

**The Proliferation of a Scientific Idea: Diffusion and Implementation
of the Ecosystem Services Concept – an Investigation at the
Regional, National, and Global Scales**

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The Proliferation of a Scientific Idea: Diffusion and Implementation of the Ecosystem Services Concept – an Investigation at the Regional, National, and Global Scales

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Published manuscripts:

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All three publications above relate to Chapter 2 – “the regional scale”. The first publication is based on the whole chapter with minor differences to adapt it to the thesis context. The two other publications describe the results of the public survey mentioned in Section 2.2.2.1. In these papers I took a major part in preparing the questionnaire of the survey as well as distributing the survey and a minor part in analyzing the survey results. I was also in charge of conducting the preliminary interviews and their analysis which provided the background information needed for developing the survey questionnaire. I took a significant part in writing and reviewing the Negev et al., (2019) paper and in reviewing the Raviv et al., 2020 paper.

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Nonacademic Publication:

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This report consists of the results of the ES assessment of the Carmel Biosphere Reserve. The second chapter of this thesis describes the stakeholder integration process that was part of this assessment. In this ES assessment I was the lead author of the cultural services chapter and in charge of conducting the stakeholder integration process including stakeholder analysis, interviews, a public survey, and stakeholder meetings and focus group discussions for communicating and discussing results.

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TABLE OF CONTENTS

| | |
|--------------------------------------------------------------------------------------------------|------------|
| 1. INTRODUCTION..... | 3 |
| 1.1 Global evolution and uptake of the ES concept..... | 3 |
| 1.2 Studying management and policy impacts of knowledge generated through application of ES..... | 5 |
| 1.3 ES as a social construct and implications for implementation..... | 7 |
| 1.4 Goals and research questions..... | 8 |
| 1.5 Organization of the dissertation..... | 9 |
| 1.6 Qualitative Approach | 10 |
| 2. THE REGIONAL SCALE: Stakeholder integration in a regional ES assessment..... | 11 |
| 2.1 Introduction - regional scale | 11 |
| 2.2 Methods - regional scale | 13 |
| 2.3 Results - regional scale..... | 20 |
| 2.4 Discussion and conclusions - regional scale | 26 |
| 3. THE NATIONAL SCALE: The diffusion of the ES concept in Israel..... | 31 |
| 3.1 Introduction – national scale..... | 31 |
| 3.2 Methodology – national scale..... | 36 |
| 3.3 Results – national scale | 39 |
| 3.4 Discussion – national scale..... | 59 |
| 3.6 Conclusions – national scale..... | 67 |
| 4. THE GLOBAL SCALE: Perceptions of global experts on ES..... | 69 |
| 4.1 Introduction - global scale..... | 69 |
| 4.2 Methodology – the global scale analysis | 70 |
| 4.3 Results and Discussion – the global scale analysis | 70 |
| 4.4 Conclusions - global scale..... | 87 |
| 5. OVERALL CONCLUSIONS AND IMPLICATIONS OF RESEARCH | 89 |
| 5.1 The importance of multiscale analysis..... | 90 |
| 5.2 Contributions of the research with respect to Diffusion of Innovations Theory..... | 92 |
| 5.3 Is the ES concept a paradigm shift? | 93 |
| 5.4 Insights on the future use of the concept in Israel and beyond..... | 95 |
| 5.5 A Personal Perspective..... | 97 |
| 6. REFERENCES | 98 |
| 7. APPENDICES | 123 |

LIST OF TABLES

| | |
|---------------------------------------------------------------------------------------------------------------|-----------|
| <i>Table 2-1 Dominant themes of the main challenges affecting ES of the Carmel BR.....</i> | <i>20</i> |
| <i>Table 2-2: Stakeholder perceptions on how ES knowledge can assist them.....</i> | <i>23</i> |
| <i>Table 3-1: Strategic planning and policy reports including ES discourse between 2016-2021.....</i> | <i>55</i> |
| <i>Table 4-1: Scientific disciplines of the international ES experts interviewed.....</i> | <i>71</i> |
| <i>Table 4-2: Important Benchmarks in the proliferation of the ES concept.....</i> | <i>73</i> |
| <i>Table 4-3: The advantages of the ES concept – main themes mentioned by respondents.....</i> | <i>76</i> |
| <i>Table 4-4: The disadvantages of the ES concept – main themes mentioned by respondents.....</i> | <i>79</i> |
| <i>Table 4-5: Stakeholder involvement methods in ES research practiced by respondents.....</i> | <i>85</i> |
| <i>Table 5-1: Synthesis of the criticisms of ES at multiple scales framed in Schröter et al., (2014).....</i> | <i>91</i> |
| <i>Table 5-2: The global and national diffusion of the ES concept according to Kuhn.....</i> | <i>93</i> |

LIST OF FIGURES

| | |
|--------------------------------------------------------------------------------------------------------------------------------|-----------|
| <i>Figure 2-1: A conceptual model of two interacting processes: Stakeholder integration and Socio-ecological research.....</i> | <i>19</i> |
| <i>Figure 3-1: ES mentioned in the websites of major open space management organizations and ministries in Israel.....</i> | <i>39</i> |
| <i>Figure 3-2: Trend in international scientific publications using the term ES by Israeli researchers.....</i> | <i>48</i> |
| <i>Figure 3-3: Trend in number of papers including the term ES in the Hebrew Journal Ecology and Environment.....</i> | <i>49</i> |
| <i>Figure 4-1: Main benchmarks in the development and diffusion of the ES concept according to global respondents.....</i> | <i>74</i> |

LIST OF APPENDICES

| | |
|---------------------------------------------------------------------------------|------------|
| <i>Appendix 2-1 – Regional scale - stakeholder interview questionnaire.....</i> | <i>123</i> |
| <i>Appendix 2-2 – Regional scale - list of stakeholders interviewed.....</i> | <i>125</i> |

| | |
|----------------------------------------------------------------------------------------|------------|
| <i>Appendix 3-1 – National Scale - stakeholder interview questionnaire.....</i> | <i>127</i> |
| <i>Appendix 3-2 – National Scale – list of interviewees and their affiliation.....</i> | <i>128</i> |
| <i>Appendix 4-1 – Global Scale - stakeholder interview questionnaire.....</i> | <i>131</i> |
| <i>Appendix 4-2 – Global Scale – list of interviewees and their affiliation.....</i> | <i>132</i> |

ABSTRACT

The Ecosystem Services (ES) concept has developed as a mission-oriented framework for informing the public and decision-makers that nature provides “services” that contribute to human wellbeing. The Millennium Ecosystem Assessment, in 2005, evoked the ecological crisis and the threat it posed to human wellbeing, and popularized the ES concept in global scientific and policy discourses. However, despite progress in advancing the concept, researchers and practitioners suggest that it has yet to gain meaningful traction in actual management decisions. This research explores the uptake and application of the ES concept in academia, policy, landscape management, and land use planning, with an objective of improving the capacity of the concept to guide planning and management in the future.

We conducted the study at three spatial scales of analysis. At the smallest scale, the integration of stakeholders into an ES assessment project in the Carmel Biosphere Reserve was studied and stakeholder perspectives on how ES knowledge might assist land-use management were explored. Results show that ES, as a boundary object, brought stakeholders and scientists from different fields, institutions, organizations, and religions together to discuss and collaborate on projects. The research underscored the efficacy of the ES concept for mobilizing civil society via catalyzing transdisciplinary research.

At the national scale, the history and application of the ES concept in Israel was explored, with an emphasis on the differing interpretations and uses of the ES concept by environmental organizations, government agencies, and academic institutions. Results revealed that the Israeli ES discourse developed as a microcosm of the global discourse, with the conflicts, challenges, and successes applying the concept, being similar in Israel as they have been elsewhere. On the other hand, we found how geographical-organizational-personal factors influenced how the ES concept was diffused or rejected by societal actors indicating that the ES concept is a social construct with its discourse strongly influenced by local culture.

At the international scale, we interviewed and assessed the perceptions of prominent ES researchers regarding the development and application of ES in the past and in the future. Among respondents, there was general agreement that the ES concept and related ideas are increasingly implemented but there is a lack of on-the-ground examples that exemplify impact. Several disadvantages of the ES concept were emphasized, and yet respondents believed the concept should be further applied to decision making and that the concept will continue to be popular in the future.

Lastly, we analyze the diffusion of the ES concept using the theoretical frameworks of 'diffusion of innovation' studies and Kuhn's theories on scientific paradigm shifts. We conclude with recommendations for the future application of the ES concept. We discuss the importance of continuing to use ES for open space conservation, especially in current times characterized by degradation of ecosystems, loss of open space, and climate change. We emphasize caveats for its use, specifying that the concept should be used selectively, especially for ecosystems modified and/or damaged by humans, and not as an alternative to creating a conservation ethic emphasizing nature's intrinsic values.

GLOSSARY OF ABBREVIATIONS

| | |
|--------------------|---------------------------------------------------------------------|
| BR | Biosphere Reserve |
| CBD | Convention on Biological Diversity |
| ES | Ecosystem Services |
| ESMERALDA | Enhancing Ecosystem Services Mapping for Policy and Decision Making |
| ESP | Ecosystem Services Partnership |
| I-NEA | Israeli National ES Assessment |
| ISF | Israel Science Foundation |
| IPA | Israel Planning Administration |
| IPBES | Intergovernmental Science-Policy Platform on Biodiversity and ES |
| IPCC | Intergovernmental Panel on Climate Change |
| IUCN | International Union for Conservation of Nature |
| KKL | Keren Kayemet LeIsrael – Jewish National Fund - Forest agency |
| LTER | Long Term Ecological Research |
| Maarag or Hamaarag | Israel's National Nature Assessment Program |
| MEA | Millennium Ecosystem Assessment |
| MoAG | Ministry of Agriculture and Rural Development |
| MoEP | Ministry of Environmental Protection |
| NBS | Nature Based Solutions |
| NCP | Nature's Contribution to People |
| NOP | National Outline Plan |
| NPA | Nature and Parks Authority in Israel |
| opeNESS project | Operationalization of Natural Capital and Ecosystem Services |
| OLI | Open Landscape Institute – Machon Deshe |
| PES | Payments for Ecosystem Services |
| SPNI | Society Protection of Nature in Israel |
| UKNEA | United Kingdom National Ecosystem Assessment |

1. INTRODUCTION

Global changes in land use, unsustainable resource exploitation and anthropogenic changes to climate and nutrient cycling are depleting the planet's resources, irreversibly altering the state of the earth system, and weakening the capacity of ecosystems to provide humans with crucial life-sustaining goods and services (Foley et al., 2005; Rockström, 2015). 'Ecosystem services' (ES) are the ecological characteristics, functions, or processes that directly or indirectly contribute to human wellbeing: that is, the benefits that people derive from functioning ecosystems [Costanza et al., 2017; Millennium Ecosystem Assessment (MEA), 2005]. In the first major work popularizing the ES concept, ES were classified into four broad types as proposed by the MEA (2005): provisioning, regulating, cultural, and supporting services¹. This classification has undergone several revisions over the past decade, the more influential of these revisions include The Economics of Ecosystem services and Biodiversity (TEEB, 2010) and the Common International Classification of Ecosystem Services (Haines-Young and Potschin, 2018). The ES concept was developed as a tool for communicating and demonstrating the importance of nature and biodiversity conservation for human wellbeing, both in the sense of advocacy and of education for the public and decision-makers (Braat and de Groot, 2012; Katz-Gerro and Orenstein, 2015). The rationale behind the approach was that, since many of the positive externalities of ecosystems are lost or strongly reduced after land use conversion, better accounting for public goods and services provided by ecosystems is crucial for improving decision making for biodiversity conservation and sustainable ecosystem management (de Groot et al., 2012). Moreover, it was developed to be used as a tool for the integration of diverse sources of knowledge related to sustainability around which multiple stakeholders could discuss and assess the tradeoffs implicit in land- and resource-use decision making (Abson et al., 2014; Schleyer et al., 2017; Maczka et al., 2019).

1.1 Global evolution and uptake of the ES concept

According to Costanza et al., (2017), the first use of the term ES was by Ehrlich and Ehrlich (1981) and more systematically by Ehrlich and Mooney (1983), who wrote about the loss of services to humanity following extinctions of species, thereby tightly linking (at least theoretically, if not empirically) biodiversity to its contributions to human wellbeing. However, similar ideas to 'nature's services to humans' had been mentioned in the academic and non-

¹ **Provisioning services** – ecosystem services that combine with built, human and social capital to produce food, timber, fiber, or other “provisioning” benefits.

Regulating services combine with the other three capitals to produce flood control, storm protection, water regulation, human disease regulation, water purification, air quality maintenance, pollination, pest control, and climate control.

Cultural services combine with built, human, and social capital to produce recreation, aesthetic, scientific, cultural identity, sense of place, or other 'cultural' benefits.

Supporting services describe the basic ecosystem processes such as soil formation, primary productivity, biogeochemistry, nutrient cycling and provisioning of habitat. (Costanza et al., 2017).

academic literature for decades (Costanza et al., 2017), for example in the work of nature conservationists such as Gifford Pinchot's (forest service) philosophy of conservation: that nature should be used wisely as a resource for human welfare (1947) and Aldo Leopold's (1949) understanding that we must learn how to use, and preserve the land 'which we dwell upon', not only for monetary gain but for our very existence as a species. What changed in the second half of the 20th century, according to Foley et al. (2005), is that the ecological crisis and the threat it posed to human wellbeing became increasingly apparent. In 1997, an edited book by Gretchen Daily and an article in *Nature* on the value of the world's ES (Costanza et al., 1997) precipitated a pulse of research, policy, and applications of the ES concept. In the policy realm, the idea of "payment for ecosystem services" (PES), linking ES to their economic value, became a prominent framework for directing management decisions. A PES program was launched in Costa Rica in response to increased global attention to biodiversity and forest loss (Chaudhary et al., 2015).

In 2005, the Millennium Ecosystem Assessment was published, concluding that two thirds of the world's ecosystem goods and services were either seriously degraded or managed unsustainably (MEA, 2005). These findings triggered a growing awareness to the global ecological crisis of the 21st century, whose impacts interact with, and are further compounded, by anthropogenic climate change and biodiversity loss (Mooney et al., 2009; de Groot et al., 2012; Portner et al., 2021). This crisis, evoked by the MEA (2005) and further elaborated in multiple publications (Rockström et al., 2009; TEEB, 2008), prepared the way for the new conceptual framework of ES to be pushed forward by scientists and policy makers. As a result, the academic literature on ES has grown exponentially (Fisher et al., 2009; Costanza et al., 2017; Schröter et al., 2019), proliferating into governmental policy and planning and into the nonprofit, private and financial sectors from the local to the international scale (Scarlett and Boyd, 2015; Albert et al., 2016; Portman and Elhanan, 2016). Since the MEA, the omnipresence of the ES concept has, as Potschin and Haines-Young (2011) suggest, begun to take on some characteristics of a classic Kuhnian paradigm (as will be discussed thoroughly in Chapter 3 and in Section 5.3).

As a part of this process, in 2008, the Ecosystem Services Partnership (ESP) was established as a worldwide network to enhance the science and practical application of ES (ESP website, 2021). Around the same time, the Economics of Ecosystems and Biodiversity (TEEB) was initiated to incorporate an ES approach into policy making (Martín-Lopez et al., 2011) and to design and implement market-based instruments to create economic incentives for conservation (de Groot et al., 2017). The adoption of the Aichi Biodiversity Targets, for the 2011-2020 period at the CBD convention in October 2010, in Nagoya, Aichi Prefecture, Japan, and then the establishment of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) in 2012 strengthened the science-policy interface on biodiversity and ES (IPBES website, 2021). The European efforts to achieve Aichi-targets, coordinated by the Mapping and Assessment of Ecosystems and their Services (MAES) project contributed to the awareness of ES among the public and to the implementation of the ES concept in decision-making (de Groot et al., 2017). More recently, national ES assessments have been conducted in several countries including the United Kingdom (Potschin et al., 2016a) and Israel (Lotan et al., 2019;2021). The National

Ecosystem Assessment (NEA) initiative, hosted by the UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC), has supported additional 14 countries in conducting national ecosystem assessments (NEA initiative website, June 2022), which contributed to the implementation of the concept in these countries².

However, studies show that although various publications demonstrate the use of ES assessments in actual decision-making processes (Braat, 2018), much work remains to advance the framework from a conceptual to an operational framework for policy, planning and management (Laurans and Mermet, 2014; Mascarenhas et al., 2015; Schleyer et al., 2015; Beery et al., 2016; Potschin et al., 2016a; Barton, et al., 2018; Pérez-Soba et al., 2018; Loc et al., 2020; Kieslich and Salles, 2021). Successful implementation is still in its early stages and information generated from ES assessments has yet to fundamentally change decision-making (Guerry et al., 2015; Martinez-harms et al., 2015; Rozas-Vasquez et al., 2019). For example, it was found that the term ES is not often explicitly mentioned in policy objectives (Schleyer et al., 2015) and in a review of 144 peer-reviewed publications of ecosystem assessment projects, Martinez-Harms et al., (2015) show that only 3% indicate that management decisions were actually influenced by ES research. The promise of land-use planning to implement ES knowledge is mostly unfulfilled. In a recent Ecosystem Services Partnership (ESP) World Conference in Hanover, Germany, in October 2019 (aptly named: “10 years advancing ecosystem services science, policy and practice for a sustainable future”), out of nearly 50 sessions, about 20 dealt with the question of how to enhance the use of ES in actual decision-making, governance and policy (ESP website, 2019). Examining how ES concepts are currently applied can provide practical and theoretical insights for supporting their further integration (Thompson et al., 2019b).

1.2 Studying management and policy impacts of knowledge generated through application of the ES concept

Linking scientific research to environmental policies and assessing their impact have been perpetual challenges for the policy research community. These have been found to be complicated by various factors such as complex feedbacks, potentially long lags between knowledge accumulation and policymaking, and lack of funding for assessing it (Guerry et al., 2015; Robinne et al., 2019). Despite these complications, there is a burgeoning literature reviewing and analyzing the impact of ES knowledge on decision-making and policy (E.g., Hauck et al., 2013; Bennett et al., 2015; Guerry et al., 2015; Martinez-Harms et al., 2015; Rosenthal et al., 2015; Ruckelshaus et al., 2015; Posner et al., 2016; Dick et al., 2018; Jax et al., 2018; Saarikoski et al., 2018; Schubert et al., 2018; and more recently: Geneletti et al., 2020; Hagemann et al., 2020; Mandle et al., 2021; Holzer et al., 2022). Analysis of these papers shows that the following three main factors can be considered as most important for a successful ES assessment process: (1) **Clearly articulated objectives**: The ES assessment is designed with

² In Section 4.3.3, we discuss the global evolution of the concept through the perceptions of international ES experts on the main benchmarks in the historical development of the concept.

stakeholders to address a clearly defined planning process, policy, or specific decision/question. (2) **Iterative, participatory science-policy process:** The ES assessment facilitates close and recurring interaction and coordination between scientists, stakeholders, and decision-makers. (3) **Communication of knowledge:** The ES assessment develops a communication plan, and conveys the knowledge to various stakeholder groups, in a clear transparent way. All three factors are directly related to strengthening the integration of stakeholders in all parts of the ES research. For example, in the concluding publications of the openESS project (Operationalization of Natural Capital and ES), Dick et al., (2018) and Saarikoski et al., (2018) assert that the key message emerging from the 27 openESS case studies is that ES knowledge is most effective, and operational, when decision-makers, practitioners and key stakeholders have been closely involved in the assessment process to ensure that they find the information relevant and reliable, and are ready to act upon it.

Nonetheless, there are still large knowledge gaps regarding stakeholder attitudes and perceptions of ES as a concept (Hauck et al., 2013; Cord et al., 2017; Jax et al., 2018) and on the ways in which the information gathered in ES assessments could be used to inform decisions (Martinez-Harms et al., 2015), although some research has emerged to address these gaps (e.g., Hauck et al., 2013; Waylen and Young, 2014; Dick et al., 2018, and Jax et al., 2018) as we discuss in Section 2.1.1. Finally, there continues to be a demand for knowledge regarding how to best implement stakeholder participation (Spangenberg et al., 2015), and a need to make ES assessments and their outcomes more accessible and communicated to stakeholders (Koschke et al., 2014). This is emphasized by the fact that working with stakeholders produces challenges different from those traditionally faced by academics (Jacobs et al., 2005) and confronts traditional modes of conducting scientific research (Reed et al., 2014; Avriel-Avni and Dick, 2019).

We began this PhD research with those ideas in mind and conducted and investigated a stakeholder integration process in a regional ES assessment project (for the Carmel Biosphere Reserve –see Chapter 2). From there we found the need to look further and examine how various practitioners of the ES concept use and adopt it into their organizations and institutions at the national level. We found that there is a dearth of knowledge regarding pathways towards ES adoption by specific *landscape* management and planning bodies, as is also reflected in research in Middle Eastern and developing nations (Pandeya et al., 2016). In addition, only few studies have analyzed the advancement, evolution, and adoption of the ES concept (a global discourse) into national policies, organizations, and governmental institutions (Chaudhary and McGregor, 2018; Kerr et al., 2021). Although the introduction of policies integrating the ES concept at the European and global scales has been documented and researched (Rozas-Vasquez et al., 2019), little is known about the implementation of the concept and barriers to its adoption on the national level. In addition, the ES concept in its entirety, is continuously being criticized and a source of debate (Schröter et al., 2014; Comberti et al., 2015; Bekessy et al., 2018; Muradian and Gómez-Baggethun, 2021), therefore assessing these critiques in a multiscale analysis, including perceptions of ES experts from the global scale can be used to advance our knowledge on how to better adopt the concept globally.

1.3 ES as a social construct and implications for implementation of the concept among land use management organizations and stakeholders

ES is often practiced as if it is an objective framework to assess a landscape. However, we argue in this research, that ES is a socially, organizationally constructed idea more than it is a concrete phenomenon. This has also been shown to be the case regarding the concept of biodiversity by Takacs (1996). Ernstson (2013) asserts in his work on '*the social production of ecosystem services*', social practice moderates the generation of benefits from biophysical processes. Since ES are socially constructed, the importance of multiple stakeholder-driven-assessments and of understanding how land use organizations and national and global government institutions influence the use and translation of the ES concept, are of paramount importance (Agbenyega et al., 2009; Martín-López et al., 2012; Albert et al., 2016; Orenstein et al., 2012).

As a social construct, the ways of using the ES concept are defined differently from group to group and person to person, as shown in the first wave of stakeholder-focused ES research (Sagie et al., 2013; Hein et al., 2016; Turner et al., 2016; Plan Bleu 2016; Cord et al., 2017; Orenstein et al., 2015). For example, to global stakeholders, forests may be valued for their carbon sequestration service for climate regulation, for honey farmers forests may be valued for their honeybee forage, and for residents and tourists - for providing shade for recreation in the forest. The management implications for each of those may be conflictual, as when different stakeholder groups derive cultural benefits from alternative forms of the same ecosystem (Orenstein et al., 2015). This aspect in our understanding of the cultural construction of ES emphasizes the potentially conflictual nature of managing ES (Fisher et al., 2009; Sagoff et al., 2016; Potschin et al., 2016a) considering that different land managers and planners may choose to increase some services in place of others depending on their private or agency's interests, agendas, cultures, ideologies, etc. (Orenstein et al., 2012; Dick et al., 2017). These types of conflicts/differences accentuate the need for enhanced understanding and consideration of institutional and organizational differences and their impact on ES adoption on different scales. This need has been identified as a critical research priority (Braat and de Groot, 2012; Bennett et al., 2015).

A more comprehensive evaluation of the social–ecological context of ES research is needed where the ES assessment framework is applied to land use policy, planning and management issues. This can be achieved by applying an ES assessment process that adheres to the social ecological considerations noted. Social research and perceptions research is mostly expressed in the ES concept through the concept of cultural ES. However, through social research techniques, ES in all their diversity are effectively being characterized as objects of collective social values, and therein, as services of cultural, institutional, organizational, national and global concern (Fish et al., 2016; Chan et al., 2012). Therefore, in this research we apply and examine the use of social research methods to make the link to scientists, stakeholders, and decision makers regarding ES in multiple scales of analysis – regional, national, and global.

The ways in which the ES concept has been adopted not only by specific scientists and stakeholders but also by land use organizations has led us to examine the factors leading to its adoption through the diffusion of innovation theory and to examine the implementation of the ES concept as a Kuhnian paradigm shift. We combine the insights of both these theoretical frameworks, that have so far been explored separately (but see Herfeld and Doehne, 2019). We explain and elaborate on these two theories in the introduction of Chapter 3. We conclude the research by looking at the ES concept from the point of view of global ES professionals – that is, those academic researchers who both study and apply the ES concept.

1.4 Goals and research questions

As we have seen, the ES concept has developed a great deal in the last two decades and gained popularity in the academic arena and among land use planners and natural resource managers and has fundamentally changed the global discourse on nature conservation and landscape management. However, the framework has yet to gain a meaningful traction in policy arenas and in actual management decisions. Recent studies have begun to focus on understanding how the concept emerged, evolved, and spread in its various forms and interpretations, and to report on practitioners' perspectives on the concept. However, there are large knowledge gaps regarding pathways towards its adoption by landscape management and planning bodies and there are few studies (if any) reviewing the evolution and adoption of the ES concept at the regional and national level (rather than the international level). As shown above, according to many scholars and critics of the framework, a more comprehensive integration of the social aspect of ES research and a closer engagement between scientists, stakeholders and decision makers in an iterative ES science-policy process are needed in order to increase the relevance of ES research on decision making. I suggest that it is an opportune time to explore user experiences in applying the framework, at the regional, national, and international scales, to research whether the framework is being implemented and useful for natural resource and land use management for enhancing human wellbeing, and to assess how it can better be used in the future. There have been several recent efforts to apply the ES concept in Israel (including a national and a regional ES assessment), providing an opportunity to address these questions through the Israeli experience.

The overarching goals of this research were: (1) to simultaneously integrate, and study the integration of, stakeholders and local communities in the ES assessment of the Carmel Biosphere Reserve and to investigate their diverse perceptions of nature management challenges and ES knowledge use; (2) to examine the arrival and diffusion of the ES conceptual framework into the Israeli environmental management discourse, and to assess its contemporary and potential future impact on spatial planning and management according to environmental scientists/managers/practitioners/planners central to the application of the ES concept in Israel and associated documentation, and (3) and to investigate the perceptions of global ES practitioners about the ES concept's advantages and disadvantages, implementation of the concept and future directions of the concept.

I ask the following research questions:

1. **How does stakeholder integration in management of complex socio-ecological systems interact with the use of the ES concept?** How can the ES concept be used to identify stakeholder conflicts and contribute to decision making? How can ES knowledge, stemming from ES assessments, be used by stakeholders to help them deal with the challenges they face in their daily lives?
2. **How did the ES concept evolve in Israel?** In what ways did land-use management organizations and research bodies use and integrate the concept into their work, into policy documents and into decision-making processes? What does the Israeli story tell us about adoption of scientific innovations in general and about factors that impact adoption of the ES concept that can be used in other countries and contexts?
3. **How do global ES experts perceive the implementation and future use of the ES concept?** What are the challenges, disadvantages, and limitations that global ES practitioners attribute to the ES concept? What were the factors that led them to adopt the concept? What do they think the future of the concept and its application will be? Will the ES concept continue to influence conservation and land-use planning and management in the future?

1.5 Organization of the dissertation:

In the next chapter (Chapter 2), we explore the use of the ES concept on the local/project-specific scale by studying stakeholder engagement and stakeholder perceptions of ES knowledge use. In this way, we elucidate characteristics of ES-related conflicts that arise from different management approaches and differing demands on ES. This research was conducted simultaneously and in conjunction with participation in an existing ES assessment project in the Mount Carmel Biosphere Reserve, where we focused on analyzing stakeholder needs (via a stakeholder analysis³) and integrating them into the assessment process. In Chapter 3, we chose to broaden our perspective about the ES concept by looking at the larger picture of diffusion of scientific concepts, diffusion of innovation factors, scientific paradigm shifts and conceptual biographies. With these theoretical backgrounds, we explored profoundly how the application of the ES concept is affected by diverse social, cultural, and organizational contexts by studying the evolution and application of the ES concept in Israel. Examining how the scientific concept of ES was implemented by environmental organizations and management agencies and ministries in Israel, we analyzed perceptions of researchers and practitioners about the ES concept and its utility. Next, in Chapter 4, knowing that what happened in Israel didn't happen in a vacuum, but in close ties with the academic world abroad, we completed the picture by reaching out to global

³A way of generating information on the “relevant actors”. useful for representing diverse interests and agendas and the conflicts of interest and trade-offs that may threaten the success of a project (Brugha and Varvasovsky, 2000; Reed et al., 2008; Prell et al., 2009). Stakeholder analysis asks who these interested parties are, who has the power to influence what happens, how these parties interact, and based on this information, how they might be able to work more effectively together (Reed et al., 2009).

