses in the three countries have changed through time. With my co-authors, we explain how protected areas are becoming less or more prevalent as a tool to support adaptation while aligning environmental agendas with national or international commitments. We also examine the many barriers to achieving national aspirations for conservation and climate change, especially the need to address structural problems that impede sustainable futures, while bridging local realities with national goals. Finally, the paper indicates some opportunities for reflexivity and deliberation to reconcile those contested issues impeding sustainability.

Australian National University

Statement of Contribution

This thesis is submitted as a Thesis by Compilation in accordance with https://policies.anu.edu.au/ppl/document/ANUP_003405

I declare that the research presented in this Thesis represents original work that I carried out during my candidature at the Australian National University, except for contributions to multi-author papers incorporated in the Thesis where my contributions are specified in this Statement of Contribution.

Title: Mismatches between beliefs and actions in adapting biodiversity to climate change

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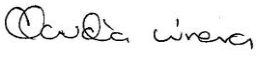
Claudia Munera-Roldan (Candidate print name)			05 July 2022

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Mismatches between beliefs and actions in adapting biodiversity to climate change

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Abstract

Policy discourses dealing with environmental change are grounded in social and political contexts, shaping interpretations of the focal problem and possible solutions. International environmental agreements help countries define aspirational goals aligned with their sustainable development priorities, commitments, and responsibilities. However, implementing those high-level agreements does not necessarily align with local realities. We examine the social construction of how climate adaptation is implemented for biodiversity conservation and the links between aspirational goals of international agreements and their implementation at the local scale. We reviewed policy documents and interviews with protected area managers in Australia, Colombia, and South Africa. Environmental approaches in each nation correspond to specific beliefs and identities, representing distinct discourses with similar metaphors to justify economic development, revealing a mismatch between conservation efforts at the local scale and national aspirations for growth. Exploring how beliefs frame action and policymaking helps identify areas of contestation to address barriers that perpetuate unsustainable practices while reconciling cross-scale needs and contexts to be meaningful and close to local realities.

Keywords: climate change adaptation; international environmental agreements; policy discourses; protected areas; social construction

Introduction

Environmental policy making is increasingly dealing with rapid social and environmental changes, high uncertainty, and contested values in closely interconnected, globalised societies. Addressing climate change and biodiversity loss are examples of where such contestation is apparent. There are over 3000 international environmental agreements (IEA) to address drivers of environmental degradation (Mitchell et al. 2020), involving multiple experts, frameworks, and organizations. Such IEA set aspirational goals and guidance for managing common-pool resources, protecting natural resources, reducing pollution and responding to extreme climate events.

Achieving these aspirational goals is often difficult. For example, the Aichi targets set by the Convention on Biological Diversity (CBD) aimed by 2020 to increase protection of biodiversity and ensure societal benefits from a healthy environment. Despite such efforts falling short (SCBD 2020), global aspirations to halt biodiversity loss, reduce threats to the environment and the supply of ecosystem services through setting aside land and waters for conservation continue. Protected areas networks underpin the achievement these aspirations (Maxwell et al. 2020). Setting new protected areas and expanding existing ones to cover at least 30% of land and sea areas by 2030 is one of the targets under the post 2020 CBD framework (SCBD 2021). Signatory nations are responsible for expanding protected areas, but it is unclear how this objective will be implemented, with questions of participation, expected outcomes, who benefits and the effects on people whose livelihoods depend directly on nature (Fedele et al. 2021).

Protected areas can have different governance arrangements, including state-based, customary conservation-based managed by Indigenous peoples, can be community or private conservation initiatives (Maxwell et al. 2020). Planning and managing protected areas require horizontal integration with other sectors (e.g., water, agriculture, and mining) and communities, while considering ecological transformations under climate change and the implications for adaptation. Conservation areas are subject to contestation over what actions can be implemented, who participates, and boundaries. Place-based conservation is implemented within specific geographical and legislative boundaries but is vulnerable to global change (Hannah 2010). Protected areas are complex, dynamic social-ecological systems (Cumming and Allen 2017), but conservation goals are often aimed at resisting change and preserving existing environmental character. Although management strategies aim to be long-term, policies, practices, and resource allocations are often short-term, creating a disconnect with ecological response times (Múnera-Roldán et al. 2020).

World views and political preferences affect what of nature should be conserved, and how. Protected areas around the world differ broadly in their objectives, including the exercising of sovereignty by nation states, aligning with modern global environmental agendas, providing economic benefits from tourism and recreation and attempting to achieve social-environmental justice (Wakild 2018). IEAs set a common language and shared aspirational goals, but with little consideration of how goals made by external decision makers might align with local realities and livelihoods. This mismatch raises questions of legitimacy and efficacy, especially as broad goals set by IEAs and implemented by nation states at local scale, often ignore local socio-political contexts and realities (Herrera 2019).

Both the CBD and the United Nations Framework Convention on Climate Change (UNFCCC) proscribe general guidance and expectations to countries. But, negotiating climate change and adaptation has become a complex issue, with diverse interpretations of the problem and the priorities to address it. This diversity of framings affects how climate adaptation is conceptualised (Goldman et al. 2018), success is assessed (Singh et al. 2021), who participates and gains benefits from adaptation

initiatives (Eriksen et al. 2015). Climate adaptation being perceived as a problem that can be resolved by more scientific information, with little focus on values, ethics, rules and governance issues (van Kerkhoff et al. 2019) will have limited impact in the long term, especially if local actors values, preferences, and aspirations are not part of the process.

Despite global efforts to build consensus on climate change actions and adapt to its impacts, successful implementation of IEA at local scale is also influenced by the degree of horizontal integration, definition of indicators and implementation of monitoring. For example, the Nationally Determined Contributions (NDC) enable the mainstreaming of climate change across sectors and sub-national units (Hsu et al. 2020), but each nation defines its priorities (e.g. reducing emissions, disaster risk reduction) and determines ways to address integration across sectors, including options to adapt natural resources and biodiversity to climate change. If adapting to global climate change is locally contextual, effective subsidiarity requires clear rules and coordination mechanisms to facilitate cross scale integration (Dovers and Hezri 2010).

The social context shapes how dealing with climate change and biodiversity loss are constructed, legitimising some approaches over others (Louder and Wyborn 2020). By social context we mean the socio-cultural, economic, political, historical and environmental settings and structures in which social interactions occur and how these settings and structures have causal powers to influence individual and collective values, preferences, perceptions, decisions and actions (Elder-Vass 2012, pp. 19-34). Our objective herein is to examine the social context of conserving biodiversity under changing climates in three contrasting case studies and explore how climate adaptation is implemented in each case. We investigate how and why narratives of adaptation and related policy discourses develop and are influenced by social contexts, structures and processes, and how clashes of aspirations and objectives at international and national scale can affect policy implementation at local scale. We identify potential mismatches between the goals and objectives of two major international agendas – the CBD and the United Nations Framework Convention on Climate Change (UNFCCC) – and how these are implemented at the local scale to adapt protected areas policies and management to climate change.

To evaluate the links between global aspirational goals and local realities, we explore adaptation discourses as expressed in policy documents and communicated during interviews with protected areas managers in Australia, Colombia and South Africa. These three countries are signatories of the CBD and UNFCCC and have a variety of common social, economic and environmental characteristics (cf. case studies section below). We outline the social and environmental historical context of the three countries and detail how the construction of national climate adaptation discourses and their contradictions have enabled and constrained policy implementation at the local scale. We propose that exploring the beliefs framing climate change and conservation discourses can

help identifying entry points for transformative adaptation and reconcile cross-scale needs and aspirations for sustainability.

Case studies: social, economic and historical context

Australia, Colombia, and South Africa share histories of colonialism, are regions of mega-diverse biodiversity, have well-established protected areas systems and economies that rely strongly on resource-intensive extractive industries, including fossil fuel production. Table 1 summarises the conservation, economic and governance contexts of the three countries.

Table 1. Summary of conservation, economic, and governance contexts of the case studies: Australia, Colombia, and South Africa. NDC: Nationally Determined Contribution: IUCN/WCPA: International Union for the Conservation of Nature, World Commission on Protected Areas

	Australia	Colombia	South Africa
Climate vulnerability ranking[1]	Medium risk	Medium risk	Medium-low risk
National Biodiversity	0.853	0.935	0.714
Government model	Federation	Republic	Republic
Environmental	Multilevel, mainly	Multilevel, mainly	Multilevel, mainly
Adaptation plans in	No adaptation component	Detailed adaptation plan	Some detail in adaptation
Adaptation outcomes in NDC[4]	Increase resilience & reduce risk	Protect biodiversity & ecosystems; protect natural capital & ecosystem services; economy; human well-being & health; increase resilience & reduce risk	Protect natural capital & ecosystem services; food security; water security; sustainable development & green growth; economy; human well-being & health
Coal exports: % of global total (world	39.5% (1)	4.3% (6)	4.7% (5)
Coal production: % of global total (world ranking)[6]	7.8% (4)	0.9% (10)	3.7% (7)

[1]https://germanwatch.org/en/17307; [2]https://update.nbspolicyplatform.org/your-nation/ [3]https://www.worldstopexports.com/coal-exports-country/; [4]https://www.statista.com/statistics/265638/distribution-of-coal-production-worldwide/; [5]https://sdgcompass.org/sdgs/; [6]https://www.cbd.int/sp/targets/

Australia is a young nation on an ancient continent with one of the oldest continuous human cultures. At least 65,000 years of Aboriginal history preceded British colonization and the dispossession of Indigenous Peoples from 1788, followed by the emergence of a post-colonial, multicultural and multiethnic society (Mcintyre 2016). Environmental history narratives highlight the world view of dominion over nature held by European settlers and their transformation of natural ecosystems to agriculture and grazing systems (Colloff 2020). With a federal system of government and Commonwealth, state and territory parliaments, each jurisdiction makes its own laws and policies, which tend not to be integrated at national scale (Ross and Dovers 2008). Despite an apparent decentralization, a number of policy areas remain largely centralised under direction from the Commonwealth (Fenna 2019). Aboriginal and Torres Strait Islander Peoples' participation in national affairs and environmental governance is still largely constrained despite proposals to provide constitutional recognition (Hobbs 2018).

The recognition of Colombia as one of the most biodiverse countries worldwide began in the early 20th Century, with collaboration between Colombian and North American naturalists enabling the development of conservation policies (Quintero-Toro 2012) which led to the formation of the national parks. But nature has also been regarded as an economic resource to be exploited and extracted. Deforestation rates have increased and are among the highest in Latin America (Armenteras et al. 2017). This perspective on development is situated within the complex social-historical context of Colombia, whereby legacies of colonisation have shaped aspirations of economic development and contested views of nation (Carrizosa Umaña 2014). Colombia has been affected by multidimensional socio-political violence, including a 50 year long civil war that ended in 2016 with a peace process between the government and the insurgent group the Revolutionary Armed Forces of Colombia (FARC; Karl 2017). In post-conflict Colombia, the involvement of former antagonists in the much-anticipated peace process has been a means for reimagining the nation and reconciling nature and society via low-impact economic development (Maldonado et al. 2018), but it has also led to illegal deforestation in or adjacent to protected areas (Clerici et al. 2020).

South Africa is known for its unique ecoregions, such as fynbos and highveld. With a complex socio-political context shaped by British and Dutch colonisation and war in the 19th century, coinciding with the development of mining for gold, coal and diamonds. Racial segregation under the apartheid regime (1948–1993), had profound effects on environmental management: nature was controlled and managed in game reserves for wealthy Whites. Blacks were dispossessed of their traditional lands and became labourers on reserves, farms and in mines (Thakholi 2021). The reserves transitioned to the South African National Parks (SANParks) reserve system from the 1920s. Up to the end of the apartheid era, national parks built a sense of identity and unity among Whites but segregated Blacks, creating a physical and psychological barrier between them and the natural environment (Mabunda et al. 2003; Carruthers 2014). The transition to democracy once apartheid was abolished, opened opportunities to reimagine options to overcome the legacies of colonialism and apartheid. However, weak policy implementation remains the main challenge to achieve the egalitarian vision of social justice declared in the constitution (Plagerson et al. 2019).

Conceptual approach and methods

This article builds from the assumption that the social world, with its complexities of structures, processes and multiple ways of sense-making, is open to diverse interpretations and meanings and how these have causal effect (Elder-Vass 2012). In interpreting social-environmental discourses and policies, we apply a realist-constructivist approach to consider the historical, political and ethical perspectives shaping discourses, and how socially accepted values, rules, knowledge and practices to address, manage or regulate a problem are reflected in there (Hajer 1995; Gorddard et al. 2016). This perspective is congruent with the Advocacy Coalition Framework of Sabatier (1988), whereby groups

of people from different positions co-ordinate decision making to pursue preferred societal aspirations based on shared values, beliefs and preferences, as represented in policies and legislation.

Aspiration is 'a transformational, future-oriented process', guiding political action and reflecting motivations, identities and values (Finnemore and Jurkovich 2020). Setting policy goals as a form of aspiration aims to support governance, develop guidelines, identify priorities for resource allocation, and define timeframes for policy implementation (Young 2017). Understanding how policy discourses are structured reveals how policies gain legitimacy through linking to normative societal values and aspirations. Analysis of the shared language and metaphors used to construct, interpret and communicate social-environmental problems, as contained in policy documents, reflect how decision makers and stakeholders create meaning and consensus about the nature of a problem and its possible solutions (Dryzek 2013).

Our analysis follows an interpretive structural approach to explore the historical, political and social-ecological context underlying discourse construction, and how discourses of public policy agendas make actions feasible and legitimate (Phillips and Hardy 2002). The hierarchical, multi-scale organisation of protected areas provides a rich basis to explore how policies derived from international agreements translate into actions at local scale. For this, we explore metaphors, storylines, key topics, and common concepts shared by epistemic communities as presented in policy documents, and how they align at different scales from international scale (CBD and UNFCCC) to local conservation (protected areas). Although we do not focus in detail on power, how policies are influenced by power structures and processes is inherent to the analysis because *what* and *whose* knowledge, values and rules are included or excluded in policy decisions is a product of power relations of decision makers and decision-making processes (Colloff et al. 2021).

We used mixed qualitative methods applied to data derived from a review of legislative and policy documents on climate change and biodiversity to reveal how particular social realities has been constructed (Phillips and Hardy 2002). The environmental discourses archetypes by Dryzek (2013) helped to classify the approaches and discursive constructions of policy in each nation. This analysis was complemented with empirical data from semi-structured interviews with stakeholders involved in conservation and adaptation policy making and implementation (see REFERENCE HIDDEN in review for details). Interview protocols were approved by the Australian National University Human Research Ethics Committee 2019/226. Written consent for the interviews was obtained, and quotes are presented referenced with country abbreviation (Colombia: Col; Australia: AU; South Africa: SA). Data from interviews helped us link local realities to national and international goals.

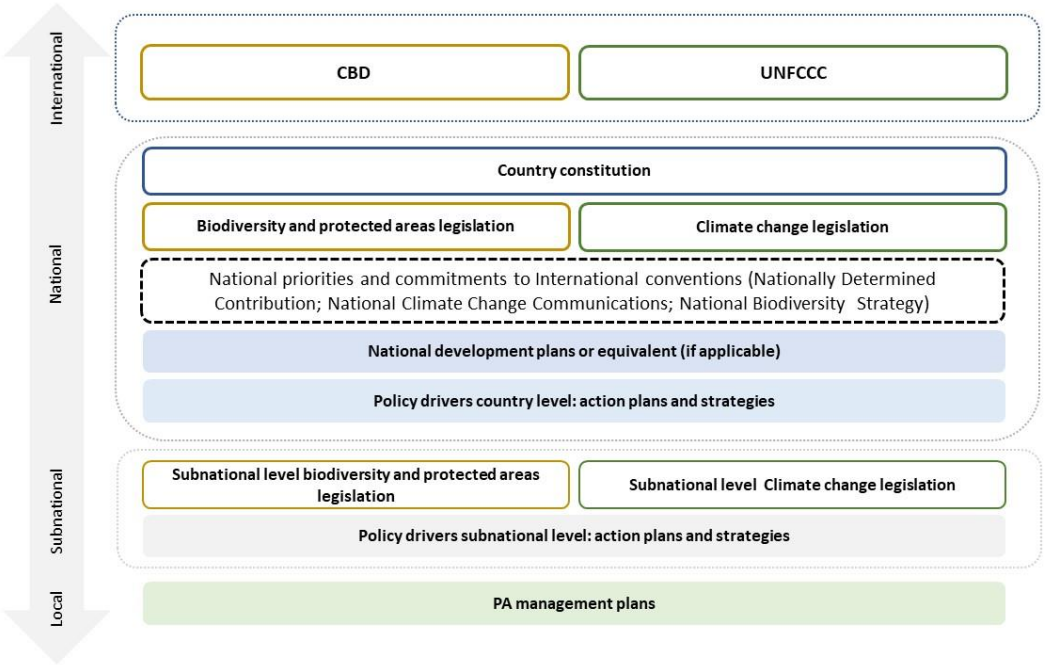


Figure 1. Policy hierarchy of legal and policy documents screened for the analysis. The hierarchy adapted from Samnakay (2017; 2021) helps establish connections between international conventions, national, sub-national (when relevant) regulations and protected area management plans

Policy and legislative documents were sorted according to the policy hierarchy model of Samnakay (2017; 2021) into international conventions, national/sub-national policies, regulations and protected area management plans (Figure 1). Our focus was policies from the last 30 years, starting in the year 1990. The complete list of documents analysed can be found in Appendix S1. Documents were screened to identify words and phrases used to communicate aspirations, approaches and expected outcomes, with reference to the following questions:

1) What are the stated reasons used to frame the issue? This question helps to identify policy drivers, logics and expected outcomes.
2) What is the overall context that shapes options and choices to address the problem? This question examines how the natural world is framed, the metaphors and phrases used to communicate the problem and connections between drivers of change that shape causal explanations of the issue.
3) Which actors are mentioned? This question identifies individuals, institutions and groups that share a common language and perspective of the issue and give that language meaning.