ES practitioners and studied their perceptions of the ES concept, their critiques on the framework, implementation experiences and thoughts on the future of the ES concept. Finally in Chapter 5 we conclude the research and provide insights on the future use of the concept.

1.6 Qualitative Approach

To address these questions, we have chosen to employ a qualitative research approach. A qualitative approach is used when the goal of the research problem is to examine, understand, and describe a social phenomenon. More particularly, qualitative research is used to describe the "human" side of an issue or process, by focusing on the "perceptions" of the participants (Shkedy, 2003; Creswell, 2012), as we have done here. The research is embedded in the 'grounded theory approach' and the 'case study approach' which are two of five types of qualitative research approaches to inquiry (Creswell, 2012). Grounded theory implies that the procedures of the research are characterized as inductive, emerging from the ground up, and shaped by the researcher's experience in collecting and analyzing the data. The main idea is that the development of the theory (a general explanation of a process, action, or interaction) does not come "off the shelf," but rather is generated or "grounded" in data from participants who have experienced the process (Strauss and Corbin, 1998). The case study research approach involves the study of an issue or process explored using one or more cases within a bounded system or context as a specific illustration (Flyvbjerg, 2006; Creswell, 2012).

2. THE REGIONAL SCALE: Benefits of Stakeholder integration in an ecosystem services assessment of Mount Carmel Biosphere Reserve

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2.1 Introduction - regional scale

The first section of the original introduction of this paper has been omitted as it repeats much of what had been said in the introduction of the dissertation (Section 1.2). Therefore, we summarized the first parts of the introduction in the first paragraph (and refer the reader to Section 1.2 above) and then continue with Section 2.1.1 “the crucial role of stakeholders”.

As we have seen, the ES concept has developed a great deal in the last two decades and proliferated into the academic and landscape management arenas; however, operationalization of the concept in real world decision making is still missing. Research about linking scientific research to policy shows that strengthening the integration of stakeholders in all parts of the ES research will enhance implementation of the concept; however, as we see in the following, stakeholder integration in ES research is yet to be implemented regularly and needs to be enhanced and studied to be further implemented.

2.1.1. The crucial role of stakeholder integration in the ES assessment process

The critical role of stakeholders within the ES assessment process necessitates a clearly articulated definition of stakeholders. We adopted our definition from Reed’s (2008) review of stakeholder participation for environmental management (2008) and the study by Röckmann et al. (2017) on stakeholder participation in marine management. ‘Stakeholders’ are defined as those who are affected by, or can affect, or have any kind of interest in, the question/problem/decision under consideration/investigation. Stakeholder ‘participation’ (for instance in planning or ES assessment) is considered the “cornerstone of democracy” (Arnstein, 1969), and it is defined as a process where individuals are involved or choose to take an active role in decisions or research that affect them.

Engaging with all relevant actors in a participatory process has been suggested to be essential for three main reasons: (1) producing solutions that address environmental challenges of land-use management (Danielsen et al., 2010; Orenstein and Groner, 2014; Sagie and Ramon, 2015; Reed et al., 2018), (2) for carrying out environmental policy and management plans successfully (Daily, 2016) with greater levels of legitimacy, credibility, and salience (Cash et al., 2003; Menzel and Teng, 2010; Langemeyer et al., 2018; Bremer, et al., 2020), and (3) for enhancing impact of study results and the knowledge gained, on decision making (Koschke et al., 2014; Drakou et al., 2017; Dick et al., 2018).

Due to the nature of ES as a social construct, stakeholder integration has been considered a central component of ES assessments. Indeed, it has been included in the ES toolkits and guidelines such as TESSA, TEEB, ESMERALDA MAES Explorer, IPBES, ESP Guidelines for Integrated Ecosystem Services Assessmentⁱ and others. Yet, while stakeholder integration and its advantages are emphasized throughout the literature, integration has been, according to several studies, lacking in ES research. Cord et al. (2017), in their paper aiming to guide researchers towards knowledge gaps in the field of ES, found that the inclusion of different stakeholder groups had been often neglected. Martinez-Harms et al., (2015) in their review of 144 peer-reviewed ES publications between 2003 and 2013 showed that only 13% of the ES studies used stakeholder integration processes. Haase et al. (2014), in their analysis of 217 papers on urban ES found that only 11% involved stakeholders and only 3% reported communicating the results to stakeholders. Fagerholm et al., (2016) in a review on ES assessments of European agroforestry systems, also emphasized the need for greater stakeholder participation.

Recent studies have invested increasing efforts to involve stakeholders in ES studies and to report on their perspectives. These studies have increased focus on the challenges and benefits of their integration (e.g., Arias-Arévalo et al., 2017; Morf et al., 2019). There is also a growing amount of literature on perceptions of different groups of stakeholders of ES supply and demand (e.g., Sagie et al., 2013; García-Nieto, 2015; Orenstein et al., 2015; Garrido et al., 2017; Zoderer et al., 2019; Rodríguez-Morales et al., 2020; Zhang et al., 2020) and, in particular, stakeholder opinions on payments for ES (e.g., Silva et al., 2016; Thompson and Friess, 2019; Bálíková et al., 2020). Nonetheless, as we mentioned previously in the introduction, there is still a lack of knowledge regarding how to best implement stakeholder participation and how to make the outcomes of ES research useful (Koschke et al., 2014; Martinez-Harms et al., 2015; Spangenberg et al., 2015; Cord et al., 2017; Jax et al., 2018).

2.1.2. Importance of stakeholder integration in biosphere reserves

As of 2021, there were 727 biosphere reserves (BRs) in 129 countries, including 21 transboundary sites (UNESCO MAB website, 2021). When the concept was originally conceived, BRs focused primarily on nature conservation, research, monitoring, and education. Since 1995, when the Seville Strategy was adopted (UNESCO, 1996), there has been increasing recognition that context-specific relationships between biodiversity conservation and socio-economic growth should be viewed as the essence of BR management (Ishwaran et al., 2008; Stoll-Kleemann et al., 2010). BRs are currently promoted as models for community-based sustainable use of natural resources, which nonetheless face challenges in meeting their objectives (Stoll-Kleemann, et al., 2010; Negev et al., 2019). Such challenges include balancing between the needs of stakeholders with diverse and conflicting perceptions regarding management of natural resources (Stoll-Kleemann and Welp, 2008; Coetzer et al., 2014) and political imbalances and discrimination in management of, and objective-setting for, the reserves (Eid and Haller., 2018). In addition, BRs are challenged by lack of suitable governance and coordination mechanisms for moderating and integrating stakeholder interests (Ishwaran et al., 2008). Stakeholder integration and cooperation is promoted as a key element in BR management (UNESCO, 1984) which is posited to increase effectiveness of management and reduce

conservation/development and natural resource-related conflicts between local communities and nature conservation authorities (Stoll-Kleemann et al. 2010; Habibah et al., 2011; De Pourcq et al., 2017; Van Cuong et al. 2018; Golan et al., 2020). It has also been found that higher levels of community participation in management decisions correlated with higher levels of local community compliance with conservation policies (Andrade and Rhodes, 2012). However, such participation has not often been conducted (Ishwaran et al., 2008; Barnaud, 2017).

2.1.3. Objectives of the regional scale analysis

With a desire to bridge these theoretical demands, the objectives of our study were (a) to conduct stakeholder integration in an ES assessment project in a biosphere reserve (BR), (b) to see how, according to stakeholders, ES knowledge can support them in addressing their landscape management challenges, and (c) observe how the ES assessment process influences the stakeholders regarding their activities within the context of the BR. As the success of BRs are tightly connected to stakeholder and community integration (Stoll-Kleemann, et al., 2010; Van Cuong et al., 2018; Golan et al., 2020), the ES assessment of Mount Carmel Biosphere Reserve (Carmel BR) was chosen as a case study to address these objectives. The outcome of the ES assessment itself is documented in Hebrew in the Ministry of Environmental Protection (MoEP) website (Izhaki et al., 2019).

2.2 Methods - regional scale

2.2.1. Mount Carmel Biosphere Reserve case study

The Carmel BR is one of Israel's most valuable natural Mediterranean areas and includes one of the most-visited Israeli national parks and equally popular nature reserves. It is characterized by both demographic and ecological diversity. The multi-ethnic region is home to 74,500 inhabitants (including 42.2% Jews, 35.1% Druze, 20.2% Muslims and 2.5% Christians (Negev et al., 2019), living amidst planted pine forests, natural woodland, coastline, and agriculture. It is managed by diverse agencies, including the Israel Nature and Parks Authority (NPA), the Jewish National Fund - Keren Kayemeth LeIsrael - Israel's quasi-official forest agency (KKL), regional and local councils and the Israel Defense Force, the latter managing military training areas. In 1996, an area of 266 square km, which includes Mount Carmel and the Carmel coast, was recognized by UNESCO as a BR, to be led by the NPA, to promote conservation of natural values and biodiversity, alongside sustainable development for residents and future generations. Since then, the BR has been considered ineffective in establishing a framework for promoting sustainable development, in part due to its failure to involve local communities in the planning and management of the area (Ken Ly-Karmi et al., 2012; Eid and Haller, 2018; Negev et al., 2019). The history of conflictual relationships among the various ethnic groups living in the region has limited the potential for stakeholder involvement in the Carmel BR, and the insufficient management of the BR, narrowly focused on nature conservation, has further exacerbated those conflictual relationships (Shmila-Vadai et al., 2015; Eid and Haller, 2018). This top-down process with no initiative from, and little engagement with, local agencies and stakeholders is common in the literature on conservation conflicts associated with the

establishment of protected areas and BRs globally (Andrade and Rhodes, 2012; De Pourcq et al., 2017; Van Cuong et al., 2018; Rechciński et al., 2019). In recent years, although national authorities point to multiple educational and outreach projects (MoEP, 2018), local communities, particularly ethnic Druze communities, have felt (and continue to feel) systematically excluded from BR management (Ken Ly-Karmi et al., 2012; Eid and Haller, 2018). In the current study, it was found that nearly 70% percent of the residents to the Carmel BR did not know that the region was recognized as a BR (Negev et al., 2019).

The exclusion of Druze communities from the establishment and management of the Carmel BR is, from the perspective of these residents, another chapter in a land use conflict that began long before the establishment of the BR. After 1948, the nascent Israeli government expropriated large tracts of land owned by the two Arab-Druze village communities of Mount Carmel, Isfiya and Daliyat Al-Carmel (Yiftachel and Segal, 1998). In 1971, the Mount Carmel National Park was established, in part, on private land expropriated from local Druze citizens (Eid and Haller, 2018). Additional privately-owned land was also placed within the boundaries of nature reserves (Naveh and Carmel, 2004). With the establishment of the BR, history for the Druze repeated itself, when large areas of private land were again included under the “protected area” status, thus precluding any other land uses by the landowners. As of 2018, the Druze residents of Mount Carmel owned only about 27% of their original forested and agricultural land (Eid and Haller, 2018) and much of their remaining private land is located in protected areas. The BR and National Park form a ring around the Druze villages preventing the physical expansion of these communities to accommodate their growing population (Negev et al., 2019). Land expropriation, limiting the ability to develop their private lands, and the general top-down approach to managing the BR all underlie the conflictual relationship between the Druze community and the NPA and other national land management organizations. As explained by a Druze resident in a focus group discussion within the context of the current research: *“This conflictual relationship perpetuates the desire of the residents to break these boundaries and continue to build houses in an illegal, unorganized way in the protected areas of the Carmel, where nature is the loser in the end”*. In addition, the reserve has, and continues to, suffer from recurring fires, which in recent decades are considered the most influential factor affecting the state of Carmel's landscape (Izhaki et al., 2019).

Both phenomena, ethnic conflict and wildfires, pose significant challenges to the biosphere's sustainability objectives. These challenges to the sustainability of the biosphere, together with two additional reasons (that we describe hereafter), caused the Israel MoEP to commission a multi-disciplinary ES assessment including a stakeholder integration process (from 2016-2019). The additional reason was that in 2014, UNESCO's periodic review of the Carmel BR resulted in a warning that official recognition of the Carmel as a BR would be rescinded unless a stakeholder integration process was implemented (Negev et al., 2019). And the final reason was that the 2008 Madrid Action Plan, aimed at elevating the contribution of BRs as internationally designated sites for promoting sustainable development, explicitly called for the implementation of the ES concept as a central objective of BRs (UNESCO, 2008). This paper focuses on the stakeholder integration process that was conducted as part of this ES assessment.

2.2.2. Methods: Transdisciplinary stakeholder integration process ('researching while doing')

We utilized a transdisciplinary approach for this research. Practically, this means that we included local actors and stakeholders of the BR throughout the ES assessment, from the construction of the assessment framework and accompanying research to the presentation and revision of results (Lang et al., 2012; Holzer et al., 2018;2019). Through qualitative, participatory methods, we simultaneously extracted necessary information regarding ES (Izhaki et al., 2019) while studying the process of stakeholder integration and learning about how stakeholders perceive the application of the ES concept and the usefulness of ES knowledge for sustainable management of the BR. These two parallel processes are presented in Figure 2-1.

Our first step was to **identify key stakeholders**. This was done via a stakeholder analysis and snowballing (Spangenberg et al., 2015). Stakeholder analysis is a way of generating information on the “relevant actors” to understand their behavior, interests, agendas, and influence on decision-making processes (Brugha and Varvasovsky, 2000), to avoid conflicts, and to empower marginal stakeholders (Reed, 2008; Prell et al., 2009; Bennett et al., 2015). We found this to be important especially in the Carmel BR, which, as noted, is characterized by conflictual relations and power imbalances (Eid and Haller, 2018). Representatives from all the main sectors and “organized” groups related to the relevant ES and land-use management (Hauck et al., 2013) were included. The selected stakeholders represented both high and low influence stakeholders as defined by Grimble and Wellard, (1997) and later developed by Garcia-Nieto et al., (2015) and Cohen-Shaham et al., (2015) for ES research. Both groups of stakeholders are defined as having a high degree of interest in the ES of the Carmel BR and their work is often directly related to the ES of the Carmel. High influence stakeholders are defined as those who have direct influence on the environmental decision-making processes, (e.g., governmental ministries, authorities and municipalities, protected areas/national park/forest managers and planners). Low influence stakeholders are defined as those who have only indirect influence on environmental management (e.g., environmental and tourism NGOs, ecologists, environmental educators and tour-guides of various organizations and authorities, academic experts, an army base commander, and resident activists from local municipalities (Druze, Jewish and Muslim) (see Appendix 2-2).

The second step was the actual integration of the stakeholders in the research (Figure 2-1). This was achieved via three pathways described in the introduction to be considered as most important for a successful ES assessment process: (1) in the beginning, ‘**designing assessment with stakeholders**’, was done by conducting interviews, (2) during the research – ‘**an iterative science-policy process**’ was done by conducting a public survey and target group discussions. (3) At the conclusion of the assessment – ‘**communication of results**’ was conducted in various stakeholder workshops and forums. Each of these engagement activities are described below.

2.2.1.1 Stakeholder engagement activities and data collection (interviews, focus group discussions and workshops):

Semi-structured interviews were carried out in the beginning of the ES assessment process with key stakeholders in May-July 2016 (n = 18). The interviews included questions regarding the respondents' work/knowledge and experience in the Carmel BR, an explanation about the ES concept, and perceptions regarding 23 ES and their level of importance [analogous to the “set the scene” stage, as described by Lopes and Videira (2016) or “selection of relevant ES to assess” as noted by Haase et al. (2014)], existing and potential threats to these services (McNally et al., 2016), possible changes for improving the state of ES supply, opinions regarding various environmental issues, and insights regarding the impact of their organization/ministry on the Carmel ecosystems. Aside from our desire to gather large amounts of information about ES, including personal preferences (Sitas et al., 2014), we used interviews for co-production of ES knowledge to guide the assessment process and to establish personal rapport between the scientists and the stakeholders (See stakeholder interview questionnaire in Appendix 2-1). Each stakeholder that was interviewed was asked to recommend other stakeholders that should be part of the process as well (i.e., snowballing).

A public survey questionnaire was circulated by field workers directly to 703 residents and visitors of the BR. The results of the survey are reported elsewhere (in two publications in the *Ecosystem Services Journal*: Negev, et al., 2019; Raviv, et al., 2020 and in the ES assessment report published on MoEP's website - Izhaki et al., 2019 - we took part in all three publications). We mention the survey here, as it served as an additional activity which contributed to engaging the public and raising its awareness to the ES assessment and the existence of the BR.

Focus group discussions were conducted with specific stakeholder groups according to different professional/knowledge/interest themes to elicit feedback and expand the assessment teams' understanding regarding specific issues and ES (O'Neill, 2001), especially issues that may have been unknown or underemphasized by the researchers. These discussions also contributed to the iterative active engagement with stakeholders and to the validation of findings. The stakeholders were convened, interim findings were presented, and stakeholder commentary was collected. Four focus group discussions were convened on the following topics (with the following participants in addition to our research team): (1) “tourism and recreation services” (three tourism researchers preparing a master plan for tourism in the Carmel and a tourism NGO manager); (2) “environmental education” (BR educational program coordinator from the NPA and four local teachers, Jewish, Druze and Muslim); (3) “fire management scenarios and their impact on ES” (five fire experts from Haifa University, KKL, NPA, and the Agricultural Research Organization; and (4) “local plant use” (a local Druze plant expert, ecologist from the NPA, and plant taxonomist from the SPNI). Two additional meetings were convened with representatives from the MoEP and the NPA, who served as the steering committee of the research.

Participatory stakeholder workshops and forums were conducted to communicate the results of the ES assessment. We interpret the responsibility of the scientist in socio-ecological research

to include presentation of results for validation and discussion as an integral part of the stakeholder engagement process (Spangenberg et al. 2015; Holzer et al., 2019). In addition, our stakeholder workshops were designed to facilitate group interactions, enhance dialogue, gather diverse stakeholders' perspectives, and to integrate discussion points into assessment conclusions (Maarleveld and Dangbégnon, 1999; Reed, 2008; Eizenberg et al., 2018; Kamberelis et al., 2018). Altogether, there were eight participatory workshops where we communicated, discussed, and evaluated the results.

The first workshop, organized by the ES assessment research group, was conducted at the conclusion of the assessment, in January 2019. Over fifty stakeholders were invited to the workshop from diverse backgrounds, including representatives of all the main sectors related to land-use management in the Carmel BR, chosen through the stakeholder analysis (described above) with additional stakeholders added to the list during the ES assessment process. Some of these were key stakeholders in previous engagement activities (interviews, survey, discussion groups) and others were invited according to recommendations by other participants. In addition to the invited stakeholders, invitees were encouraged to publicize the workshop and invite interested colleagues from their offices/organizations/communities. The workshop was, in fact, open to anyone interested in the subject. Thirty stakeholders attended the originally scheduled workshop. However, due to expressions of interest in the assessment results, they were later presented in additional venues (described below), which made it possible for stakeholders who didn't attend the first workshop to be involved. The venue selected for the original workshop was Haifa University, chosen as a potentially neutral meeting place, which is also conveniently located next to the Carmel BR. The workshop began with a presentation of the assessment results presented by the interdisciplinary research team. This presentation included: an explanation about the ES concept and economic assessment of ES, key findings about the region's biodiversity and about provisioning, regulating and cultural services, survey results and maps produced from assessment results, and finally – an analysis of ES tradeoffs under different land management scenarios. Following the presentation, a 'validation phase' was conducted with the participating stakeholders, who were asked to respond, critique, and ask questions about the presentation content (Nowotny, 2003; Holzer et al., 2018). In particular, they were asked: *“These are our findings; do they reflect the reality of the open space in the Carmel?”* Next, we split into small groups to discuss the following subjects: *“What are the main challenges that you deal with in your work, regarding the ecosystem of the Carmel?”* *“What threatens the benefits we gain from the open space of the Carmel?”* and lastly *“How can our findings contribute to your professional objectives in the Carmel?”* We concluded by reconvening the entire group to discuss *“how knowledge gained from using the ES concept contribute to questions of management and planning of open space.”*

This workshop, unexpectedly catalyzed additional activities initiated by the stakeholders themselves, which then started to take on their own momentum. The assessment team was invited to present their findings in several other stakeholder-initiated workshops and forums organized by the local communities, organizations, and government ministries. All in all, the assessment team presented the ES assessment in seven different venues: the Carmel Regional council (12 participants), the Druze villages community forum (20 participants), the senior

leadership of the MoEP (including a tour and a meeting; 8 participants), the regional district unit of the MoEP (including additional stakeholders; 22 participants), the UNESCO Man and the Biosphere committee in Israel (11 participants), and to a local Druze, Jewish and Muslim teacher's environmental training forum held at the NPA offices in the Carmel (22 participants). In each of these, a similar protocol was used: Presentation of ES assessment results followed by a discussion on how the ES assessment can contribute BR management and stakeholder wellbeing.

2.2.1.2 Data analysis

All material from the interviews, discussion groups, and stakeholder workshops were analyzed qualitatively based on an iterative, grounded theory approach (Strauss and Corbin, 1998) by using applied thematic analysis (Boyatzis, 1998; Guest et al., 2011; Charmaz and Belgrave, 2012). Similar approaches have been used in previous ES research (e.g., Kaplowitz, 2000; Sitas et al., 2014). The first step of the thematic analysis was transcribing audio recordings of stakeholder interviews, discussion groups, and workshops. The second step was an open-coding process – through which the author read through the transcribed text and the notes gathered during the engagement process, sometimes several times, until certain repeated topics, concepts, and ideas emerged from the text (rather than from a predetermined list of codes). The researcher then assigned a word or phrase to each category – i.e., coding process. Next, the text was reread to note and document more items or key ideas, and pieces of text that were related to each code. These were sorted into related categories and themes, through an iterative process, called axial and selective coding, through which the themes and categories were evaluated and reevaluated, and grouped and regrouped according to the text, until eventually core themes were identified and all other categories were related to them. The themes are reported in Tables 2-1 and 2-2, and their meaning according to the stakeholders who mentioned the theme is explained by using respondents' general ideas or with direct quotes, in the table or in the text following Table 2-2. We report only on the themes that were mentioned by stakeholders from at least four different stakeholder groups.

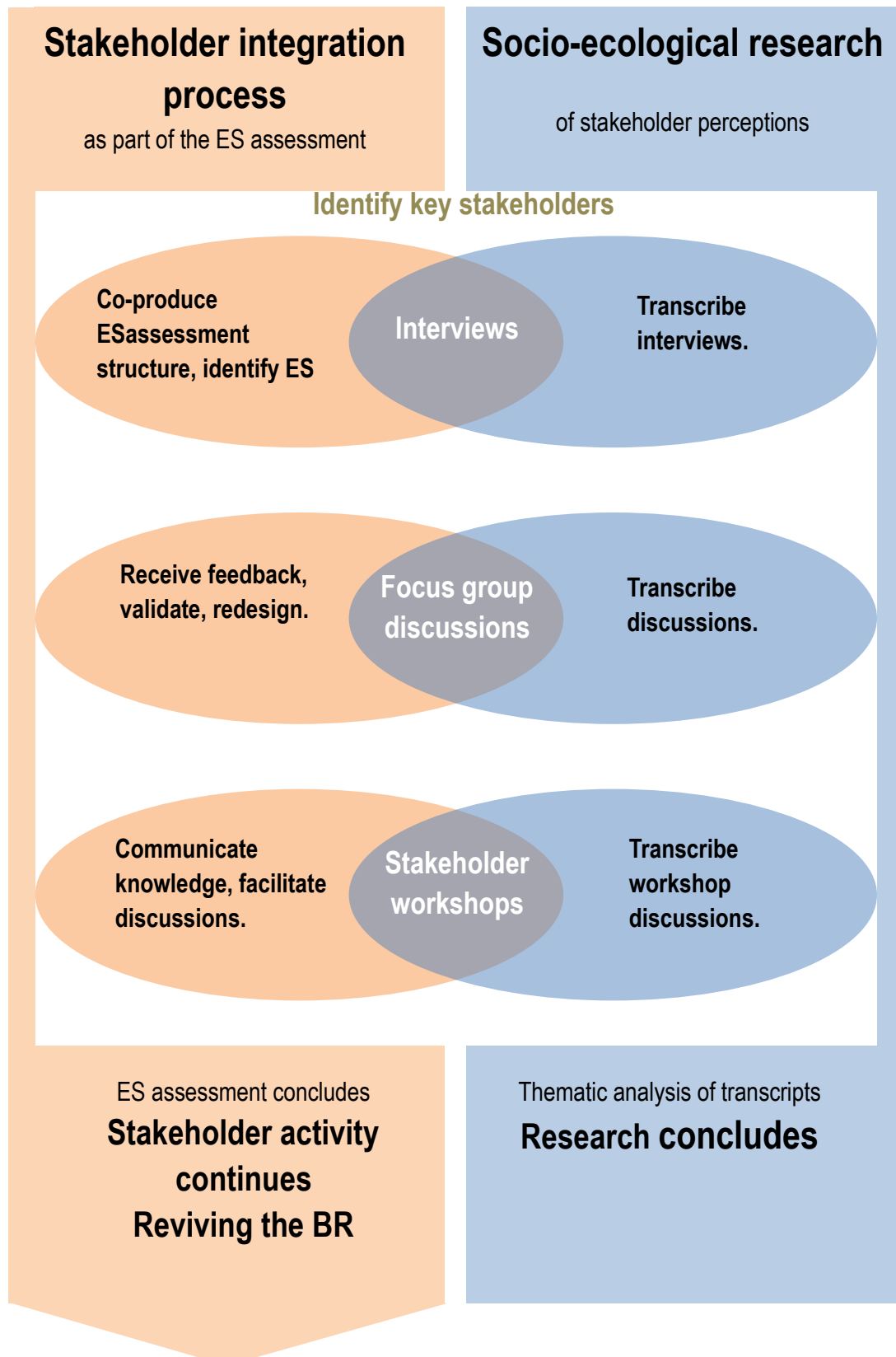


Figure 2-2-1: A conceptual model of two interacting processes: (1) Stakeholder integration in the ES assessment of the Carmel Biosphere Reserve, that informs stakeholders and allows them to impact the subsequent phases of the assessment (2) Socio-ecological research of stakeholders' perceptions of BR challenges and ES knowledge use

2.3 Results - regional scale

The Results are divided in two sections. The first section presents the results of the specific questions asked of respondents in three different venues (key stakeholder interviews, focus group discussions and stakeholder workshops). These are divided to categories and core themes according to our thematic analysis and are summarized in Tables 2-1 and 2-2. The second section is dedicated to outcomes and lessons learned regarding the stakeholder integration process and how it potentially contributes to stable and efficient BR management.

2.3.1. Part one: Stakeholders' perceptions of environmental challenges and ES knowledge

Throughout the various phases of the assessment, stakeholders were asked about the main environmental challenges, and threats to the provision of ES, in the Carmel BR. Most stakeholders did not directly relate their challenges to particular ES, but rather to general issues threatening their environment or to managing the BR. The main challenges mentioned were divided to two core categories according to our thematic analysis: "direct physical threats to ES" and "indirect managerial challenges for ES". We present these challenges in Table 2-1, followed by stakeholder responses to questions regarding how the ES assessment knowledge may assist them in managing the BR and the challenges mentioned?" (Section 2.3.1.2 and Table 2-2). Finally, we relay the criticisms that some stakeholders expressed regarding the application of the ES concept.

2.3.1.1 Environmental Challenges

Table 2-1: Dominant themes from thematic analysis of workshops, discussions and individual interview protocols of the main challenges affecting ES of the Carmel BR as identified by stakeholders, listed from the most mentioned to the least mentioned themes in each category.

| Emergent themes | Meaning summarized from all stakeholders | Number and type of stakeholder groups mentioning each theme |
|---------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Direct physical threats to ES | | |
| "Eating away at nature" (residential and commercial development) | Construction of buildings on private land inside the Carmel National Park, on the coast or on agricultural land, expanding the road network, infrastructure development, and tourism facilities such as hotels. | 8 <ul style="list-style-type: none"> •Local Jewish environmental NGO •Jewish Regional Council •Society Protection of Nature •NPA •Druze municipalities •Residents (unaffiliated) •KKL •River and drainage authority |
| "Fires and fire prevention regimes" | Damage to forest ES provision resulting from recurring human induced fires and from the management strategies implemented to prevent them such as increased grazing, vegetative buffer | 6 <ul style="list-style-type: none"> •NPA •KKL •Ministry of agriculture •Local environmental NGO |

| | | |
|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | zones, and paths for fire trucks. Fire from the Carmel BR outward to adjacent city of Haifa. | <ul style="list-style-type: none"> •Haifa municipality •MoEP |
| "Waste disposal" | Garbage thrown in the park, on the beach, and in the outskirts of the villages (litter and construction waste) increasing fire risk and lack of sewage systems causing groundwater pollution. | <p>4</p> <ul style="list-style-type: none"> •Druze municipalities •Jewish Regional Council •Society Protection of Nature •NPA |
| Indirect managerial challenges for ES | | |
| "Lack of environmental awareness and connectedness to nature" | Difficulty of connecting people, particularly children, to nature and encouraging greater environmental awareness around the BR. Trouble in convincing residents, visitors, planners, construction entrepreneurs and decision-makers about the value of nature as opposed to other land-use alternatives. | <p>9</p> <ul style="list-style-type: none"> •MoEP •Druze municipalities •Residents (unaffiliated) •High-school teachers •Tour guides •Tourism NGO •Jewish Regional Council •NPA •KKL |
| "Biosphere management controversies" | Conflicts and lack of cooperation between different stakeholder groups that impede sustainable management of the BR. Such as: between the NPA and the Druze residents regarding private lands located within the core areas of the BR, the army and shepherds on where to graze, the NPA and a tourism NGO about the number of tourists, type of activities, and locations where tourists can enjoy nature, and between the regional councils and the planning administration regarding settlement expansions. | <p>8</p> <ul style="list-style-type: none"> •Druze municipalities •Israel Defense Force •MoEP •NPA •Tourism NGO •Ministry of Agriculture •Residents (unaffiliated) •Jewish regional council |
| "How to promote sustainable use of open space" | Promoting, for example, organic agriculture, green building, development densification instead of sprawl, ecological tourism and agrotourism. | <p>4</p> <ul style="list-style-type: none"> •Jewish Regional Council •KKL •Residents (unaffiliated) •Ministry of Agriculture |
| "Accessibility versus conservation" | How to make nature more accessible (paths, recreational and tourism infrastructures) to various types of visitors with minimal harm to nature and ecological corridors. | <p>4</p> <ul style="list-style-type: none"> •NPA •Tourism NGO •KKL •Haifa Municipality |

2.3.1.2 How can ES knowledge assist stakeholders?

Our engagement with stakeholders revealed several ways regarding how knowledge gained through the ES assessment can assist BR management in addressing the multiple challenges noted in the previous section. These are explained below and summarized in Table 2-2.

Educate the public and raise awareness

Numerous stakeholders from the NPA, the KKL, MoEP, local teachers, and tour guides perceived the ES assessment as useful material for creating educational programs for formal and informal education. The ES assessment, they purported, would help convey the importance of nature conservation by explaining the diverse ES and their importance for the residents' wellbeing. They were excited about the ES concept as *"a new way of looking at nature"* and educating about it. A stakeholder mentioned: *"teachers thirst for such data"* (referring to quantitative data about the services such as biodiversity, provisioning services in agricultural fields, and regulating services attributed to trees). In addition, various respondents suggested how to spread the idea of nature contributing to human wellbeing via guided tours (each of the nature organizations and the defense forces host dozens of guided tours a year). A tour guide of the NPA said: *"During our guided tours we explain about history and biology, but we are missing the subject of benefits of nature"*. A teacher of environmental studies said, *"we should show the students why we need to conserve nature beyond classical nature conservation of unique species"*. A forest agency respondent thought it could be useful to construct signs about the ES of the Carmel in the entrance of the parks. Respondents also saw the education about ES as the solution for many of the threats to the region by creating a sense of attachment and connections to nature. *"The more people speak in the language of ES, the more it will penetrate and influence"* suggested an environmental educator.

Influencing decision-makers

Stakeholders, such as representatives from the NPA, the MoEP, and regional councils noted that the ES assessment can be a useful tool to convince decision-makers in planning and building committees of the value of open space and the economic loss of degrading it. As a regional council representative said, *"especially in committees that are meant to represent all interests but lack a representative for nature."* A representative of MoEP said: *"In the Carmel it can also be helpful to show the benefits and economic value of burnt areas which are treated by development advocates as worthless"*. *"It is very difficult to convince others about the importance of biodiversity... decision-makers do not have time to dive deep and listen ...And in this ES assessment there is something that conveys the message"* (MoEP representative).

Developing policies and land-use plans

Participants in the stakeholder workshops spoke of how the ES assessment can help them realize their desire for halting the aforementioned challenges of "eating away at nature" and promoting

sustainability by developing a statutory masterplan for the area or strengthening the implementation of the existing National Outline Plan 35 for Open Spaces⁴. Others emphasized the need, reflected in the assessment, for conserving the Carmel as a ‘green lung of Israel’ and suggested that the ES assessment could be used as a tool for enriching ecological impact assessments, and to catalyze discussions to revive the BR. As one respondent from the regional council mentioned, *"Anything that can help us stop the process of land-use change for construction"*.

Fundraising and enforcement

Respondents noted that they were interested in sharing the knowledge acquired through the ES assessment with regional councils and nature conservation organizations. They expressed hope that the ES assessment and the research gaps identified in the assessment could be used to support fundraising opportunities and calls for proposals for environmental initiatives and education that are lacking in these groups. Further, respondents suggested, the assessment could be used for fundraising for enforcing environmental laws such as illegal dumping of waste.

Increasing management focus on cultural services

In the ES assessment, especially in the public survey, a lot of knowledge has been collected on the preferences of the public and the residents regarding the use of cultural services in the BR (Negev et al., 2019), so that a more suitable, well-planned, data-informed strategy can be taken for the visitors of the BR according to the unique needs of each user group. *"We are very intrigued by the questionnaires... we will be happy to use them"* (NPA Park manager and tourism NGO representative). Representatives of NPA emphasized that it is especially important nowadays because of the current trend of the organization, to place increased attention on cultural services and making nature accessible and inviting for humans, together with the emphasis on conservation.

Table 2-2: Summary of stakeholder perceptions on how ES knowledge can assist them in relation to the challenges mentioned, from the stakeholder workshops and the target group discussions.

| How can ES knowledge assist stakeholders | Which challenges can it mostly address? | Number and type of stakeholder groups mentioning each theme |
|-------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| Educate the public and raise awareness | <ul style="list-style-type: none"> • Lack of environmental awareness and connectedness to nature • Eating away at nature | 8 <ul style="list-style-type: none"> • NPA • KKL • MoEP • Jewish Regional Council |

⁴ **National Master Plan (NOP) 35** – or “Tama 35” is a national master plan designed to define the planning policy and settlement layout in Israel by 2020. It was approved by the government in 2005. The plan’s stated goals are “to meet the construction and development needs of the country while maintaining open space and nature reserves for future generations.”

| | | |
|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | (residential and commercial development) <ul style="list-style-type: none"> • Waste disposal • Biosphere management controversies | <ul style="list-style-type: none"> • Druze municipalities • Tour guides • High-school teachers • Residents (unaffiliated) |
| Influencing decision-makers | <ul style="list-style-type: none"> • Eating away at nature • Sustainable use of open space | 6 <ul style="list-style-type: none"> • MoEP, • Environmental NGOs, • Jewish Regional Council • Druze municipalities • NPA • Ministry of Agriculture |
| Developing policies and land-use plans | <ul style="list-style-type: none"> • Eating away at nature • Sustainable use of open space | 6 <ul style="list-style-type: none"> • KKL • Jewish Regional Council • Druze municipalities • MoEP • NPA • River and drainage authority |
| Fundraising for environmental initiatives and enforcement | <ul style="list-style-type: none"> • Lack of environmental awareness and connectedness to nature • Waste disposal • Fires and fire prevention regimes • Sustainable use of open space | 5 <ul style="list-style-type: none"> • High-school teachers • Tour guides • Jewish Regional Council • Druze municipalities • NPA |
| Increasing management focus on cultural services | <ul style="list-style-type: none"> • Accessibility versus conservation • Biosphere management controversies (between NPA and tourism NGO) | 5 <ul style="list-style-type: none"> • NPA • Tourism NGO • KKL • High-school teachers • Tour guides |

2.3.1.3 Criticisms of the ES assessment

One of the most predominant criticisms of the ES assessment expressed by stakeholders, specifically from the MoEP, who had not participated in the ES assessment process, was that the assessment did not highlight the disadvantages or the ‘disservices’ arising from natural areas that reduce stakeholders’ quality of life. For example, the assessment results referred to using wood as a provisioning service for fire, or olive trees for olives and oil, but did not mention air pollution from wood-burning fireplaces or waste from the olive production industry (two ongoing environmental disputes). A second recurring criticism related to the economic assessment of ES. Some respondents thought that it would be dangerous to assess the monetary value of services of an area that was burnt in a forest fire, because low estimated values would discourage decision-makers from protecting the area from development. Finally, a third criticism

was that the assessment was too general, and that it did not focus attention on specific planning dilemmas, making it harder to use for influencing specific plans.

2.3.2. Part two: Rippling effect of the stakeholder integration process (stakeholder-initiated projects)

One of the unforeseen and encouraging outcome of the ES assessment was the spontaneous, independent organization among stakeholders who participated in the assessment process to use it as a springboard to collaborate in the conflict-ridden Carmel BR. This part of the results section describes these optimistic outcomes of the stakeholder integration process.

- 1. Stakeholder initiated meetings to share the ES assessment knowledge:** The initial and planned research process (interviews, focus group discussions and stakeholder workshop) were followed up by further stakeholder meetings initiated independently by the stakeholders who were engaged in the assessment process. The assessment researchers were invited by stakeholders to present the ES assessment in seven additional venues. These included presentations to local government agencies, national government ministries, nature organizations, and civil society forums (the exact list is described in Section 2.2.1). In addition, the researchers were invited to present results to high-school teachers focusing on environment and the Carmel, who then passed the information to their students. One group dedicated their final class project to ES and the researchers were invited to serve on an expert panel that appraised the students' final projects.
- 2. Collaborations among stakeholders and between stakeholders and scientists:** The stakeholder meetings of the ES assessment catalyzed additional collaborations among stakeholders who otherwise may not have met, including meetings between stakeholders who were in conflict over issues of planning and management. They developed ideas for future collaborations to address the challenges they mentioned, some of which have since materialized. For example, a member of the research team proposed to conduct research on the idea of payments for ES to help solve the conflictual issue of building on ecologically sensitive parts of the Carmel BR that are owned by Druze residents, either by paying them for not using their lands or for swapping them with less sensitive parcels of land. Another example: a representative of Haifa municipality responsible for forest fire prevention sat in a discussion group with an official from the Ministry of Agriculture in charge of grazing policy, a Druze traditional plant expert, a grazing scientist, and an NPA ecologist and the five individuals decided to collaborate on developing a grazing policy for Haifa's open space as a fire prevention tool. Another example considered the need for further ES research on specific planning dilemmas and policy questions, such as zoning for tourism infrastructure development. Two research projects have already spun off from the ES assessment, including 1) "The contribution of Haifa's (urban) green infrastructure to ecological connectivity and the welfare of the city's residents" funded by the Foundation for the Conservation of Open Spaces (Israel Land Authority) and the Haifa Municipality (2020-2022), and 2) "The impact of minimal management practices on regulating ecosystem services and their economic value in the multifunctional forest" funded by KKL (2019-2022). Additionally, a partnership to develop an environmental education program focusing on ES in Haifa was created by a

collaboration of local Druze, Jewish and Muslim environmental teachers from the Carmel with Haifa municipality representatives.

3. **Catalyst for rejuvenating the Carmel Biosphere Reserve:** During the initial phase of the ES assessment, participating stakeholders from the Druze and Jewish regional councils, along with one of the assessment researchers (who is also a resident of the BR), decided to initiate renewed discussions about the BR. Three meetings were convened (at the Jewish Regional council, the Druze local municipality and in the national Man and the Biosphere committee) where the ES assessment was presented, and the future of the BR and plans for its sustainable management were discussed. This led to the NPA, who have been the historical managers of the BR, to pass responsibility of managing the BR to the local communities. In the beginning of 2021, a chairman from the Druze community has been appointed and a steering committee has been formed to continue the process of reorganization vis à vis UNESCO. The process has been slowed down by the Covid 19 outbreak and will hopefully continue soon. If successful, these changes indicate a shift from top-down management by the NPA to a bottom-up, community-engaged management regime. It is revealing that at the beginning of the ES assessment process, a BR stakeholder meeting ended in a contentious encounter between the Druze community leader and the NPA representatives. In the stakeholder workshop conducted at the end of the ES assessment process, stakeholders from all organizations (including Druze leaders and NPA representatives) were working collaboratively to define the management challenges of the BR. This change can be directly attributed to the outcome of stakeholder integration process in the ES assessment and its impact on the stakeholders representing multiple sides of the conflictual issues.

2.4 Discussion and conclusions - regional scale

In this research we set out to integrate stakeholders and residents in an ES assessment process, study the integration process, and investigate their diverse perceptions on how the knowledge from the ES assessment can be useful for them. The research and the ES assessment under investigation follow a growing trend in adopting participatory approaches, supporting the ‘movement’ of the ES assessment approach from interdisciplinary to applied-transdisciplinary socio-ecological-science (Jacobs et al., 2016). This approach is well aligned with the goal of BRs to increase partnerships between scientists and nonscientific stakeholders to work towards sustainability (Barnaud, 2017). We conducted an ES assessment of the Carmel BR that richly integrated stakeholders throughout the process to explore the potential for a two-way exchange of knowledge between researchers and stakeholders. In doing so, we created a platform for stakeholders and researchers to coproduce knowledge on ES, to discuss the challenges they face in land-use management, and to explore the effectiveness of ES knowledge to address these challenges.

2.4.1. Stakeholder perspectives on ES knowledge use and challenges

By focusing on ES and tradeoffs inherent in management decisions, the stakeholder inquiry highlighted specific environmental challenges that, according to stakeholders, should be at the

center of BR management discussions. These included both concrete, physical challenges (e.g., construction, fires, waste disposal) and indirect managerial challenges (e.g., lack of environmental awareness and ability to promote sustainability, management conflicts, and accessibility issues). Similar challenges have been documented for other BRs and protected areas around the world including the threat of ‘development’ and the desire to ‘promote sustainability’ (Batisse, 1997; McNally et al., 2016; Stoll-Kleemann and O’Riordan, 2017; Van Cuong et al., 2017), ‘management controversies’ (Habibah et al., 2011; Coetzer et al., 2014), ‘waste disposal’ (Gavio et al., 2010; Nguyen and Bosch, 2013; Ghosh and Ghosh, 2019) and ‘forest fires’ (Fulé and Covington, 1999; Kodandapani et al., 2004; Braasch et al., 2017). The ES assessment process assisted stakeholders in redefining problems as science-based and, utilizing ES knowledge, helped them to explore ways to deal with them directly or indirectly.

McKenzie et al. (2014) describe three pathways through which ES knowledge can translate into influence; these include ‘instrumental’, ‘conceptual’, and ‘strategic’ (later used also by Waylen and Young, 2014; Bremer et al., 2015). ‘Instrumental’ refers to direct use of knowledge to address policy problems; ‘conceptual’ refers to changing mindsets about existing issues and raising awareness, and ‘strategic’ refers to the political use of knowledge to justify actions or to build support for plans and policies. All three types of pathways for using knowledge were apparent among stakeholders involved in the Carmel ES assessment.

The theme “influencing decision-makers” was regarded as an important ‘instrumental use’ of knowledge, as stakeholders explicitly supported using the outputs of the ES assessment, such as maps, ecological data, and economic assessments, to influence planning committees. But stakeholders also reflect their understanding of the ‘conceptual use’ of knowledge to explain [to planning committees] the idea that nature has inherent value, and so value is not only generated from building on it. Dick et al. (2018), who inquired about the perspectives of users of ES knowledge in the 27 Open-NESS (Operationalization of Ecosystem Services and Natural Capital) case studies, found in their analysis of open-ended questions that one of the most frequently identified advantages of the ES work was: “input to an existing decision-making process or management system”. On the other hand, in closed questions, only approximately a third of the respondents considered that the ES research would result in an actual change in decision-making. In order to make an actual impact on planning and policy, according to our respondents, further ES research on specific planning dilemmas, policy questions, or user groups is needed (also see Waylen and Young 2014; Guerry et al., 2015; Martinez-Harms et al., 2015; Rosenthal et al., 2015; Ruckelshaus et al., 2015; Posner et al., 2016; Geneletti et al., 2020). Waylen and Young (2014), in their analysis of the application of knowledge derived from the UKNEA, found that many respondents from the policy-making community were disappointed that they could not identify ES knowledge as directly instrumental for solving policy problems.

The theme “developing policies/plans/actions” was regarded both as ‘instrumental’, but more so as ‘strategic’. Stakeholders thought that the knowledge generated by the ES assessment, including maps, economic valuations, and health benefits (such as pollution regulation by forests) could be applied to dealing with the Carmel BR development challenges and to support and advance outline plans and policies on the agenda such as the action to conserve the Carmel

as ‘a green lung of Israel’. In addition, the fact that the ES assessment was conducted at all was considered to be of strategic value, reflecting the possibility of receiving renewed recognition of the Carmel BR vis à vis UNESCO. In Dick et al., (2018) most responses considered that ES research would result in a change in the future vision of the area and would be applied to land-use planning. However, respondents also thought that such change was within the power of the decision-makers and not that of the participants. In our assessment, several respondents noted the importance of spreading the ES knowledge to stakeholders that are not from the environmental milieu, or what they called “the already convinced” (as also found by Waylen and Young, (2014) regarding the UKNEA). Other examples for instrumental use of the ES knowledge refer to the public survey that focused on cultural services, which could be used by stakeholders from the nature/forest authorities, tourism NGOs, and regional councils for developing tourism, recreational opportunities, and for developing infrastructures for accessibility alternatives suitable to different types of user groups (such use of ES knowledge was also conveyed by Hauck et al., 2013).

‘Educate the public and raise awareness’, emphasized often by stakeholders, is an exemplary conceptual use of knowledge. From the initiation of the ES concept, scientists promoted the idea of ‘services offered to humans by natural systems’ as a tool for conservation education (Daily, 1997; Gómez-Baggethun et al., 2010; Krasny et al., 2014). In Dick et al., (2018) one of the most frequently identified benefits of the ES research was awareness-raising and a deeper understanding of the ES concept. In our case study it was suggested by respondents that the ES concept could be used in education and guided tours to increase sense of attachment and connections to nature and consequently affect the willingness to actively participate in sustainable management of the environment (as found in Nisbet et al., 2009; Avriel-Avni et al., 2010; Liefländer et al., 2013) and to promote eco-friendly behavior, as primarily argued by Aldo Leopold (1949) and tested by (Mayer and Frantz, 2004; Mayer et al., 2009; Shwartz et al., 2012). In addition, the conceptual use of ES knowledge was emphasized often as an innovative “way of looking at nature through the ES glasses” and, as one participant from the forest agency mentioned, “*the concept was innovative and even more effective than the quantitative data themselves*”. The ES assessment was also strategic in raising awareness of residents and visitors of the Carmel, not only to the ES concept, but also to the BR and to the benefits provided by its ecosystems. Such awareness is frequently lacking among BR residents and stakeholders (Price, 2017), not least among the Carmel BR residents (Negev et al., 2019).

To summarize, stakeholders perceive ES knowledge as embracing all three knowledge use types: as an empirical tool to influence decision-makers (*instrumental*), as a support tool to advance plans/actions/policies/initiatives that they are already advancing (*strategic*) and mostly as an effective rhetorical to raise public awareness (*conceptual*). Our results corroborate those of Waylen and Young (2014) and McKenzie et al. (2014), that such assessments should be less focused solely on instrumental use (as was emphasized when the Carmel ES assessment was first proposed, and in other ES assessments). Instead, they should focus more on the stakeholder engagement processes and the communication of the knowledge, so that the conceptual knowledge use and continuation of stakeholder dialogue and cooperation, will receive greater

emphasis. And as we have seen, the actual process of stakeholder integration itself helped to overcome many of the challenges inherent in the BR, even more effectively than the empirical ES knowledge generated through the assessment.

2.4.2. ES as a boundary object for stakeholder integration in biosphere reserves and beyond

Positive stakeholder interactions that resulted from the Carmel ES assessment testify to the potential of stakeholder-driven ES assessments to serve as boundary objects providing a constructive framework for discussion around a relatively neutral scientific discourse. We agree with other research suggesting that when certain conflicts in socio-ecological systems (like BRs) are defined in terms of ES tradeoffs, stakeholders can transcend beyond their conflicts of interest (Castro et al., 2011; Urgenson et al., 2013; Langemeyer et al., 2018) and can cooperate within the project and initiate new collaborative opportunities (Dick et al., 2018). Especially because the ES assessment brings together scientists and stakeholders from different fields/organizations/ministries/positions to focus on the common goal of maximizing benefits from nature. One of the main challenges revealed in the present research hindering the BR from functioning is ‘management controversies.’ These controversies relate to problems like those experienced in other BRs, such as unequitable distribution of local resources, conflicting organizational objectives (Dawkins, 2007; Van Cuong et al., 2017; De Pourcq et al., 2017) and more specifically, conflict with local communities over private land (Goldman et al., 2007; Taylor, 2010; Habibah et al., 2011; Urgenson et al., 2013). In this research, we saw how the actual ES assessment process brought stakeholders to meet and discuss solutions to help them overcome these conflicts.

Coordination between stakeholder needs is known to help overcome challenges BRs face in meeting their objectives (Reed, 2008; Stoll-Kleemann and Welp 2008; Fitzsimons et al., 2013); we emphasize in this research the usefulness of the ES assessment as a boundary object that helped facilitate such coordination for BRs. As Ishwaran et al. (2008) conclude in their paper on BRs: “The identification of an authority with the mandate and resources to coordinate stakeholder interests... will be the key to innovation and success... of the (BR) concept and its practice”. We suggest that the ES assessment project helps to facilitate this process. The reverse may also be true: BRs that have active stakeholder steering committees would offer a successful platform for ES assessments (also noted by Barnaud, 2017).

2.4.3. Transdisciplinary socio-ecological approach

Due to the multiple benefits outlined here, we advocate for an ES assessment process that adopts a socio-ecological research approach: promoting meaningful public and stakeholder involvement as a transdisciplinary activity, engaging stakeholders in knowledge co-production through processes of collective inquiry and reflection with relevant stakeholders (Lang et al., 2012; Carmen et al., 2018; Holzer et al., 2018;2019; Avriel-Avni and Dick, 2019). Two of the central claims of transdisciplinarity are (1) the ability to generate a broader, more diverse foundation of knowledge and (2) that the process itself is cathartic in that it inspires people to participate, use the knowledge, produce a sense of ownership, and continue to improve the local environment

(Haberl et al., 2006; Spangenberg et al., 2015). The fact that the ES assessment created stakeholder collaborations that are continuing spontaneously after the research has concluded reflects a sense of ownership among stakeholders. The ES assessment served as a basis for active participation of the local population in the BR decision-taking process (Rescia et al., 2008), and thus as a catalyst for reviving the Carmel BR. This is one of the most important contributions of the ES assessment and reflects promising contributions of socio-ecological research to local sustainability. We hope this research and the ES assessment that it analyzed will continue to strengthen partnerships between scientists and nonscientific stakeholders, and between diverse stakeholder groups, to find equitable solutions to their disagreements and to work towards sustainable outcomes.

3. THE NATIONAL SCALE: The diffusion of a science-based management concept in Israel

3.1 Introduction – national scale

In the previous chapter we discussed research results regarding the application of the ES concept, and more specifically about the use of ES knowledge from a specific ES assessment project, in a specific region (the Carmel BR), and conveyed the benefits of the transdisciplinary concept as a boundary object to create collaborations, among and between scientists and stakeholders. In this chapter, we extend our inquiry to the national scale and to the general application of the ES concept (rather than the application of the knowledge gained from a specific ES assessment) in order to examine how the concept and its attributes are played out in a spatially broader (i.e., national) planning and management context. The national scale allows to focus on the factors and characteristics influencing the diffusion of the ES concept among scientific communities, organizations, and governmental institutions (rather than on specific local and regional stakeholders). We also expand our theoretical framework to investigate the concept through the theoretical lens of a Kuhnian paradigm shift and diffusion of innovation studies.

3.1.1. ES as a Kuhnian paradigm shift?

In this chapter we consider the ES concept within the framework of a scientific paradigm shift. A paradigm shift is a fundamental change in the underlying assumptions or world view of how things work in nature and society, among the members of a community of practitioners. Kuhn (1962) argued that new theories, or paradigm shifts only gain credence when anomalies, or evidence that challenges the status quo, become overwhelming, or when crisis is being evoked. The acknowledgement that a crisis exists loosens theoretical orthodoxies and provides the necessity for novel data and tools essential for a fundamental paradigm shift. The ecological crisis of our era was identified and brought to a broad scientific public by the publication MEA (2005), which has led to the growing interest in academia and policy making of the ES concept which the MEA was promoting (Potschin and Haines-Young, 2011). Here we ask whether this development constitutes what Kuhn defined as a scientific paradigm shift. From among the characteristics specified by Kuhn (1962) as indications of a paradigm shift, we specifically examine three key identifiers: (1) new scientific communities adopt the concept, (2) there are often intense and widespread controversies and debates about the emerging concept, and (3) they examine problems in new ways. We begin by briefly examining how these identifiers of a paradigm shift [as developed by Spash (2020) referring to Kuhn (1962)] are played out in the global diffusion of the ES concept and later examine it thoroughly in the national context of Israel.

Kuhn's first identifier for a paradigm shift is that **the new paradigm, attracts scientists to conduct research under the new framework and new scientific communities adhere to the concept** (Kuhn, 1962). Several indicators suggest that this describes the case for the ES concept, particularly following the publication of the MEA. The MEA (2005) precipitated a pulse of ES

research. Since then, the journals dealing with ES and number of papers on the subject rose (de Groot et al., 2017). The launch of Ecosystem Services Partnership in 2008 as a worldwide network to enhance the science and practical application of ES (ESP website, 2021) drew upon a rapidly growing community of scientists focused on the conceptual framework. In 2012, the Journal on Ecosystem Services was launched to address the high volume of publications on ES, signaling that the concept had developed into a sub-discipline of its own (Chaudhary et al., 2015). In addition, numerous textbooks, guidebooks, and manuals on how to use the ES concept have been published by international organizations (e.g., TESSA, TEEB, ESMERALDA MAES Explorer, FRMES, IUCN, ESP, IPBES⁵ and others) and application of ES guidebooks has been reported on in several papers (e.g., Crossman et al., 2013; Schaefer et al., 2015; BenDor et al., 2017; Dunford et al., 2017⁶).

Kuhn's second identifier shows that **controversies and debates accompany the emerging paradigm and are critical to its evolution (Kuhn, 1962; 2011)**. The move from using the ES concept for educational, research, and management purposes to an emphasis on monetizing ES on markets (particularly following the publication of the MEA) added to the growing scientific debate and associated literature concerned with how utilitarian/market framing of ecological concerns may change the way humans perceive nature in a way that may be counterproductive for conservation (Gómez-Baggethun et al., 2010). The criticism of the monetary valuations of ES and of the general focus on services instead of the intrinsic value of nature, in addition to several other criticisms (which are described in more detail in Section 4.4.3) have been expressed often (e.g., Norgaard, 2010; Schröter et al., 2014; Silvertown, 2015; Gunton et al., 2017; Bekessy et al., 2018; Diaz et al., 2018; Craig et al., 2019; Spash, 2020; Muradian and Gómez-Baggethun, 2021) and have been an integral part of the development of the ES concept.

The third identifier as Kuhn (1962) explains, is that **the subscribers of the new paradigm approach existing problems in novel ways**. The proliferation of the ES concept added novel aspects of seeking to explain nature by how it affects and serves human wellbeing. In some ways, this was a continuation of the previous concept of Biodiversity that encouraged the study of nature as a holistic system rather than focusing on its individual parts (Naeem, 2002). And as

⁵TESSA: Toolkit for Ecosystem Service Site-based Assessment (Peh et al., 2013).

TEEB: The Economics of Ecosystem services and Biodiversity (Kumar, 2010).

ESMERALDA MAES Explorer: a tool guiding and explaining how to map and assess ES as required by Action 5 of the EU Biodiversity Strategy to 2020 (Burkhard et al., 2018).

FRMES: Federal Resource Management and Ecosystem Services Guidebook created by the National Ecosystem Services Partnership (NESP, 2014).

IUCN: International Union for Conservation of Nature, thematic group on ES.

ESP: Ecosystem Services Partnership: Guidelines for Integrated Ecosystem Services Assessment (de Groot et al., 2018b).

IPBES: The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services - Guide on the production of assessments (IPBES, 2018).