Below, we introduce how the relationship between economy and environment in the CBD and UNFCCC has been interpreted in the three countries before presenting detailed findings on each case study.

Two conventions with the same goal but different approaches

The CBD and UNFCCC have the same broad logic and objective: the goal of sustainable development, which requires a healthy environment. Economic development based on extractive

industries is common in political discourses and is an aspiration shared by the three countries. Regardless of this common story, each nation addresses climate change and biodiversity loss differently.

Is not unusual to find partisan ideologies behind narratives of economic development, as with the case of how Australian governments have framed climate change discourses, often using manipulative language of fear to frame climate action as a threat to employment and prosperity (Talberg et al. 2016; Hobbs 2020). Environmental discourses can also align with aspirational goals such as reducing poverty, addressing inequality, or addressing social conflicts, as in Colombia and South Africa. For example, after apartheid, South African climate change and biodiversity discourses changed to include principles of equality and ideals of emancipation. In Colombia, these discourses have shifted from climate change and biodiversity loss as problems of development to addressing these issues as providing opportunities to implement the peace process and ensure supply of ecosystem services.

Below, we explain how each nation has framed climate change and links with biodiversity conservation. The timelines in Figure 2 summarise the policy documents we analysed and the major changes in discourses.

The Australian Way: threatened species, emissions reduction and the economy

Australia was one of the first countries to become a Contracting Party to ratify the CBD, in the year after the Convention was opened for signature at the 1992 Earth Summit in Rio de Janeiro. These important international commitments gave impetus during the 1990s to the development of national policies to address climate change and biodiversity conservation. The Australian constitution – from 1900 – does not provide guidance for environmental considerations but enables the Commonwealth parliament to legislate for domestic implementation of international treaties[1].

The first Australian communication to UNFCCC addressed the need for cross-sectoral actions, including opportunities for natural ecosystems and protected areas. But subsequently, some elements of the environment became privileged over others in national legislation. The Environment Protection and Biodiversity Conservation Act (hereafter the EPBC Act) provides legislation to avoid impacts on 'matters of national environmental significance' such as threatened species and communities, Ramsar wetlands, world heritage sites, national heritage sites, nuclear actions and water. Although water is one of the most contested issues in Australia, under the EPBC Act water is only significantly relevant in relation with coal and coal seam gas extraction activities. The EPBC Act is enforced through preventive and ameliorative approaches, but lacks vertical and horizontal policy integration mechanisms, which creates a blind spot regarding the implications of climate change for the environment and the economy across scales and sectors (Ross and Dovers 2008; Samnakay 2017).

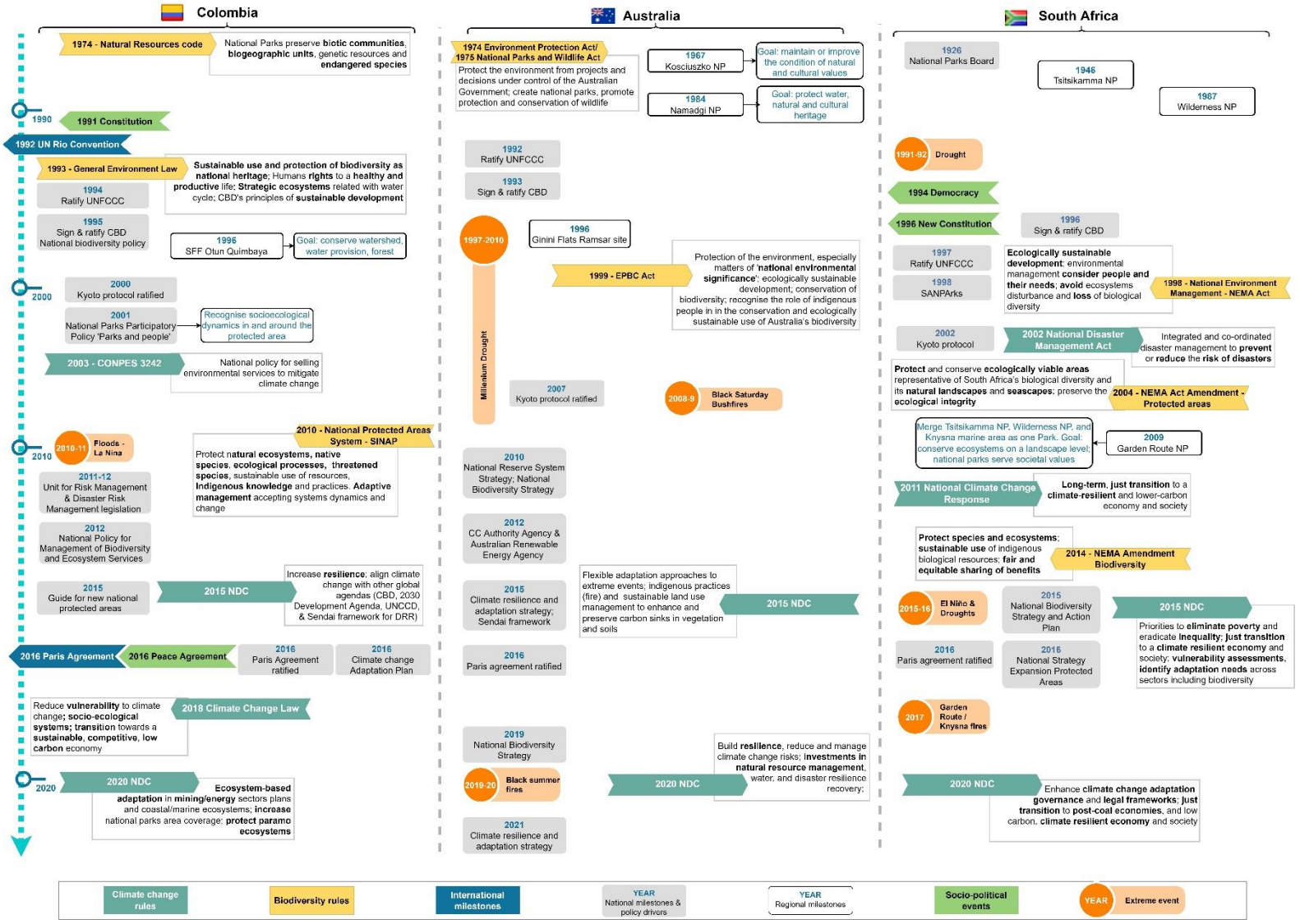
Despite a proactive start in the early 1990s, Australian climate change discourses and policies in the last 20 years have been volatile and highly politically polarised (Talberg et al. 2016). Australian

governments from both major parties, to differing degrees have framed action on climate change as a threat to economic growth, employment and prosperity. Though committing to climate change in international forums, Australian climate change policies focuses on emissions reduction. There has been little change in two decades except for the shifts in emphasis of the policy mechanisms, metaphors and symbols used in the discourse: emissions trading, clean energy, offsets, and new technology. No actions or goals are enforced by legislation and few policies show commitment to proactive approaches. Instead, policy has been reactive, incremental and ineffective, while relying on future, unproven technologies to reduce emissions (Crowley 2021). This policy conservatism has been legitimised by promoting a sense of national identity and the national interest while favouring corporate political allies (Bloomfield and Nossal 2013). For example, coal and gas production are invoked as good for the national economy, exports, jobs and prosperity and threats to their production are used to fuel a narrative of fear and strong opposition to an emissions trading system (Bell and Hindmoor 2014; Hobbs 2020).

Climate adaptation has been almost absent from national policy. At the 2009 Durban Climate Change Conference, Australia was part of a group of industrialised countries that opposed negotiations to develop obligatory national adaptation plans (Banerjee 2012). The term 'resilience to climate change' appears in discourses from around 2000: 'building resilience' is the preferred policy term used instead of adaptation, and is typically linked with disaster risk reduction and recovery but with no explanation or guidance about how to implement such actions (McEvoy et al. 2013) or even what 'building resilience' actually means.

Ecosystem resilience, achieved by protecting ecosystems, managing external threats and addressing biodiversity decline, underpins the adaptation approach for biodiversity in the National Climate Resilience and Adaptation 2015 and 2021 Strategies. The 2015 version highlights the strategy for the national reserve system[2] as critical to ecosystem resilience. However, the aspirational goal of long-term protection of Australia's biodiversity through a 'comprehensive, adequate and representative national system of protected areas' has fallen short (Pressey et al. 2021), as evidenced in the lack of preparedness to protect biodiversity from extreme events due to climate change during and after the Black Summer bushfires of 2019–2020 (Wintle et al. 2020). There is no mention of the national reserve system in the 2021 version of the National Climate Resilience and Adaptation Strategy as part of the overall goal to 'better anticipate, manage and adapt to climate change' through addressing cross-sectoral links, including the natural environment[3], but Ecosystem-based adaptation (EbA) is mentioned for the first time in a Commonwealth government adaptation policy document; EbA is aligned with market-based solutions and a focus on linking natural capital with industry and the economy[4]. Regardless, protecting native species and threatened species remains the focus for biodiversity adaptation in the 2021 strategy.

Figure 2. Timeline summarising changes in discourses through time in Colombia, Australia, and South Africa.



By framing action on climate change as against the national interest, conservative governments have defended their policies as *serving Australia first, then the world*, using the rhetoric of nationalism and nation-building. Such an appeal to national identity is a throwback to the colonial, pioneering past (Kanowski and Edwards 2021), yet the nation is now highly urbanised. The social construction of climate change policy is based on the prioritisation of jobs and the national economy, and freedom from international policy influence, over global citizenship and Australia's international responsibilities. The ideological focus is on emissions and mitigation (Colvin et al. 2020), while ignoring cross-cutting linkages to address sustainable transitions and transformative adaptation. This narrow policy focus is evident in the disconnect between climate change and biodiversity conservation policies, and the two major environmental conventions that Australia is a party to.

Pragmatic and opportunistic adaptation in a megadiverse nation – Colombia

In actively building its identity as a megadiverse nation, Colombia has successfully legitimised its environmental policies as part of the process of creating a modern state (Leal 2017). This narrative of biodiversity and bountiful nature is an intentional political construction of nationalism and identity (Quintero-Toro 2012). Linking ecological knowledge and science to this narrative has legitimised and enabled Colombia's participation in international environmental policy forums and has been used to attract research collaboration and funding.

In 1991, the new constitution mandated the National Government to protect cultural and natural assets, guarantee rights to a healthy environment for society, protect environmental diversity and integrity, and provide guidance to protect areas of ecological relevance. A year later, major changes in environmental policies were triggered by the 1992 Rio Convention and the CBD. New environmental legislation and institutions were created in response to the new Constitution, following the principles of sustainable development and demonstrating commitment to the CBD. Building on the 1974 Natural Resources Code, the 1993 new environmental legislation focussed on strategic ecosystems related to the water cycle (e.g. paramos) and framing biodiversity as protection of national heritage protected. The word 'biodiversity' appears for the first time in legislation, while the 1990s saw major changes in environmental policy and for the national protected areas system.

Colombia's construction of a national identity based on its rich biodiversity is also reflected in its recent climate change strategy[5]. Climate change legislation had a late start compared to environmental laws and the Colombian approach builds on the opportunities created by international biodiversity collaborations. The discourses on conservation and climate change represent pragmatic approaches to international commitments and national interests: economic growth, sustainable development, and recently peacebuilding. Fossil fuel extraction has been central to development discourses in the last two decades (Strambo and González Espinosa 2020). The social construction of climate change is based on a transition from emissions reductions, risk and vulnerability to building socio-ecological

resilience to climate change. Knowledge and science-based approaches like monitoring and capacity building are central to the discourses. Climate change policies initially focussed on opportunities for selling environmental services to mitigate climate change, but after Colombia experienced several extreme climate events, risk reduction and vulnerability became critical issues.

The 2018 climate change law reflects utilitarian, risk reduction discourses, to reduce social-ecological vulnerability while promoting a transition to a sustainable, competitive, low-carbon economy. The 2015 and 2020 Nationally Determined Contributions (NDCs) build on ecological responses to climate change including expanding protected areas, increasing protection of strategic ecosystems and promoting ecosystem-based adaptation for the mining and energy sectors as part of the nation's international adaptation commitments while also responding to national interests and priorities. The 2020 NDC defines adaptation goals for priority sectors, including the environment, which has 11 goals listed, with five for the transportation sector and four for water.

Colombia promotes extractive economies as part of the nation's economic development. However, its approach to addressing climate change acknowledges the need to address cross-scale, cross-sectoral issues and promote EbA in its policies and legislation to contribute to global goals. Promoting extractive industries and protecting biodiversity are clearly competing objectives, reflecting the many underlying socio-political factors affecting policy action. For example, extractive discourses have been criticised for prioritising short-term agendas and economic interests (Strambo and González Espinosa 2020). As evidenced by increasing deforestation, environmental inaction in Colombia reveals a disconnect between high level international commitments and the national socio-political context (Clerici et al. 2020; Krause 2020). Extractive industries are framed in environmental discourses as necessary to provide financial support for post-conflict initiatives (Strambo and González Espinosa 2020), and nature is assigned an utilitarian role providing opportunities for territorial development, reduce deforestation, promote conservation, and land reforms to support implementation of the peace process (Woroniecki et al. 2020).

Justice and resilience in South Africa

South Africa has a comprehensive environmental legal framework aimed at balancing a healthy environment for society with economic development based primarily on mining. Laws and policies under the 1996 post-apartheid Constitution provide cross-sectoral frameworks and mechanisms for implementation (Taljaard et al. 2019).

Post-apartheid, environmental narratives has shifted from White world views of nature and interventionist approaches, towards innovative new approaches to environmental management during the 1990s (Carruthers 2014). SANParks set the core philosophy of strategic adaptive management (SAM) for national environmental policies (Mabunda et al. 2003), including transformed management of protected areas, application of SAM as a basis for institutional learning and adaptation, resilience

thinking and acknowledging uncertainty and systems complexity (Roux et al. 2022). These new approaches enabled a culture of collaboration between researchers and managers, facilitating the participation of local communities (Roux et al. 2021) and helping re-integrate South Africa back into the international conservation community after its isolation during the apartheid era.

Environmental laws and policies aim to overcome poverty and inequality as aspirational goals. Debates about environmental management focus on environmental justice, a healthy environment for society, and sustainable livelihoods and subsistence (Carruthers 2014); issues made more urgent by climate change. There is clear recognition that climate change is a challenge for South Africa to achieve its goals and acknowledgement of its economic dependence on coal production and mining. Attempts are being made to identify opportunities for adaptation, mitigation and transitions to renewable energy, while addressing poverty and inequality. But climate change is still not well addressed in national policies because there is no climate change legislation to link effective collaboration and implementation of actions across sectors (Taljaard et al. 2019). Climate change was initially framed as a scientific problem, but it now recognised as a development problem to reduce the impacts of climate on society and its interaction with drivers of vulnerability (Ziervogel et al. 2014).

The 2011 National Climate Change Response addresses adaptation as a risk-based process across sectors, including water, agriculture, health, biodiversity and human settlements. Adaptation for the biodiversity sector is addressed via healthy ecosystems to help society adapt to climate change. This EbA approach is complemented by building resilience to climate change for adaptation through conserving, rehabilitating and restoring natural systems, and expanding the protected area system. The 2021 NDC aim for a ‘just transition’ for mitigation and adaptation goals, with biodiversity and ecosystems listed as priority sectors for adaptation.

As in Colombia and Australia, South Africa has competing discourses between goals for a healthy environment and an economy based on mining (Carruthers 2014). Environmental management and mining offer employment and are necessary to achieve development goals, but addressing poverty and inequality in the highly unequal and politically-contested South African society is proving a major challenge despite good intentions and policies aiming for just climate adaptation (Millington and Scheba 2021).

Multi-scale adaptation: aligning global, national, and local agendas

Above, we outlined approaches to address climate change and biodiversity conservation at national scale in the three case studies. Despite common features (Table 1), each nation has constructed narratives and policies differently, as reflected in their commitments to the two international conventions. Competing political interests and agendas influence these approaches, affecting environmental discourses and actions at local scale. In Colombia and South Africa, climate adaptation and conservation are important, credible and legitimate; in Australia they are barriers to economic

growth. Below, we discuss how adaptation discourses are constructed at the local scale in each nation, using data from interviews with protected area managers (REFERENCE HIDDEN in review).

Concepts such as adaptation and resilience usually have different interpretations and operational modes. High-level discourses from Australia and Colombia frame resilience as an aspirational goal for adaptation. But at local scale, respondents in Colombia had poor understanding of the resilience concept, and therefore it has no practical application in management. In Australia, resilience is perceived as part of 'business as usual' in reducing threats and maintaining ecological integrity: "the general response to climate change has been to ensure the parks are as resilient as they can be and that means trying to get on top of existing pest and weed problems" (AU-7). Complexity, social-ecological systems and resilience have been central to environmental policy and management in South Africa (Biggs et al. 2012), implemented in protected areas management[6]. SANParks has been working to understand climate change impacts on management (Wilgen et al. 2016), but climate adaptation is not yet incorporated or acknowledged as part of management. The perception is that resilience approaches and SAM are sufficient to address change at local scale. One respondent mentioned that SAM might be sometimes reactive in the context of climate change: "I don't think we're always particularly good at it. We're good at re-active management" (SA-19).