⁶ See a more comprehensive review of the global evolution of the ES concept in the introduction (Section 1.1) and then the most important benchmarks in the evolution of the concept as synthesized from the interviews we conducted with global ES experts (Section 4.4.3).

Costanza et al., (2017) argue, the ES concept is a ‘whole system aware’ approach in which humans are considered to be embedded in both society and the rest of nature. **Another major novelty of the ES concept lies within its mission oriented ‘post normal’ objective** of increasing public and policy makers’ interest about the importance of biodiversity and environmental conservation (Westman, 1977; Ehrlich and Ehrlich; 1981, Portman, 2013). Takacs, in his analysis of the evolution of the concept of biodiversity and its values-laden character, concluded that “biologists need to find a way to communicate biodiversity’s complexity, lucidly to the lay public” (Takacs, 1996). The ES concept is meant to take this role of demonstrating how the disappearance of biodiversity directly affects critical services for human well-being (Braat and de Groot, 2012) by using a language that reflects accepted and prevailing political and economic views (Kull et al., 2015; Ernstson and Sörlin, 2013) where traditional narratives for conservation had failed (Gómez-Baggethun et al., 2010). Advocates of the ES concept are shifting their boundaries from scientifically neutral observers to “activists” integrating their values into their research (as Takacs, 1996, already said about scientists and their embrace of the concept of biodiversity). Biodiversity, which was also meant to be a concept leading to action, remained restricted to the academic field of ecology, and with ES the idea was to operationalize it more effectively than the previous concept into other academic disciplines and beyond academia into practice and public discourse (in the Overall Conclusions - Chapter 5, we will further discuss these issues).

As suggested by Ainscough et al., (2018) and later by Keune et al., (2015), ES has all the characteristics of a ‘post normal science’ - a concept developed by Silvio Funtowicz and Jerome Ravetz (1993). As opposed to “normal science”, which is defined as the regular work of scientists theorizing, observing, experimenting and slowly accumulating detail within an established paradigm (Kuhn, 1962), ES is by conception a mission-orientated field (Cowling et al., 2008), and is mostly carried out in a inter - or transdisciplinary process with the intention of informing policy or guiding decisions (Jacobs et al., 2016) in situations that are likely to display high uncertainty, be value-laden, and require pressing decisions (Ainscough et al., 2018). Therefore, ES can be considered both a normal and post normal scientific paradigm, which is used by scientists and by representatives of nature organizations, governmental ministries, and business. In our current study we examine the implementation of the ES concept within both the scientific realm and the policy/governance realm.

The diversity of ways that the ES concept has been defined and the novel aspects it brings, reflect the search of advocates for novel and paradigmatic ways in which its advocates are addressing the ecological crisis. The concept of ES, since its entry into widespread use two decades ago, has been defined alternatively as a rhetorical tool to conserve nature (Fisher and Brown, 2015), a discourse through which we make sense of the world (Chaudhary et al., 2013; Jax and Heink, 2015), a scientific paradigm (Potschin and Haines-Young, 2011; Winthrop, 2014; Gunton et al., 2017), a worldview that humanity must be treated as part of nature and that we fundamentally rely upon functioning ecosystems (Mace, 2014), a sub discipline (Chaudhary et al., 2015) and we argue that it can also be defined as an innovative way to study and promote nature conservation.

Therefore, aside from asking the question of **whether the proliferation of the ES concept represents** a paradigm shift in the Israeli context (spoiler: there might not be an unequivocal answer), we also ask a more nuanced question of **how** the idea proliferated among and between Israeli scientists and among the policy making communities. To analyze this, we adopt the diffusion of innovation theory (Rogers, 1995) which focuses specifically on factors supporting/inhibiting adoption of a new scientific concept.

3.1.2. Diffusion of innovations

As noted, our analysis of the ES concept as a possible example of a scientific paradigm shift led us to examine the process by which the concept originated, was disseminated, and eventually adopted by scientists and practitioners through the theory of diffusion of innovations. This theory originated within the discipline of sociology, where it was used to describe and theorize about factors that influence the spread of innovations across groups, communities, societies, and countries (Wejnert, 2002). The definition of “diffusion of innovations” according to Rogers (1995) is “the spread of abstract ideas and concepts, technical information, and actual practices within a social system, where the spread denotes flow or movement from a source to an adopter, typically via communication and influence”. Studies of diffusion offer an empirical basis for developing approaches for social change or for economic/political development. Wejnert (2002) grouped diffusion variables into three major components which we will relate to in this work. They are: (1) characteristics of the innovation (such as private versus public consequences and level of risk/benefit associated with adopting the concept), (2) characteristics of the actors spreading the diffusion (such as position in social networks, social/professional/political status, and funding availabilities etc.) and (3) the “environmental context” - innovations depend on their suitability to the environments in which they are introduced, such as the geographical environment, the organizational culture, and the globalization context. We have not found papers thoroughly dealing with the proliferation of the ES concept applying the theory of diffusion of innovations (with the exception of Scott et al., 2018); however, we have identified studies relating to the diffusion of national policy programs related to ES such as “payments for ecosystem services” using diffusion of innovation theory (e.g., Van der Horst, 2011; Garbach et al., 2012; Wolff, 2013; Kagata et al., 2018).

By using the diffusion variables defined by Wejnert (2002) and the characteristics of a Kuhnian paradigm shift, we aim to better explain the process of spread and diffusion of the ES concept among individual scientists and stakeholders and among nature organizations, ministries, and agencies in the national context of Israel. The insights derived here could prove useful to advocates of the ES concept for further mainstreaming of the concept in Israel and abroad, or more generally, for promoting any conceptual frameworks that strengthen nature conservation efforts.

3.1.3. Publications reviewing the global evolution and uptake of ES leading to the need for country-scale analysis

Several papers have been written focusing on how the ES concept emerged, has evolved, and has spread in its various forms and interpretations globally in both policy and scientific communities (Chaudhary et al., 2015; Everard, 2017; Schröter et al., 2019; Craig et al., 2019). Among these, some focus on the economic aspects (e.g., Gómez-Baggethun, et al., 2010; Baveye et al., 2013), with others focusing on the ecological aspects or the interaction between ecological and economic considerations (Bratt and de Groot 2012; Costanza et al., 2017; de Groot, et al., 2017). Other papers, with particular relevance to the current study, focused specifically on the global diffusion of the concept in specific contexts such as in planning discourses (Portman, 2013; Hansen et al., 2015), in law (Ruhl and Salzman, 2006), in political contexts (Kull et al., 2015; Craig et al., 2019), or in specific ecosystem types such as for urban environments (Pincetl, 2015; Ernstson and Sörlin, 2013; Woodruff and BenDor, 2016; Cortinovis and Geneletti, 2018). The content of these reviews and the fact that these reviews have been written, reflect how ES has fundamentally changed the global discourse on nature conservation and landscape management.

Acknowledging the different approaches to human-nature interactions that derive from diverse geographies and cultures was found important to effectively engage with ES in policy and practice (Schröter et al., 2014; Chaudhary and McGregor, 2018). Many researchers have pointed out that there is a general absence of “on-the-ground” examples of ES approaches being used systematically in policy decision-making and planning by governments (Sitas et al., 2014; Levrel et al., 2017; Langemeyer et al., 2018). By examining this phenomenon at the national level (as we do here with the Israel case study), we can closely follow the impact of individuals and institutions in a more simplified system than the global system, so diffusion can be documented between actors and institutions and reveal how local context (culture, politics, ecology) can impact the nature of the discourse and the uptake or rejection of it.

3.1.4. *Studies on ES adoption on the national scale*

There are several examples of studies examining the adoption of the ES concept into national (rather than international) policies and environmental scientific discourses and governance and into land-use management and planning organizations (Pandeya et al., 2016; Chaudhary and McGregor, 2018). Most of them typically refer to adoption in a certain aspect of diffusion of the ES concept, meaning, either adoption of ES in scientific research (e.g., Zhang et al., 2010 for China) or adoption in policy (e.g., Keune et al., 2015 for Belgium; Maczka et al., 2016 for Poland, or; Kerr et al., 2021 for Canada) or in certain types of ecosystems (e.g., integration into forest management, Smith et al., 2011 for the US, and; Hansen and Malmaeus, 2016 for Sweden). However, few have examined the adoption of the ES concept at the national scale referring to both policy *and* research (but see Molnar and Kubiszewski, 2012 for the US, and Chaudhary and McGregor 2018 for Nepal) and including all ecosystem types.

There have been several efforts to apply the ES concept in Israel, including a national ES assessment (I-NEA), which was recently published (Lotan et al., 2019; Cohen-Shacham and Grossbard, 2021). These efforts offer an opportunity to advance our knowledge through Israel’s experience – an opportunity exploited here.

3.1.5. Objectives of the national scale analysis

The objectives of this chapter are to identify and elucidate the details regarding the arrival and diffusion of the ES conceptual framework into the environmental science and land-use management discourse at the national scale in Israel and analyze its contemporary and potential future impact on spatial planning and management in the country. Our aim is to develop an understanding of how this global scientific term (ES) blends with national culture and receives various geographically-specific interpretations to advance its implementation (or resist it) and the role of different actors and organizations in the implementation of the concept. The insights derived by using Israel's past and present experiences with the ES concept could prove useful to advocates of the ES concept to guide planning and management in the future in Israel and elsewhere. In addition, we aim to show how several characteristics of Kuhn's theory (1962) of a paradigm shift, and Roger's diffusion of innovation theory (1962; 1995) may be detected and exemplified in the national implementation of the ES concept in Israel. In this way we aimed to expand our understandings on the diffusion of the ES concept, as well as on how global scientific concepts evolve and diffuse in place.

3.2 Methodology – national scale

The data for this chapter was collected by direct fieldwork including in-depth, open-ended interviews, collection, and analysis of primary documents (reports, abstracts, conference proceedings, meeting protocols), participation in national meetings, workshops, seminars, and conferences on the topic of ES, and systematic analysis of published, peer-reviewed research. These methods are explained in detail below.

Interviews: 34 in-depth interviews were conducted with ES practitioners, decision-makers, planners, and environmental scientists central to the application of the ES concept in Israel. In these interviews, we explored how and through what media these individuals first learned of the ES concept, how they interpret and understand the concept, how it has been applied to managing Israel's open landscapes and to what effect (with particular emphasis on the interviewee's organization or academic institution), advantages and disadvantages of the application of the ES concept, challenges to its implementation, stakeholder integration in ES projects and the future of the concept (Appendix 3-1 – interview protocol). Our interviews lasted between 30 minutes to two hours each and were recorded and transcribed. The first half of the interviews were conducted before Covid19 restrictions and were held face to face, and the second half were performed via Zoom. In our analysis of the interviews, we identify the actors, organizations, interests, agendas, challenges, debates, and controversies through which the ES discourse is being constructed and integrated into environmental organizations, governmental ministries, and research institutions in Israel and identify the national and international factors conducive to its uptake.

The interviews were held with representatives of the major land and resource management agencies in Israel, including KKL, Nature and Parks Authority, Society Protection of Nature (SPNI), Hamaarag (Israel's National Nature Assessment Program), Ministry of Environmental

Protection (MoEP), Ministry of Agriculture and Rural Development (MoAG), Israel Planning Administration (IPA), River and Drainage Authority, Regional Council Center and researchers from several academic institutions who conduct ES research and who were central to the diffusion of the concept in Israel (see list in Appendix 3-2). In most cases more than one representative from a single organization was interviewed in order to get a diversity of narratives about the organization's use of the ES concept. The interviewees were chosen according to prior consultation with leaders in the field of ES in Israel and according to the snowball method where the interviewees themselves referred us to other relevant representatives. After these 34 interviews we reached a level of data saturation (Saunders et al., 2018), as no significant new information on ES adoption and implementation in Israel was arising from additional interviews (Crouch and McKenzie 2006).

Content analysis: In order to further examine the process of diffusion of ES into Israel's environmental land use management and planning, a content analysis was conducted focusing on the different layers of institutional adoption. This analysis used as its input the official policy documents (i.e., national strategies, outline plans, policy and planning reports, legal acts, and decrees), land-use management organization websites and professional Hebrew periodicals, meeting protocols and conference and workshop abstracts (after Bauler and Pipart, 2013 in the Belgian context). The Nevo—online Legal Data-Base search engine was used to find legal decrees and planning documents including national outline plans, integrating the ES concept. The documents and websites were screened to detect the usage made of the ES terminology and to record the presence of the term 'ecosystem services' in each document. The amount of times ES appeared were counted for each document and the context(s) was noted. In order to include all uses of the term ES, we searched for the word "service/s" and then checked throughout the text where it was related to ecosystem/environmental/ecological services. We found that especially in the first years of adoption, until there was a consensus on the translation of ES into the Hebrew language, several different terms were used for the same concept. We took the occurrence of the concept in documents as an indicator for its institutional adoption by the authoring institution. The information gathered during the interviews regarding the historical evolution of ES in Israel was cross-examined with the documents to verify dates and details. As argued by Wilkinson et al. (2013), and Chaudhary and McGregor (2018), policy document analysis represents a useful complement in attempting to improve understanding of the implications of, and opportunities for, operationalizing the ES approach. A list of all documents, papers, workshops, conferences, initiatives and fundings that we found, that include ES terminology and are important to the evolution and implementation of the concept in Israel were arranged in chronological order, divided into four time periods which we describe in Section 3.3.1).

Qualitative Analysis - We used a qualitative interpretative approach (Strauss and Corbin, 1998) to analyze the gathered material from the interviews and documents. We extracted insights by iteratively analyzing the transcribed interviews and the documents, thereby identifying key points, figures, events, and themes that make up the factors conducive to the uptake of ES in Israel. More explanations about the qualitative data analysis can be found in Section 2.2.2.2.

Systematic analysis of academic publication search engines: We conducted a systematic analysis of search engines, similar to Plant and Ryan, (2013) for Australia, and Jiang (2017) for China. We searched in the Web of Science and Scopus engines, using the set of:
TS = ("ecosystem service*") AND CU= (Israel).

We searched for the appearance of the set of ecosystem services (plural or singular) in Topic (title, abstract, or key words) together with 'Israel' in the country/region affiliation of one of the authors of the paper. We aimed to include all ES research done by scientists in Israel, and not only that which focused geographically on Israel. The search was conducted primarily in June 2021 and then updated in June 2022. In addition, we searched for the most popular keywords within these research articles. Primarily we identified twenty keywords that are often used in the general body of ES research and then checked which are the ones that are most common in the Israeli ES research by using the same set as before, with the additional keyword. And identifying the ones that appear the most.

Observations in conferences and workshops (disclosure): I have been personally involved in ES workshops and conferences for more than a decade, and information collected at these events was also integrated into the analysis. I was also involved as a researcher in particular ES projects in Israel (e.g., Sagie et al., 2013; Sagie and Ramon, 2015; Izhaki et al., 2019; Lotan et al., 2019;2021).

3.2.1 Israel as a case study

Although geographically small ($\approx 22,000$ km²), Israel is located on a sharp climate gradient, hosting diverse ecosystems including deserts (semi-arid, arid, and extreme arid; 52%), and Mediterranean ecosystems (18%). Four percent of Israel is covered with natural or planted forests. Agriculture covers about 20% of the land area (in comparison to approximately 40% in Europe; Eurostat website) and 26% of the land area is set aside as protected areas (nature reserves and national parks). Urban ecosystems are 7% of Israel and more than 90% of the population live in cities (Lotan et al., 2019; Map 1). In addition to Israel's unique ecosystems, Israel's open landscapes have exceptional cultural heritage meaningful to Jews, Muslims, and Christians both in the country and around the world.

Regarding environmental management, planning, and governance, by the time of this writing, most of the country's major landscape management agencies and ministries have integrated the ES concept and discourse into decision-making to greater or lesser degrees. They mention ES in their websites⁷ (Figure 3-1) and have promoted the concept, through grants and through the work

⁷ **Websites of open space management organizations and ministries using the ES discourse in their websites:**

- KKL-<http://www.kkl.org.il/afforestation-and-environment/forestry-environment-policy/sustainable-development-policy/>
- NPA-<https://www.parks.org.il/new>
- SPNI-<https://www.teva.org.il/?CategoryID=881&ArticleID=6861>
- Hamaarag-<http://www.hamaarag.org.il/ecosystem-services>

of their staff members' research in the field of ES. Figure 3-1 exemplifies concisely how the ES concept is used in the websites of the major landscape management organizations/ministries/authorities in Israel. A national Israel ES assessment (I-NEA) project was conducted from 2013 to 2019, and recently published in three reports (Lotan et al., 2019;2021; Cohen-Shacham and Grossbard, 2021). Israel is part of international projects and consortiums promoting ES such as: The CBD Aichi targets (since 2010), IPBES (since 2012), and EU H2020 project ESMEALDA (Enhancing Ecosystem Services Mapping for Policy and Decision Making 2015-2018). To date there is no comprehensive historical overview regarding how the concept arrived in Israel and how it spread among researchers and practitioners, and more importantly, how the concept's proliferation has influenced, and may continue to influence, landscape management and the environmental discourse in Israel. Since there have been several efforts to apply the ES concept in Israel, there is an opportunity to advance our knowledge through the Israeli experience.



Figure 3-1: ES mentioned in the websites of major open space management organizations and ministries in Israel

3.3 Results – national scale

Our results section includes four parts. We begin with the story of arrival and diffusion of the ES concept in Israel, divided into four distinct periods. The second part zooms in to the academic uptake of the concept (including into environmental education) and the third part focuses on the uptake of the concept through the story of the adoption of the ES concept into two dominant land use organizations: the Nature and Parks Authority (NPA) and KKL-forest agency (KKL). The fourth part examines the institutionalization of the ES concept in government planning and legal documents.

- MoEP-<http://www.sviva.gov.il/subjectsEnv/OpenSpaces/Pages/OpenSpacesMOE>
- MoAG-https://www.moag.gov.il/shaham/ProfessionalInformation/Pages/Biodiversity_in_Agriculture

3.3.1 History of the ES concept in Israel

In this section we divide the history of the adoption of ES discourse in Israel into four time periods. These are based on an analysis of our interviews cross examined with a chronological list of all important benchmarks in the evolution of ES in Israel including: workshops, conferences, policy and planning documents, fundings, calls for proposals on ES research, academic publications and nature organizations' websites. The four time periods are:

1. 1997-2008: "Seeds" describing the first uses of the term in academic and policy discourse and studies. 1997 signifies the first time ES appears in a peer reviewed paper by an Israeli researcher.
2. 2009-2012: "Spreading the Gospel" describing the proliferation of the concept through the I-NEA and via professional and academic workshops. 2009 signifies the first ISF for ES research, and the beginning of the planning stage of the I-NEA and first international speaker about ES in a conference in Israel.
3. 2013-2015: "Initial adoption, diffusion and diversification" describing the work of the I-NEA and beginning of diffusion. 2013 is the year that the writing of the I-NEA officially begins.
4. 2016-2021: "Institutionalization, critique, and fatigue" describing the concept's diffusion into institutions, planning documents and legislation, and growing criticism of, and fatigue from, the concept. 2016 marks the first strategic report by the Ministry of Energy based on ES.

3.3.1.1 First period: 1997-2008 "Seeds"

During the initial period of 'seeds', the concept began to appear in multiple venues, including academic research, NGO activities, government planning, and science education. The first conduit for the concept was via academic writing by a few well-known and internationally-networked ecologists. Prominent among them were Uriel Safriel (Safriel, 1997), who was a Millennium Assessment author (Safriel, 1997), Millennium assessment author (Safriel et al., 2005) and Moshe Shachak, who was actively engaged with international scientists via LTER Europe and US, where the term was already becoming entrenched (Israel is part of the international LTER network from 1996). They introduced it into both research and policy and wanted (according to their own words) to introduce and apply the concept in Israel. They were joined by environmental economists who also collaborated with ecologists (Becker, 2004; Fleischer and Sternberg, 2006) and then by PhD students, who began to conduct interdisciplinary ES research in their graduate studies (Koniak, et al., 2009;2011; Cohen-Shacham et al., 2011;2015) (See more about the academic evolution of ES in Israel in the following Section 3.3.2.1). In those years, Prof. Moshe Shachak received a prestigious grant for establishing LTER sites and mapping ES, and this formed the basis for the establishment of the 'Maarag' (Israel's Nature Assessment Program) which later became responsible for conducting the national Israeli ES assessment (I-NEA).

In those years, a handful of planners and environmental NGO advocates started using and promoting the ideas of ES and payments for ES (PES), implicitly, in their planning/policy reports, especially for forests (e.g., National Outline Plan (NOP) 22 - Kaplan, 2000) and agricultural systems (Sagi, 2000;2003). Regarding the latter, the author promoted the idea that farmers are the stewards of open space, and that they should be compensated for “taking care of the land and providing services to society”. These ideas later provided the basis for the first Israeli pilot projects examining the potential of providing PES to farmers by the Open Landscape Institute in collaboration with the MoAG and regional councils in 2004 (Sagi, 2021).

Later in 2008, ES terminology explicitly appears in a report on urban nature (Brickner-Brown, 2008). Additionally, the concept was described in science education material in an education guidebook about biodiversity and Sustainable Development (Gavriely, 2003). Finally, during this period, open spaces in Israel receive statutory recognition in the NOP 35 (See Footnote 4). Although ES was not explicitly noted in this document, the ideas behind the ES concept, such as that open spaces in Israel should provide multiple functions, begin to sink, as described by several respondents in this research and publications (Cohen et al., 2005; Sagi 2021).

From an analysis of our interviews, we found that more than two thirds (25/33) of the respondents heard about the term ES for the first time in this period (1997-2009), mostly around the preparations and publication of the MEA. Prof. Safriel was the most common conduit through which respondents learned about the concept. One third of the respondents (12/33) cited they learned about ES from him (either in his university ecology class, workshops, conference lectures, or publications). Another third first heard about the concept from their peers in Israel, Moshe Shachak being prominent among them, and another third via international scientists or projects.

3.3.1.2 Second period: 2009-2012 “Spreading the gospel”

Most interviewees saw the concept as having gained prominence in Israel during this period. It is a period both of “spreading the gospel” and of first steps in diffusion of the framework. Governmental Ministries begin exploring, funding, and pushing forward ES, and scientific publications are increasing. Scientists began integrating the term to their research. And new acolytes began promoting the term into the Israeli environmental governance becoming messengers of the concept, conducting workshops and seminars.

Israeli ecologist involved in the MEA, Prof. Safriel, who served at the time as an external biodiversity consultant to the MoEP, representing the ministry in international treaties, brought the concept to the MoEP. At the time the Israeli national biodiversity plan (Safriel, 2010), as part of Israel’s commitment to the CBD and Aichi targets (2010-2020), was being prepared, and Safriel, the editor of the document, decided to integrate a chapter about ES emphasizing the importance of using the ES concept. Motivated by the MEA and the UK national assessment, Safriel prompted that Israel should run a national assessment too. The Open Space Department manager of the MoEP, who was a former student of his, together with the chief scientist, decided to allocate money for ES projects, and to promote the **National ES Assessment (I-NEA)**.

Hamaarag (Israel's nature assessment program formed of the main open space management organizations) was assigned to lead the national assessment and established a department specifically to deal with ES.

From that moment, the MoEP together with associates from other nature organizations, began to actively push forward the concept (which until then was only known to a few scientists in Israel) to make it familiar to Israelis both in Academia and decision-making milieus. This was mainly done in four ways – (1) publishing **calls for research proposals** on the topic of ES, (2) **running workshops about the concept** to summon scientists to join the I-NEA project, (3) **inviting international keynote speakers** to Israel to speak about ES (such as Charles Perring, Agro-Ecology Seminar 2009; Claire Brown, National ES assessment workshop, 2010; Rudolf de Groot, Science and environment annual conference, 2012; Guy Ziv, Invest and the Natural Capital Project seminar, 2012) and (4) **sending delegates to participate in international ESP conferences** to learn about the concept (Wageningen, 2011; Portland, 2012). The message was beginning to pass from researchers and environmental NGO advocates to governmental ministries' representatives, from workshops in the desert organized by Hamaarag, to workshops in the center of the country organized by several other organizations in specific professional milieus and inside organizations. In one of the first workshops, **the first public resistance to the concept** is heard by the Nature Protection Authority chief scientist saying: *"The whole process seems wrong...It's a double-edged sword that we should stay away from. For example, in the desert the economic value of ES will be higher if we transform it into agricultural systems...But I need to protect these natural areas"*. The head of the Open Landscape Institute also expressed his concern saying: *"Especially because of the concern that this concept might be taken to the wrong places, I wanted us to use the concept in our projects, in order to learn about it and influence the direction its implementation may take"*.

Major milestones at that time include, the Minister of Environmental Protection and the Minister of Agriculture mentioning the term in their greetings in national environmental conferences (the SPNI conference to present the National biodiversity plan, 2010; Science and environment annual conference, 2012, respectively). The first ISF grant for ES research is awarded (Mandelik, 2009), ES begins to enter the discourse of strategic reports concerning other environmental buzzwords such as: 'biodiversity', 'sustainable development', and 'Biosphere Reserves', (e.g., Strategy report for sustainable development, MoAG, 2010; Biodiversity workshop and report, Kark et al., 2011; Biodiversity reports, Rothschild et al., 2012; 2014; Israel Sustainability Outlook for 2030, 2012). The MoAG publishes a call for pilot project of agriculture-supporting the environment and 'Payments for ES' to farmers and establishes the agro-ecology department.

In the academia, multidisciplinary Israeli scientists begin using the term (30 publications using ES in Topic). ES research projects receive funding from the MoEP, the Israeli Science fund and

Agro-Ecology fund (Nekudat Chen-Rothschild Fund⁸). ES is a central topic of the largest environmental conference in Israel (Science and environment annual conference, 2012) and the first large scale conference specifically about ES is initiated in 2012 by the Maarag in Jerusalem. A guidebook on how to use ES is translated to Hebrew (WRI, 2010). The Hebrew Academic Journal “Ecology and Environment” is established in 2010, and begins to include papers mentioning ES (e.g., Gasith et al., 2010; Sagie et al., 2012).

3.3.1.3 Third period: 2013-2015 “Initial adoption, diffusion, and diversification”

The national Israeli ES assessment (I-NEA) officially begins, involving and convening many environmental scientists and stakeholders from all fields having a major impact on the diffusion of the concept. From an analysis of our interviews, we found that two thirds of the respondents attributed the diffusion of the concept in Israel to Prof. Safriel and the I-NEA project. In this period, designated-ES-conferences are organized and simultaneously, sessions and lectures about ES enter conferences of diverse disciplines. Adoption of the discourse by Ministries and land-use management organizations becomes more apparent (the concept begins to appear in their reports, websites and even management frameworks).

The national ES assessment involves more than 150 interdisciplinary environmental scientists (36 lead writers and 120 research associates) and 40 stakeholders as part of the public council (from 36 different organizations and governmental ministries). ES Workshops for all the contributors and the public council are held annually, including a large-scale workshop organized by TAIEX with lecturers from the UKNEA (2015) and the I-NEA program. Intermediate results from the I-NEA interim report (Lotan et al., 2017) are presented in the Knesset (Israel's parliament, 2015).

Four processes began and strengthened which characterized this period:: (1) **designated conferences and seminars** about the ES concept continue to be initiated focusing on specific tools to assess the services (e.g. InVest and Natural Capital Project, Milken Institute, 2013; ES and spatial planning, MoEP, 2013, on PES, Milken Institute, 2013; ES based forest management, KKL, 2016), (2) **the ES concept diversifies and appears in the titles of sessions and lectures** of conferences organized by academic institutes and governmental agencies of **diverse disciplines and topics** (e.g., grazing, river restoration, forestry, nature conservation, planning, agricultural Research and Development, agro-ecology, and soil conservation). Keynote speakers focusing on ES continue to be invited to environment, ecology, and agro-ecology conferences. (3) The ES discourse begins to appear more often in **strategic policy reports on diverse subjects** (e.g., external benefits of agriculture, MoAG, 2013; Water to nature and river restoration, Water administration, 2013; Guide for planning open space, Regional Council Center, 2014; Planning of agriculture and villages in Israel, MoAG, 2015; Environmental

⁸ Nekudat-Hen program is a framework for the advancement of diverse projects at the junction where agriculture, ecology, environment meet. Funds research and projects related to agro-ecology and holds a yearly seminar presenting the projects and keynote international lecture.

planning guide, MoEP, 2014; Stopping the deterioration of biodiversity and the environment, Rothschild, SPNI, 2014; Marine plan for Israel, Technion, 2015). (4) **Organizations explicitly adopt the concept.** The KKL-Forest Agency was the first environmental organization to explicitly adopt ES as a central management framework (Forest Management Doctrine, JNF-KKL, 2014) and from 2013, the organization begins funding ES research (for details on KKL's adoption of the concept see Section 3.3.2.2). The SPNI, who decided to experiment with the concept in order to influence the way it is being implemented (as mentioned earlier), conducted workshops for businessmen and for decision makers on biodiversity and on using ES to assess environmental impact of development projects. This had an important impact on mainstreaming the concept, many stakeholders heard about the concept for the first time through these workshops, and some took it forward and implemented the ideas in their offices or strategic reports (e.g., "Biodiversity and ES considerations and their integration in planning", Southern District Committee Policy Report, Planning Administration, 2017). **Critique of the concept in this period was raised in two specific contexts:** SPNI criticizes the use of the ES concept as part of KKL's rationale for planting trees in the desert, especially following KKL's report about "Functional rehabilitation of desertified ecosystems in Israel: Ecological and socio-ecological perspectives" (Brand et al., 2015), where ES appears around 100 times. Important to mention that SPNI have been critics of KKL for decades, and this can be seen as the latest chapter of this longstanding critique (more on this critique is elaborated on in Section 3.3.2.2). And secondly, the first national economic ES assessment, funded by the MoEP, was published. The assessment appraised ES monetary value according to land designations for alternative uses, based on the value transfer method (Becker, 2013). This assessment raised concern and doubt among nature conservationists about the use of economic methods for ES assessments, fearing that for some areas the assessment may lead to undervaluation, and therefore maybe harmful for nature conservation.

In the scientific arena, more funding is allocated for ES projects from diverse funding bodies. In these years the number of scientific publications on ES by Israeli authors increases to 55, and Israeli delegates join international ES projects such as the EU H2020 project ES MERALDA (Enhancing Ecosystem Services Mapping for Policy and Decision Making, 2015-2018).

3.3.1.4 Fourth period: 2016-2021 "Institutionalization, critique, and fatigue"

This period is characterized by institutionalization and more diversification of the concept's definition and application, including into official planning documents and legal decrees. Simultaneously, there is also increasing dispute regarding the efficacy of the ES concept for strengthening conservation goals and an expression of fatigue from the concept. As we show, many of the steps indicating further adoption of the concept also include barriers and critique hindering the adoption of the concept.

During this period, additional government, and non-governmental agencies (that hadn't been involved with the ES concept before) began to integrate the ES concept into their official policy, management, strategic and national planning documents (see Table 3-1). Significant among them were the IPA (under the Ministry of Interior) and the Ministry of Energy. For example, a

monetary ES assessment was conducted as part of the “Environmental strategic survey for fossil fuels and natural gas in the sea” (Ministry of Energy, 2016), and the Southern District Planning and Building Committee approved the policy document that integrates biodiversity and ES considerations into the planning process (Planning Administration, 2017). This was an exciting milestone for advocates of the ES concept, but at that point it was the only district in Israel obliging ES considerations and a preliminary impact assessment survey for plans. Since 2016, ES are also included in major national outline and strategic plans (details in Table 3-1) that are also making use of the I-NEA outputs (such as maps and models). However, from interviews with planners involved in these plans, and from examining these plans, we understand that the term ES was only integrated sparingly due to three main reasons: (1) political - there were disputes about it with NPA representatives and others, (2) practical - they already have a “working terminology” that they are using (some of which overlaps in meaning and intent with the ES concept) and (3) personal - dislike for the economic assessments (see more about this issue in Section 3.3.2.2).

In this phase, organizations that adopted the ES concept, continued to develop their management frameworks to use ES. For example, KKL, developed ES-based forest masterplans and funded research about ES and tools (JNF-KKL Call for Proposals, 2019). However, the period was also noteworthy for the heightened dispute regarding the ES concept and its utility. Chief among the critique were representatives of Israel’s governmental NPA and largest environmental NGO, the SPNI. Exemplifying the SPNI’s critique, (who, we are reminded, initially adopted the concept), the Deputy Director-General of Environment and Nature Conservation at the time, Nir Papay, said in a panel in the national ES conference (2018) of over 200 participants: *“We came with open arms, did ES workshops, now we realize that the best campaigns are based on emotions, and not by showing benefits”*. The SPNI’s growing opposition to the concept also expressed itself in an ongoing dispute with the KKL regarding afforestation in Israel. The SPNI published, with the input of many of Israel’s premier ecologists, a report harshly critical of afforestation practices and their impact on Israel’s biodiversity (Rothschild, 2018;2019). Within this criticism were specific arguments against the way in which the ES concept is applied by the KKL. The stand taken in these reports was also presented in ecology and environment conferences by SPNI representatives, leading to disputes among nature organizations. A MoEP ex-employee said that after one of these disputes in the Annual Convention of Science and Environment, *“it really felt like the ES concept divided the community of conservationists in Israel, for those who support the ES discourse and those who don’t”*.

In 2017, the MoAG allocated an additional grant for PES pilot projects (for three projects around the country); however, it is still a very small grant and a small number of PES projects compared to other developed countries (Salzman et al., 2018) and, as of 2022, this allocation has not continued since. In some departments of the MoAG the concept entered the professional discourse such as for soil erosion, agroecology, and open space and grazing departments; however, it is much less accepted, if at all, in departments focused on provisioning services of food production. There are some policy programs that support farmers for providing ES, such as ‘incentives for soil conservation’, and ‘incentives for grazing’; however, the programs do not

explicitly mention ES. In general as described by Sagi (2021) in his book about the history of open space conservation in Israel “*regulation and funding for environmental friendly agriculture is still very negligible in Israel today*”, and, apparently, the proliferation of the ES concept has not yet changed this situation considerably.

One of the most significant advances in the institutionalization of the ES concept was its use in a major court ruling regarding the damages incurred to nature by an oil spill in the Evrona Stream⁹ (economically assessed by Becker et al. 2019) that occurred in 2014 in the south of Israel. It was estimated to be one of the most severe environmental disasters in Israel’s history, and severe concerns were raised regarding its long-term damage to the region’s unique ecosystems (Hershkovitz et al., 2018; Groner et al., 2015). Following this event, public lawsuits were filed for compensation of ES lost by other development plans (see section 3.3.2.3.).

During this period, in the research-academic realm, the I-NEA continued to develop and engage dozens of scientists in the systematic review of ES provided by Israel’s diverse ecosystems, and funding agencies continued to encourage research on ES. Prestigious Israel Science Foundation grants and grants from various agencies (e.g., KKL, Nekudat Hen), distributed approximately 7 million shekels to ES research on topics connected to urban ecosystems, wetlands, food security, cultural services, regulating services of forests and agroecology). These events contributed to the continuing upward trend of academic publications focusing on ES (Section 3.3.2.1 and Figure 3-2) and, additionally, ES appears in significant books reviewing open space management and agro-ecology in Israel (e.g., Perevolotsky, 2019; Sagi, 2021) and more often in papers using ES for enhancing conservation in agricultural systems (e.g., Stavi et al., 2016; Segre et al., 2020; Shapira et al., 2020) and river restoration (e.g., Yaacovi et al., 2021; Kaiser et al., 2021). Ecology and agro-ecology annual conferences continue to have presentations about ES studies; however, compared to previous phases, international keynote speakers about ES are less prominent. In addition, the first Israeli guidebook on using ES for planning and management of open space (Open Landscape Institute, Sagie et al., 2016) and the first regional ES assessment (Carmel Biosphere Reserve ES assessment, Izhaki et al., 2019) were published, both involving multiple stakeholders in the process and communication of results. However, scientists also expressed challenges with the concept, well exemplified in the celebratory conference of the publication of the I-NEA in 2021 (Lotan et al., 2019;2021; Cohen-Shacham and Grossbard, 2021). Despite the generally positive reception of the final I-NEA and the commitment of researchers to writing chapters, the process was also a microcosm for the debate around the utility of the concept and the challenges of the ES assessment process. The process took around ten years and several lead authors revealed the hardships and challenges they experienced trying to understand how to work with the concept, how to write the assessment, and challenges with identifying with its

⁹ On 3 December 2014, approximately five million liters (unofficial figure) of crude oil spilled from the oil pipeline of the E. Ashqelon Pipeline Company, from north of the Arava Evrona Nature Reserve, while it was in the process of relocation. The oil flew into many ravines within the alluvial fan and the margins of Evrona Salt Flat up to a distance of approximately seven kilometers from the leak site. Part of the oil has already been removed from the reserve and part remained in the area (Groner et al., 2015, pg. 5).

underlying anthropocentric foundation. They often mentioned the multiple drafts submitted for each chapter, and the difficulty in procuring the editor's (Uriel Safriel) final confirmation. In addition, the long period needed to write the assessment, and the funding it required, created recurring struggles between the co-managers of the Maarag (the land use management organizations in Israel) on the importance of completing the assessment for conservation in Israel. In 2019 they decided that the unit of ES in the Maarag, which was established in 2011, would be terminated.

In contrast, in a panel of the major land use organizations discussing the implementation of the concept during the celebratory meeting of the I-NEA report (2021), participants hailed the concept as crucial for open space management, particularly in light of the emerging threats of climate change and population growth to biodiversity. Many of them enthusiastically advocated integration of the results of the I-NEA into government and NGO planning, even more so than in previous conferences. For example, the NPA, chief scientist who was against the concept from the beginning, eventually spoke about how it could be useful and helpful in certain cases (see Section 3.3.2.2 about NPA). The MoAG Deputy Director of Environmental Resources said: "although ES doesn't explicitly appear in most of our *documents yet, the prominence of the language and ideas are gradually increasing*". The chief forester of the KKL praised the I-NEA report saying, "*I believe we should even increase our use of the ES concept... it helps us recruit the public to the struggle to protect the forest from development*" (more about KKL in Section 3.3.2.2). The after effects of the publication of the I-NEA reports to the diffusion of the ES concept in Israel were seen in the popular media when papers about the project were published in three major newspapers in Israel (Haaretz, Ynet, Yisrael Hayom, 2021), the MoEP minister adopted ES into her discourse on several occasions (e.g., in her opening comments for a special issue of the journal *Ecology and Environment* about rivers; 2021) and several ecologists and environmental activists, and individuals involved in environmental management organizations and ministries are using ES in their presentations to describe the importance of biodiversity conservation to human wellbeing (e.g., *Biodiversity and open space course for regional/local municipalities and councils*, 2022).

In summary, results from the final, most recent period suggest that the ES concept and discourse are now institutionalized within the professional discourse. The concept is embedded within the institutional thinking, documents, and speech of multiple governmental, academic, and third sector institutions. However, funding for governmental plans and schemes are still missing, the utility and desirability of the concept is still debated, and it is used differently by different organizations, often interpreted and applied to support their particular institutional goals (this theme is expanded upon in the following Section 3.3.2.2). For those interested in mainstreaming the concept, large-scale implementation in planning discourses, environmental impact assessments and decision making, and policy documents would still need to increase in order to implement more ecological considerations into open space management.

3.3.2 ES and institutional culture

3.3.2.1 Academia

Unlike its use internationally, where the ES concept was used in publications ‘explicitly’ as early as 1983 (Ehrlich and Mooney, 1983), the earliest explicit mention of ES by an Israeli author in the international literature appeared in 1997 (Safriel, 1997) and the first time it appeared in a paper in Hebrew was in the title of a paper about ES and climate change by the same author in 2001 (Safriel, 2001). However according to our systematic analysis search of ES in literature ‘Topic’, ES begins to appear with growing frequency from 2002 (Figure 3-2). The idea was first introduced into the Israeli discourse with significant emphasis by dryland ecologists (Eldridge, Zaady, and Shachak, 2002; Perevolotsky and Shachak, 2004; Safriel et al., 2005a;b). Chronologically, it was then taken up by environmental economists, who embraced the idea to fulfill their objective to monetarily quantify nature’s value (Fleischer and Sternberg, 2006; Becker and Katz, 2006; Katz, 2006). The second generation, who adopted the concept early in their careers, was brought in by graduate students, for whom the concept was at the center of their PhD research, which was interdisciplinary and used ES as a tool (as opposed to just mentioning ES as a concept) (e.g., Koniak et al., 2011; Cohen-Shacham et al., 2011). Social scientists began applying the concept shortly after, and their initial research focused on perceptions of diverse demographic groups and cultural ES in particular (e.g., Sagie et al., 2013; Orenstein and Groner, 2014).

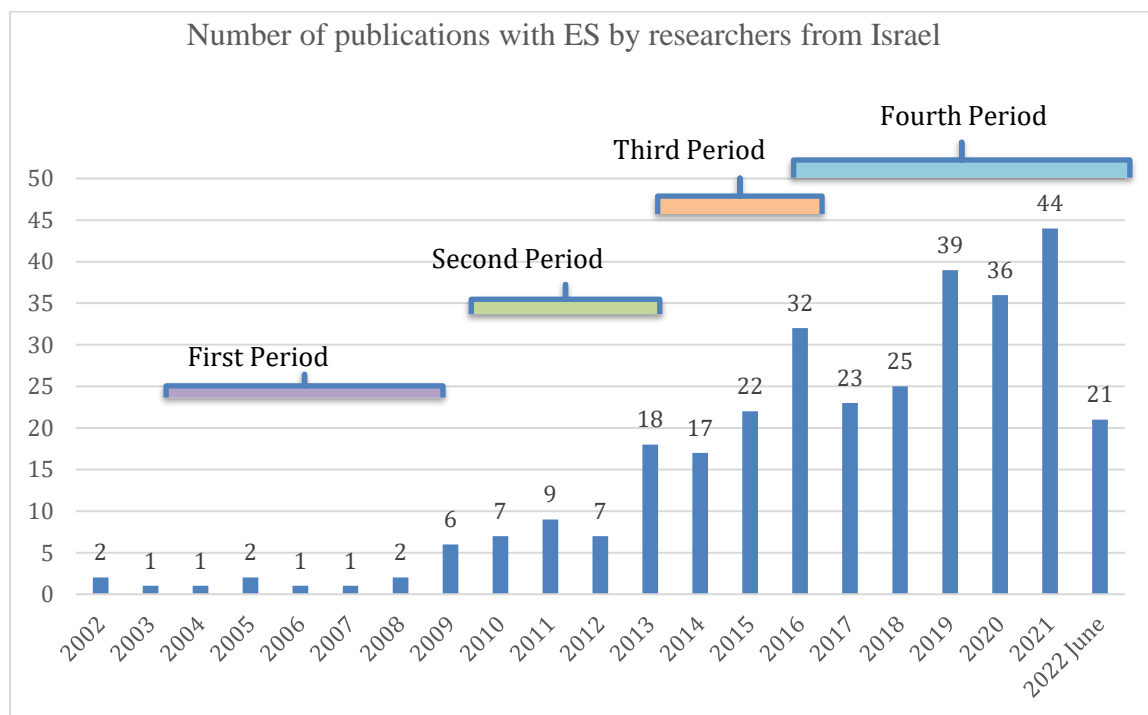


Figure 32:- Overall trend in international scientific publications using the term ES in TOPIC and “Israel” in the affiliation of author/ or by Israeli researchers - updated to June 2022, synthesis between -Web of Science and Scopus results. The increase in the number of published papers aligns with the four time periods of the evolution of the concept in Israel, as defined in Section 3.3.1.

The total amount of papers with ES in title, keyword or abstract in international journals authored by researchers from Israel was 301 (Figure 3-2; updated to June 2022), where the total amount of papers including ES in Topic by international researchers was 43,837 papers. The

number of papers published annually begins to increase significantly from the year 2013, which is the year that the writing of the I-NEA officially began. Since the I-NEA involved more than 200 Israeli environmental scientists, most of whom were not familiar with the term ES prior to joining the assessment, this apparently had an impact on their academic research activities. The increase in the number of published papers aligns with the four time periods of the evolution of the concept in Israel, as defined earlier in this research.

Alongside the growing number of ES-focused publications was a shift in the subject matter of these publications. Among the dominant key words appearing in these articles are (in increasing frequency) regulating ES, cultural ES, forests, agriculture, economics, and ecology. We found that the emphasis on ‘cultural’ and ‘regulating’ services entered the Israeli ES research around 2010 (during the second period) after ‘ecology’, ‘economics’ and ‘agriculture’ that have been emphasized in the first period of ES research in Israel.

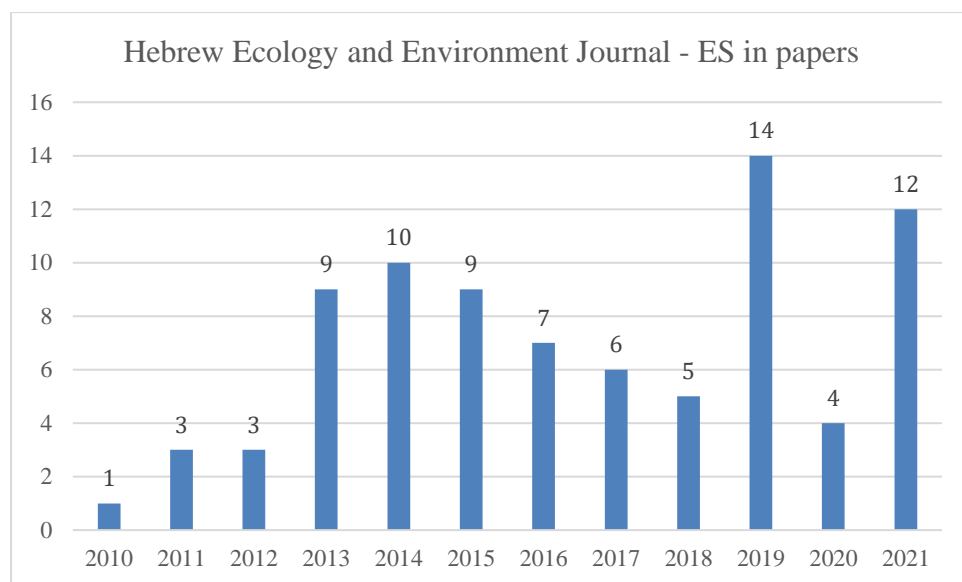


Figure 3-3: Trend in number of papers including the term ES (*Shirutei Hamaarechet Haecologit*) in the Hebrew peer reviewed Journal Ecology and Environment. Updated to October 2021 - With ES appearing anywhere in the paper.

The primary peer-reviewed academic journal in Hebrew serving the ecological and environmental science communities is the journal “Ecology and Environment.” Since 2010, 83 papers, representing 10% of all the published articles in this journal, mentioned ES in some way. The first papers were about policy for river restoration (Gasith et al., 2010), Israel’s national biodiversity plan (Safriel, 2011), and management principles for forests (Osem et al., 2011). In 2012, the first paper with ES in the title appeared in this journal (Sagie et al., 2012). In 2019, as we see in Figure 3-3, there was a very large increase in papers (14) probably due to the increasing interest in subject matter that often integrated consideration of ES, namely climate change, ecological corridors, agro-ecology, and forests. In 2021, in a special issue about rivers (published shortly after the final publication of the I-NEA), the term appeared in 8 out of the 22 articles in the issue, including in the Minister of Environment Protection’s opening greeting for the special issue. We also checked the appearance of the concept ES in the popular media of “Zavit”, a science and environment online news agency platform which provides content to

popular newspapers. We found that from its inception in 2014 until May 2021 - the term appeared in 42 articles produced by Zavit, which is about 3% of all their articles.

Regarding ES in environmental education in Israel, according to Chen et al., (2019), in a thesis about 'the occurrence of ES in education in Israel', the concept appears in environmental studies, in the geography and biology syllabus for high-schools as well as in the science program for the primary school and junior high-school. However, as described by Chen et al., (2019) and in the I-NEA in the cultural services chapter (Ram in: Lotan et al., 2019), ES receives only anecdotal, indirect reference and is studied primarily as a sub-topic under other subject headings such as ecosystems, biodiversity, human nature relations, and environmental ethics. Regarding the diffusion of ES in the courses of Israel's major academic institutions, according to our academic respondents (among them professors from all major academic institutions in Israel), ES is being taught in all major academic institutions; however, it is not yet taught as a course in itself but as part of the syllabus of ecology, environment, policy and some planning courses. One respondent even mentioned receiving a decline for his proposal to teach a whole course about the ES concept from one of the academic institutions where he teaches.

3.3.2.2 Implementation among land-use management organizations - two case studies: one embracing ES and one opposing it

"There are two main ecosystem management organizations in Israel, NPA and KKL-forest agency. One clearly opposed the concept from the beginning and the other adopted it quickly" (Israeli Desert ecologist).

As already suggested above, there were distinct indications that whether or not the ES concept was embraced depended on the institutional objectives and culture of potential users. In this section we will look closely into how each of these organizations have dealt with the ES concept in the years since it began to spread in Israel up until today.

JNF-KKL - Forest Agency

Keren Kayemeth LeIsrael - Jewish National Fund – is Israel's official afforestation agency. The organization is somewhat of an anomaly among international forest management administrations, as it has been tightly intertwined with national objectives since prior to the creation of the state. It is a non-government, public corporation, established in 1901 to develop the land of Israel, and strengthen the bond between the Jewish people and its homeland (Tal and Billig, 2020). In 2021, KKL managed about 800 km² of natural forest ecosystems and grasslands and 940 km² of afforested land (KKL website, 2022). About 7% of Israel's land is forest, most of which is managed by KKL. According to KKL, in the past, afforestation conducted by KKL was coordinated to meet national goals of protection of extensive land areas on behalf of the state, as well as to transform drylands and degraded soils into more productive and useful parks, rangelands, and forests (Tal, 2013). Since the first decade of the 21st century KKL's work, according to the organization's publicity material, has been increasingly focused on sustainability, environmental conservation, and on providing Israel's growing population with opportunities to recreate in forests for their wellbeing and that of future generations (KKL

website, 2022). Due to the nature of the organization, their priorities, and the shift they went through, we suggest that KKL was “primed” and ready to take up the ES concept, as we will see below.

Indeed, by 2022, the KKL has largely embraced the ES concept and its scientists and foresters were among the most vocal and enthusiastic proponents of the concept. In their website the term ES is prominent. It is mentioned both in the principles of the organization “The JNF will work to preserve and improve nature's ability to provide ES...”, as well as in their goals: “Conservation and strengthening of ecosystems and natural processes to enable forests to sustain ES”. Indicative of the KKL's embrace of the ES concept and its compatibility to its central mission, the first appearance of ES in a major policy paper in Israel was in the country's "NOP 22 for Forests", written by the nationally known environmental planner Moti Kaplan, in collaboration with the KKL. In this document he wrote of the need of surveying "the influence of afforestation... on ecological services" (Kaplan, 2000). This document also emphasized that the main purpose of the forest in Israel is “to provide cultural-recreational services to the public”. At the time, we are reminded, the term ES was hardly known in Israel.

In those years (the early 2000's), other terms, similar to ES in their meaning and/or purpose, were becoming more common in KKL's discourse. For example, 'a multi-purpose afforestation policy' to combine diverse needs and different trends in the areas of the forest and open space, and 'long-lasting forests' (those capable of replenishing themselves and resistant to disease and injury). Another similar term to ES, found in a book from the 1970's, about forestry and afforestation in Israel (Weitz, 1970) was 'forest benefits to people'. In that sense, as Omri Bonne, the Chief-Scientist of KKL in 2020, said “*ES is a different packaging for concepts that were beginning to be introduced*”. In those years a few KKL planners participated in a workshop in the US about 'ES in forests' and began to implement the ideas in a few of their plans. Following, few research projects funded by KKL in forest LTER sites also began to implement the ES concept (e.g., Koniak and Kigel, 2014; Zaady et al., 2017; Uni and Katra, 2017).

The most important benchmark for KKL's implementation of ES was in 2014, when KKL introduced their “New Forest Management Policy/Doctrine” for the forests it manages in Israel (KKL, 2014 - the first versions of this document were already in 2009 parallel to when the I-NEA was beginning to be planned). The policy states that the main purpose of forests in Israel is "to supply ES for the well-being of all citizens and the environment" and to “maximize diverse ES”. In 2016, KKL held a conference with the US Forest Services and the World Resource Institute on 'ES based Forest Management' which was another significant turning point in their implementation of the concept and the worldview of ES (KKL website, 2022). The new policy and the workshop served as the foundation for particular and ecosystem-specific forest management master plans that are tailored for each forest, defining which basket of services each forest would provide and the types of plant communities that would support these services with minimal intervention and biodiversity conservation typical to Israel (Porat and Rotem, 2019). As of 2022, 20 such plans have been conducted or are in preparation. “*ES is our tool for forest planning, there is no longer just a forest for the sake of a forest*” (Gilad Ostrovsky, Chief Forester and Director of the Forestry Department). After the workshop the Afforestation

Division Ecology Director, Yahel Porat said: “*KKL is the first organization in Israel to formulate an applied framework and tools for land-use management for the provision of ES.*” Then both agreed that: “*Today, when speaking with the foresters they are speaking the language of ES*”.

One of the important innovations brought by the ES concept to KKL in their forest management plan, as mentioned by several interviewees, is placing emphasis on regulating services such as climate regulation, dust and pollutant mitigation, soil erosion regulation, and using grazing for fire control. Accordingly, in KKL’s Journal “Forest”, there has been a gradually growing amount of research about ES and specifically about regulating services. KKL has also been distributing an increasing amount of research funding for ES-related topics. For example, in their 2019 call for proposals, five sections called for ES-related research (cultural services, public health, economic valuation, tools for ES, and regulating services). Implementation of ES created a great shift in the way forests are perceived, because previously, in Israel, the symbolic role of forest restoration was part of the Jewish people’s national political restoration. Tree planting was considered by some as a fundamentally political act (Tal and Billig, 2020). As one interviewee mentioned, the main narratives for ‘forest services’ during most of the 20th century included a tool for realizing national goals such as ‘providing employment in peripheral areas’, ‘protecting state territories’, and ‘recreating landscapes to resemble European forests’ (which were familiar landscapes for early European Jewish immigrants (Amir and Rechtman, 2004; Long, 2009).

The alignment of KKL afforestation approaches, which had traditionally been criticized by nature conservation organizations, with the ES conceptual framework was received by nature conservationists with criticism. On the side of the KKL, a forest scientist working with KKL said: “*The term ES was very convenient for KKL... It allowed them to reason against classical nature conservation arguments by saying ‘our forest provides ES’, especially in the Negev desert where there are controversies over afforestation*”. A former MoEP representative said: “*it’s a way of branding their activities as conserving nature, according to up-to-date international science*”. But the perspective of the SPNI was less flattering. In 2018, the SPNI publishes a critique report on KKL’s use of ES for justifying afforestation actions in natural areas (Rothchild, 2018;2019) arguing that the claim that forests increase ES should be questioned, especially regarding some regulating services that are not necessarily increasing with forests, especially in the Negev desert. Further, Rothchild argued that, with regard to cultural services, the public doesn’t necessarily prefer to recreate in forests as opposed to open landscapes (Koniak et al., 2011; also discussed in Orenstein, 2021). Finally, they argued that: “*Ecological restoration must be carried out by restoring the natural ecosystems and not by transforming them into forests*”. As we mentioned in the previous section (Section 3.3.1.4), these arguments have created much tension among the nature conservationists and landscape managers (particularly forest managers) in Israel.

To conclude, according to our interviewees and the words of KKL representatives in ES conferences, the use of ES and ES research in KKL has a significant impact on decision making, policy and on-the-ground actions. Regarding the future, leading figures in KKL mention the importance of continuing to implement the ES concept and even increase its use (including monetary assessments) for KKL’s purpose of convincing decision makers to protect the forests

from development, and the need to expand areas designated for forests. They believe that ES will continue to be a significant part of the discourse that will ripen with time in future outline plans.

Israel Nature and Parks Authority (NPA)

The NPA is a government authority, that manages many of the country's public land assets, including nature reserves and national parks. It was established as two entities (which were unified in 1998), for the purpose of fulfilling the goals of the National Parks Law, the Nature Reserves and Commemoration Sites Law and the Wildlife Protection Law. Its goals and purpose are "to protect treasures of nature, landscape, and heritage sites for the benefit of the public, to foster a connection to nature, affinity to the land of Israel, and to educate the public to protect nature's values" (NPA website, 2021). In a search in the NPA's website in 2021, we found that the term ES is not prominent (in particular, as compared to KKL's website), and it does not appear in the goals or vision of the authority. However, it is found in a few places such as in a page about "biodiversity and its utilitarian aspect", in a page about "marine ES protection", in about ten articles in the authority's online Journal, and in one of the lesson plans of their educational program (NPA website, 2021).