Vulnerability and disaster risk reduction are commonly linked with adaptation. In Colombia, disaster risk reduction responses at national scale were triggered after extreme climate events, creating an opportunity for managers to collaborate with local governments in territorial planning beyond the boundaries of protected areas. In South Africa, the managing protected areas is based on a long-term perspective that includes envisioning conservation goals, monitoring, implementing actions, and learning (Roux et al. 2021). However, reactive responses to disasters under South African national disaster management legislation may neglect environmental matters (Seymour et al. 2020), contrary to the goal of building resilience at local and national scales.

Landscape approaches and EbA are mentioned in the conservation adaptation discourses in all three nations but are practiced at the local scale only in South Africa and Colombia. In Australia, managers, especially in New South Wales (NSW), were frustrated by a lack of guidance on implementing adaptation and the barriers to applying landscape approaches: "we're never going to get the landscape approach. It's never going to happen…you have private properties [as] clearing more than were cleared before, so, I don't think that it's been linked to landscape" (AU-02). Respondents from the Australian Capital Territory (ACT) were more optimistic about local government landscape approaches, despite the ACT boundaries being contained within NSW. Some opportunities exist for inter-agency collaboration in the management of the protected areas corridor of the Australian Alps, shared by both jurisdictions. Australian protected areas prioritise the conservation of ecological values over social and Indigenous values (Hernandez et al. 2021) closing down opportunities to integrate local knowledge and perspectives to effectively implement landscape approaches considering local

realities. In South Africa, despite advocacy for EbA by national governments, implementation at local scale is impaired by a generally poor understanding of the effects of climate change, ecosystem services and EbA (Pasquini and Cowling 2015). However, EbA and the concept of ecological infrastructure have become central to local narratives in the Garden Route National Park district, representing a social construction of adaptation that relates to local values and visions for the future (Guerbois et al. 2019). SANParks runs participatory workshops to define conservation goals and management actions for protected areas (Roux et al. 2021), providing opportunities for vertical integration of adaptation goals at local, regional and national scales, definition of roles and responsibilities and identification of the cross-scale benefits of adaptation (Pasquini and Cowling 2015).

Adaptation approaches for conservation require policies and laws to enable strategic conservation planning (McDonald et al. 2018). Clear governance and legal frameworks, as exist in Colombia and South Africa, are fundamental for agencies to implement adaptation at local scale. In Colombia, managers and practitioners see themselves as agents of change in the climate adaptation agenda, helping to connect local actions with regional, national, and international policies: "national parks and regional authorities have clear restoration goals, and they are contributing to the [adaptation] goals that the country has to meet the nationally determined conditions and the Paris agreement" (Col-4). Climate change action is legislated in Colombia, creating opportunities for local governments and sectors for horizontal integration. Although there is a lack of legislation on climate change in South Africa, the current environmental policy and management framework enables vertical integration between protected area management plans, regional and national goals.

In Australia, state and territory governments take an active approach to climate change adaptation (Crowley 2021), but managers receive little guidance on cross-scale integration. This deficit is mainly because environmental legislation lacks a climate change trigger, constraining integrated, trans-boundary adaptation (McCormack 2018). Managing threats to native biodiversity from invasive species is part of the conservation adaptation approach of the 2021 climate resilience Commonwealth government. But differing social constructions of environmental discourses at local scale, such as the desirability of native and invasive species, can impair cross-scale implementation of adaptation, as observed in the different state and territory regulations for managing invasive species. For example, managing feral horses in Kosciuszko National Park (NSW) and Namadgi National Park (ACT), both part of the interstate Australian Alps corridor, has proved almost intractable. In 2018, a law to protect feral horses was passed in NSW, following pressure from some rural residents regarding their heritage status and guiding how feral horses should be managed in Kosciuszko National Park[7, 8]. Accordingly, feral horses remain largely unmanaged in in the park (Beeton and Johnson 2019), yet are controlled in the neighbour park, Namadgi (Braysher and Arman 2014). This example demonstrates how local narratives and world views can elicit political contestation and action on the ground.

Aspirational conservation goals promoting narrow targets such as the percentage of land in protected areas, especially should consider contributions of conservation to climate change adaptation, other sectors and society (Angelstam et al. 2021). Colombia has expanded its protected areas coverage as a commitment to support adaptation under the NDC. But the high deforestation rates within and adjacent to protected areas is a clear disconnect between local realities, national and international aspirations to implement a peace process (Clerici et al. 2020; Murillo-Sandoval et al. 2021). In South Africa expanding protected areas or creating new ones are recognised as opportunities for adaptation, but managers recognise conflicts with land tenure inequality while reflecting about the social role of parks under climate change.

Adapting nature to climate change: beyond rhetorical discourses

The three countries each have major contradictions between aspirations for sustainability, the implementation of environmental governance at national and sub-national scale and the consideration of local realities. These contradictions are reinforced through discourses that legitimise extractive industries as essential for economic development. The different approaches by each nation demonstrate how words, beliefs, and identity enable or constrain actions at national scale, sometimes without considering options for the future, or understanding of how to apply conservation adaptation concepts at local scale.

Table 2 summarises the main discourse categories from each nation, based on Dryzek (2013). In Australia, climate change policies of the Commonwealth government promote 'promethean responses' (Dryzek 2013, pp. 52-72), favouring economic growth based on extractive industries and weakening the effectiveness of environmental conservation laws while supporting agendas of corporate multinationals (Baer 2016). The EPBC Act promotes sustainable development and conservation of natural resources, but environmental management in practice is fragmented rather than systemic, with a focus on site-based protections for threatened species. The promotion of environmental offsets to compensate for damage to ecosystems and species from mining and other economic development represents a strongly instrumental view of nature, which is aligned with the administrative rationalist discourses (Dryzek 2013). In prioritising economic outcomes while overlooking the need for systemic action, discourses in Australia represent a short-sighted, fragmented incremental adaptation approach to addressing climate change, neglecting the protection of nature as a pre-condition for economic development (Coffey and Marston 2013), closing up options to protect nature in the long-term. This narrow, short-term approach neglects the consequences of future climate change and has been linked with conservative political ideologies and climate scepticism (Većkalov et al. 2021).

Table 2. Summary of environmental discourses from Australia, Colombia and South Africa, with its description following Dryzek (2013), and extracted quotes from the policy documents. AU: Australia, CO: Colombia, SA: South Africa

Discourse	Description (Dryzek 2013)	Examples from the case studies
Promethean responses	Nature second to human needs and knowledge, prioritising market and technology-based solutions	• AU: "Australia's policies and measures … enable the deployment of new and emerging low-emissions technologies to drive emission reductions and support economic growth" (Commonwealth of Australia, 2020)
Administrative rationalism	Nature dependent on capacity of human problem-solving through regulations, management, and expert-based decisions, top-down planning	• CO: "create and manage a protected areas system, to conserve natural ecosystems and viable populations of native species, restore ecological processes and habitats, support threatened species recovery legislation, harmonize conservation and sustainable use of resources" (Republica de Colombia, 2010) • AU: "Private investors and corporations can also purchase Australian carbon credit units … to voluntarily offset their carbon emissions and support environmental, cultural and social co-benefits" (Commonwealth of Australia, 2017)
Sustainable development	Nested and networked social-ecological systems, nature provides services need to be protected in the long-term to support economic growth, and distributive justice	• CO: "Reduce society and ecosystems vulnerability to climate change impacts, and promote a transition towards a sustainable, competitive, low carbon economy" (Republica de Colombia, 2018) • SA: "… build the climate resilience of the country, its economy and its people and manage the transition to a climate-resilient, equitable and internationally competitive lower-carbon economy and society … [addressing] national priorities for sustainable development, job creation, improved public and environmental health, poverty eradication, and social equality" (Republic of South Africa, 2011)
Ecological modernization	Complex systems and collaborative partnerships, balance between environmental protection and economic prosperity	• SA: "…biodiversity assets and ecological infrastructure … support [SA] development path and … the economy; Well managed and well functioning ecosystems … play an important role in enhancing resilience to … climate change" (Republic of South Africa, 2015) • SA: "national parks must serve societal values and … interrelate with the broader landscape and socio-economic context. The goal of the park within the public participation process is to work directly with stakeholders to ensure [their] concerns and aspirations are consistently understood and considered" (SANParks, 2020)

Environmental discourses in Colombia, with its many instruments and rules for managing natural resources, also align in part with administrative rationalism. However, the addition of climate change and post-conflict scenarios shift the discourse towards that of sustainable development (Dryzek 2013, pp. 147-162). The motto of the 2018-2022 National Development Plan, *producing while conserving and conserving while producing*, reflects the aspiration for sustainability based on a circular economy, where nature is instrumental in economic development and *vice versa*. This aspiration is promoted through commitments to reduce deforestation and environmental degradation as part of the approach to addressing climate change, peace building and conservation (Furumo and Lambin 2020; Woroniecki et al. 2020). However, Colombian discourses do not address structural issues of poverty, inequality and illegal use of natural resources, thus reinforcing contested interests between outcomes for conservation, development and social justice. Illegal deforestation happens under weak local governance, hidden power structures and highly contested land tenure arrangements that have been

the cause of social-ecological conflict and violence in the nation (Faguet et al. 2020; Murillo-Sandoval et al. 2021).

With its focus on justice and equality, environmental approaches in South Africa have elements of the sustainable development discourse. However, the focus on complexity and resilience as applied in national protected areas indicate some elements of the ecological modernization discourse (Dryzek 2013, pp. 165-183). Post-apartheid democracy has enabled innovative ways of thinking about the social reconstruction of biodiversity and environmental management. However, critical discussions about cross-sectoral implications of subsidising fossil fuels and extractive industries to support economic transformation to end racial inequalities are needed (Burton et al. 2018). Climate change adaptation policies require clear legal guidance, collaboration, and funding to support action across sectors and scales (Ziervogel et al. 2014). The social construction of adaptation as resilience and justice require major effort in addressing structural problems in ways that are socially and ecologically credible, legitimate and relevant for local communities.

Concluding remarks

The cases presented from Australia, Colombia, and South Africa demonstrate how environmental approaches in each nation represent specific beliefs and identities, giving form to distinct epistemic communities and discourses. However, these discourses share similar metaphors to justify economic development over biodiversity protection and climate change adaptation. The social construction of adaptation to climate change in protected areas reflects the influence of international agreements as opportunities to build capacity, fill gaps in scientific knowledge, and adapt planning. South Africa and Colombia frame climate change as an opportunity for sustainable development and environmental justice. For Colombia, building an identity as a biodiverse nation has been critical for local areas to identify alternatives and opportunities for adaptation and planning, legitimising conservation areas and connecting local efforts to national commitments under international agreements. In contrast, unclear rules and policies on climate change in Australia has constrained agency for adaptation in protected areas.

Despite calls for pluralistic approaches and the inclusion of traditional knowledge, the three countries advocate primarily for scientific and technical solutions to reduce uncertainty and define policies, legitimising some knowledge and practices over others from discussions on climate change policies. This bias risks legitimising specific interests for sustainable development over others, making it harder to enable sustainable development aspirations based on environmental and social justice. The contestation between development and conservation goals requires consideration of what elements of nature should be conserved, used, or enjoyed and which stakeholders benefit or lose out. In this regard, conceiving, operationalising and implementing adaptation is not just an epistemological task

but also requires consideration of relational and ontological issues as well as social justice, ethics, and values.

To be effective, credible and legitimate, adapting natural resources to a changing climate requires fundamental changes in discursive practices, recognition of power structures and imbalances and addressing underlying barriers that perpetuate maladaptive practices. At the local scale, clear environmental and climate change laws and policies can enable agency, support cross-scale integration and open opportunities for adaptation, as seen in Colombia and South Africa. Bridging local realities with global aspirations needs fundamental shifts in current practices to address the ethics of how to respond to environmental change, who is affected by conservation and adaptation approaches, and its impacts on social-ecological systems. These practices can be aided by critically exploring the discourses, symbols and metaphors therein shaping collective thinking and actions, to identify areas of contestation and finding options to incorporate new questions, knowledge, and practices.

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Supplementary Information - List of policy and legislative documents reviewed

This supplementary information has not been peer reviewed.

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Endnotes

1. See section 51[xxix] in the Australian Constitution
2. Page 52 in: Australia's Strategy for the National Reserve System 2009–2030.
3. Page 6 in: National Climate Resilience and Adaptation Strategy 2021

4. Page 23 in: National Climate Resilience and Adaptation Strategy 2021

5. The Colombian government climate change strategy indicates long-term climate change goals for 2050
6. Garden Route National Park Management Plan 2020-2029
7. Kosciuszko National Park Wild Horse Heritage Management Plan
8. Kosciuszko Wild Horse Heritage Act 2018 No 24

5.5. Futures consciousness as an operational framework for adaptation to global change in South Africa (Paper 5)

Paper 5 expands on the understanding of futures consciousness to inform current practices and transitions toward future-oriented conservation practices in the South African case study, focusing on the time perspective as an entry point to address the 5DFC. I used the concept of temporal enclosures to explore how managers address temporal constraints involved in managing and planning protected areas. Temporal enclosures refers to modern political processes that shape and manipulate geographical areas or parts of a landscape to appropriate land and control access and rights to use resources through time (Jeffrey et al., 2012; Vasudevan et al., 2008).

Using a relational perspective, I focused on the interviews held in GRNP to identify futures consciousness elements involved in managing the park and negotiating a collective vision for the park. Focusing on this case study allowed me to have more detailed analysis of the individual case study, developing more in-depth insights from the data. I illustrate how interviewees understand and integrate the function of day-to-day actions into a system-based perspective when managing the complexity of social-ecological systems. The paper also identifies how managers think about the implications of implementing adaptation in future park management.

The findings show inherent contradictions in the narratives shared by interviewees. These contradictions are related to responding to climate change under current short-term institutional rules and aspirations for long-term approaches (sub-question 1a), as they conflict with existing approaches used to understand and manage SES complexity (research questions 1, 2 and sub-question 2a). Despite such contradictions, there is evidence of how elements of futures consciousness are critical for rethinking the purpose of the protected area beyond its geographical limitations. The paper also illustrates how futures consciousness can enable transitions toward future-oriented practices and transformation.

Options towards future-oriented approaches start with exploring where managers are, understanding barriers, and exploring the necessary steps to change current practices and governance. I discuss which elements of futures consciousness come into play to address necessary management changes toward future-oriented practices (research question 3). I use the four transitions for future-oriented conservation (van Kerkhoff et al., 2019) as an indicator of how futures consciousness enables reflexivity and transformative governance and its implications for management in the Garden Route in South Africa.

Drawing from the findings in South Africa, I discuss how futures consciousness can help protected areas to overcome the temporal enclosure as a barrier to inclusive futures and identify options for future-oriented conservation.

Australian National University

Statement of Contribution

This thesis is submitted as a Thesis by Compilation in accordance with https://policies.anu.edu.au/ppl/document/ANUP_003405

I declare that the research presented in this Thesis represents original work that I carried out during my candidature at the Australian National University, except for contributions to multi-author papers incorporated in the Thesis where my contributions are specified in this Statement of Contribution.

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Futures consciousness as an operational framework for adaptation to global change in South Africa

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Abstract

In a context of climate change, protected areas play an important role in implementing the Sustainable Development Goals and resource nexus challenges. However, setting aside portions of land for long-term conservation is often criticised for using narratives framed by political, economic, and scientific assumptions to justify which elements of nature should be conserved, and what actions should be implemented, creating a sense that conservation outcomes are both desirable and universally accepted. Such narratives exclude other voices, values, and practices, limiting alternative options for the future. Adapting protected areas to climate change requires innovative approaches to address societal challenges and critically examining conservation strategies to make informed decisions under scenarios of change. This article presents the case of the Garden Route National Park in South Africa, and the approach used to co-create inclusive visions of the future with local stakeholders. I draw on theoretical insights and empirical data collected through interviews with the park staff, to describe the use of futures consciousness as a framework to understand how people perceive change, prepare for, and embrace the future. I explore how people's perceptions about change mobilize action to address complex problems and create alternative imaginaries beyond existing spatial and temporal boundaries. Futures consciousness can contribute to understanding processes that enable or constrain transformation and identifying options for mobilising change towards desired future goals. These findings can inform future-oriented practices to assess collective processes of adaptation and address the transformational challenges to build resilient, just futures for nature and people.

Keywords: climate change adaptation; futures consciousness; protected areas; reflexivity; sustainable development; transformative change

1. INTRODUCTION

Protected areas can play a critical role for sustainable development, providing a range of benefits for society. Area-based conservation, or the practice to set aside areas for conservation of natural resources, is a common practice around the world (Maxwell et al., 2020). By 2021, about 17% of

global land and inland waters were protected (UNEP-WCMC and IUCN, 2020), and there are plans to extend this to a goal of 30%. These areas can potentially integrate and contribute to meet the Sustainable Development Goals (SDG) at local level and across scales, with direct links to 12 of the 17 SDGs (Dudley et al., 2017), making the case for more interdisciplinary, cross-sectoral work beyond the traditional focus on just protecting biodiversity.

Despite being a preferred tool for biodiversity conservation, protected areas are often contested. In designing and governing protected areas, some portions of land and resources are mapped, their spatial features enclosed into boundaries with the aim of being protected in the long term. These enclosures are justified by diverse narratives, including political issues, economic considerations, or even scientific assumptions defining 'what of' nature should be conserved (Wakild, 2018), restricting which actions can be performed in the present, who participates in decision making, and closing off options for the future.