Since the beginning of the spread of the ES concept in Israel Dr. Yehoshua Shkedi, the Chief Scientist of the NPA, opposed the concept and had a significant influence on the authority's avoidance of the concept because he believed that "*it is usually improperly used, creating more damage than benefit*". He perceived the translation of ES into economic language as a major concern especially in places such as the desert saying, "*you can't manage nature based on economic value.... the desert is hardly significant in economic terms*" fearing that it will make it harder to "*protect the intrinsic value of nature*" and he dislikes the idea of approaching politicians asking them to conserve nature "*because it provides services to humans*". He believes that the concept can better serve urban green infrastructure, forests, and agriculture than nature reserves. "*It is less relevant to us (nature reserve managers) if nature gives or doesn't give services to humans*". The National Open Space Ecologist of the NPA, Dotan Rotem, added that "*as a conservative organization we are afraid of innovative ideas that may shift our way of conduct...we prefer conserving natural ecosystems and corridors and their biodiversity than increasing biodiversity and ES*". Another NPA employee said: "*I am careful to use the term in the things I write for the organization*", implying that using the concept as part of NPA's documents will not necessarily be welcomed by the organization. A MoEP representative spoke about NPA's approach to ES and the I-NEA: "*they were reluctant to the ES concept from the beginning, and we received a lot of critique and opposition from them about the I-NEA project*".

Even though interviewees representing the NPA or discussing the NPAs use/non-use of the concept initially spoke about how the term ES is barely used in the NPA, they all eventually found examples where it was implemented, some of which were significant in their scope and impact. These included:

- (1) In the NPA ‘Community Relations and Visitors Division’, where the ES concept is more applicable and accepted than in other divisions (especially because their goals are to increase the cultural services).
- (2) NPA representatives were involved in several international projects implementing and experimenting with ES, such as ‘Biosphere Reserves’, the ESMERALDA project, in the national assessment (I-NEA) and in research on specific services, such as pollination.
- (3) Notably, as of 2020, one of the requirements for establishing a new nature reserve, is that “*one should pay attention to the ES provided by the site*” which is a significant milestone as required through the Unified National Outline Plan (NOP 1, 2020; Table 3-1).
- (4) The use of an ES assessment to estimate the monetary damage caused by the damage to the Evrona stream. A shift in the NPA approach was noticed by the MoEP when they eventually agreed to the monetary ES assessment of the Evrona stream damage (Becker et al., 2019), for the legal compensation for ES for the restoration of the reserve (2020).
- (5) Lastly, we found that, ironically, one of the first papers about ecological corridors for open space management, describes ‘ecological corridors as a tool to conserve ES’ (Shkedi and Sadot, 2002). And one of the few documented appearances of the ES concept in the national planning and building committees’ protocols, was introduced by NPA representatives in a discussion about the relation of NOP 35 to the principles of sustainable development and the importance to consider ES and create economic incentives that internalize their cost (Protocol of the Subcommittee on Fundamental Planning Issues, no. 465, 2011).

To conclude, as the chief scientist said: “*as an organization that needs to protect natural ecosystems, ‘services to humans’ are less at the center*”; however, since they also need to convince the public why it is important to conserve nature as well as to make nature accessible to the public, in those aspects ES contributes to their discourse and management.

3.3.2.3 Institutionalization in governmental discourse – planning and legal documents

Israel Planning Administration (IPA)

The IPA is an independent unit within the Israel Ministry of Interior. Its primary mission is to plan and regulate land use and development in the State of Israel through the formulation and execution of national and regional planning policies (IPA website, 2022).

An inventory of the occurrence of the words *ecosystem service(s)* in Israeli planning and legal documents reveals that by 2021, ES was increasingly used in the discourse of national outline plans and planning policy documents (Table 3-1); however, it is also important to mention that according to the planners interviewed, “*ES is still far from being customary in the planning discourse*” as one said.

From the early 2000, similar terminology to the ES concept is found in documents, e.g., “Ecological services”, “environmental services” and “recreation services”, as they are referred to in the policy document NOP 22 for forests and afforestation (Kaplan, 2000), and in the NOP 35 for open space (Cohen et al., 2005). Later, in 2010, in the National Biodiversity Plan (Safrieli,

2010), ES is not only explicitly mentioned, but a whole chapter is dedicated to it. From 2016, the use of ES became more prevalent and systematic, as reflected in its appearance in at least eight major planning documents (see Table 3-1).

Table 3-1: Strategic planning and policy reports including ES discourse between 2016-2021.

| Planning document | Document description | Year published | Agency responsible | Specific reference to ES |
|----------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Environmental strategic survey for fossil fuels and natural gas in the sea | Designed to weigh environmental considerations in sustainable development of offshore oil and natural gas resources and minimize potential harm to the marine ecosystem. | 2016 | Ministry of National Infrastructure, Energy, and Water | ES are mentioned over 60 times and a monetary ES assessment was performed for the survey. In the report it is mentioned that this type of strategic survey is done for the first time in Israel, and they hope that it will be just the beginning for many more such surveys to come. |
| Biodiversity and ES considerations and their integration in planning | Southern District Committee Policy Report. | 2017 | Israel Planning Administration (IPA), Southern District | Inspired by SPNI's workshops about the ES concept (in 2014), the vice manager of the Southern IPA said about the ES <i>concept</i> : "it's a change of consciousness and discourse...and a way to reach the public. It motivated me and others to do something and promote this policy report". |
| National outline plan for the energy sector infrastructure - NOP 41 | The plan focuses on safeguarding land for renewable energy, the addition of transportation pipes, and plans at the district and national levels to produce electricity using renewable | 2019 | IPA | In the first chapter, in the major principles of the plan, and in the fifth clause about open space conservation and cultivation, preservation of biodiversity and ES are mentioned. |

| | | | | |
|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | energy. | | | |
| Unified National Outline Plan - NOP 1 | Major plan merging all existing outline plans in to one, defining how Israeli infrastructures should be developed in the coming decades. | 2019 | IPA | ES are mentioned six times. In the protected areas chapter and in a clause about open space conservation, saying that the ecosystems and biodiversity of open space should be protected because their services are vital for the open space and human well-being. In two appearances it says that the planner will need “to provide his opinion about ES when a change of designation or a development project is under consideration on the protected area” (among other issues such as an inventory of the values of the land, sequence of open space etc.). Implying that the plan must include an inventory that lists the ES in the area. |
| Guide for biosphere reserves in Israel | Principles for planning, establishing, and managing Biosphere Reserves. | 2019 | IPA (Kaplan, 2019) | ES are mentioned 24 times and a chapter is dedicated specifically to assessment and mapping of ES. |
| Strategic Development Plan for Israel 2040 | In response to the housing targets set by the government for 2040, a long-term integrative plan was developed, based on national planning policy with an emphasis on quality housing conditions, access to opportunities while optimizing the use of land | 2020 | IPA and National Economic Council (Prime Minister’s Office) | ES is mentioned in the open space chapter, and maps and models created by the I-NEA are being used. In this report we also found use of specific services such as regulating services – pollination, and pest control services. From the interviews with stakeholders from different ministries and organizations involved in the plan, we found out that they were using the ES discourse in their discussions while developing the report. They also mentioned the efforts they made to include the outputs of the I-NEA in the report, and some difficulties in doing so. |

| | | | | |
|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | resources. | | | |
| Regional master plan for the open spaces of Hevel Asher of the Western Galilee Regional Cluster | A plan unifying local, regional, and national plans applicable to the area, and classifying areas according to sensitivity and value levels, for determining a policy of conservation along development of rural space. | 2020 | Ministry of Construction and Housing of Israel | ES is part of the vision of the area: “The open spaces in the region will constitute quality green spaces that provide green lungs and a variety of ES”. However, one of the planners interviewed, said that although they included ES in the report, most of the regional council employees are not familiar with the ES language. |
| National outline plan for the Kineret and its surrounding beaches - NOP 13/13 | The plan aims to develop tourism and make beaches more accessible to the public, all the while preserving nature, the environment and heritage. | 2021 | IPA (Ministry of Interior) | In Section 3.3 - guidelines for local plans – in one paragraph it is written: “In the areas designated to nature and the landscape, only activities that support nature conservation and ES will be permitted”. |

Another important achievement of the implementation of the ES concept into the planning discourse, is that since it is increasingly being used in the objectives and requisites of outline plans (especially in the NOP 1) it is also mentioned in protocols of the regional and national planning and building committees that are examining all plans in consideration of the NOP 1. The ES concept is mentioned in planning objections and decisions. For example, in a planning objection submitted by SPNI regarding a KKL plan for a forest in a dryland ecosystem, there was an objection stating that planting a forest would damage the ES provided by the existing (shrub) vegetative community. Another example, in one of the protocols in October 2020, the planning committee of the northern district approved a plan for the construction of an entrance to the Ayun Stream Nature Reserve, because it had been convinced that “the plan wasn’t damaging the natural ES of the site”. In other protocols, we found the ES discourse being used by scientists

that were invited to give their expert opinion on certain plans. On one occasion in July 2019, in a plan near Jerusalem, the “green” organizations were demanding that an ES assessment will be held in order to decide about the best location for the plan, and the committee replied that they were missing methodological tools to assess ES. They noted that tools for assessing ES for plans in Israel were unavailable and should be further developed as well as experts to conduct these assessments. In other cases, ES entered the discussions in the planning committees through the representatives of the “green” organizations, who raised the subject of ES to convince the planners and engineers of the committees of the importance of conserving ecosystems for humans (e.g., plans for Kiryat Yaarim or the Caesarea sand dunes). Another example where ES is often mentioned is within discussions about ecological corridors for mobility of biodiversity. ES is used to describe the importance of such corridors for assuring functioning ecosystems and the services they provide. Finally, on several occasions, we found that when speaking of ES that should be assessed before a development project, decision makers and planners thought that also ‘security services’ and ‘national services’ should be assessed.

When interviewees were asked about the implementation of the ES concept in planning, one employee of the planning administration said that: “*ES is used because of the need to look at the multi-functionalities of open space*”. A well-known planner, one of the first to use the term added: “*it is common sense to use the term if I want my plan to convince [the reader] to conserve nature, it's just common sense*”. But on the other hand, the concept also receives opposition from planners saying: “*As a slogan it didn't catch on*”, or “*we already have a working terminology for planning*”. Instead of ‘services’, as mentioned by respondents engaged with the planning administration, planners prefer ‘resources’, ‘designations’, ‘functions’, ‘values of nature’ and ‘benefits’. As we found in our content analysis, in most plans, this terminology is currently much more apparent than ES. They also added that another reason for minimal adoption of the concept was that the upper echelons of the planning administration dislike the idea of monetizing the ecosystem services. A planner also said “*when trying to promote ES or other ‘green’ discourses we get feedback from the public saying: we need housing, not ecosystem services... the term ES is too complicated*”. However, a political-environmental scientist interviewed, emphasized that “*in the planning administration in Israel the penny has dropped in the last generation, and from the 1990's a shift towards becoming more environmental, is occurring even without explicitly adopting the discourse of ES, but integrating the ideas that this concept brings*”. For example, ecological corridors are being promoted and farmers and planners realize that agricultural land is not only provisioning services but also regulating and cultural services. A consultant planner said: “*the term ES itself doesn't necessarily contribute to planning, but the ideas behind it are the base for planning whether we call it services or not*”. Looking to the future, MoEP representative interviewed mentioned that they are trying to promote that ES assessments will be required for every environmental impact assessment, (as was strategically promoted by the policy document of the Southern region of the IPA), and that a textbook to make it a structured process for any outline plan will be written.

Legal Documents

We found one of the most tangible applications of the ES concept in Israel in the legal realm. Although we found only a few occurrences of the term ES in legal documents, these occurrences provided a strong indication that the concept had penetrated the academic and practitioner communities, and that it had indeed become 'mainstreamed' into society. ES was mentioned in four different legal suits for compensation for environmental damages. In a decree (from 2020), on environmental liability regarding the compensation of ES damages from the oil spill in Evrona Stream (see more about this issue in Section 3.3.1.4). This is regarded as a breakthrough of the green organizations in Israel, mentioned often in the interviews and panels on ES, which opened doors for similar rulings to provide compensation for environmental damages. Another case of environmental damage demanding ES compensation in an acid spill in Ashelim stream, which as of this writing, is under arbitration. In the end of 2020, a civil suit was filed against Eilat Ashkelon Pipeline Company for the loss of ES provided by the coral reef ecosystem in Eilat due to construction work on the bay, and compensation for the damages were awarded. And another civil suit was filed for compensation for the ES lost because of soil and sea water pollution near Akko.

We also found one example of an implicit integration of ES into a law or order in Israel, namely the 'Streams and Springs Authorities Order' – written in 2003 (with amendments in 2005, 2008, 2010) – which uses the term “gifts of nature”. Specifically, the order states, “.... For the rehabilitation of streams and rivers their plans should be prepared with an inclusive environmental and ecological view of the basins...and will include instructions for preserving landscapes and gifts of nature”. In a report referring to this order and evaluating the activity of the administration for river restoration in Israel (Eylon et al., 2019), the ES concept is used to describe the order. It is written: “the main achievements and challenges of the river restoration authorities are to increase biodiversity and ES” and that this should be done by “operating in the entire basin”. This is in line with the trend that we have found in this study that the discourse surrounding river restoration in Israel is often including ES (as found in publications, interviews and conferences on the subject).

3.4 Discussion – diffusion of the ES concept at the national scale

This research provides an example of how global science-policy concepts are translated and interpreted into national contexts through a 'conceptual biography' of the ES framework in Israel. Conceptual biographies, or more commonly referred to as conceptual histories, stress the cultural, political, strategic, and intellectual context in which concepts are developed (Koselleck, and Presner, 2002). In this section we discuss the factors and themes affecting the diffusion of the ES concept in Israel in both the scientific and policy realms, framing this process within the theory of diffusion of innovations (Rogers, 1995) and analyzing it according to the three diffusion components as defined by Wejnert (2002), including: (1) Characteristics of the ES concept itself; (2) Characteristics of the actors responsible for promulgating or resisting the diffusion, and; (3) Factors that relate to the context (geographical, organizational, globalization). The discussion will also relate to three key characteristics of Kuhn's conceptualizations of a

paradigm shift, including new scientific communities formed around the concept, the controversies resulting from the adoption of the concept, and the novel ways in which the organizations that adopted the concept addressed emerging problems with its application. Finally, we address the ES concept as a post-normal concept, being mission-orientated and using a language that reflects predominant political and economic views in Israel (Cowling et al., 2008).

3.5.1 Diffusion of Innovation - Factors affecting ES adoption in Israel

3.5.1.1 Characteristics of the innovation:

The first characteristics examined are the attributes that relate to the innovation itself (as opposed to the characteristics of the adopters for example). According to Wejnert, (2002) whether the innovation has public or private consequences and whether there is risk to the adopter or to society, associated with adopting the innovation, is the first characteristic affecting adoption. The ES framework was originally initiated to influence decision makers to protect ecosystems and their capacity to provide ES (Katz-Gerro and Orenstein, 2015; Braat and De Groot, 2012) and as such it is meant to have positive public consequences; however, as with most other innovations, there is risk associated with the adoption of the ES concept. As we documented from several informants, nature conservation managers and activists in Israel were concerned that the ES concept would be used to justify activities that would harm nature/biodiversity, which is the exact opposite of the intent of ES advocates. This risk formed the basis of many of the arguments against adoption of the concept (described further in Section 3.4.2).

The second characteristic that relates to the innovation is whether the innovation is really something new. In this research one of the key themes that were identified relates to the oft raised question of whether the ES concept was an **“innovation or repackaging [of previous ideas]?”** This question has been raised in international forums, such as by Gomez-Baggethun, who asked in his lecture at the 3rd Conference of the European Ecosystem Services Partnership, “Paradigm shift or old wine in new bottles?” (Gomez-Baggethun, 2021) or in the literature, where ES has been discussed as “repackaging” (Plant and Ryan, 2013). In our case study, employees and researchers in multiple agencies associated with forestry, agriculture, and national-level planning employed terminology and concepts emphasizing multiple-use land management, such as “multi-purpose-forest” and “forest benefits to the public”, prior to and after the proliferation of the ES concept. They were often among those who quickly adopted and applied the ES concept. In the IPA, terms such as “maximize functionality of the land”, “land designations”, “multiple-uses”, “conservation of natural resources” and “agricultural-scenic complex” all emphasized the need for trade-offs to balance the provision of diverse benefits derived from open and natural spaces. In the MoAG, the term “public benefits” was and remains a popular term often used in similar ways to ES. The dilemma as to whether the ES discourse is better or different from other existing discourses has also been discussed in other research, such as Kindler, (2016) who conducted a comparison between the terms ‘ES’ and ‘forest functions’, concluding that they should be combined when considering forest management and science.

For these agencies that use the ES concept, the adoption was not simply seen as replacing one concept with another, similar, concept. Many informants emphasized the **innovative aspects** of the ES concept, such as the focus on considering regulating services, which had been less common or unknown before the introduction of the ES concept, and likewise focusing on the wide diversity of cultural services (particularly in dryland ecosystems) as a conservation strategy. We also found that for some ecosystem types, particularly aquatic and marine, and in urban green infrastructures, the adoption of the ES concept was considered especially useful for convincing policy makers about their relative importance for supporting human wellbeing. A representative from the MoAG working on river restoration and soil erosion, said: *“I no longer know how to speak without ES, I made a real transition, an assimilation of the language”* (MoAG, soil erosion research station).

Another theme characterizing the diffusion of the concept was the **confusion concerning its meaning**. Interviewees mentioned that the concept was “unclear”, “vague”, “not intuitive”, or “not for laypeople” (i.e., too scientific or jargony). As a MoAG representative explained, she preferred to use “public benefits” with the farmers, as she considered it more intuitive, and to use ES with the professional and scientific community. This suggests a gap between the terminology preferred by practitioners and that which is used by the scientific community. This terminological gap has been noted by researchers in several different national contexts (e.g., see Plant and Ryan, 2013 in Australia; Kerr et al., 2021 in Canada; Quine et al., 2013, in the UK; and Sitas et al., 2014 in South Africa). In Israel, advocates of the concept suggested that the diffusion of the concept could be more successful if it had a catchier name, as “every good marketing starts with a catchy name” (MoEP representative). Respondents also thought the Hebrew translation - “Sherutei Hamaarechet Haecologit” - was “clumsy” and “not sexy” and was even confused with other phenomena such as waste removal companies or composting toilets (also noted by Orenstein and Groner, 2015).

3.5.1.2 Characteristics of the actors either promulgating or resisting the diffusion

This research clearly indicated that the **personal influence** of particular individuals was crucial for the mainstreaming of the ES concept in Israel. While there were several individuals who were prominent in advancing the concept at the national scale, Prof. Uriel Safrieli emerged as a dominant figure in its diffusion. As relayed through both interviews and textual analysis, Prof. Safrieli’s constant advocacy combined with his respected standing in both the scientific and policy communities reflected the characteristics of actors who become, retrospectively, “champions” of a new concept (Wejnert, 2002). As defined by Rogers (1995), ‘champions’ are usually both ‘lead users’ and opinion leaders (‘promoters’). Safrieli was well-known in international circles and was actively engaged in international platforms such as IPCC, BRs, IPBES, and the MEA) (see also Adam, 2012). He was a former chief scientist of the Israel NPA and the graduate advisor of a broad swath of Israeli ecologists. He brought his mission-oriented approach to the ES concept to his former students, many of whom hold positions in Israel’s universities and land management agencies (including of several respondents in this research, both advocates and critics of the concept), and to the MoEP, with the intention to convince the MoEP and nature conservation organizations in Israel to conduct a national ecosystem

assessment. We suggest that his role was analogous to Prof. Robert Watson, chair of the UKNEA, who served as a bridge between science and policy and was identified as the ‘champion’ of the UKNEA (Lawton and Rudd, 2016). One representative from the MoEP suggested that Safriel’s personal charisma was responsible for the uptake of the concept in that ministry, stating that *“if it was someone else dealing with this concept, the ministry might have seen and reacted to the concept differently”*.

There were additional prominent figures who were exploring and influencing the mainstreaming of the concept over the past two decades, such as another globally recognized desert ecologist working with the International LTER network, Prof. Moshe Shachak, whose long-time collaboration with the KKL influenced the organization to adopt it. Another prominent advocate was the head of the Open Landscape Institute, Yoav Sagi, who experimented with the PES concept and influenced MoAG and regional councils to initiate pilot projects with farmers to conserve open space (Sagi, 2000; 2003; 2021). In addition, Dr. Sinaia Netanyahu, the chief scientist of the MoEP and Menachem Zalutski, the Head of Open Landscapes Division of the MoEP were influenced by Prof. Safriel and their activities prepared the groundwork for the I-NEA and funding for additional ES research projects. Another example of an influential advocate of the ES concept from the planning milieu was the deputy director of the IPA southern district, Eli Forti, who pushed forward the planning policy document to include biodiversity and ES considerations in plans, inspired by SPNI’s workshops about the concept.

Institutions can also serve as “champions” in publicizing and advancing the diffusion of the ES concept (Sitas et al., 2014; Keune et al., 2015). In Israel, aside from the individuals noted above, the Ma’arag (Israel’s Nature Assessment Program), who led the I-NEA, gathered a community of scientists, stakeholders, and decision makers around the concept. As noted throughout this research, the I-NEA was one of the most important events in the diffusion of the ES concept in Israel.

The adoption of the concept was not without opposition by equally prominent and charismatic “resisting actors”, who vociferously opposed institutional adoption of the concept. These included prominent individuals such as the NPA chief scientist, Dr. Yehoshua Shkedy, who was resistant to the concept from its introduction, and who catalyzed opposition within the NPA to the concept, and the SPNI, biodiversity policy coordinator, Alon Rothschild, who, according to his own reporting, was an early advocate of the concept, but with time began to question its usefulness for meeting SPNI conservation goals and criticized the way the concept has been utilized by organizations, particular by the KKL, whose activities SPNI has long criticized. These internal and cross-organizational conflicts were apparent both in policy and strategizing documents and research articles, as well as in explicit disputes among board members of the I-NEA. The disputes within the I-NEA led to long delays in the project completion, which took a decade from inception to publication of the final report. Finally, as elucidated by our respondents, there were key personnel in the IPA who opposed the concept and prevented its wider application in national outline plans.

3.5.1.3 Characteristics of the context: geography, organization, and globalization

Geographical context

The geographic context for applying the ES framework in Israel, particularly that 52% of the country's land area consists of drylands, led to scientific debate and modifications in the conceptualization of ES to better suit Israel's unique ecological and geographic context. Early definitions of ES emphasized that ES were derived from the biotic aspects of ecosystems, thereby underlying the importance of biodiversity. This could have led to the conclusion that dryland systems that are largely lacking in primary productivity would then necessarily be assessed as generally lacking in ES. However, Israeli scientists studying ES in dryland environments found the regions to be rich in regulating and cultural services, particularly when the definition of ES was expanded to include abiotic components such as the geodiversity, environmental conditions (heat and aridity), and landscape services (Orenstein and Groner, 2015; Hummel et al., 2019). This suggestion of a broader definition of ES, which was later vindicated by similar expressions in the UKNEA and IPBES documents, expanded the range of services perceived to be derived from arid ecosystems, with a particular emphasis on cultural services and (later) relational values (Sagie et al., 2013; Orenstein and Groner., 2014; Teff-Seker and Orenstein, 2019). This also impacted the fact that cultural services were integrated relatively early into the ES research in Israel since 2010, as compared to other countries such as China, according to Jiang (2017) Chinese scholars had paid no attention to cultural services until 2016.

The 'desert' was a dominant theme with particular influence on the uptake and critique of the ES concept. The first messengers of ES were dryland ecologists working in research institutions in the desert, and the first workshops to familiarize with the concept were, not coincidentally, in the desert. The critique of the ES approach was often related to the challenges of applying the ES concept to deserts. As the NPA chief scientist said: *"in areas such as deserts it is hard to convince the decision makers that you can get more services from nature conservation than from agriculture or forest land uses... [or] to show that it is significant in economic terms"*. Or, as SPNI biodiversity policy coordinator said, *"the ES approach was created when you see green from the window, the products of ES assessments are not convincing in desert regions"*. Another major critique of the concept stems from opposition to the forest agency's use of the ES concept to promote tree planting in the desert, which has been a longstanding debate among ecologists and environmental activists (Rothschild, 2019; Rotem et al., 2014).

Another recurring theme influencing the adoption of the ES concept in Israel was the constant refrain that it "is a very small country" both socially and geographically. Socially, the scientific and policy communities are relatively small and intimate, and members meet often to exchange ideas formally and informally. This means that the ideas, including the ES concept, spread quickly, accompanied by associated tensions and critique. Geographically, being "a small country" refers to a small spatial area with rapidly growing population and rapidly expanding built environment, with a concurrent decrease in open spaces. An average of 30 sq. km. is developed each year (Hamaarag, 2022). 11% of Israel's land area is built compared to 4.4% in Europe (Sorek et al., 2017).

In this research, respondents suggested that the ES concept helped in the ongoing struggle/action of nature conservationists in Israel to raise awareness of open space conservation and its multiple benefits for the public. As one of Israel's major planners said: "*a piece of land can no longer serve for one ES but needs to be multi-functional*". The rise in the significance and awareness to the importance of "open spaces" and the increase in the use of the term "open spaces" in policy and scientific documents, formed the base for the process that led to the diffusion of the ES concept. In the beginning of the 21st century, NOP 35, embodied this approach in its definition of various types of landscape templates. (More about the diffusion of the open space discourse in Israel can be found in Kaplan, 1999; Assif and Shachar, 2005; Han, 2004;2012; Orenstein and Silverman, 2012; Sagi, 2021).

Finally, the geopolitical aspect of Israel also had an impact on the diffusion of the concept, where some planners argued that 'security services' and 'national services' should be assessed as part of the services that the open spaces in Israel provide.

Organizational context

A major factor affecting the evolution and uptake of the ES concept is found to be contingent on the organizational context, and in particular, whether or not the ES concept supports an organization's a-priori goals and values vis-à-vis nature and humans' role in managing it. The usefulness of ES tools to promote the goals of the organization seems to have had an influence on the willingness of the organization to adopt the concept. For example, the KKL found a practical political advantage in using ES, as opposed to the NPA respondents, who found acceptance of the concept to be a threat to their understanding of their organization's mandate to protect habitats and biodiversity. In some organizations we found that specific departments were more receptive to the concept than others, such as in the NPA where the 'Community Relations and Visitors Division' were positively predisposed to the concept or in the MoAG, where the 'soil erosion', 'agroecology' and 'grazing' departments were more receptive than departments associated with food provisioning. The fact that the KKL found ES to be a convenient argument to promote further tree planting and was adopted easily, was also found in other forest management departments or organizations globally (Quine et al., 2013; Meyer and Schulz, 2017; Raum, 2018) and the opposite trend, the slow adoption by nature protection organizations, was also shown by Hummel et al. (2019).

Globalization context

Several scientists interviewed drew on the fact that 'ES is a global trend' as the main rationale for adopting the concept into their work. More than half of the interviewees stated that they heard about the ES concept for the first time from an international scientist or research project. Several respondents added that Israel is often a laggard in adopting new discourses, due to difficulty and rigidity among local scientists and policy makers in accepting new concepts and terminology (Trop, 2017). ES diffused into the national discourse through existing global discourses that had become popular in Israel before ES arrived, such as: "biodiversity" and "sustainable development". We found that in most policy strategic documents and educational books to

promote and teach about biodiversity conservation and sustainable development, the ES concept appeared in the text, and often as a whole chapter. This was also found by Bauler and Pipart, (2013) referring to the appearance of ES in biodiversity documents in Belgium. Another aspect mentioned was that through concepts such as ES and biodiversity, in conventions and reports (such as the IPBES) Israel can be represented globally through the environment in an apolitical way.

3.5.2 Kuhn's identifiers of a paradigm shift applied to ES diffusion in Israel

In this final discussion section, we examine how Kuhn's identifiers of a paradigm shift are relevant to the Israeli context and assess whether the ES concept can be regarded as a paradigm shift in the Kuhnian sense. Each item in the analysis begins with a question derived from Kuhn's identifiers.

1. ***Do new scientific communities adhere to the concept?*** Based on the rapid growth in papers by Israeli scientists using the term ES (Figure 3-2: 301 papers by June 2022 including 201 authors and coauthors and Figure 3-3: 83 papers in the Hebrew peer-reviewed journal "Ecology and Environment"), we suggest that a growing community of scientists are using the concept, and moreover, these are often scientists who collaborate because of their common interest in ES (for example, we find many interdisciplinary collaborations that were catalyzed by a focus on ES). Moreover, we found transdisciplinary collaborations of scientists that work in landscape management organizations and institutions with stakeholders working in these places (including farmers, foresters, regional councils etc.) All the scientists who were interviewed that focus on some aspect of ES in their research also teach the concept in their university and college courses, thereby developing a future cadre of practitioners of the concept. Another identifier as described by Kuhn, are guidebooks that define the objects of research and the methods of the field for practitioners (Kuhn, 1962), and as we see during the "spreading the gospel" timeframe (Section 3.3.1.2), guidebooks on the application of the ES concept in Hebrew were published (e.g., Campus Teva, 2010; Open Landscape Institute, Sagie et al., 2016). Lastly, and importantly, the I-NEA formed an ES community of more than 200 scientists and stakeholders, convened in workshops, seminars, conferences, and public council meetings to write a mutual report.