I examine protected areas from the perspective of temporal enclosures, or the modern political processes that shape and manipulate geographies to appropriate land and exercise control of resources, redefining rights to access and decision making through time (Jeffrey et al., 2012; Vasudevan et al., 2008). Creating these enclosures entails practices of control, legitimised by narratives that justify exclusions, dispossessions, and activities for private or state use and benefit (Fairbanks et al., 2018). Temporal enclosures have been studied in the context of resource extraction to explain how coal mining narratives create temporal and spatial dispossessions affecting people's ability to plan, predict, and build futures, legitimising some actors over others (Jaramillo and Carmona, 2022). Protected areas are temporal enclosures, legally defined by states and justified by prevailing conservation narratives. Enclosing areas for long-term conservation can involve physical barriers such as fences, to separate wildlife from humans (Woodroffe et al., 2014). An unfenced park is often referred as an open park, although the lack of physical barriers is not an impediment to restrict human access to the park. These conservation-based areas represent complex social-ecological systems (SES), with intrinsic and complex interactions across temporal and spatial scales (Cumming et al., 2015), which are then enclosed within static boundaries often taking for granted spatial and temporal frames for management. The concept of temporal enclosures can reconstruct collective understanding of values, shaping preferred outcomes and creating a perception that the future is manageable, under narratives that present future actions as inevitable and desirable (Jaramillo and Carmona, 2022).

Global change is challenging such narratives. Climate change is already affecting ecosystems functionality and the supply of ecosystem services (IPCC, 2022), limiting and re-framing perceptions of nature's contributions to adaptation (Colloff et al., 2020). Adaptation to climate change in place-based initiatives requires assessment of potential impacts of ecological transformation across temporal and spatial scales to make informed decisions about responses to future scenarios. Future-oriented

approaches have been proposed to transform environmental governance strategies under scenarios of change (Pereira et al., 2021; van Kerkhoff et al., 2019; Wyborn et al., 2016). Exploring options for the future and deciding on actions to achieve preferred visions requires a reflexive step to rethink existing assumptions about conservation goals under global change.

One way in which reflexivity can be engendered in adaptation for conservation is through exploring futures consciousness. Futures consciousness explains the level of awareness by individuals of the consequences of their actions, whether they accept or question established assumptions and presuppositions, and the ability to imagine and evaluate alternative options for the future (Ahvenharju et al., 2018). Developing and operationalising futures consciousness has been proposed as a means to use critical thinking and decision-making to increase social engagement when considering future consequences (Ahvenharju, 2021).

This article contributes to understanding the role of futures consciousness in strengthening decision making in protected areas and opening options for the future. In studying how protected area managers understand, communicate, and implement adaptation to climate change in practice, the article applies a relational approach to take 'ordinary experience seriously' and identify individual acts of consciousness (Wagenaar, 2007). Drawing from theoretical insights and empirical findings from interviews performed in the Garden Route National Park in South Africa, this article discusses how individuals' perceptions about change mobilize desires and action to address complex problems, and the creation of alternative imaginaries beyond existing temporal enclosures. The analysis takes elements from futures consciousness (Ahvenharju et al., 2018) and theoretical perspectives of social change (Feola, 2015; Sztompka, 1993), to provide a dialogical understanding of managing conservation-based areas under climate change. This include exploring assumptions about change and expectations for the future, to identify options to change maladaptive practices. The findings demonstrate the relevance of understanding futures consciousness through recognising the circumstances under which individuals can be agents of change and the basis for mobilising collective change towards desired future goals, to inform collective processes of adaptation and transformation.

2. CONCEPTUAL APPROACH AND METHODS

2.1. Futures consciousness and transformative governance

For the analysis, I adapted the Five Dimensions of Futures Consciousness (hereafter 5DFC; Ahvenharju et al., 2021; Ahvenharju et al., 2018) to understand how individuals and collectives prepare for and embrace the future. Futures consciousness consider elements of social psychology to study how individual cognitive basis is affected by social interactions, therefore influencing a sense of self, of belonging, and its role in defining collective futures (Ahvenharju et al., 2021). The 5DFC are: 1) time perspective: having a long-term outlook to understand and connect across temporal scales; 2)

agency beliefs: perceived ability to influence and change current realities; 3) openness to alternatives: the capacity to think critically about options for change; 4) systems perception: the comprehension of interconnected social and natural systems and the consequences of decisions across spatio-temporal scales; 5) concern for others: the values, moral, and ethical underpinnings of a better future for current and subsequent generations (Ahvenharju et al., 2018). These are not discrete dimensions and is important to consider relations between them.

Addressing temporal characteristics helps to understand the role of futures consciousness to open options in protected areas' temporal enclosures, which are shaped by "future-oriented affects - wistfulness, hope and anxiety, which lead actors to act in the present to secure (or prevent) imaginations of the future" (Jaramillo and Carmona, 2022, p. 14). A temporal perspective helps to understand the relational, experiential, embodied practices over time while recognising the pace of ecosystem processes, their responses to change, and the inherent tensions with clock and calendar times in specific spatial settings (Adam, 1998, p. 10) as protected areas.

There are numerous perceptions and conceptualisation of time and temporal processes in relation to environmental phenomena. Time helps human societies, individuals, and institutions to measure and locate themselves in relation to events, and can influence our understanding of changes in a system or its elements, and therefore our responses to address such changes (Kolinjivadi et al., 2019). A sense of time allows us to critically examine our understanding of the temporal contexts in which people operate, and how we assign timeframes to events or the solutions to respond to such events and in managing the environment (MacKenzie, 2021). Social change depends on social contexts of stability, inertia, incremental, and dramatic social change (de la Sablonnière, 2017) which are related to the pace of change (a temporal characteristic) leading a system into different states. The process of change thorough rapid or slow onset events can have different implications for the identities and characteristics of socio-ecological systems and adaptation responses to change. Addressing temporal perspectives involved in decision making can facilitate understanding how social-ecological responses to climate events unfolds, and determine the implications across temporal and spatial scales of adaptation options (Adamson et al., 2018).

Environmental phenomena have inherent temporalities operating across spatial scales. Protected areas are temporal enclosures embedded within 'timescapes', or landscapes embodying time-related characteristics across spatial scales (Adam, 1998; Múnera-Roldán et al., 2020). One example of environmental temporalities is the dynamic flow of ecosystem services across space and time (Rau et al., 2019). Attributes inside protected areas are subject to change over time. However, protected areas management approaches often manipulate spatial and temporal characteristics into simplified management timeframes, reducing options for alternative trajectories (Massey, 2001). In anticipating climate related ecological transformations, a temporal perspective forces us to move beyond the *once-upon-a time* (past-present orientation) to focus on the now and the future. It also implies

understanding the role of memories, or the evolutionary function that helps individuals (human and non-humans) interact with each other's, learn from past decisions, anticipate and make decisions about the future (Cilliers, 2006; Klein, 2013).

Addressing climate change impacts in protected areas challenges assumptions about long-term conservation in static borders. Transformative governance can support the difficult task of mobilizing change in governance systems to respond to and accommodate social-ecological transformations while acknowledging the inherent political processes involved across scales, sectors, and actors (Chaffin et al., 2016; Wyborn et al., 2019). A transitions approach helps to identify entry points for transforming institutions, rules, and practices (Chaffin et al., 2016), reframing problems, and envisioning alternative options through learning and participation (Loorbach et al., 2017). Reframing conservation strategies to address climate change can be enabled through identifying where people and institutions are now to determine the necessary transitions to transform current preferences, rules, and practices (van Kerkhoff et al., 2019). The 5DFC can help to identify individual and collective processes and motivations influencing decision-making to mobilise agency towards alternative futures. The transitions in Figure 1 are used as indicators of the applications of futures consciousness in transformative governance as part of a learning process of rethinking conservation and management under rapid change.

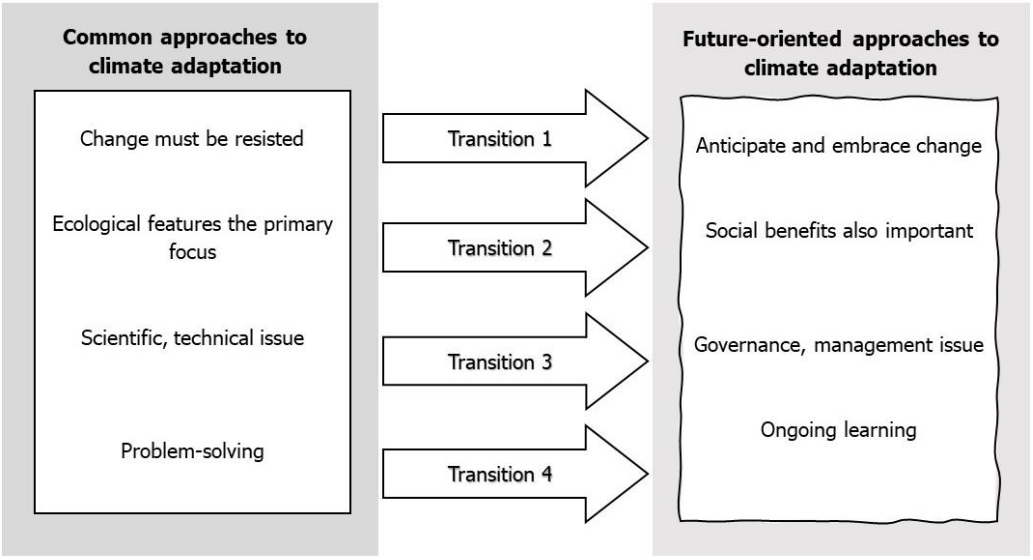

Figure 1. Transitions involved in transformative adaptation towards future-oriented conservation approaches to adaptation (adapted from van Kerkhoff et al., 2019).

2.2. Relationality in social ecological systems

The narratives framing protected areas and conservation practices can be influenced by emotional affects and the frames of reference used to understand nature, influencing options for the future in conservation agendas (Múnera-Roldán et al., 2022). Relational approaches have been proposed to

understand the intrinsic, co-producing human-nature processes (Jasanoff, 2004; West et al., 2020), including institutional processes to govern nature (Wyborn, 2015), or the principles and actions guiding how people interact with nature and with others (Pramova et al., 2021). Relationality helps understand how multiple meanings assigned to social-ecological systems, the relations therein, and the interpretations and expectations about adaptation mobilise action (Lejano, 2019). Given their role in both implementing rules and making individual choices in a collective setting that is governed by laws and management guides, protected area managers embody both institutional and human relational perspectives in their everyday practice. This provides an opportunity to understand elements of futures consciousness in decision making processes.

2.3. Overview of the case study

Located in the southern coastline of South Africa, the Garden Route National Park (GRNP) is a fragmented matrix of landscapes covering mountain, forest, lakes, estuaries, coastal and marine ecosystems, alongside agricultural lands, and urban areas. The park was created through the merger of three protected areas (Wilderness, Knysna, and Tsitsikama), and is one of the few open parks (unfenced) in South Africa. This complex of ecosystems is managed as a single unit by South African National Parks (SANParks), which is the national agency in charge of managing and planning protected areas in South Africa, under the corporate vision of achieving 'a world class system of national parks re-connecting and inspiring society' (SANParks, 2020).

Box 1. Garden Route National Park: vision, goals, and management programs

- **Collective vision**: An innovative and accessible national park, spanning mountains to marine, conserving the natural and cultural heritage of the Garden Route collaboratively for the benefit of people and the environment.

- **Goal**: conserve the diverse ecosystems of the Garden Route on a landscape level

- **High-level objectives guiding management programs**: natural heritage (conserve terrestrial and aquatic ecosystems through adaptive, collaborative, and innovative approaches), cultural heritage (preserve, interpret, and present the diverse cultural heritage through allowing access, engagement, responsible utilisation and research), responsible tourism (nature- and culture-based opportunities), equitable access and benefit sharing, participative engagement, learning, interpretation research and monitoring (promote up-to-date knowledge and awareness to biodiversity and cultural heritage), and good governance.

- Extracted from SANParks (2020) Garden Route National Park Management Plan

GRNP is home of a rich biodiversity and special ecosystems. Portions of the park include a Ramsar site (Wilderness Lakes) supporting some of the most significant waterbird assemblages in South Africa (Russell et al., 2014). The diversity of landscapes and land uses in the area is reflected in the

complex and diverse stakeholder relations and co-operative governance arrangements. Approximately 60% of GRNP overlaps with South Africa's Strategic Water Source Areas, with 28.8% protected in the GRNP (Nel et al., 2017). A large portion of the rivers in the area has been designated as a Freshwater Ecosystem Priority Area (Nel et al., 2016). Climate change has been identified as the most significant emerging challenge for the park and extreme events such as flooding, storm surges and fires are expected to increase (van Wilgen and Herbst, 2017).

The social context of the park is diverse and contrasting. Poverty and unemployment levels are high in the region (Quinn et al., 2019), with informal settlements around the urban and suburban centres (Roux et al., 2021). The coastal landscape has been modified by an increase in private properties and public infrastructure (Guerbois et al., 2019). Tourism is an important economic activity in the park, as consequence of the designation of the park in 2009.

SANParks implements long-term monitoring in almost all its parks. The management approach acknowledges systems complexity and associated uncertainty (Freitag et al., 2014; SANParks, 2020). Strategic Adaptive Management (SAM) supports continuing learning while navigating such uncertain contexts. Management of protected areas is supported by collaborative knowledge-based structures where scientists and managers interact constantly (Roux et al., 2019). GRNP is implementing participatory processes to define the collective vision and integrate local perspectives and aspirations for the future (Roux et al., 2021).

2.4. Methods

Adopting a qualitative, dialogical approach, I identify elements of futures consciousness from narratives shared by interviewees in the GRNP. Narratives as a distinct mode of knowing are used here to understand a context, consequences of decisions, and capture 'learning from practice' stories (Wagenaar, 2011). Empirical data was collected through 15 semi-structured interviews with SANParks managers and scientists working in GRNP, and participant observation over four weeks of fieldwork during February-March 2020. The results presented here focus on the rich dialogues held through the interview process where participants were invited to share their stories to understand their experience, feelings, and aspirations towards managing protected areas under climate change. The dialogical approach helps to give voice to how interviewees describe and understand the problem of adapting protected areas to climate change, their actions in response to it, and their expectations for the future (Tanggaard, 2009; Wagenaar, 2011). To understand the role of futures consciousness in creating and communicating adaptation narratives, the analysis is situated ontologically on social constructivism building from the understanding that social reality is an institutional construction (Hay 2016).

The interviews focused on understanding how managers conceptualise climate adaptation and their expectations for the future. The questions covered explicitly the limitations of doing long-term

conservation under the limited geographic boundaries of protected areas, to elicit their perceptions about how climate change might affect decision making, what are expected outcomes of adaptation, and what innovations or actions can help to facilitate conservation under scenarios of global change. All interviews were audio recorded and transcribed. The transcripts were coded using NVivo 12 (QSR, 2020), applying a deductive coding focusing on 5DFC themes (time perspective, agency beliefs, openness to alternatives, systems perception, and concern for others) to evaluate to what degree climate change is considered in future planning. The GRNP management plan (SANParks, 2020) was also imported to NVivo and analysed alongside the interviews. To analyse the findings, the results also draw on literature to explain elements of futures consciousness from the interviews.

The interviews were part of a bigger project across three countries (HIDDEN REFERENCE, in review), but the present paper only focuses on South Africa and the GRNP. This project was approved by the Australian National University Human Research Ethics Committee 2019/226. Written consent for the interviews was obtained, and quotes are presented without attribution (Int. #).

3. RESULTS

Somebody asked what does it feels likes to be a park manager? I said, it is like having a baby, you are all the times looking [to see] if the baby is hungry, or the baby is tired…or safe; you are all the time worried about the baby (Int. 17)

The 'baby' metaphor used by this interviewee summarizes the relational aspects involved in making decisions for managing a state-owned protected area. The metaphor addresses futures consciousness dimensions, including agency, time perspective, and issues of care and responsibility. The results section describes the interviewees' experiences engaging with social-ecological dimensions in the park, to understand and make visible respondents' individual understandings of environmental processes and transactional world views involved in decision making (Altman, 1992).

In their daily actions scientists and managers in GRNP face and reflect on the challenges of decoupling the social from the ecological, the individual from the collective, the epistemological from the ontological, or singular events from processes that happen over time. The interviews aimed to understand their role in the park, to gain a sense of the challenges they face, their existing opportunities, and what expectations they hold for the future under the possible transformational effects of climate change. When asked to define from their perspective what climate adaptation is, a common answer was: *I don't know*, some of the respondents admitting it was the first time they had thought about climate adaptation in relation to their roles. But as the conversation kept going, I was able to collate a general understanding that adaptation for them is about dealing with new conditions and accepting that change is happening, as observed by impacts on infrastructure, ecosystems, and livelihoods. Some respondents pointed out the need to reduce vulnerabilities, learn from past

experiences, avoid resisting change, and create space for nature. Others questioned how to conserve and adapt dynamic systems inside static borders.

The following sections describe the findings using the 5DFC to explain respondents understandings of change, and how they integrate and synthesise the function of day-to-day actions into a holistic, system-based perspective in managing complex SES.

3.1. Time perspective and managing social ecological systems

Time perspective is the process of individuals creating mental representations of time and assigning their personal experiences to temporal frameworks involving the past, present, and future (Przepiorka et al., 2016). It can be related to emotional, cognitive, and experiential processes (Zimbardo and Boyd, 1999). This temporal awareness is part of an imagined logic of connection between temporal elements, influencing understandings of system dynamics, perceptions of change, and how to respond to transformations as part of the meaning-creating process. In the process, individuals create mental representations of how a system works (relations within a system, responses to events) to organise and coordinate management of natural resources (Bastian, 2012).

GRNP (and SANParks in general) aims for the long-term conservation of natural resources. Management plans are upgraded every 10 years (SANParks, 2020), with elements of SES managed under programs and plans that respond to specific objectives. Dividing features of the system for management helps to simplify the complex SES and interactions therein, but it can lead to conflicts between events time vs. calendar time. This tension is a concern for interviewees, and some mentioned the challenges to update monitoring to understand system responses under the specific narrow calendar times of management. There is also a perception that qualities of the park – what makes the place special – can vary through time and depends on subjective observations and values, making it harder to reconcile different perceptions of conservation outcomes through time with management timeframes:

> *[there are] more and more ecosystem processes that are breaking down. More and more environmental services that are not being realised. [There] comes a time when it just all falls apart. And we just blunder on, often, as a society. How you communicate that to short-term thinking where you've got to have long-term visions – our national parks visions are long term* (Int. 12).

Mental representations of systems are related to memories and emotions, influencing how critically humans think about time, connecting distant events from the past with the present and projecting those memories to anticipate the future (Cilliers, 2006). Interviewees acknowledge that climate change is a threat but are questioning how much of the observed changes in the system are caused by anthropogenic climate change, or if the system would naturally adjust; consequently, they are questioning to what degree climate change should be something to be addressed through a

management plan. Current SAM approaches apply complex systems thinking and resilience theory and practice, therefore the preferred option is to observe and learn, instead of flagging specific adaptation actions in the management plan. But the potential cascading effects of climate change transcend spatial and temporal scales, and managers are questioning how to rethink actions while maintaining efforts toward higher-order goals, and the challenge of incorporating longer horizons into planning, even under high uncertainty:

> *It's a long-term thing, you can't just throw a quick thing now, if you're not planning now for then it's going to hit you…Climate Change, it's one of those big, overwhelming drivers [of change] for most people. They see it happening when it's drought or fire, even though that's not always even climate change, sometimes it's just part of natural variability. I think we allow them to think that because it makes it more real and tangible. Because, you know, you don't conceptualise longer term, the future that might be very different, it just seems that as humans we struggle with it, and we don't even see locally* (Int. 15).

This quote reflects the disconnect between perceptions of climate change, the fragmented responses to it, and the challenges of balancing different temporal orientations in planning. Respondents are concerned about the tension of reconciling SAM with rigid administrative structures that prevent proactive decision making in the face of uncertain global change. Environmental management approaches tend to ignore temporal considerations in relation to spatial planning, and ecosystems services responses across scales (Rau et al., 2019), mainly because management respond to calendar cycles in the enclosed temporalities of a national park. Interviewees perceive calendar times is constraining understanding systems responses to change and to adapt research questions and management responses in the complex social-ecological context of the park.

The time perspective links with how individuals understand causality (i.e. linear vs. nested; Bussey, 2014), assignment of function, and intentionality (Feola, 2015; Sztompka, 1994). This linkage helps to explain how people's mental interpretations of events and their consequences influence the capacity to act and respond to change, influencing agency beliefs. The contestation between aspirations for long-term thinking and calendar management times constrain agency beliefs for implementing adaptation actions as part of the management plan. Therefore, planning responses to climate change are mainly reactive. As interviewees are assessing current reactive approaches and its implications across temporal and spatial scales, it opens options for adaptation and enables agency beliefs as the next section describes.

3.2. Agency beliefs: learning and opening options for transformation

Agency beliefs are related to how much individuals or institutions are confident of having the capacity and capabilities to influence future events, and therefore how responsibility is addressed (Ahvenharju et al., 2021). In recognising that the future unfolds in everyday action, individuals can reflect on how

passively or actively they are creating the future (Sztompka, 1993), and how their perceptions about the pace of change (slow vs rapid) and the speed at which an event impacts collective structures, influence choices and action (de la Sablonnière, 2017). Interviewees in GRNP are critically thinking about practices in use, considering issues of ethics and care, demonstrating a strong sense of responsibility in managing natural resources. Respondents are questioning the inherent contradictions of managing natural evolutionary processes under human defined boundaries, reflecting on the task of reconciling different perceptions about the speed of change in defining management actions:

> *we've gone through these periods of marine dominated and freshwater dominated. So that isn't the problem. The problem is that it's happening so fast that we probably find the environment is going to struggle to adapt. And we as humans are certainly going to struggle to adapt and change. And when people's properties start to get flooded, then the sort of pressures are to sit and try and prevent it, and the ways in which you can prevent it aren't necessarily always going to be good environmental decisions* (Int. 12).

Agency is implemented through actions that create processes to resist or accommodate change, as ecosystems change functionality in response to external environmental changes (Colloff et al., 2020). Responses from the interviews indicate mixed feelings about agency beliefs to anticipate climate impacts and implement adaptation. On one hand, individuals feel encouraged by their capacity to effectively respond to surprise events (e.g., outbreaks of animal diseases) which require capacity to think and act outside existing rules, giving them a sense of control regarding the future. But as mentioned above, responding to the effects of climate change under current management calendar times and planning for distant events under conditions of uncertainty, respondents had feelings of helplessness:

> *just having the institutional agility and ability to react to these things quicker, because it's quite frustrating when you work on the ground and then it just takes forever* (Int. 17)

Responding to climate change is facing a conceptual critique about how much management must deal with uncertain climate change, or when extreme events become climate change. However, some interviewees acknowledge that current approaches might be enough to respond to and accommodate environmental changes. The tension between actively preventing change or living with it, is part of current discussions. I noted such tensions during the interviews and when attending meetings (as an observer) with managers or scientists. In part, such tensions are related with rigid management rules mentioned before. Participants also mentioned the role of SAM methodological framework in observing systems responses, promoting learning and reflexivity, which at least in theory, encourages avoiding reactive responses. Despite the inherent conceptual and practical tensions, climate change is becoming part of an institutional rethinking of management, and participants are trying to reconcile the novel idea of climate adaptation with management:

> *It was difficult for us to write a section into our management plan about climate change...We've spoken [about] things like extreme weather events, fire, storm surges, coastal erosion. Some of those things that came up yesterday in the discussion is something that's starting to come through* (Int. 5).

When individuals' agency focuses on maintaining desired outcomes, people can miss opportunities to reframe rules in place that prevent accommodating change. Critical thinking and questioning commonly accepted views and practices require explicit exploration of options, instead of sticking to plans (Ahvenharju et al., 2018). Climate change involves opening the door to such critical thinking, but in the GRNP, new practices to support adaptation at species level (e.g. genetic interventions or assisted colonization, see Prober et al., 2019) are received with scepticism, as observed during discussions they had at meetings, and shared in some interviews. Participants acknowledged that current institutional rules allow the implementation of such options for adaptation at species level, therefore the reaction against those methods seems to be more about individual preferences towards systemic approaches shaped by the institutional SAM approach. If options for species level adaptation are perceived as controversial, agency beliefs are stimulated though a strong systemic perception to address SES adaptation beyond the parks' boundaries and reconcile sustainability goals across scales and for society:

> *The reliance's and dependencies on nature for various services would shift with climate change, and how are we thinking about putting in place a resilient system to buffer the impacts we're going to experience from climate change. There's been a kind of central part of our narrative in making the case for ecological sustainability for a long time. That's in the policy space…trying to get policymakers and government departments to really think about nature playing a role in facilitating a more robust future, in the face of climate change* (Int 20).

Agency opens options to new or different relationships between human agents and non-human agents (Neely, 2021). As part of individual responses to change, affective experiences are part of the ontological lens through which individuals make sense of the world, and are reflected in the imagined mental models of a system, and therefore the motivations behind actions (Pramova et al., 2021). The participatory approach for co-creating a desired vision for the Garden Route management plan mentioned by interviewees and documented by Roux et al. (2021), is an example of collective agency expressed through relational approaches and duties of care, allowing acknowledgement and reflection on options to overcome past colonial legacies to address sustainability and environmental justice, while opening options to imagine desired, alternative futures:

> *SANParks vision of reconnectors with [local knowledge and sustainability] that's actually very powerful, if the people understand exactly what it means… we want to get to a point*

> *where people used to be before, how they used to interact with the natural environment. One thing I can tell you is that we did not have to dig for gold in this continent…we were just depending on the nature of the system, purely, and people's interaction to the natural system was seamless. My dream would be to get to a point where we are, once again, like that and not for one group to see the other group as inferior and not knowing what they're doing* (Int. 16).

Social change processes rooted in systemic thinking and holistic visions, link with purposes of care and duty towards nature and others instead of desires to 'command and control' nature (Fischer et al., 2021) or the utilitarian and instrumental views of nature that assign value to some elements over others. Social justice represents an aspirational goal for adaptation as mentioned by interviewees in GRNP. Despite the interest in justice and sustainability, adaptation options are still embedded within command-and-control management (article in review) which limits agency. However, it is opening options to co-create a pluralistic vision of the future.

3.3. The tale of an elephant: systems perception and concern for others

The imagined temporal extension of processes is linked with individuals' mental models of causality. Causality can be explained as linear, discreet, distinctive steps, with predictable consequences. A linear perception of causality, where systems are reduced from whole to constituent parts, can constrain imagination and agency, limiting the understanding of complex systems and their dynamic interactions (Juarrero, 2008). Mental models that construct causality as part of a layered, complex system allow individuals to imagine the interconnections and consequences of actions at different scales, therefore opening future options to act (Bussey, 2014).

Climate adaptation requires consideration of individual, social, and institutional learning processes, which needs addressing reflexivity. Reflexivity refers to the self-critical capacity to question ideas, accepted truths, and norms to 'be and do' differently, not just better (Dryzek and Pickering, 2019). Learning and reflexivity are acknowledged as part of the SAM approach as documented in the GRNP management plan and the responses shared by the interviewees. Examples of learning and reflexivity from the interviewees included the process of documenting and observing ecological processes and responses and not taking scientific observations for granted. An example of learning and openness to try new options was illustrated with the case of the Knysna Seahorse (*Hippocampus capensis*), an Endangered species restricted to some bays on the south coast of South Africa, which is reported to prefer artificial (rock mattresses) to natural habitat in the Knysna Estuary (Claassens et al., 2018). The seahorse case enabled a rethinking of conservation actions considering the urban context of the park. While reflexivity is part of constant questioning about the implications of SAM and its unintentional effect on simplifying complex systems for management:

> *We don't always know what the impacts are going to be, sometimes we must wait and observe what the impacts are* (Int. 14)

Theories of complex systems and resilience, as applied in SANParks, help to build imagined models of a system, its boundaries, and the inherent uncertainty associated with understanding the dynamic relationships of a large number of components within a system and responses through time and different spatial scales (Cilliers et al., 2013). Having a systems perception enables futures consciousness through observing ecological processes and responses to drivers of change at different spatial and temporal scales, considering the multiple ways societies respond to change and how decisions will affect the different elements of the system across scales. This is reflected in the collective institutional vision, and an aspirational goal expressed by one interviewee:

> *I would see the role of a park like the Garden Route, as being critical at a regional level, to provide resilience and opportunities for adaptation…we're in a very constrained area, but we pretty much cover the whole area between the mountain and the sea. We have strong relationships with people, there's a willingness and openness to learn and experiment and, to some measure adapt, if it doesn't cost too much. But I think that's also part of life* (Int. 15).

Climate change is not part of the collective vision of the GRNP but is addressed as a separate program in the management plan. Existing management actions that can contribute to adaptation include landscape approaches, restoration, and actions to maintain functional ecosystems, not just single system attributes. Such actions are not identified as climate change adaptation in the management plan. However, respondents acknowledge that existing management actions can contribute to national efforts to address climate change adaptation. Participants provided examples from their experience of using landscape approaches to negotiate different stakeholders' needs and interpretations of change (e.g. elephants management in other parks, see also: Freitag et al., 2014; Smit and Archibald, 2019). They also mentioned the importance of building a long-term relationship between staff and local stakeholders.

Precisely, a compelling and immediate challenge, is balancing the sense of responsibility towards protecting natural resources and allowing local impoverished communities to benefit from the park, especially if climate change can affect such benefits, making evident the contested role of protected areas and who benefits from them:

> *It's sort of a conflicting thing too because there's so many people in the landscape and they have requirements and needs. There's continuous pressure on these protected areas to provide resources, otherwise, they're not seen as being valuable enough…is quite a difficult situation. We might say protected areas are great in terms of climate change, and that whole argument, but at the same time, we need to provide a growing population with resources, so*

that protected area automatically come under discussion and threat…if they're not being utilised by the people for the people, then why do we have them? (Int. 5).

Despite the systemic approach by SANParks for managing national parks, climate change seems to reinforce linear perceptions of causality, as observed by how some respondents try to understand the problem and break the system down into constituent parts. For some respondents climate change concerns are about preventing the loss of species, guaranteeing provision of ecosystem services for local communities or, indirectly, ensuring the wellbeing of a non-human individual. For example, the case of the Knysna elephant, which is believed to be the last individual of the local population (Moolman et al., 2019), is raising questions about rethinking the interface between management and science regarding future options for park planning (e.g. by including corridors to facilitate animal movements). Decisions about what the park can do with one individual demonstrates a complex approach, bringing issues of ethics, morals, and care for human and non-human agents to avoid human-animals conflicts in a park with no fences.

4. DISCUSSION

Why does futures consciousness matter in adaptation and future-oriented approaches? The ideas and expectations about adaptation shared by interviewees uncover some of the conceptual and practical challenges that individuals and institutions face in realising options for the future. Exploring futures consciousness can encourage practitioners and scientists to critically examine existing assumptions about change and current practices, while unpacking potential contradictions between individual and collective aspirations about the future. In this article, I address the reflexive step mentioned in the introduction: to facilitate transitions towards future-oriented approaches to accommodate future, uncertain, ecological transformations in management.

Despite climate change not being part of the collective vision of the GRNP, I documented transitions in thinking about climate change and its implications for managing the park. According to the future-orientated transitions described in Fig. 1, transitioning toward future-oriented practices in the GRNP is enabled by different futures consciousness characteristics and happening at different levels (Table 1; Figure 2). It is essential to highlight the inherent contradictions across the dimensions of futures consciousness and adaptation choices in the park. The long temporal approaches and systems perception observed in GRNP, which encourage participants to embrace change through careful observation of SES responses to drivers of change through time and across scales, enables transition one, two, and four. However, as future climate-related transformations are not anticipated, and as the climate change program in the management plan only considers incremental approaches (SANParks, 2020), transition one is only halfway there. On the other hand, implementing a climate change program in the management plan (short-term calendar times) contradicts the resilience and complex

systems theories used for decision-making and the long-term adaptation options defined through landscape and ecosystem-based approaches mentioned in the interviews.

The findings indicate that existing futures consciousness elements enable transformative change toward co-learning and participatory methods (Pahl-Wostl, 2009). This transformative process is facilitated by high levels of systems perception and concern for others to address transitions two and four. Emphasising the relational dynamics of SES through space and time helps understand how SES relations resist and renegotiate temporal enclosures (Fairbanks et al., 2018), enabling management to address social values and benefits, facilitating the second, third, and fourth transition. However, responding to institutionalised calendar times constrains agency, imagination, and options to anticipate future changes, which might be a barrier for the third transition.

The potential impacts of climate change in the social context of the park make more compelling the need to include social and environmental justice considerations in management and adaptation. A transformative process occurring in the GRNP is how participants rethink top-down conservation approaches inside the static boundaries of a protected area and shift towards pluralistic approaches in open systems. The matrix of conservation-based areas mixed with different land uses, being an open park, and using the SAM approach in decision making, facilitate rethinking temporal perspectives concerning managing change and future transformations. Acknowledging the ontological qualities of time can help review the social aspects of landscapes transformations, the preferences for accessing and using resources, and its implications for negotiating futures with diverse stakeholders (Jaramillo and Carmona, 2022). Such rethinking requires patience, empathy, and understanding of futures needs of stakeholders as natural processes unfold (Adam, 1998, p. 95). Traditional adaptation options such as expanding or creating new protected areas dissent with the social context and the desire for environmental justice. But concern for others, systems perception, and time perspective help reconcile people's perceptions of what a park is while considering other perspectives, values, and aspirations in management. This translates into managing social benefits, not only ecological features, therefore opening alternatives for different and plural futures, indicating that GRNP is well into transition two.

Openness to alternatives links agency beliefs with systems perception, and concern for others, enabling the third transition in Figure 2. Power imbalances are addressed as empowering communities through participation, as observed in the interviews and literature (Roux et al., 2021). GRNP managers and scientists apply different processes to negotiate power imbalances to define a collective vision for park management, indicating moves towards intentional transformative adaptation (Colloff et al., 2021). In the GRNP, the temporal enclosure is no longer a barrier to defining collective visions and allowing negotiation of preferred outcomes. The biggest challenge toward futures consciousness in GRNP is overcoming near-term calendar management time that reduces complexity to specific events (e.g. droughts, wildfires) without losing the long-term potential for the future to come (Múnera-Roldán et al., 2020).

Table 1. Unpacking The Five Dimensions of Futures Consciousness (Ahvenharju et al., 2018) enabling the transitions (van Kerkhoff et al., 2019) for transformative change in the Garden Route National Park (GRNP), South Africa.