2. ***Were there controversies catalyzed by the adoption of the concept?*** Disputes surrounding the concept were apparent between and among scientists and stakeholders from the first introductory workshops in Israel, to ecology and nature conferences, and into the disputes associated with the writing of the national ES assessment and strategic planning reports and in documents. For example, disputes were apparent between the land-use organizations of the board of the Maarag (the institution leading the I-NEA) about the writing and publication of the I-NEA. In addition, the controversies were apparent within the working groups of the major strategic planning reports (Israel 2040 and the NOP 1) if to include the ES concept or not. And the adoption of the concept by the KKL, produced another flashpoint of disagreement between that agency and the NPA and SPNI (for example, the forest agency presented tree planting as an opportunity to sequester Co2 (a regulating service), while nature conservationists criticized the activity for its purported negative impact on biodiversity). The broader disputes were

philosophical-ethical in nature. Should nature be conserved for people or for nature itself (“anthropocentric” versus “inherent” value)? Is monetary valuation useful for fulfilling conservation goals and will be used by policy makers to conserve nature or whether it will be used for promoting their political and economic objectives (Sagi, 2021)?

We find that the opponents of the concept in Israel were usually from three different groups: nature conservationists, ecologists, and planners. Nature conservationists in Israel employed arguments similar to those discussed in previous ES research about challenges to adopting the ES concept elsewhere around the world (Sitas et al., 2014; Schröter et al., 2014). For example, conservationists have criticized ES for being overtly anthropocentric and negligent regarding intrinsic values of nature, as noted by Schröter et al., (2014). Others from the SPNI and OLI also thought that the concept and the products of the economic assessment may conflict with biodiversity-based conservation objectives (also see Reyers et al., 2012) and would divert attention away from biodiversity and habitat preservation towards provisioning or cultural services (Schröter et al., 2014; Hummel et al., 2019). Israeli opponents also offered arguments such as the concern that the ES concept leads to an over-emphasis on economic valuation, the fear that we are ‘selling nature to save it’ (McAfee, 2012), and that we are over-commodifying nature (Schröter et al., 2014) in a way that could negatively influence our worldviews regarding human-nature relations (Gomez Baggethum et al., 2010). Hummel et al., (2019) emphasize the underlying philosophical positions that are conflicting: since PAs were founded to protect nature, putting an economic value on them conflicts with the principle that they should exist in their own right irrespective of their economic (or other) value to humans. The challenge, they say, is to simultaneously maximize benefits to society, while also protecting the natural systems and intrinsic values. As Prof. Safrieli mentioned: “*the argument ‘nature gives us services’ is supposed to be a stronger argument to conserve nature than ‘for the uniqueness of the Gazelle’*”.

There was also resistance to the concept from scientists who did not subscribe to the “post-normal” aspects of ES science and expressed that they were confounded regarding how to use it for scientifically informed decision making. Respondents offered statements such as: “*concepts such as biodiversity and ES - as a scientist you don’t know what to do with them*”, “*it is hard to work with this concept scientifically*”, “*it serves more as a buzzword to influence decision makers*”. This type of opposition was apparent surrounding the publication of I-NEA, when the lead authors (who were supposed to be ES experts but most of them experimented with applying the ES concept for the first time in this project), described the challenges they confronted in understanding how to apply the concept and how to write the assessment and the multiple (“*never ending*”) revisions they received from the editor (Prof. Safrieli), ultimately leading several scientists to quit the project. It showed that ES (as a new paradigm) requires a whole different set of thinking about nature than most scientists were accustomed to.

Lastly, several planners and policy makers expressed opposition, they found the concept itself to be “*too complicated*” or “*confusing*” (as we have seen above in Section 3.4.1.1) or, as one planner suggested, “*it is not useful as we already have a discourse that works*”. They also complained that practical tools to properly integrate ES into planning were missing (as also found in Portman, 2013; Plant and Ryan 2013). Interestingly, juxtaposing the second and third

groups of opponents, one respondent suggested that “*scientists thought it [the ES concept] to be a more political term and decision makers think it is too much scientific*”.

3. Do the practitioners and the organizations who adopt the concept approach existing problems in novel ways? In organizations such as KKL-forest agency who adopted the concept as a management framework, and also in departments and divisions of other organizations and among certain scientists that have adopted ES, novel tools are being developed and used, and especially it has broadened their perspective about how to deal with and how to plan sites with consideration of multiple aspects: regulating, cultural and provisioning services and biodiversity of a site. Alternatively, they saw the ES concept as a useful, novel way to promote their agendas. For example, as we heard, in the KKL ES are used to create masterplans for forests very differently than before the adoption of ES. We also heard in the complaints of the scientists working on the I-NEA and the “never ending” revisions they received from the editor, that ES (as a new paradigm) required a whole different set of thinking and writing about nature than most scientists were used to. However, it must also be said that, on the other hand, as was suggested in interviews and found in documents, ES can also be considered as a ‘repackaging’ for ideas that already existed in the discourse (discussed in Section 3.4.1.1) and exploited to advance particular organizational goals. This suggests that the ES concept may not be considered a novel approach, and perhaps not a paradigm shift (we will discuss this further in the overall conclusions Section 5.3).

3.6 Conclusions – national scale

This section has provided a comprehensive historical overview regarding how the ES concept arrived in Israel and how it spread among academics and practitioners and influenced landscape management and the environmental discourse. This research is an example of how global initiatives are translated into national contexts through a ‘conceptual biography’ of scientific ideas. Through Wejnert’s (2002) conceptualization of diffusion of innovation factors we saw that the diffusion of the ES concept in Israel was mostly influenced by (1) existing similar discourses that ‘competed’ with ES, (2) difficulty in understanding the Hebrew translation of the concept and the concept in general, (3) the personal influence of champions, (4) the geographical context of desert, (5) Israel being a small country, lack of open space (growing population), (6) suitability of the concept with organizational agendas, and (7) globalization – global discourses and ideas that were spreading globally and which formed a basis for ES adoption in Israel, and the need to maintain Israel’s standing in the international community. We also found that even if the ES concept wasn’t always adopted explicitly, the ES ideas increased awareness and are being progressively integrated into Israel’s land-use management framework and implemented via planning documents. We analyzed in detail the disputes around the diffusion of the concept (Kuhn, 1962) between those that easily adopted and promoted the concept (such as several MoEP and MoAG employees, forest managers and planners, scientists, and others) and those that opposed it (such as several nature conservationists).

Overall, we saw that the use of the concept in Israel contributed to broadening the environmental discussion, especially in landscapes characterized by intensive human management such as

agricultural landscapes, urban landscapes, rivers, marine ecosystems, and forests. Areas where management had previously focused only on a few specific services are now increasingly managed for a larger basket of ES and biodiversity considerations.

Our results suggest that in order to further implement the ES concept in Israel's open space management (if that is what would be desired by planners and managers), we need more focus on developing practical tools and experts that can assess ES for plans and make ES a required framework for environmental impact assessments of development plans. It was advised to integrate ES into social indexes such as the wellbeing index (Israeli Indicator of Well-Being, Sustainability and Resilience), and less focus on economic assessments that may prove counterproductive in the long term (Plant and Ryan, 2013). We should alleviate fear from, and continue to promote productive economic assessments, such as compensation for damages to ES from environmental catastrophes such as the breakthrough of the green organizations with the oil spill in the Evrona Stream. In addition, more effort is needed in promulgating the concept beyond the environmental milieu, as was often mentioned. One way offered was by dedicating funds for ES assessment through the local and regional governance. Finally, promoting nature-based solutions (NBS) as tools to cope with climate change and implement ES, was advised [the use of the NBS concept just began to be introduced in Israel (Egozi, 2021)].

We discuss the application and contribution of this research for the study of diffusion of innovations in the overall conclusions Chapter 5 (Section 5.2) and address the question of whether ES can be considered a paradigm shift, according to the examined characteristics with a view on both the global and national diffusion of the concept (Section 5.3).

We conclude this chapter with the observation that the Israeli ES discourse has developed as a microcosm within the global discourse, the conflicts are similar, the challenges to adoption and the successes; however, with the important addition of special place-specific factors that indicate on how the ES concept is culturally and organizationally constructed. We will further examine this in the following chapter in which we look closely at what sixteen different ES scientific experts think about the ES concept and its future and then further discuss these factors and characteristics and examine them in light of the Israeli experience.

4. THE GLOBAL SCALE: Perceptions of global experts on the diffusion, implementation and future of the concept ecosystem services

4.1 Introduction - global scale

As we found in the literature and in the case study of Israel, governments, decision makers, conservation organizations and scientists have increasingly implemented ES as part of environmental policies, research, and management frameworks. However, simultaneously, the ES concept continues to be criticized and inspire debate (Norgaard, 2010; Schröter et al., 2014; Silvertown, 2015; Comberti et al., 2015; Potschin et al., 2016b; Bekessy et al., 2018; Muradian and Gómez-Baggethun, 2021), and implementation continues to be a significant challenge (Jax et al., 2018; Meraj et al., 2021). Although much has been realized, more remains to be done to further develop the concept and implement it in everyday policy and practice to enhance nature conservation and sustainable use of ES (De Groot et al., 2017). Accordingly, the name of the upcoming ACES (*A Community on Ecosystem Services*) conference in December 2022 in Washington, DC is: Leveraging Opportunities for Ecosystem Services Implementation.

In addition, it is important to continue to evaluate the ES concept critically (Bull et al., 2016), and to consider whether the approach continues to be suitable, effective, and efficient or whether another paradigm shift is on the way that will, conceptually and practically, replace the ES concept. Considering these concerns and challenges, substantial research efforts continue to pursue implementation routes for the ES concept (Dang et al., 2021; Kieslich and Salles, 2021; Merj et al., 2021). As part of a collective endeavor to better understand how to implement the ES concept, research focusing on implementation and operationalization of the concept (Cowling et al., 2008; Haase et al., 2014; Hagemann et al., 2020; Kieslich, and Salles 2021; Schubert et al., 2018; Carmen et al., 2018; Jax et al., 2018), and about perceptions of ES practitioners about the concept have been conducted. Perspectives of ES **scientists** (as opposed to practitioners) of the ES concept and its implementation have been collected in only a few studies (e.g., Dick et al., 2018; Ainscough, 2019; Bull et al., 2016). For example, Bull et al., (2016) surveyed members of “The Young Ecosystem Services Specialists (YESS)” about Strengths–Weaknesses–Opportunities–Threats (SWOT) analysis of the ES concept. Ainscough et al., (2019) explored the trade-off that exists between the role of ES as a boundary object and the needs of policy and decision makers of more standardization by studying the perceptions of academics, policy makers and practitioners of ES.

In the previous chapters, perceptions about ES have been examined in two different contexts. In the first chapter, perceptions of stakeholders that were engaged in the ES assessment project of a specific case study (the Carmel Biosphere Reserve), focusing on how the ES knowledge collected may assist them in land use management. In the second chapter, perceptions about the evolution and implementation of the ES concept on the national level (Israel) were collected from various stakeholders, decision makers and academics working on land use management, planning and nature conservation. In this chapter, the perspectives of global academic experts who work several years with the ES concept in scientific and policy frameworks were studied in

order to expand our knowledge of the global historical evolution of the ES concept and its proliferation and influence at the international level. Further, we wish to understand the results of previous chapters in a broader context. Knowing that what happened in Israel did not happen in a vacuum but in close ties with the academic world outside of Israel, we examine the differences and similarities with the Israeli experience with the ES concept compared to global perceptions of how it was adopted, diffused, criticized and what the future holds for the concept.

4.2 Methodology – the global scale analysis

The perceptions of a sample of ES practitioners from different countries around the world, about the ES concept, were collected by conducting 16 semi-structured interviews. Only respondents who were ES practitioners who had dedicated a large part of their work to ES studies, research projects, and initiatives were chosen (See list of interviewees in Appendix 4-2). They were chosen according to opinions of experts in the field, and according to the snowball method, where the interviewees themselves refer to other relevant representatives to be interviewed (Patton, 1990). Ten of the interviews were carried out face-to-face at the Ecosystem Services Partnership 10th World Conference in Hanover, Germany – “10 years advancing ecosystem services science, policy and practice for a sustainable future” held in October 2019. As this is one of the important conferences of the ES community, we thought it was a good venue to query many ES experts. Two additional interviews were held via zoom in the beginning of 2020, and four more were held face-to-face in Israel during 2019-2020. Among those interviewed in Israel, two were ES practitioners from abroad currently working in Israel, and two were Israeli ES practitioners involved in international ES projects. The interviews lasted between 25 minutes to an hour.

In these interviews, we elicited perceptions on how, when and through what pathways these individuals first learned of the ES concept and what triggered them to start using the concept. Then we explored what they thought were the main benchmarks in the global development of the concept, and what they considered the advantages and disadvantages of the concept to be. Then, we queried interviewees regarding their experiences with applying the ES concept in management, planning, decision making and policy and their experiences with integrating stakeholders in ES projects. Finally, we inquired about their thoughts on the future of the concept (see questionnaire in Appendix 4-1).

Data analysis: All material from the interviews was analyzed qualitatively by using applied thematic analysis (Boyatzis, 1998; Guest et al., 2011) as described in Section 2.2.2.2. The themes are reported in the text and in Tables 4-2, 4-3, 4-4 and the meaning according to the respondents who mentioned the themes is explained by using their general ideas or with direct quotes, in the tables or in the text.

4.3 Results and Discussion – the global scale analysis

In this chapter we combine the "results" with the "discussion" so that the themes and ideas presented are embedded, when relevant, in the recent literature expressing those views. The

reason for this is also that respondents themselves are among the most prominent authors in the field and in this way, it allows for a more direct dialogue between the information derived from the interviews and the literature.

4.3.1 Demographic profile of respondents: Nationality, academic background, age group, and experience with the ES concept

Nationality: Our respondents were primarily European, including respondents from Holland, Spain, Germany, Finland, Belgium, Italy, France, and Cyprus. An additional two respondents were from the United States and two were from Israel. Despite being mostly Europe-based, almost all the respondents had conducted research (applied and theoretical) on, or applying, the ES concept in more than one academic or governmental institution during their career in several other locations around the world, including South America, Australia, Asia, and Africa. Nevertheless, we consider the fact that none of our interviewees was from the global south, a significant limitation of our research, particularly considering the prevalent call to integrate more voices of indigenous communities and representatives of the global south into the discussion on the global application of ES (Diaz et al., 2018; Gould et al., 2020), as we will also see here.

The scientific background of the respondents was found to be very diverse. Each respondent had at least two scientific disciplines which they affiliated themselves. Among these disciplinary affiliations, some were traditional disciplines and some multidisciplinary fields (Table 4-1).

Table 4-1: Scientific disciplines of the international ES experts interviewed

| Scientific Discipline or sub discipline/field of study | Number of respondents self-identified with each discipline |
|----------------------------------------------------------------|------------------------------------------------------------|
| Traditional scientific discipline | |
| Ecology | 3 |
| Geography | 3 |
| Geology/Soil sciences | 3 |
| Economics | 3 |
| Engineering or environmental/resource/agricultural engineering | 3 |
| Planning/Land-use planning | 3 |
| Agriculture | 3 |
| Biology | 2 |
| Sociology | 1 |
| Interdisciplinary field of study | |
| Sustainability/Sustainable management/sustainable development | 4 |
| Environmental/ Resource management | 3 |
| Environmental sciences | 3 |
| Environmental policy | 3 |
| Social ecology | 3 |
| Urban Forestry/ Urban green infrastructure | 3 |
| Systems ecology | 3 |

| | |
|----------------------|---|
| Ecological economics | 2 |
| Climate studies | 1 |

Similarly, the study of Bull et al., (2016) interviewing ES practitioners from the YEES community, also showed that the backgrounds of respondents span the natural sciences and environmental and ecological economics, social sciences, and other interdisciplinary fields of science such as sustainability. This interdisciplinary background of ES practitioners is one of the unique aspects of the ES concept allowing common ground for discussions and methodological development in different scientific fields as well as connection with decision-making and the formulation of policy (Reyers et al.,2010; Schröter et al., 2014). What can clearly be noticed in Table 4-1 is that the interdisciplinarity of ES scientists goes far beyond the 'sacred threesome' of economics-sociology-ecology as it is often referred to (Gómez-Baggethun et al., 2016), but into several other areas, and that draws on the fact that the large field of environmental sciences had branched into various interdisciplinary fields.

Age and experience with the ES concept: We divided our respondents to three groups according to their association to the development of the ES concept over its historical development. Five of the respondents were tagged as the “founding generation”, meaning that they had an influential role in the development of the concept and pushing it forward, internationally and/or in their own countries. These respondents had been using the concept since the 1990s or before. The second group of respondents were the “second generation” or the “early adopters” of the concept that made it at the center of their careers. These six respondents had an important role in the more recent developments of the concept’s definitions and methodological tools. And finally, the “emerging generation”, including five respondents who began their academic careers by studying and working with the ES concept academically and in international initiatives or via NGOs that provide training in the ES concept and methods¹⁰ (Appendix 4-2 – list of respondents). They could also be called “early career ES researchers”, as described by Bull et al., (2016), such researchers are likely to critically think about established concepts of ES.

4.3.2 First encounter with the term ES

Our first questions were “When was the first time you heard of the term ES? From whom, in what context?” Three fourths of the respondents encountered the term between 2000 and 2007, and mostly heard about it during or from being directly engaged with the preparations and publication of the MEA. From the “founding generation”, three encountered the term in the 1970’s and the other two, around the 1990’s, one interviewee from the “emerging generation” had only encountered it after 2010. Respondents mentioned that they learned about the concept from either their professors (mostly ecologists), from peers, or from ES publications – and most prominent among them was the MEA.

4.3.3 Main Benchmarks in the historical development of the ES concept

¹⁰The respondents were also roughly divided by age, with ages 60+ included in the “founding generation”, ages 40-60 in the “early adopters”, and 25-40 in the “emerging generation”

The historical development of the ES concept according to our interviewees, including the types of benchmarks and how many respondents mentioned each of the benchmarks and from which generation they are, are listed in Table 4-2. The main benchmarks are depicted on a timeline in Figure 4-1.

Table 4-2: Important Benchmarks in the proliferation of the ES concept. Only the benchmarks mentioned by seven or more of the 16 respondents are highlighted.

| Years | Benchmarks: Books, reports, events, initiatives, and recent developments in ES. | Type of Benchmark | Number of respondents citing source (n = 16) | Generation group when relevant |
|-------------------|---------------------------------------------------------------------------------------------------------------|-------------------|----------------------------------------------|--------------------------------|
| 1970's and 1980's | Westman, (1977): "How much are nature's service worth?" | Paper | 3 | Founding generation |
| | Ehrlich and Ehrlich (1981): "Extinction: the causes and consequences of the disappearance of species". | Book | 3 | |
| | Ehrlich and Mooney, (1983). "Extinction, substitution, and ecosystem services". | Paper | 3 | |
| 1993 | (CBD): Convention on Biological Diversity, UNEP | Event | 2 | |
| 1997 | Daily, (1997): "Nature's services: societal dependence on natural ecosystems". | Book | 7 | |
| | Costanza et al., (1997): "The value of the world's ecosystem services and natural capital". | Paper | 9 | |
| 2005 | (MEA): The publication of the Millennium Ecosystem Assessment. | Report | All | |
| 2007 | (TEEB): Launch of the Economics of Ecosystems and Biodiversity study. | Initiative | 8 | |
| 2008 | (ESP): Establishment of the Ecosystem Services Partnership and the conferences organized. | Initiative | 7 | |
| 2012 | (EcoSer): Launch of the Ecosystem Services Journal. | Initiative | 7 | |
| | (IPBES): Initiation of the Intergovernmental Panel on Biodiversity and ES. | Initiative | 7 | |
| | (CBO): Cities and Biodiversity Outlook. | Initiative | 2 | Emerging and |

| | | | | |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|---|------------------|
| 2013-2018 | Pascual et al., (2017): “Valuing nature’s contributions to people: the IPBES approach” - Integrative, relational and plural valuations. | Development within the ES framework | 2 | young generation |
| 2015 | ESMERALDA project - The Horizon 2020 | Initiative | 2 | |
| 2016 | (MAES): Mapping and Assessment of ES | Initiative | 2 | |
| 2015-2018 | ‘Climate Change’: initiatives and movements-IPCC report, Paris agreement (2015), the Greta Thunberg movement (2018) | Initiative, report, movement | 2 | |

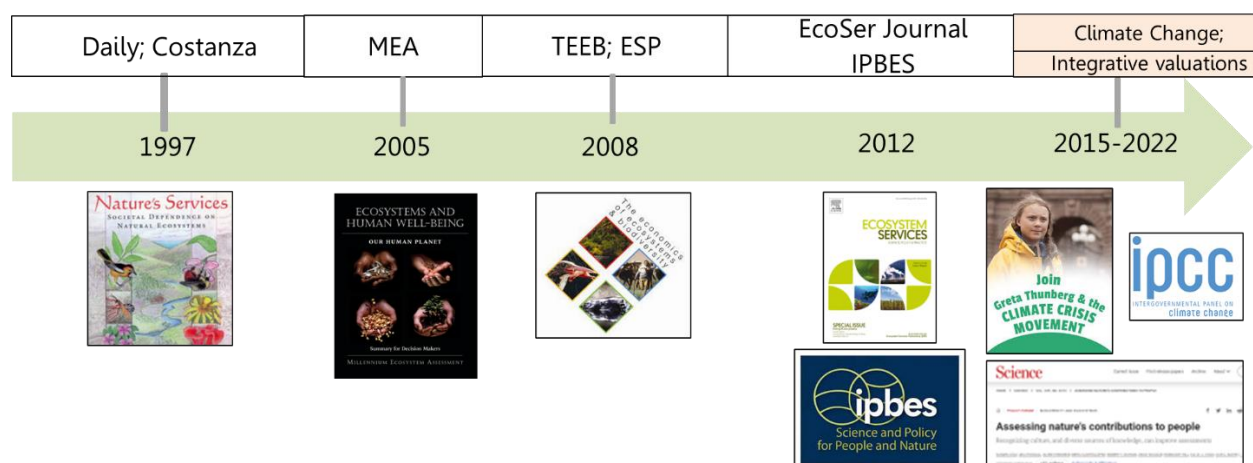


Figure 4-1: Main benchmarks in the development and diffusion of the ES concept according to respondents.

The most significant benchmarks mentioned by a third or more of the respondents included the book “Nature’s services: societal dependence on natural ecosystems”, edited by Gretchen Daily, with contributions from over thirty authors, published in 1997 (**Daily, 1997**). Another was the paper published in that same year in *Nature* by Robert Costanza et al. who conducted a ‘meta-analysis’ of the literature on seventeen ES across sixteen biomes, using a value transfer technique (**Costanza et al., 1997**; mentioned by 9 out of 16 respondents). Respondents from the “founding generation” also mentioned the more historical benchmarks, such as the publications of **Westman (1977)**, **Ehrlich and Ehrlich (1981)**, and **Ehrlich and Mooney (1983)**. A consensus among all respondents was the opinion that the Millennium Ecosystem Assessment was the most significant benchmark in the concept’s proliferation into policy and science (**MEA, 2005**). Half of the respondents agreed that “The Economics of Ecosystems and Biodiversity” (**TEEB**), a global initiative that focused on “making nature's values visible”, launched at 2007, as the next most significant benchmark after the MEA. After that, the establishment of three significant initiatives were mentioned, including the **Ecosystem Services Partnership** in 2008 and the conferences organized by the partnership, the launch of the journal **Ecosystem Services** in 2012, and finally the initiation of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (**IPBES**) in 2012.

The recollections of respondents were quite similar to our conclusions from our synthesis of the most prominent publications about the historical development of the concept (Introduction - Section 1.1). These publications included the highly-cited article written by the members of what we called the “founding generation”, entitled “Twenty years of ES: How far have we come and how far do we still need to go?” (Costanza, De Groot, Braat, et al., 2017) and the chapter by the same authors titled “A short history of the ES concept” in the book “Mapping ES” (de Groot et al., 2017). Additional prominent publications were those of Gómez-Baggethun et al., (2010), about the history of ES in economic theory and practice, and Chaudhary et al., (2015), who explored the evolution of the ES concept from a discourse-centered analysis perspective. The fact that all the interviewees (from the founding generation, as well as from the second and emerging generation) mentioned almost the same benchmarks as in the literature suggest that these papers shaped the discourse and “wrote the history” which today ES practitioners recite.

The more novel and diverse responses that we received for this question, mentioned mainly by the “second” and “emerging” generations, were about benchmarks of the last decade, which concentrated around four important and relatively recent developments and science-policy initiatives of the ES concept:

- 1) Recommendations for more pluralistic and integrative valuations: pluralistic that can encompass a wide variety of dimensions that assess the interdependence between nature and societies, including biophysical, health, sociocultural or holistic approaches and integrative that can represent a multitude of different worldviews instead of a single one. Such calls were linked in particular to four publications, including: Pascual et al. (2017) based on the work of Müller et al., (2010) about integrative approaches to ES; the publication by Jax et al. (2013), “Ecosystem services and ethics”, which introduced these ideas in relation to ES assessments, and; the introduction by Chan et al. (2018) to a special issue of the journal, *Current Opinion in Environmental Sustainability*. Their introduction, “Relational values: what are they, and what’s the fuss about?”, and the special issue as a whole further advanced these ideas.
- 2) The growing significance of ES in urban contexts, an idea that was embedded in the initiation of the Cities and Biodiversity Outlook (CBO)¹¹.
- 3) Initiatives aimed at spatially mapping ES for enhancing the use of ES in decision making, such as the Horizon 2020 funded ES MERALDA project¹² (2015) and the MAES – Mapping and Assessment of ES – funded by the European union in 2016 (under Action 5 of the EU Biodiversity Strategy to 2020 (2014).

¹¹ Cities and Biodiversity Outlook (CBO) combines science and policy in a global assessment of the links between urbanization, biodiversity, and ecosystem services.

¹² ES MERALDA aims to deliver a flexible methodology to provide the building blocks for pan-European and regional ES assessments. The work will ensure the timely delivery to EU member states in relation to Action 5 of the CBD Strategy, supporting the needs of assessments in relation to the requirements for planning, agriculture, climate, water and nature policy (Burkhard et al., 2018).

- 4) The influence of ‘Climate Change’ initiatives and movements promoting ES awareness such as successive IPCC reports, the 2015 Paris agreement, and the Greta Thunberg movement that began in 2018, challenging world leaders to take immediate action for climate change mitigation.

4.3.4 Advantages of the ES Concept

The next question asked was, “What are the main advantages you see in the theory and application of the ES concept?” The main themes raised by interviewees about the advantages of the ES concept are arranged from the most mentioned to the least (Table 4-3).

Table 4-3: The advantages of the ES concept – main themes mentioned by respondents

| Advantages of the ES concept – Emergent themes | Meaning summarized from respondents | Number of respondents mentioning each theme and the generations to which they are associated | Indicative Quotes |
|------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Interdisciplinary concept | An effective way to connect between different disciplines and catalyze interdisciplinary dialogue and collaborations. | 9 Noted by respondents from all three groups | “ES managed to connect different players from different disciplines and fields”. “ES as a tool to ‘ecologize’ economics.” |
| Communicate nature to people | A Practical tool to show people from different audiences, including people that don’t understand nature conservation, why to care for nature and why biodiversity is important. | 8 Noted by respondents from all three groups | “... we are on the edge of the abyss environmentally ... ES is an important tool to show the interdependency of people and nature.” |
| Holistic and transdisciplinary concept | A field that can be used as a boundary object to bring researchers, stakeholders, and local people together. | 7 Noted by respondents from the second and the emerging generations | “I liked that it could bring different people to the table”. |
| Social-ecology | It encourages systems thinking ¹³ and seeing people as part of nature instead of separate entities. | 6 Noted by respondents from all three groups | ” I really liked the idea that the human sphere can be brought in” |
| Applicable tool | An Effective and applicable tool to inform and influence decision makers. | 5 Noted by respondents from the second and emerging generations | “Easy to convey messages visually with spatial mapping of ES”. It is a particular tool for planning, and for the space and managerial decisions”. |

¹³Systems thinking is the process of understanding how things influence one another within a whole. In nature, systems thinking examples include ecosystems in which various elements such as air, water, movement, plants, and animals work together to survive or perish.

| | | | |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | | “Helps scientists contribute to solving problems”. |
| Economic argument | A powerful way to present and integrate the value of nature in terms that resonate with those who think in market terms. | 5 Primarily noted by respondents of the founding generation | “Sentiments and ethics are not enough to stop the loss of biodiversity and ecosystem destruction. The possibility of quantifying [monetarily] was the trigger.” |
| All services not just one | A great tool to look at the entire range of benefits of nature and not just one aspect. | 4 Noted by respondents from the founding and emerging generations | “Not only cultural services but also the importance of regulating services”. |

The theme most mentioned by respondents as a strength of the concept was its interdisciplinary nature. The respondents reinforce a claim by Reyers et al., (2010) that use of the ES concept has primarily helped ecologists to make links with many disciplines. In general, there were strong similarities between our results and advantages described in the literature. Bull et al., (2016) in their research surveying 20 young ES practitioners about the strengths and weaknesses of the ES concept found very similar themes to ours. For example, “interdisciplinary approach” was also highlighted by them as the most important strength of the ES concept. After that, they found the chance to improve accounting for nature (similar to our “economic argument”) as the second most important strength and then “holistic approach” as the third. They also found the advantages of ES as a “communication tool” and as a tool to “(re)connect people to nature” same as we found in our research. In short, there is agreement between our response and the research literature that essential advantages of the ES concept lie in its holistic - inter and transdisciplinary potential, its ability to support improved decision-making and in its potential to reach the public.