Transition	Futures consciousness dimensions	Illustrative quote
1. From preventing change and reducing uncertainty, to anticipate and embrace change and accept uncertainty	Systems perception: understand social-ecological system processes, responses, and feedback across space and time	Do we fight it? Or do we live with it? Probably a bit of both. We try and prevent it obviously as much as you can, but there are going to be radical changes that are beyond our control (Int. 12)
	Time perspective: to address management timeframes while observing, understanding, and anticipating the system	
	Agency beliefs: feeling able to respond to unexpected events, through incremental or transformative actions	
	Openness to alternatives: embracing change require being flexible and spontaneous when faced to different alternatives and pace of change (rapid or slow)	
2. From approaches focusing on some ecological features to social values and benefits	Concern for others: a shift from ecological to social values calls to reflect on issues of ethics, care and responsibility towards human, and relations with non-human agents	Climate change is not just going to impact fish stocks, it's going to impact the people that are utilising those fish stocks and how they change their behaviour might change the fish stocks even more. We need to think beyond just the depth our parks for the corridors and the movement of animals, to think about how it's going to be influencing those [SES] systems all together (Int. 13)
	Systems perception: having systemic and holistic approaches helps to consider complex societal problems and implications of solutions across scales	
	Openness to alternatives: rethinking existing assumptions about conservation goals	
3. From adaptation as a scientific/technical issue, to adaptation as governance	Agency beliefs: organising strategies and rules to better respond to future changes	That means working with stakeholders, and seeing we as part of a mosaic landscape, not as a park that's separate from the landscape. And how do we allow these bigger processes across multiple land uses and multiple land tenure or ownership (Int. 15)
	Openness to alternatives: questioning how science informs planning and decision-making, to rearticulate knowledge systems and governance	
	Systems perception: addressing participation of different governance models across scales and sectors	
	Concern for others: negotiate and reconcile power imbalances between different stakeholders	
4. From reactive problem solving, to learning and reflexive approaches	Agency beliefs: understanding and shaping future events through learning, rethinking, and envisioning	The GRNP is a very fragmented and open access park. So, there's a lot of land uses in between pockets of the park [it makes] more important to have stakeholder participation because people are so influenced by the park, and they influence the park so much (Int. 14)
	Time perspective: anticipating future changes while 'keeping an eye' on the present, learning from past events, and being aware of events and consequences through time	
	Systems perception: learning through relational engagement with SES to rearticulate management	
	Concern for others: participation as a transformative process through engaging stakeholders with diverse ways of knowing, doing, and values to address complexity and long-term change	

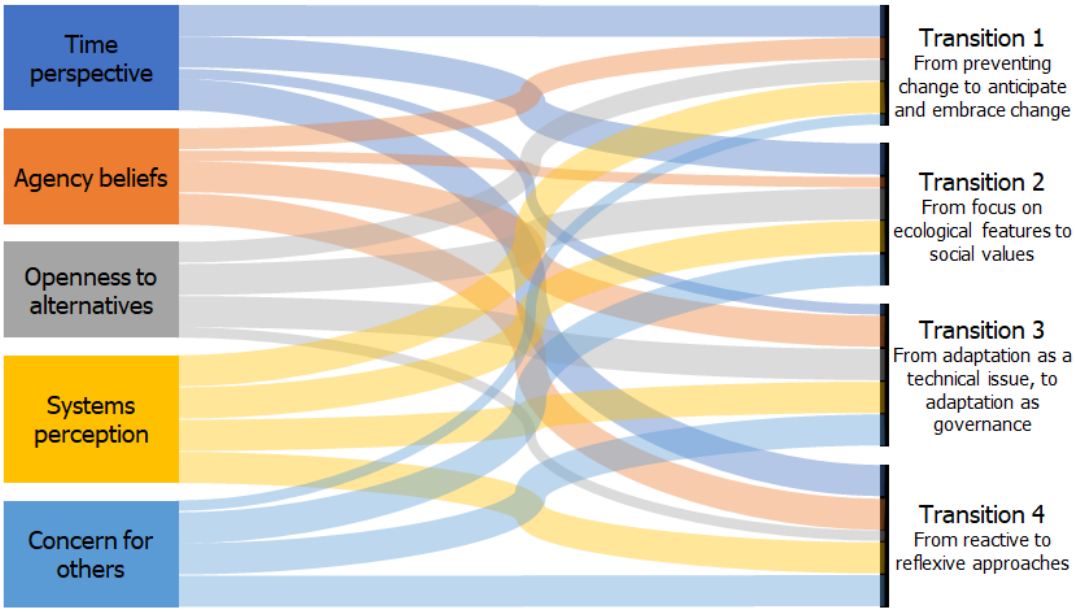

Figure 2. Futures consciousness elements enabling the transitions towards future-oriented conservation in the Garden Route National Park.

Elements of futures consciousness can elicit the critical thinking and capabilities required for evolutionary learning-based processes aiming for transformative change and reflexivity. Reflexivity requires critically questioning frames of reference and foundational concepts within individuals' ethical positions (Pahl-Wostl, 2009). Under a traditional conservation practice, the SAM approach applied by SANParks indicates strong elements of reflexivity, as observed with respondents critically questioning strategies, frames of reference, and foundational concepts. Accepting and anticipating climate change in management is a systemic and structural problem that requires learning (and unlearning), engaging in transformative approaches, and rethinking existing assumptions. With climate change, learning approaches in GRNP get constrained by rigid institutional rules and are only aiming at incremental improvements. Learning and reframing SAM is a continuous individual and collective process in SANParks (Roux et al., 2022). Then, addressing climate change as a driver of social and ecological transformation that can affect the park's collective vision offers opportunities to enable adaptation (Múnera-Roldán et al., 2020) and transformative governance.

Social and transformative change studies have poorly studied individual attitudes towards change and preferences to engage in collective action (Benessaiah and Eakin, 2021; de la Sablonnière, 2017). Futures consciousness can help understand such linkages and support the implementation of intentional transformative change and learning. Transformative change is a long-term learning process and is not straightforward. It requires building trust, collaboration, and reflexivity (Gupta, 2016). As proposed by Colloff et al. (2021, p. 164), "knowledge about adaptation is given meaning by and for

participants engaged in real-world co-production of ITA [intentional transformation adaptation] initiatives, particularly in developing visions for the future". While current management actions in the GRNP are not explicitly described as adaptation, they are opening options for reflexivity and learning about adaptation and transformation in the future. Transformative change is determined by the interplay between individual and collective agency, which in the GRNP is facilitated by the participatory workshops to co-create the park vision.

Adaptation can be transformative, incremental, or a continuum of resistance, resilience, and transformation. Defining which adaptation type best suits conservation practice can be influenced by perceptions of time and systems, and the degree of beliefs towards transformation or maintaining the status (Múnera-Roldán et al., 2022). Futures consciousness can help to elucidate collective and individual processes involved in defining adaptations and transformative change and navigating necessary transitions toward future-oriented adaptation practices (van Kerkhoff et al., 2019). These transitions can enable transformation while addressing power imbalances, co-production, and learning (Colloff et al., 2021). Critical thinking requires examining existing governance contexts and politics behind past failures when exploring new options (Chambers et al., 2022) to understand the complex characteristics of social-ecological systems and negotiating change.

Futures consciousness can help understand what is in play when individuals face the challenge of radically different scenarios of change (i.e., stability or rapid change) and identify options to restructure knowledge and practices through unpacking individual temporal and systems perspectives, identifying what (and whose) principles and values are used in decision making, and how institutional frameworks facilitate or constrain agency beliefs and action. Areas of future research might include addressing the role of agency beliefs and openness to alternatives in enabling the transitions towards accepting change rather than attempting to prevent it and addressing the role of concern for others in enabling environmental justice in protected areas and other temporal enclosures. Similarly, exploring how different imaginaries about time influence understandings of adaptation: is change a constant feature of the world that we can manage at any time, or is it something to prevent as it threatens the world (Hanusch and Meisch, 2022).

5. CONCLUSIONS

In doing their work, SANParks staff often face the contested question of *conservation of what and for whom?* But as they rethink the challenges of managing an open park, the GRNP staff are trying to balance collective aspirations of wellbeing and livelihoods for local people with national mandates to conserve nature and sustainable development (Republic of South Africa, 2015; Republic of South Africa, 1998). Although decoupling the system is part of the daily management and planning, the responses from the interviewees demonstrate how the 5DFC provides ways to recouple the system

and acknowledge its complexities. The collective envisioning for defining objectives and programs in the management plan is one of the most innovative and transformational approaches in protected areas management, and an example for other parks in South Africa and abroad. It can potentially catalyse structural changes, transform conflicts, and negotiate power at different scales.

I elaborate the characteristics of futures consciousness that are involved in decision-making processes by parks staff. The 5DFC provides a structure to understand climate adaptation preferences, expectations, and motivations behind actions, and considering diverse onto-epistemological perspectives and relational approaches of the interviewees. The findings can inform managers in planning processes, revisiting existing assumptions of conservation goals under climate change, and finding the best options to address adaptation. The conversations with GRNP staff indicate they hold strong elements of futures consciousness, critical thinking, and openness to alternatives.

Whose options will prevail in the future is an ongoing process of social becoming in South Africa, to which the protected area can contribute. Being an open park, protected area boundaries of the GRNP are not seen as a limitation for conservation and adaptation actions, opening options to negotiate multiple trajectories, coexistences, and futures across scales and stakeholders. Drawing from the recommendations to assess diverse future approaches as described by Pereira et al. (2021), the GRNP is addressing three of the four challenges described for sound future decision-making: the park is working to be relevant at multiple scales, the participatory approach is enabling inclusion of diverse actors and perspectives, and it is creating innovative options for environmental management in conditions of uncertainty. However, the park is still not working on actively anticipating and responding to unpredictable future conditions (such as climate change). But thanks to the systemic approach to management, options for the future remain open in the GRNP, demonstrating that it is possible to overcome enclosed temporalities of protected areas.

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DISCLOSURE STATEMENT

The author reports there are no competing interests to declare.

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Chapter 6. Discussion and key contributions

As presented in the introduction and documented in the results, global change impacts on the environment are challenging traditional approaches to conserve biodiversity and natural resources management. Protected areas, as a form of area-based conservation (Maxwell et al., 2020), are often used as instrumental tools to achieve countries' aspirations and commitments to international agendas. Defining new protected areas and expanding existing ones are well-established strategies for adaptation globally (Carrasco et al., 2021), with countries around the world continuing their commitment to reduce climate change and biodiversity loss through increasing protected lands and oceans.

As noted at the start of this thesis, management strategies aim to be long-term. However, policies, practices, and resource allocation are often short-term, creating a disconnect between management and ecological response time. This temporal disconnection opens questions about the aim of long-term conservation practices, especially as climate change, alongside other drivers of change, challenges protected areas' commitment to sustain certain values in the future. Analysing concepts of time involved in managing complex systems helps in defining options to facilitate management changes and reconcile management calendar times with unfolding changes in social-ecological systems (**Papers 1** and **5**).

I have documented in **Papers 2, 3** and **5** the multiple adaptation narratives involved in conservation and protected areas management, and the implications for future management. Paying attention to how the problem of ecological transformation is framed in adaptation narratives is a starting point to understanding what is worth protecting and what is missing to enable adaptation (Dewulf 2013; Clement 2021). Adaptation narratives in the case studies differ in how climate change is anticipated, how change is accepted or not, and adaptation responses. The narratives reflect different ways of thinking about the climate change problem but also shed light on the role of institutional contexts in framing decisions (Table 5.2).

Climate adaptation in biodiversity conservation requires examining governance arrangements and rules that allow or prevent implementing planning for alternative futures (Wyborn et al., 2016). Protected area managers in all case studies are increasingly concerned about the impacts of climate change in parks. In Colombia and South Africa, they are considering how conservation and adaptation strategies affect local communities. However, I found that there is often little reflection on whether conservation strategies and institutional settings where decisions occur are prepared to address climate change impacts.

Shifting the paradigm of long-term conservation in the enclosed temporal and spatial boundaries of protected areas requires rethinking our assumptions of change, understanding where the motivations to do conservation come from, and the role of rules in shaping action. With some differences, this rethinking is happening in the case studies. For example, **Papers 3**, **4** and **5** describe how managers recognise themselves as agents of change and how are they working to identify adaptation options while reflecting on the barriers constraining action. And in **Paper 4,** I have explored the mismatches across scales between expectations of adaptation and existing decision-making processes and governance contexts.

Based on my findings, and drawing from anticipatory governance (Boyd et al.,

2015; Muiderman et al., 2020) and future-oriented approaches (van Kerkhoff et al., 2019; Wyborn et al., 2016), I propose that future-oriented conservation can support adaptation to climate change in protected areas through:

i. building an understanding about how future climate-related transformations can affect conservation values through time and across geographic scales (social or ecological),
ii. evaluating existing dispositions (at individual and collective levels) to accept or not accept such future transformations,
iii. examining the degree to which existing rules and knowledge in use allow stakeholders involved in planning and managing protected areas to reach desired futures,
iv. reconciling expectations about social and natural systems relations, and how values and practices across temporal and spatial scales challenge conservation inside static borders.

The above points require clarification of which concepts and values are underpinning decision making, including mental models used to understand human-environment connections through time, motivations for adaptation, and capacity to rethink current practices. I found evidence that managers in the case studies are discussing the above points and working towards future-oriented conservation.

For example, managers in the three countries are reflecting on the temporal and spatial challenges of conservation strategies under climate change (iv), although managers from Colombia are most actively discussing the implications of climate change in conservation goals, recognising the need to work beyond protected area boundaries (i, iii). Managing protected areas in South Africa already considers systems complexity, and applies learning and reflexivity processes (i, ii). In Australia and South Africa, managers are questioning existing rules constraining action and adaptation options (iii). These points are not intended as a golden rule for future-oriented conservation, but as evolving steppingstones to create desired futures.

In the next sections I discuss how the 5DFC helped in understanding existing assumptions, values, and dominant ways of thinking about adaptation.

6.1. Futures consciousness attributes in adaptation narratives

Defining climate change adaptation in conservation contexts is not straightforward. Adaptation means many things and is usually context dependent, which was reflected in my findings. Across the case studies, some narratives are looking to prevent change, managing to prevent loss of threatened species and maintain ecological integrity, as observed in Australia and partly in Colombia. Other narratives mention vulnerability and reducing risks (Colombia), while others are strongly focused on finding options to address environmental and social justice (Colombia and South Africa). These narratives are all framed in specific socio-political contexts, and reflect different aspirations for the future, different ways to address ecological change, different expectations about adaptation in protected areas, and about how management should deal with climate change.

I have illustrated how, and which, futures consciousness elements come into play when defining a system or parts of a system for management, the implications for managing – or preventing – changes in protected areas (**Papers 2, 3,** and **5**), and the socio-political contextual issues affecting adaptation across scales (**Paper 4**). **Papers 3**

and **5** explain the diverse narratives and understandings of what adaptation is, how to implement it, aspirations for the future, and who participates and gains benefits from adaptation initiatives.

Approaches for managing biodiversity conservation under climate change have not evolved much in the past 20 years (McLaughlin et al., 2022). Biodiversity conservation adaptation is mainly through reactive options looking to ameliorate impacts or avoid change, which can neglect the magnitude, extent, and rate of climate change related transformations (Prober et al., 2019). My research showed that adaptation in conservation still prioritises reactive approaches in response to disturbances, especially if conservation goals are focusing on preserving ecological attributes (as in Australia and to some degree in Colombia). In the other hand, conservation strategies focusing on SES seem to be more proactive, as observed South Africa and partly in Colombia. But I also found that focus on the technical aspects of climate change is becoming less relevant as protected areas agencies start questioning the implications of climate change beyond the enclosed boundaries of a national park.

In practice, adaptation is about having clear rules to enable agency to prepare for and respond for change. Recommendations to change conservation strategies to address global changes are increasing, including calls for anticipatory approaches and scenario planning to assess alternative futures (McLaughlin et al., 2022; Pressey et al., 2021). However, aspects like governance and readiness to undertake adaptation are often not properly addressed in conservation. Climate adaptation readiness refers to the social, economic, and institutional capacity that enable countries or institutions to implement adaptation (Chen et al., 2015). My research shows how managers in the three countries reflect the degree to which institutional mandates are in tension with what park management wants and can do. For example, a lack of clarity about climate change rules is a barrier for adaptation in Australia, while in Colombia managers take advantage of existing institutional environmental and climate change frameworks.

In my case studies, rethinking adaptation comes as part of existing relationships and negotiation processes with stakeholders inside and outside the protected area. Such interactions encourage managers to pay more attention to legal and institutional arrangements that prevent or enable them to deal with changing climates, indicating elements of reflexivity to rearticulate existing practices and in some cases, to integrate other ways of knowing and perceptions of change (Dryzek and Pickering, 2019; Múnera-Roldán and van Kerkhoff, 2019) as summarised in **Papers 1, 3** and **5**.

The narratives presented in **Paper 3** are examples of how existing rules and concepts shape the interpretation and expectations of doing adaptation, reflecting the political and institutional settings from which the narratives build (**Paper 4**). For example, adaptation aiming for landscape and ecosystem-based approaches builds on existing territorial planning or watershed management regulations, environmental justice desires follow constitutional mandates, and in the case of Colombia takes advantage of new regulations to implement the peace process. In Australia, respondents from the Australian Capital Territory were quick to indicate how existing legislation on threatened species is a barrier for landscape, ecosystem-based approaches. The results also show how managers reflect on existing barriers and structural contexts that prevent them achieving desired futures as presented in **Papers 3, 4,** and **5**.

Individuals' perceptions of change, of time, and about systems, are socially influenced through practice and everyday relations created in the park. The narratives

in the three countries differ in their tolerance to change and response times. The findings illustrate that managers are critically thinking about the implications of climate change in relation to management timeframes. In South Africa, managers are aware that actions to address climate change are often reactive, and how management timeframes are in tension with understanding ecosystems responses. The implications of this tension within management and ecological response times provide insights for the implementation of future-oriented practices to avoid undesired outcomes and misunderstandings related to envisioning futures without properly addressing consequences of decisions (Nalau and Cobb, 2022).

Integrating Local and Indigenous Knowledge to support adaptation has been proposed before (Adger et al., 2009; Lam et al., 2020) and has been documented in natural resource management and protected areas (Fatoric and Moren-Alegret, 2013; Leon et al., 2015; Múnera-Roldán and van Kerkhoff, 2019). In those parks where adaptation is related to landscape approaches (especially in Colombia and South Africa), managers are recognising the relevance of diverse knowledge systems for adaptation and looking to integrate Indigenous and local communities' perspectives inside and beyond the park. Colombian narratives demonstrate desires to diversify knowledge systems, while the South African approach to incorporate local stakeholders' visions in planning indicate moves toward future-oriented conservation. Including other stakeholders' knowledge and practices facilitates reconciling SES across temporal and spatial scales, while considering whose values are included in decision-making processes.

The narratives in the three countries commonly describe adaptation as a cyclical approach, and as actions to reduce harm and build resilience. However, such aspirations for building resilience and what they mean in practice, are not properly discussed in management with the exception of South Africa. Poor consideration of system boundaries, tipping points, or limits to adaptation is a missed opportunity for learning from practice and rearticulating existing approaches for adapting biodiversity conservation, as discussed in **Papers 1, 2, 3, 4** and **5**.

Although the plurality in adaptation narratives is normal, the different conceptions of adaptation can have consequences. The main implication is related to how change is addressed in management as it will influence choices for the future. Perceptions about ecological change will influence defining conservation goals and adaptation options, as discussed in **Papers 2, 3** and **5**. For example, if conservation goals are focused on preserving ecological structure and functions, adaptation actions aim to maintain current conditions through reducing climate-related risks via incremental short-term responses. Without careful reflection about how to sustain conservation values in the long term, this approach can be maladaptive if ecological change is not prevented, and at some point, transformation might be necessary. Similarly for building resilience as a management strategy in response to climate change (**Paper 2**).

Parks staff should discuss how much change are they willing to accept, and the degree to which existing rules allow the achievement of conservation goals affected by climate change. Such deliberations can help to avoid contestation between desires of preventing versus accommodating change, while discussing potential limits to adaptation and consequences of decisions in the future. Scenario planning and envisioning futures often don't contemplate the multidimensional issues involved in how individuals understand the future, therefore poorly connecting with collective processes (Nalau and Cobb, 2022). Futures consciousness can facilitate reflection on how to connect individual and collective domains in future-oriented practices through

understanding where managers are at about what they think about how climate change will affect their work.

Protected area managers can be agents of change as they create relations with local communities and other stakeholders. Therefore, it is important to understand their role as part of social change, the role of institutional settings influencing what individuals can do now, and how they can address power imbalances to renegotiate agendas under conditions of uncertainty. The 5DFC offers a starting point to examine individuals' assumptions about how climate change can impact conservation goals and reconcile potential conflicts to mobilise collective action.

6.2. Institutional contexts and narratives

As presented in Papers 3 and 4, the three countries have different environmental discourses and policy approaches to address climate change at the national scale. My findings demonstrate that institutional arrangements shape adaptation decisions ruling interactions between individuals, groups, and states, as Dovers and Hezri (2010) explained. Examining the institutional contexts shaping adaptation narratives is essential to contextualise enablers and barriers of future-oriented practices.

Existing environmental policy and legal frameworks are shaping the narratives and guiding action, including Australia's narrow reactive approaches following threatened species legislation, Colombia's opportunistic climate adaptation narratives aligning with the country's development policies, or aspirations for social justice in response to the South African constitution.

In Australia, environmental discourses suggest that human, physical, and information resources will solve environmental problems to accomplish conservation goals and address climate change. These discourses represent top-down approaches to solving environmental issues, prioritising human needs over nature, and denying environmental limits while centralising decisions and resource allocation (Dryzek 2013). The climate change problem is framed as an emissions problem to be addressed through mitigation (Dewulf 2013) with few options to integrate other sectors' agendas (Colvin et al. 2020). Australia's biodiversity policy prioritises site-based protection of threatened species (McDonald et al. 2018). Under such a narrow policy vision, one can ask whether participants can examine their assumptions about a changing environment within the socio-political aspects of adaptation. Some participants recognised the limited space for an ecosystem-based adaptation approach under existing commonwealth and state legislation. However, despite their interest in learning about adaptation, thinking about and implementing adaptation remains reactive, with few mechanisms for environmental management and climate change outside the species approach. Some state and territory governments have taken a more proactive approach (Crowley 2021), as is the case of the ACT. However, there are still barriers to integrated, transboundary adaptation (McCormack 2018), which I observed in the different approaches for managing feral horses in both Australian parks studied.

Policy discourses in Colombia frame climate change and biodiversity loss as development problems, taking top-down and expert-based approaches. However, the peace process and ensuring the supply of ecosystem services promoted a shift towards sustainable development discourses. Governance is still top-down, but the government is not the only one in charge of decisions, and there is a nested network of actors sharing information to support decisions (Dryzek 2013). This change in discourses has helped Colombia to legitimise its environmental policies (Leal 2017), providing an

opportunity to engage in international environmental policy forums, research collaboration, and funding. This opportunistic adoption of environmental-related ideas from international forums into domestic strategies was observed by Milhorance et al. (2022), and I also document this adoption in the adaptation narratives of the three parks studied. Biodiversity has been mainstreamed in Colombian climate change policies, such as expanding its protected areas as a commitment to adaptation under its Nationally Determined Contribution. The three Colombian parks studied have strong alliances with national and international environmental organisations to support ecosystem-based adaptation goals and two parks to support the peace process implementation. Despite critiques of opportunistic policies based on instrumental views of nature as the means for sustainability (Woroniecki et al. 2020), I found that protected area managers draw from such approaches to integrate adaptation into management and provide an opportunity to identify and implement adaptation actions with other stakeholders and sectors outside the protected area. Although this provides an opportunity for adaptation at the local level, effective cross-sectoral integration at the national scale remains a challenge (Milhorance et al. 2022), as addressing the underlying vulnerability factors to climate change, the political aspects of adaptation (e.g. land tenure conflicts, poverty) and illegal use of natural resources.

Social justice and equality are central to environmental discourses in South Africa framed under the country's constitution. Post-apartheid environmental discourses shifted from interventionist views of nature to innovative approaches to environmental management (Carruthers 2014). The inherent complexity of social-ecological systems means a balance between environmental conservation and economic growth is necessary to address social inequality, opening possibilities for governance changes and collaborative partnerships (Dryzek 2013). As mentioned during interviews, these new approaches have enabled a culture of collaboration and participation between researchers, managers, and local communities. However, climate change is not a management priority in the park. A potential explanation lies in SANParks' philosophy of strategic adaptive management of complex adaptive systems, which involves an institutional learning approach based on resilience thinking, acknowledging uncertainty and systems complexity (Roux et al. 2022). Therefore, reactive management approaches to prevent species or ecosystem loss in response to climate change are not well received (with some exceptions). However, managers are worried about the implications of climate change for human communities in and around the park, considering the potential future impacts of climate change on the provision of benefits for society. Although the park's interest in increasing collaboration and engagement with local communities and other stakeholders was not motivated by climate change, it provides an opportunity to balance conservation, adaptation, and environmental justice, potentially reducing a climate change legislation barrier that is preventing adaptation actions across sectors (Taljaard et al. 2019).

Environmental approaches in each nation respond to specific beliefs and identities, giving form to distinct discourses and epistemic communities. Environmental discourses in the three countries reflect the influence of international agreements for conservation but with different narratives of adaptation. South Africa and Colombia frame climate change as an opportunity for sustainable development and environmental justice. For Colombia, building its identity as a biodiverse nation has been critical for local areas to identify adaptation options, legitimise protected areas, and connect local efforts to national commitments under international agreements. In contrast, unclear rules and policies on climate change in Australia have constrained managers' agency for adaptation.

6.3. Towards future-oriented practices

A future-oriented practice requires accepting two fundamental realities. First, that change is an inherent component of complex social ecological systems. And second, that the speed and rate of climate change challenges traditional conservation strategies. Recognising protected areas as SES can help in reframing strategies from protecting some attributes while aiding to conceptualise adaptation and conservation to manage the multiple benefits for human societies and address sustainability (Basak et al., 2021). This reframing in conceptualising parks as SES is fundamental for transforming biodiversity conservation, while critically unpacking the multiple and potentially contested voices, beliefs, and practices (Massarella et al., 2021). Under conditions of rapid change, our frames of reference guiding which action is best, what response timeframes are adequate, and how perceived climate change impacts on what is valuable, influence how we make decisions. As was discussed above (section 6.1), understanding individuals' assumptions about how managers think, prepare, and respond to climate change impacts can offer pathways to identify what actions can support collective agency to support desired conservation outcomes and to avoid maladaptive responses.

The findings from this research contribute to transformative adaptation and futures thinking approaches, through unpacking individuals' ideas and expectations about adaptation and conservation. The 5DFC framework brings out the conceptual and practical challenges that individuals and institutions face in defining options for the future. Futures consciousness can support reflexivity to rethink and critically examine existing assumptions and practices, to facilitate transitions towards future-oriented approaches (**Papers 2** and **5**). The transitions start with revisiting our assumptions about social-ecological change and rethink whether conservation strategies are ready to deal with transformation.

Aspirations for conservation in protected areas largely ignore issues of scale and temporal considerations involved, as well as the intrinsic and complex relations people create with place and with nature. Human needs and preferences for certain ecosystem services change over time (Scholes, 2016), and can continue to change with climate change. Acknowledging that change is happening, and some conservation goals might not be achievable, does not mean that the protected area is less relevant in the future. It does not mean either to give up on attempts to conserve threatened species or ecosystems. I found that managers in the three countries are starting to think about the implications of climate change inside and beyond the enclosed boundaries of protected areas. In Colombia and South Africa, managers are considering social values, perceptions of change from stakeholders affected by conservation strategies, and the dynamic relations of humans with nature. This reasoning becomes imperative for future-oriented practices.

This shift in thinking to address climate change can happen through exploring where individuals and institutions are now, understanding existing barriers and opportunities, and examining options to achieve desired futures. The transitions proposed by van Kerkhoff et al. (2019) can help in identifying how to transform current approaches. The transitions model was developed during the implementation of the Conservation Futures project in Colombia (van Kerkhoff et al. 2019). The project drew from an evolutionary learning perspective (Ansell and Gash 2007) to take participants through abstract concepts grounded in real problems to learn from their views and experience. The model is based on the values-rules-knowledge framework (Gorddard et al. 2016) and was used to explain the necessary management and institutional changes toward a future-oriented conservation considering participants' operational context. The transitions are used in this research as an indicator of how futures consciousness enables reflexivity to enable necessary changes in governance to adapt to climate change. Futures consciousness offers one way to understand linkages between individual attitudes towards change and preferences to engage in collective action, supporting the implementation of intentional transformative change (Colloff et al., 2021).

Adhering to technical and scientific options is only one part of the solution. The increase speed of climate change means that we need to be able to make rapid decisions with incomplete information. Protected area management can start thinking beyond understanding climate change concepts, to consider other forms of knowledge and practices for monitoring change and informing decisions, as documented in the narratives from Colombia and previously by Múnera-Roldán and van Kerkhoff (2019). Recognising that climate change is more than a scientific problem, but about how and whose values legitimize adaptation decisions facilitates the third transition: adaptation is political and therefore is also a matter of governance. Then, it is also an invitation to examine if and how existing policies and the set of worldviews and values underpinning them, will still be relevant in the future (O'Brien and Wolf 2010). Examining futures consciousness attributes in the adaptation narratives can be a first step for more deliberative adaptation approaches where future generations are considered, while critically examining consequences of decisions today.

Addressing the social benefits provided by parks to society is another of the transitions toward future-oriented conservation. Managing for social benefits can make protected areas relevant and facilitate collaboration with other stakeholders and sectors, reconciling the mismatches across scales explained in **Paper 4**. Dialogues with local communities about the protected area's benefits and identifying management

options to address climate impacts can add legitimacy to adaptation choices (O'Brien 2010). Collaborative deliberations about adaptation actions based on multiple values can open various pathways for biodiversity to be central in future decisions and planning, as Pereira et al. (2020) proposed, and also for nature's contribution to adaptation (Colloff et al. 2020). However, such deliberations with local communities still need to confront difficult choices if adaptation options for those benefits are beyond adaptation limits.

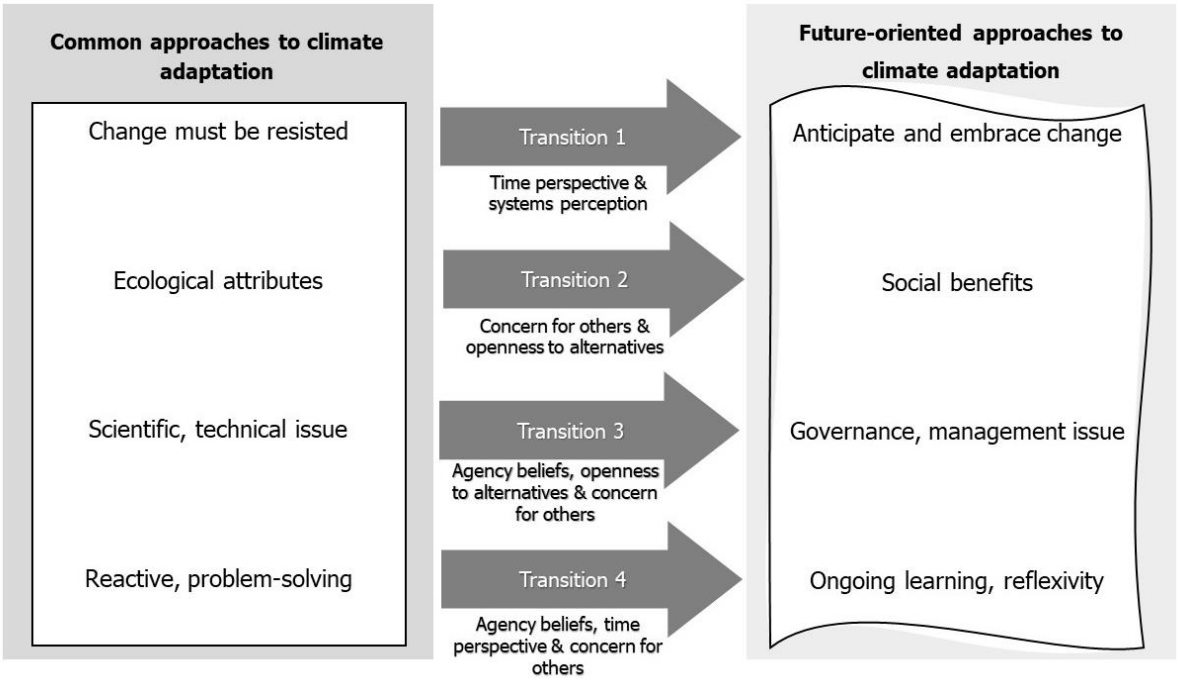

Figure 6.1. Futures consciousness and transitions for future-oriented conservation documented in South Africa (Source: author, adapted from van Kerkhoff et al., 2019).

In this research, the transitions were formally analysed only in the South African case study (Fig. 6.1, **Paper 5**). I found evidence of how the GRNP is reflecting on current management and moving toward future-oriented practices. Although the park management plan does not actively anticipate future climate change impacts, existing long-term monitoring and systemic approaches are enabling managers to embrace change as a normal issue in management. Managers in the GRNP are critically thinking about how to reconcile rigid governance frameworks making difficult to manage complex systems and responses to change, indicating the most pressing issue to address climate adaptation is about governance.

6.4. Futures consciousness: contributions and moving forward

Futures consciousness supports realising and connecting how individuals face the challenge of new and radical scenarios of change and identify options to restructure knowledge and practices. For example, unpacking individual temporal perspectives, identifying what principles and values are used in decision making, and how institutional frameworks facilitate or constrain agency beliefs and action. Future-oriented practices should consider that people's mental models about a system and their expectations for the future will be different, which can be influenced by different social, cultural, and educational contexts.

Consciousness is about the present moment, of being aware of the social and environmental context shaping current decisions and future goals (Bernecker and Michaelian, 2017). Futures literacy, or the capacity building process to actively use the future in the present, as part of day-to-day actions (Liveley et al., 2021; Poli, 2021) can contribute to developing future-oriented practices. Based on my findings, I propose that futures consciousness can inform futures literacy processes as part of transitioning toward future-oriented practices. The 5DFC can help in unpacking how individuals imagine and connect temporal elements, their understanding of system dynamics, and how to respond to transformations, as part of the meaning-creating process. Identifying futures consciousness characteristics underpinning beliefs and action can support futures literacy and future-oriented practices, to understand existing capabilities to think about the future, and which assumptions about change exist to create culturally context related pedagogic practices (Facer and Sriprakash, 2021).

As discussed by Wittmayer et al. (2019), narratives and practice inform and construct each other. The rationale behind the conceptualisations of adaptation can help identify individuals' preferences towards accepting/resisting change and identify options toward social change (**Paper 3**). For instance, uncovering existing narratives can help in finding options for transforming existing paradigms, grounding transitions in individuals' perceptions and situations, while connecting potential ecological transformations with the places they value (Köpsel et al., 2017).

The narratives approach was helpful to understand how current socio-political contexts and individuals' perceptions are co-produced together, influencing preferences toward managing change, which is then translated into the design and implementation of adaptation strategies. It illustrates the role of values, emotions, and the sense of responsibility managers have in relation to adapting protected areas to climate change. It also illustrates the relevance of everyday practices, building relations, and learning in defining choices for the future. The narratives in each country cannot necessarily be attributed to specific organisations or groups, but rather demonstrate how institutional rules influence meaning creation and action.

This research informs anticipatory governance research and practice, helping to understand how individuals make sense of the future to implement adaptation. The findings demonstrate the relevance of understanding individuals' and institutions' positions towards the future and examine barriers that prevent managers from being agents of change to create options towards the future. Future-oriented conservation and anticipatory governance can benefit from using futures consciousness as a framework to critically (and constructively) examine current contexts and assumptions about the future.

Some of the challenges to implement adaptation in protected areas as those reported in this thesis, have been proposed previously in other countries (Lemieux and Scott 2011; Hagerman and Satterfield 2013; Lonsdale et al. 2017; Whitney and Ban 2019). The findings demonstrate the importance of examining socio-political contexts shaping adaptation preferences, and how policy translation prevent or facilitate new ideas to construct different futures for conservation. This thesis highlights the importance to consider protected areas beyond aspirational conservation objectives that promote narrow targets (e.g. the proportion of land in PA), to focus on how conserving biodiversity can contribute to climate adaptation, to other sectors and society (Angelstam et al. 2021).

One of the Global Biodiversity Framework's (GBF) goals is expanding or creating new protected areas (SCBD 2022). The GBF represents a high-level, international narrative. Defining narrative-based goals that meet people's needs and conservation biodiversity targets remains a gap for the GBF implementation (Phang et al. 2020). The GBF's Theory of Change describes some assumptions, such as that countries are taking transformative actions to reduce threats to biodiversity and sustainable use of nature; however, it does not explain what enabling conditions are needed to implement such measures, nor does it guide how new protected areas will adapt to climate change. Those involved in expanding or creating new protected areas would need to reconcile tensions across different beliefs and assumptions about adapting conservation in a changing climate and co-create positive futures despite inherent uncertainties. The research addresses this challenge by advancing an understanding of how different constructions of the future influence choices in the present, elicit adaptation options, and understand what enables and constrains deliberations when developing narrative-based goals. Understanding future consciousness shaping local-based narratives can facilitate the implementation of reflexive approaches to critically examine current practices (Sharpe et al. 2016) and identify potential contradictions between individual and collective aspirations for conservation and how to adapt to future changes while creating enabling conditions to enable collective agency.

Adaptation is inherently political and not exempt from tensions and contestation. A future-oriented approach must be aware of diverse attitudes toward the future. This thesis documented how conservation managers understand change and adaptation differently. The multidimensional futures consciousness model can complement other biodiversity adaptation frameworks and approaches (Clifford et al. 2021; Lynch et al. 2021; Schuurman et al. 2021; Peterson-St Laurent et al. 2021), providing a basis for a reflexive, future-oriented practice, especially when defining collective desired outcomes. Understanding recent and future climate changes and what that means for setting conservation goals in the future can help managers better prepare to negotiate adaptation decisions with other stakeholders. Critically examining future consequences of management decisions, identifying what needs to change to understand and assess future impacts of climate change, and encouraging greater appreciation that conservation goals aiming to maintain or return to past conditions might not be possible in all places. With imagination and openness, they can create pathways for collective action, building options in the present where people’s values, beliefs, and aspirations for the future are made explicit and considered.

6.5. Limitations

This research has some limitations in scope, methods, and application. This thesis examined narratives of adaptation from only a few protected areas. Even in the same country, at different scales and levels of governance, people perceive things differently and have specific arrangements and management approaches depending on cultural, political, and even educational histories. Although there is no clarity regarding sample size adequacy in qualitative research, drawing from Boddy (2016) and Vasileiou et al. (2016), I consider the sample size adequate for identifying futures consciousness attributes in the adaptation narratives in the case studies. Body (2016) explains that determining the sample size can be contextual and affected by specific scientific positionings, but in-depth qualitative data, as in this thesis, can be relevant and

informative.

However, considering that each protected area and region is different, and those differences will persist and perhaps increase over time, I don't aim to generalise these findings to other contexts. Future research could include further validation, including more data collection using different methods and comparison with other contexts. Further study about how futures consciousness influences action is also relevant. The 5DFC is descriptive, rather than action-oriented, but provides a basis for understanding people's preferences for the future (Ahvenharju et al., 2018).

The data allowed to answer my research questions, I acknowledge that capturing the complexity of how people understand and make decisions to adapt to climate change require complementary approaches. My case studies used a qualitative approach to identify narratives and futures consciousness attributes. Still, other methods can help determine how individuals and institutions internalise and operationalise the future. Future research might be needed to critically evaluate the validity and effectiveness of these findings in different cultural and political settings.

Chapter 7. Conclusions

The aim of this thesis was to understand how individuals and institutions make sense of the concept of adaptation influencing choices for the future of biodiversity conservation. This thesis contributes to climate adaptation studies to better understand the challenges and barriers to implementing adaptation in specific contexts, in this case, within biodiversity conservation. The research provides insights into understanding how individuals and institutions anticipate and prepare for future changes through exploring adaptation narratives in different social-ecological contexts, and through comparing protected areas in Australia, Colombia, and South Africa.

The research has shown how, and which characteristics of futures consciousness are involved in understanding change, and how such understandings influence adaptation narratives in biodiversity conservation. The 5DFC approach was originally developed outside the fields of conservation and climate adaptation, and this research has helped to demonstrate the value of this model to gain deeper insights into the multiple adaptation narratives, interactions, and mismatches. The 5DFC model is a meta-synthesis of concepts relevant to adaptation and biodiversity conservation, as for example resilience, complexity, social and ecological systems, systems thinking, and values. This thesis addresses an important prerequisite for adaptation, which is understanding how people need to change the ways they think and act about change and adaptation. The research reaffirms the relevance of examining how individuals mobilise and express desire for change at broader scales, and the enablers or barriers to linking with collective action.

Engagement in future-oriented practices requires acceptance that people's systems perceptions and expectations for the future will be different, influenced by social and cultural contexts that affect planning and action. The three countries studied have similarities including that they represent multicultural post-colonial societies, have rich and unique biodiversity, well-established protected areas networks, and climate change has been identified as a major driver of ecological change. Despite those similarities, I found a diversity of understandings about what adaptation aims and how to implement it. Those differences are grounded in the different history and contexts of each protected area. Using the 5DFC model I was able to investigate if, and how, futures consciousness attributes can enable transitions toward future-oriented conservation practices.

The diversity of interpretations of adaptation I found in the research was expected and is normal. The challenge lies in being able to critically examine aspirations for the future and deliberate about options to reframe management under conditions of change and uncertainty. Future-oriented conservation needs to consider that people's mental models about a system and their expectations for the future will be different, which can be influenced by social and cultural contexts influencing action and planning. Futures consciousness can encourage practitioners and scientists to critically examine current practices, while identifying potential contradictions between individual and collective aspirations about the future.

If based in day-to-day management, future-oriented strategies can enable reflection and learning about previous successes or failures and identify how to move forward. Also, accepting that change can happen is fundamental to enabling future-oriented practices. In that way, managers can reflect in positive ways that potentially losing

some values in a park should not be a barrier to conserving other benefits, making the case for protected areas to maintain their relevance for society across scales, including local communities, economies, or as part of international commitments.

Areas of future research might include addressing the role of agency beliefs and openness to alternatives in enabling transitions towards accepting change rather than attempting to prevent it. Exploring how change is perceived and addressed in management should consider prevalent values and the cultural and social issues involved in defining adaptation. Further research should explore how different imaginaries about time influence understanding change in values attached to a place and influencing management (Hanusch and Meisch, 2022). Similarly, addressing the role of concern for others in enabling environmental justice in protected areas.

Each protected area has different contexts, and managers will face different challenges and choices. Anticipatory and future-oriented strategies can draw from day-to-day experiential management to enable reflection on what has been done, what has worked or has not worked, and identify what could change or new options to transform current practices. The futures consciousness model provides a structure to understand preferences, expectations, and motivations behind actions, while considering the diverse ontological and epistemological perspectives and relational approaches involved in managing protected areas. This study offers one pathway to understand how individuals and institutions anticipate and prepare for adaptation, to empower them to co-produce positive and desirable futures for conservation.

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Appendix A.

Table 1A. Details on sample for the interviews conducted in Australia, Colombia and South Africa.

Number of interviews and interviewees profiles per country. NSW: New South Wales; ACT: Australian Capital Territory; PNN: Nature National Park; SFF: Flora and Fauna Sanctuary; WWF: World Wide Fund for Nature: SANParks: South African National Parks

Country	Government level	Office/department	No. interviews	Total country
Australia	Federal government - Department of Environment, Water & Agriculture (DAWE)		4	16
	New South Wales government	NSW Adaptation office	2	
		NSW National Parks and Wildlife Services	5	
	Australian Capital Territory government	ACT Conservation Office	2	
		ACT Environment Commissioner Office	1	
		ACT Parks	2	
Colombia	Colombian National Parks Agency - Central level		4	15
	Regional direction	Amazon	1	
	Protected area	PNN Alto Fragua	2	
	Regional direction	Western Andes	1	
	Protected area	SFF Otun Quimbaya	1	
	Regional direction	Caribbean	2	
	Protected area	SFF Los Colorados	2	
	Other	Humboldt Institute	1	
		WWF Colombia	1	
South Africa	National Department of Environment, Forestry and Fisheries (DEFF)		2	20
	South African National Parks - SANParks	Scientific services	12	
		Management	5	
		Regional planning	1	

Table 1B. Themes and guiding questions covered in the semi-structured interviews.

Theme	***Questions***
Introduction	• *Please describe your role*
Conservation goals	• *Can you explain the process for defining the Park's vision and conservation goals?* • *[only in south Africa]: Conservation objectives in SANParks management plans are closely related with defining a "desired state" and collective vision for the national park. Can you explain the process to define the collective vision?* • *To what degree climate change is a challenge in achieving the vision and conservation goals* • *Have you already experienced environmental changes that may be attributed to a changing climate?* • *Can you give an example of any decision made, or steps taken, to address those environmental changes related with climate change?*
Management	• *Can you give me an example of what happen during the implementation of the management plan, how do you follow the conservation goals?* • *How do you identify something is changing from the expected vision and goals?* • *Do you have timelines for this? how often is the management plan and goals updated?* • *In documenting system responses to climate change, do you incorporate other stakeholders' perceptions of change?* • *Do you know an example, from your experience or somewhere else, where an unexpected event helped to change or update policies or management actions, at local or higher levels?* • *Is there something that could have been done differently in response to that event?*
Knowledge systems	• *Can you give me an example of how you identify and use information to assess effects of management in relation with climate change?* • *Is science informing management, or do you think management also can inform science?* • *Is Indigenous and local knowledge used in environmental management or planning?*
Adaptation and future	• *In a context of climate change and biodiversity conservation, how would you define adaptation?* • *What would be the expected outcomes of adaptation?* • *In a context of rapid social and environmental change, are there any innovative ideas that you might like to see to facilitate adaptation and conservation in the future?* • *The way we are designing protected areas defines your territory and authority, limiting where can you act. Thinking about climate change and considering this geographic limitation, what would be your expectations to facilitate biodiversity to adapt to climate change in the future?* • *Talking about connecting high-level objectives and management at local level, do you know an example where the outcomes of management in the park are used to inform or update strategies at higher levels?* • *Is there something you would like to see to help connect local management outcomes with the country or Regional adaptation goals?* • *Considering current management approach and policies, what would be your vision for the park in the future?*

Appendix B

Appendix B1: Recruitment or invitation letter for participants

Appendix B2: Information sheet

Appendix B3: Consent sheet

Australian National University

Introduction and invitation to participate

Narratives of adaptation for future-oriented conservation

My name is Claudia Munera, I am a PhD candidate at the Fenner School of Environment and Society in the Australian National University in Canberra.

As part of my PhD I am looking to undertake a research project in the (Park and country name) in (date). In this research I will study the narratives of the future framing climate adaptation in conservation policies, to understand how the future of biodiversity is conceived in the conservation and adaptation strategies.

The overall aim is to identify entry points and transitions to dynamic management of biodiversity under climate change while connecting practical planning and decision-making challenges. Expected outcomes include outputs relevant to the scientific community and for protected area practitioners, as well as technical guidance for conservation partners to integrate future-oriented conservation approach towards a dynamic management that can cope with transforming landscapes under climate change.

Towards this end, I expect to conduct interviews with a range of people involved in the management of (Country name) protected areas at different management levels. This can include local environmental managers, as well as relevant NGOs and government agencies. The interview is intended to last no more than one hour.

Participation is entirely voluntary and participants can opt out of the research at any time at least until the work is submitted for publication. The insights you provide will be analysed and form the basis of a report, a journal article and a PhD thesis, as well as any recommendations for the protected area system that may emerge.

I am very much looking forward to visiting you in (add date) and hope that you will be able to meet with me and share your experiences and insights. Full information about the research project will be provided at the time of our meeting, but if you have any questions please feel free to contact me.

Claudia Munera

PhD Candidate

Fenner School of Environment and Society

The Australian National University

Claudia.munera@anu.edu.au

Narratives of adaptation for future-oriented conservation

Participant Information Sheet

Researcher: My name is Claudia Munera. I am a PhD candidate at the Fenner School of Environment and Society in the Australian National University in Canberra. This project is part of my PhD research, and covers three countries: South Africa, Australia and Colombia.

Outline of the Project: In this research I am studying the narratives of the future framing climate adaptation in conservation policies, to understand how the future of biodiversity is conceived in the conservation and adaptation strategies. The overall aim is to identify entry points and transitions to dynamic management of biodiversity under climate change while connecting practical planning and decision-making challenges. Expected outcomes include outputs relevant to the scientific community and for protected area practitioners, and technical guidance to integrate Future-oriented conservation approach towards a dynamic management that can cope with transforming landscapes under climate change.
For this, I expect to conduct interviews with people involved in the management of [Country] protected areas at different management levels. This can include local environmental managers, as well as relevant NGOs and government agencies. The case study were selected in consultation with local collaborators, using criteria related to the sites' management goals, and where climate related projects are going on.
Participation is entirely voluntary and participants can opt out of the research at any time at least until the work is submitted for publication. The insights you provide will be analysed and form the basis of a report, a journal article and a PhD thesis, as well as any recommendations for the protected area system that may emerge.

Important points about your participation

- **Voluntary Participation & Withdrawal:**
  Participation in this project is voluntary. You may refuse to take part in the research and decline to answer questions during the interview. You can also withdraw from the research at least until the work is submitted for publication, without providing explanation and without consequences or implications for you. If you decide to withdraw, any data previously collected from you will be destroyed and will not be used in the research.
- **What does participation in the research entail?** If you take part in the research as part of an interview, I will be asking questions to understand better the situation. Data would be collected using audio-recording and writing down notes. The interview will only be recorded if you give your written consent beforehand; these recording will be transcribed for analysis, and after that we may provide a written note from the recordings alongside with a feedback form, before the project is finalised and data published.
- **Location and Duration:** The research takes place in the [Park name]. The fieldwork include interviews and meetings with key stakeholders. If necessary, we may request more information via email.
- **Risks:** We are not going to identify participants by name or role in our reports and publications. In the consent form you will be asked how you prefer to be identified within the research inputs (no attribution or full name/professional position). If you ask to remain anonymous (no attribution) please be aware that other readers may be able to identify positions in the report. If you feel this could be conflictive, please refrain to provide information that might identify yourself or others; alternatively you can opt to withdraw from the interview. We understand and respect different cultural practice and customs, please inform us if you find a question outside the cultural parameters in order to redirect the conversation.

- **Benefits:** The fieldwork will contribute to my PhD project "Narratives of Adaptation for Future Oriented Conservation". It is unlikely that you will personally benefit from participating in this research, but I expect that benefits will flow to the academic community, and the national protected areas system in the two countries.
- **Confidentiality:** All information collected during the research process will remain confidential as far as the law permits. Only the researchers of this project will have access to the data provided by you during the research process. All names of the participants will be kept confidential, but we cannot guarantee whether other readers of final reports may be able to identify an individual by the position stated. During publication, participants will not be referred to by name. Where professional context may reveal identity (e.g. leaders of organisational units), we will ensure permission to use professional affiliation has been granted (written consent stating clearly the participant agree to be quoted and disclose his/her professional affiliation) before specific quotes or other data are reported.
- **Privacy notice:** In collecting your personal information within this research, the ANU must comply with the Privacy Act 1988. The ANU Privacy Policy is available at https://policies.anu.edu.au/ppl/document/ANUP_010007 and it contains information about how a person can:
  - Access or seek correction to their personal information;
  - Complain about a breach of an Australian Privacy Principle by ANU, and how ANU will handle the complaint.
- **Data Storage and handling:** Audio records and notes taken during interviews will be transcribed and stored in computers protected with password with access only to the researcher. Once in Australia data will be stored on computers at the Australian National University, which can only be accessed through ANU protected accounts. Data collected will be stored for at least 5 years following the date of any publication arising from the research and then destroyed after final publications from the project in compliance with ANU policy.

Queries and Concerns:

- **Contact Details for More Information:**
  If you have any questions or concerns related with the research process in the Conservation Futures project, please contact Claudia Munera, email: Claudia.munera@anu.edu.au, phone +61 2 61561865.

The ethical aspects of this research have been approved by the ANU Human Research Ethics Committee (Protocol 2019/226). If you have any concerns or complaints about how this research has been conducted, please contact:

Ethics Manager
The ANU Human Research Ethics Committee
The Australian National University
Telephone: +61 2 6125 3427
Email: Human.Ethics.Officer@anu.edu.au

Australian National University

WRITTEN CONSENT for Participants, to be kept by the researcher

Narratives of adaptation for future oriented conservation

I have read and understood the Information Sheet you have given me about the research project, and I have had any questions and concerns about the project (listed here

_____

_____)

addressed to my satisfaction.

I agree to participate in the project YES ☐ NO ☐

I agree to be identified in the following way within research outputs:

Full name and position YES ☐ NO ☐

No attribution YES ☐ NO ☐

Name (please print): ……..

Signature: ……..

Date: ……..