The theme of ‘transdisciplinarity’ and of ES being an applicable tool for planning and decision making were advantages that were recognized by the ‘second generation’ and the ‘emerging generation’. Transdisciplinarity was found to be an advantage and a necessity for operationalization of the ES concept in our two previous chapters (on the regional and national scales) and in a growing number of publications (e.g., Carmen et al., 2018; Steger et al., 2018; Avriel-Avni and Dick, 2019; Holzer et al., 2019). ES was defined as an ‘emerging scholarship that goes beyond disciplinary boundaries’ by Costanza and Kubiszewski (2012). The connection between ES as a boundary object, and “transdisciplinarity” is often echoed in the literature because ES facilitates cooperation between different groups and disciplines (Abson et al., 2014; Kull et al., 2015; Schröter et al., 2014; Steger et al., 2018; Ainscough et al., 2019). The fourth most important advantage is “social-ecology”, which is often mentioned as the fundamental base of the ES concept, implying the worldview that humanity must be treated as part of nature rather than separate from it, and that we fundamentally rely upon functioning ecosystems (Mace, 2014). Human concerns have become integrated in the way ecologists conceptualize complex social-ecological systems (Reyers et al., 2010). The theme of looking at “all services not just one” also referred to as “holistic” often came up, in our national scale chapter through interviews with land use organizations’ managers. For example, forest managers

said that the ES concept helped differentiate between different types of forests according to which services each forest is designated to enhance. A forest for regulation services, for example was a relatively new addition to the forest types, which had typically been assessed and managed for provisioning and/or cultural services.

Another question we asked respondents was about their triggers for using the ES concept in their work, which is similar to the question about advantages, but more focused on the factors that made them personally adopt the concept and what it added to previous work that they did. "The most commonly recurring reason that researchers offered for their adoption of the ES framework was that it enabled them to adopt and transmit a much broader, more holistic understanding of nature and its importance to human well-being. Rather than being restricted to often abstract connections between biodiversity and human wellbeing, the ES framework offered a more systematic and diversified way of assessing the benefits of nature for people while considering the people involved and their needs. They also hoped to contribute to nature conservation with this concept. In addition, there were far more prosaic reasons for adopting the concept. For example, adopting ES terminology was considered 'a way to get funds', as one said: "*I couldn't avoid ES as it was the term for getting funds and projects*" or as others called it, 'academic fashion'. One respondent said: "*Using ES was simply for making my terminology sexier*". The academic institution and policy initiatives decided to adopt the globally popularized concept and allocate funds for it. Accordingly, as Acharya et al., (2019) show in their study about analyzing funds for ES, the growing trend of researchers publishing on ES and developing tools for ES have been significantly influenced by Global biodiversity and climate related policies that allocated funding for ES research and projects. Finally, by adopting the ES concept scientists thought that it can be a 'professional opportunity' for using specific tools that interested them (such as participatory mapping) and developing theories and methods for the missing aspects of the ES concept.

To conclude, respondents cited four main advantages of the ES concept that triggered them to adopt the concept: (1) **Effective** for supporting nature conservation by connecting with the public and with decision makers; (2) **Holistic**, allowing the scientist to work with various disciplines, stakeholders and examine diverse benefits provided by nature; (3) **Broad** in its worldview, integrating humans into nature and recognizing nature as much more than biodiversity (social ecology), and; **Practical**, adopting the concept allows access to research funding, it is interesting academically, and it aligns research pursuits with global academic trends.

4.3.5 Disadvantages of the ES Concept

After discussing with respondents the advantages of adopting the ES concept, we asked them: "What are the main disadvantages/limitations in the theory and application of the framework?" We collected the main themes arranged them from the most mentioned to the least (Table 4-4).

Table 4-4: The disadvantages of the ES concept – main themes mentioned by respondents.

| Disadvantages of the ES concept – Emergent themes | Meaning summarized from respondents | Number of respondents mentioning each theme and the generations to which they are associated | Indicative Quotes |
|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Not effective enough in changing decision making. | The science-policy aspect needs to be improved to communicate to decision makers. It remains hard to convince decision makers about the value of nature. Only a relatively small group of decision makers know the term. | 6 | “The term didn’t really catch up in the general public”. “It is not taken enough in decision making because they don’t understand what to do with it”. “Still the perception outside of science is that ES is just ‘green’. Politicians still see in it – hippies that think that every leaf is important” |
| Overemphasis on economic assessment | Fear of economic assessments and extrapolations that will cause wrong decisions. Preference for a less utilitarian approach. Misinterpreting the valuation as being an attempt to privatize services or put a price tag on them. | 5 | “I never liked the economic part. It’s a pity that this is the way our market world understands the value of nature”. “Extrapolations can disengage the policy makers”. “People think that we are trying to ‘sell’ nature”. |
| Fussiness of methods and definitions | The classifications, definitions and tools are sometimes unclear for the scientists. | 3 | “The cultural ES are still somewhat fussy and difficult to put in boxes”. “There is no consensus about the ‘taxonomy’ of ES”. |
| Complex for non-professionals | The term is often technical and complex for non-professionals. | 3 | “I’m careful not to bring complex maps and models that can disengage people”. |
| Anthropocentric distancing from biocentric | Benefits for people instead of intrinsic values of biodiversity | 3 | “It moves away from biocentrism, from philosophies of nature that are meaningful and encourage the modesty of our place in the world”. |
| Social science missing | Still stronger foundation in natural sciences and economics. Relational values missing | 3 | “Social science never really took the approach”. “To put the demand after the supply is the error, but now researchers are trying harder to involve social scientists”. |
| Scientific colonialism | ES concept is being regarded as colonial thinking because of injustices in the global world. | 2 | “The label ES is contested by people in other regions... to force this view which originated and developed in North America and Europe, on other countries is problematic”. |

According to our respondents the main weaknesses of the concept are that the concept is still “not effective enough in changing decision-making”, that it places “overemphasis on economic assessments” which relates to it being “anthropocentric distancing from biocentric values of nature” and disadvantages related to the imperfect and not consensual methodological and terminological aspects related to ES assessment and the missing contribution of social science.

Similar disadvantages were seen in other perceptions research such as Bull et al., (2016) and also in the general literature body criticizing the ES concept (e.g., Norgaard, 2010; Gómez-Baggethun et al., 2010; Schröter et al., 2014; Silvertown, 2015; Bekessy et al., 2018; Craig et al., 2019; Spash, 2020). Schröter et al., (2014) provide a synthesis of critiques and counter-arguments to the ES concept, grouping the critique to three types of arguments: 1) **ethical** – regarding how humans relate to nature, 2) **strategic** – for nature conservation relating to the science-policy interface and 3) **scientific** – ES as a scientific approach. The disadvantages found in our research can also be divided to these types.

The ethical type of critiques suggested that the concept places overemphasis on economic assessments and that it is too anthropocentric, which were also the main critiques found by Norgaard (2010), Gómez-Baggethun et al., (2010) and Bekessy et al., (2018). These critiques emphasized the fear of reframing nature as services, supporting the market-driven worldview that nature is important only to the extent that it provides goods and services to humans (Bekessy et al., 2018).

The strategic type refers to applying the ES concept as a strategy for nature conservation. This arose in our research when the respondents mentioned disappointment that the concept was still “not effective enough in changing decision-making”. This is defined as a major gap in the ES concept literature as described at the end of Section 1.1.

The scientific type of critical arguments in our research included the disadvantages of the methodological and terminological aspects of ES: “fussiness of methods and definitions” and that the “social science methods and tools are still missing. This was similar to what Bull et al., (2016) found from their interviews with ES practitioners that the main weaknesses in the ES concept are an ‘incomplete scientific basis’, ‘inconsistencies in the application of ES frameworks’ and the ‘ambiguous, fussy language of the ES concept’.

Our research uncovered an additional disadvantage that has been less emphasized in the literature (final row in Table 4-4). This disadvantage refers to the political aspects of the concept. This is a relatively novel framing of the concern, or ‘accusation’ of the ES concept as being ‘scientific colonialism’ or ‘colonial thinking’ in the efforts to impose ‘this view’ that was developed in the west, on other countries. Galtung (1967) described ‘scientific colonialism’ as the process whereby the acquisition of knowledge in a certain nation is located outside the nation itself. We add that the development of methods and a framework for acquiring this knowledge

are located outside the nation¹⁴. This colonial notion isn't completely new, as the ES concept has often been criticized for the lack of emphasis on local knowledge and on ways to include local and indigenous knowledge, which is also one of the reasons for the IPBES conceptual framework to adopt the concept "nature's contribution to people" as explained in Diaz et al., (2018). The call to further emphasize social inequalities and injustices and power asymmetries among actors in ES research (McAfee, 2012; Berbés-Blázquez et al., 2016; Martín-López et al., 2019) also accentuates this thinking. ES has also been considered a tool for neoliberalizing nature (Kull et al., 2015), by controlling what type of decisions other actors can make on using or managing ES and influencing other actors' knowledge. We haven't found research specifically referring to the ES concept as 'scientific colonialism'; however, the need to expand beyond the work and definitions of scientists and practitioners from the global north was mentioned (e.g., Gould et al., 2020). The specific term 'scientific colonialism' was found in the critique of 'sustainable development' science referring to the use of the concept or branding companies as 'sustainable' while continuing colonial exploitation of indigenous people's land (Parson and Ray, 2018; Ziai, 2016). In other cases, this term was mentioned when referring to the "rational" management of resources, being integral to the western economy, and imposed on developing countries which threaten to colonize spaces and sites in developing countries, by making spaces "efficient" in order to be conserved (Banerjee and Campus, 2002). On the other hand, researchers say that European colonial expansion and capitalist demands from nature, were also the reasons that led to the understanding that earth's natural resources are limited which led to a rise of a global environmental consciousness and the need for conservation (Grove, 1995 in Redford and Adams, 2009) because ES were seen as vital for maintaining the economic output of the colonies. Robertson (2004) referred specifically to ES as 'colonial' saying that the use of ecosystem science to define ES in easily measured commodities is Neoliberal colonial thinking. Our results emphasized this critique as another important aspect that should be addressed in future ES research.

4.3.6 Implementation and impact of the ES concept

Next, we asked respondents to report from their experiences, on implementation of an action based on ES assessment and research. Most implementation examples given were general, with fewer examples of real-world, on-the-ground impact of ES assessment. Some spoke of the challenges of implementation.

Examples of implementation were divided between global implementation of ES and national/local examples. In the global arena, respondents referred to the implementation of ES in five different spheres: (1) **discourse** - everyday language of researchers and stakeholders dealing with nature, particularly notable in international forums and conferences); (2) **academic institutions**, including research and courses: (3) **international research-policy platforms and initiatives** on ES, such as MEA, TEEB, IPBES and ESMERALDA; (4) **commissions** including

¹⁴ Ironically, the current research perpetuates the problem, given our selection of respondents from the global north to study a global concept that aims to be used in both the global north and the global south.

ES into their policies and assessments, such as the UN Statistical Commission, who accepted to expand the System of Environmental Economic Accounting to include ES, and the CBD, and; (5) **business**, such as Coca Cola comparing different European replenishment projects on their overall ES benefits (Natural Capital accounting, 2016). National examples offered by the respondents referred to: the use of ES maps and assessments as the basis for (1) strategic policy reports, such as green infrastructure report, (2) planning, for example in land-use planning or for prioritization of lands for conservation, (3) as a requirement in existing environmental assessments, such as environmental impact assessments, resilience assessments, annual state of nature, and (4) ES initiatives, such as national ES assessments or “urban strategy plans for enhancing ES”.

As mentioned earlier, examples of on-the-ground impact where improved conservation management were made based on the ES research, were less common. However, some examples were mentioned. I followed up on some of the publications on these projects noted by respondents, to further characterize the projects to supplement their descriptions. These examples included:

- A pioneering project of ES in the South African mountain fynbos ecosystem (a world hot spot of plant diversity) used an ES model to show how controlling invasive alien plants led to an increase in native plant biodiversity, water production, ecotourism and other services. As described by Cowling, Costanza, and Higgins, (1997), the added value of using the ES concept was the model that brought together both ecological and economic processes and assessed various policy interventions, as the area was threatened by a lack of funding for effective management of these invasions. According to the respondent there was a change in management following the project.
- Projects in Germany were inspired by ES assessments of urban green infrastructure, such as a revitalization of brown fields, after mapping ES on brownfields in Leipzig (Pueffel, Haase, and Priess, 2018).
- A management plan for sustainable growth and prioritization of conservation areas of the Northern Mozambique Channel (a world hot spot for marine biodiversity) was based on results of mapping and assessing ES and using the Driver-Pressure-State-Impact-Response framework (Ghermandi et al., 2019).
- Conservation management of Serra de Collserola Natural Park near Barcelona was based on a quantitative assessment of the ES provided by the ecosystem of Barcelona and the peri-urban park to prove that these matter for the city's livability (Depietri et al., 2016).

Lastly, examples of local communities using the ES concept to create new national parks or to convince why to conserve a forest in threat, were given. These examples show how with the help of the ES assessments and tools there was eventually a shift in the management plans which then changed the ecosystems they were dealing with according to the assessments.

Not all experiences regarding application of the ES framework were positive, and several respondents spoke of the **difficulty of effecting real world decision making** and others of the **difficulty to “measure” or assess whether it had an impact on policy or not**. Aside from the

lack of tools to measure impact, respondents noted that when research funds end, researchers move on and no longer follow the impact of their research and assessments. Some spoke from their experience about how to get a better impact, such as by **involving stakeholders and local knowledge**, and “by understanding the economic drivers of the stakeholders”. Some spoke of the realization that if they had involved stakeholders more in their past ES assessments, maybe their work would have had more of an impact. These findings correlate with findings from our literature review about how to enhance the impact of ES knowledge on decision-making and policy: namely by strengthening the integration of stakeholders in all parts of the ES research (see Section 2.1.1 in this research and Dick et al., 2018; Jax et al., 2018). Further, our research in the Carmel Biosphere Reserve in Chapter 2 also supports these assertions.

Recalling the three pathways through which ES knowledge can translate into influence as ‘instrumental’, ‘conceptual’, and ‘strategic’ (McKenzie et al., 2014; as analyzed in the discussion of Chapter 2 about the Carmel, Section 2.4.1), also here we see that all three pathways were addressed. The ‘instrumental’ pathway of direct influence was mentioned in the specific examples of on-the-ground impact, the ‘conceptual’ was mentioned in the adoption of ES into the discourse and the ‘strategic’ in the global science-policy political platforms and initiatives and local ones. This strengthens our conclusion from Chapter 2, that measuring direct impact is only one of three potential pathways of impact, and practitioners should be aware (and encouraged) of positive impact via all three pathways.

4.3.7 Stakeholder involvement in ES research

Next, we asked whether stakeholders were involved in ES projects that they took part in, and how. Five out of the 16 respondents (all from the emerging generation and the early adopters) mentioned that they involve stakeholders in **all** ES research projects and the rest said that they involve stakeholders in **some** of the projects. One said: “*all my research is informed by the needs of stakeholders*”. Another said: “*without stakeholder involvement it’s not a real ES assessment...*”. Another said: “*Without talking to local people, it is just science*”. These quotes emphasize the uniqueness of ES as a post-normal science. One respondent also mentioned that even the subject of their research is initiated by the stakeholders approaching them, (“*more and more NGOs and interest groups... are approaching us in order to help them rethink of how they manage their ecosystems*”) and others mentioned that stakeholders request the results of their studies.

Respondents mentioned the gradual trend over the years of increased stakeholder involvement in ES research, and in parallel, a growing level of familiarity of stakeholders with the ES concept. They also mentioned that ES projects often require to involve stakeholders. Some examples of such ES projects include: URBES¹⁵, ESMERALDA, OpenNESS¹⁶, NATURVATION¹⁷, ES

¹⁵The URBES project (Urban Biodiversity and ES) bridges the knowledge gap on the role of urban biodiversity and ecosystem services for human well-being. It further aims to inform urban management and decision-makers on how to best integrate the natural environment and human needs.

assessments in Biosphere Reserves, ALTER-Net¹⁸ and YESS projects (Young ES Specialists of the ES Partnership). Moreover, the guidelines of how to use the ES framework emphasize stakeholder integration (e.g., TESSA, TEEB, ESMERALDA MAES Explorer, IPBES, ESP Guidelines for Integrated ES Assessment and others).

Some said that whether they involve stakeholders is dependent on the type of ES research. For instance, if their role in the ES project focused on assessing ES from an existing database or on developing tools to assess ES by coding other valuation studies from the literature, then involving stakeholders is not needed. One respondent also mentioned feeling pressured to involve stakeholders and their needs in his research saying: *“I think that scientists sometimes need to develop their research priorities objectively and not just because there was a need from the stakeholders”*.

The principles and methods for how to integrate stakeholders as mentioned by respondents are summarized here:

- 1) **Train stakeholders in the language and thinking of ES** or if better understood use other simpler terms instead such as “benefits” (as we also did in previous research: Sagie et al., 2013).
- 2) **Involve stakeholders from the beginning** of the ES process to understand the drivers of change, to generate ownership, and to increase the chance that they will use the knowledge created (also mentioned by us in Chapter 2 and by others e.g., Acharya et al., 2020).
- 3) **Co-produce knowledge** with the stakeholders/locals. Lemos et al., (2018) describe how *co-production* is becoming a rapidly spreading practice among sustainability and climate change studies promoted as a panacea to overcome barriers of knowledge use; however, as they show it may also have negative effects that should be considered. For instance, not all co-production leads to inclusion, use, or advantageous use and not all co-production processes pay attention to equity among participants and non-participants.
- 4) **Balance and limit the amount of stakeholder meetings** in order not to create stakeholder fatigue (as also found in: Reed, 2008; Holzer et al., 2019).

Table 4-5 lists the stakeholder integration methods that were mentioned by respondents.

¹⁶OpenNESS (Operationalisation of natural capital and ES) aims to translate the concepts of Natural Capital (NC) and Ecosystem Services (ES) into operational frameworks.

¹⁷Naturvation (NATure-based Urban innovation) is a 4-year project, funded by the European Commission and involving 14 institutions across Europe to examine how innovation can be fostered in this domain, and contribute to realizing the potential of nature-based solutions for responding to urban sustainability challenges by working with communities and stakeholders.

¹⁸ALTER-Net is a network of partner institutes from 18 European countries. ALTER-Net integrates research capacities across Europe: assessing changes in biodiversity, analyzing the effect of those changes on ecosystem services and informing policymakers and the public about this at a European scale.

Table 4-5: Stakeholder involvement methods in ES research practiced by respondents

| Stakeholder involvement methods | Times mentioned |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Participatory GIS/mapping <ul style="list-style-type: none"> • Participatory valuation exercises | 4 |
| Stakeholder Workshops <ul style="list-style-type: none"> • communicate the results • ‘Vision development workshops’ • scenario planning | 5 |
| Online surveys/questionnaires | 2 |
| Focus group discussions | 2 |
| Interviews | 2 |
| Ethnography | 1 |
| Public council of stakeholders | 2 |

All of our respondents were involved in ES projects and initiatives which supported, increased, and developed various methods and principles for stakeholder involvement. In several cases it was emphasized that involving stakeholders was a prerequisite of projects. It is important to note that none of the respondents said that they do not engage stakeholders in their work. These findings are in line with the general trend found in the literature on the growing awareness towards the importance of stakeholder involvement in ES research and environmental research and about the transdisciplinary aspects of ES research. As found in the literature of the last twenty years popularized with the work of Reed (2008) and others (e.g., Menzel and Teng, 2010; Reed et al., 2018; Morf et al., 2019; Röckmann et al., 2017; Ramírez Gómez, 2019) as also described in earlier chapters (see Sections 2.1.1 and 2.4.3). However, as we found in this study, on the one hand respondents believe that actual involvement of stakeholders still needs to increase along with developing tools of how to involve them, but on the other hand they believe that stakeholder engagement and co-production of knowledge should also be practiced critically and moderately.

4.3.8 The future of the ES concept?

4.3.8.1 What is still missing?

When asked about how they see the future of the ES concept, some respondents steered the conversation to what they perceive is still missing in the ES paradigm and its application or what needs improvement for the future. The general aspects that need to be emphasized or developed in the ES discipline, from the most mentioned theme to the least were:

- 1) **Emphasis on social aspects** such as considering power relations - winners and losers, who decides who is involved, social-environmental injustices, continued focus on socio-ecological and systems thinking and increased focus on relational values and intrinsic values.

- 2) **Make ES more applicable, accessible, and appealing for decision makers** by creating useful tools and addressing real-world problems. As one respondent mentioned; *“For the future we still need a major breakthrough in policy, because until now it is more scientific”*.
- 3) **ES research that is less focused on economic assessments** as one respondent mentioned *“we need to step back to a less utilitarian approach”*. One of the founders of the ES concept reflected on that saying that in the coming decade “wellbeing economy” will be in the center, and the contribution of ES to sustainable well-being will be emphasized.
- 4) **ES research on climate change.** For example, one respondent referred to the need to study *“long-term effects of climate change and land use change on ES”*.
- 5) **Using digital information and social media for ES research.** As one respondent mentioned: *“...it is a game changer in the way we analyze how people interact with nature”*.
- 6) **ES as a mandatory part of national accounting and planning.** In the same way as population and GDP are measured periodically also national ES should be measured.
- 7) **ES assessments as a mandatory requirement of environmental impact assessments.**

4.3.8.2 Will the ES concept survive?

All respondents thought that the ES concept or at least the idea behind it will continue to be used in the future. *“The message is important, not the name”* as one respondent said. One third of the respondents thought that the idea behind ES might continue under a different name (two of them referred specifically to Nature’s Contribution to People (NCP). However, four respondents emphasized the importance of ES continuing as ES, and specifically referred to their opposition to the NCP concept. They said that since ES is the most established concept, and already a common language among scientists, planners, and decision makers, changing the name will confuse or disengage people working with ES. *“We should stop jumping from one concept to the other as happened with Nature Based Solutions”*. However, several respondents mentioned that some ‘jumps’, like the jump from Biodiversity to ES, was important as it adds the human aspect and speaks more to decision makers (as mentioned previously in this research). Most were optimistic about ES continuing in the future showing how it is already part of many global initiatives.

Discussion: The NCP approach was mentioned by six of our respondents, some in favor of the concept and some against it. NCP developed as a theoretical framework for the assessments of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). It is based on the ES approach and aims to address some of the shortcomings of the ES approach and extend beyond them, by paying close attention to the significance of culture, local knowledge, and indigenous knowledge for understanding human nature relationships and specifically nature’s contribution to people (Díaz et al., 2018). The new framework received some harsh reactions especially because of its threat of trying to replace the ES approach, already implemented in science and policy and confuse policy makers and practitioners already using ES (de Groot et al., 2018a; Muradian and Gómez-Baggethun, 2021). The threat of ‘competing approaches’, the different approaches to biodiversity conservation and sustainable resource management that will divert interest away from ES research, was also mentioned by YEES respondents in Bull et al., (2016) as one of the threats to the future of ES. The NCP approach

places emphasis on social aspects that were often mentioned as missing in the ES approach by our respondents, in their perceptions of “disadvantages of the ES concept” (Section 4.3.5) and of “what is still missing” described above. Although there has been a consistent rise in the amount of social research focusing on ES, and pluralistic, integrative, and other forms of valuations are being developed and even mentioned by our respondents as one of the recent benchmarks of the evolution of the concept, several researchers assert that it can and should play a much stronger role in the future in understanding human values, motivations, and activities vis-à-vis ecosystems and their services (Martín-López et al., 2012; Katz-Gerro and Orenstein, 2015). Moreover, there is a call to further emphasize social inequalities, injustices, and power asymmetries among actors in ES research (McAfee, 2012; Berbés-Blázquez et al., 2016; Martín-López et al., 2019; Gould et al., 2020). As a response to this trend, the name of the upcoming 4th ESP Europe Conference, Heraklion Greece, in October 2022 is: “*Ecosystem services empowering people and societies in times of crises*”. The conference title suggests the increasing centrality of social aspects of the ES concept and its application.

4.4 Conclusions - global scale

In this chapter we examined the perceptions of global experts of ES regarding the history, current state, and future potential of the ES concept and its application. Prominent among the issues raised included critiques of the concept, triggers for adopting the concept, perceptions on implementation of the concept in policy and the future directions. We found certain themes that came up recurrently in different questions and subjects. We described and discussed the most prominent of their perceptions and compared their statements to the literature on the ES concept. We note a change in the generational perceptions of some of the issues, which shows that the concept is evolving, morphing, and adapting. But since the ES community is still relatively small and with frequent interactions and knowledge exchange, we also found similar ideas that were discussed by all respondents and also found in the literature.

To conclude, we mention here some of the main themes that arose that emphasize several aspects of the ES concept. The ES concept was often regarded as “**holistic**” - a whole systems approach rather than one that separates and isolates parts of the system. The concept was perceived as contributing to **inter-transdisciplinary** collaborations involving several scientific fields and stakeholders, noted as both a current, advantageous characteristic, and as something to continue emphasizing and developing in the future. However, **stakeholder engagement** and co-production of knowledge was also mentioned as something that makes the concept ‘fussy’ or unobjective and a challenge for the use of scientists, therefore should continue to be critically assessed. **ES as a strategic concept for nature conservation** promoting science policy interactions was mentioned both as the advantage of ES but also what still needs to be strengthened. The **economic assessment**, which was regarded (especially by the founding generation) as a breakthrough that popularized and enabled the discipline to be diffused and mainstreamed, was very often criticized by the emerging generation of ES researchers as something ethically and politically problematic that should be less emphasized in the future. Similarly, the **anthropocentric worldview** that the ES concept entails was regarded as helpful

for influencing decision making but problematic in the long run because it is decreasing intrinsic values of nature. **Climate change** and its connection to ES was mentioned both as an important benchmark in the evolution of the concept's global diffusion and, again, as a field of research still missing for the future. Politically, ES was regarded by a few respondents as a framework that reflects and encourages **scientific-colonialism** (i.e., as it is a scientific concept developed by scientists and practitioners from the global north to be used globally including on indigenous cultures). The need to expand beyond the work and definitions of scientists and practitioners from the global north was mentioned calling for more awareness and **development of social tools** to enable assessment and integration of local people's values and integrative, plural, relational values, and more awareness to environmental injustices. Politically, as often mentioned, the ES concept has been adopted as it was a good way to get funding and stay up to date regarding the most recent global scientific trends. Some differences in opinion were notable regarding the future of the concept and whether Nature's Contribution to People or other discourses will challenge the future of the concept; however, all agreed that the ES concept and ideas are strongly anchored in today's scientific and policy discourses, and are thus, as one respondent mentioned - "here to stay".

5. OVERALL CONCLUSIONS AND IMPLICATIONS OF RESEARCH

It has been 17 years since the ecosystem services concept was popularized into policy and science via the publication of the Millennium Ecosystem Assessment (MEA, 2005), the most significant benchmark in the proliferation of the concept. ES evolved as a scientific paradigm shift (as we show in this research) as scientists realized there was a necessity for a better conceptual framework for nature conservation. The MEA recognized that need and developed the ES conceptual framework to fill the gap. Since the publication of the MEA, the ES concept has rapidly become one of the most dominant concepts in ecosystem/landscape/open space management and, as shown in this research, it has not only become integral to discussions among land use management organizations and scientists but also remains a lightning rod of conflict. As all paradigm shifts, it came with much ‘revolutionary competition’, and tension, not only among the scientific community but also between different open space managers, activists and planners representing different organizations and institutions.

In this research we looked closely at two gaps in the literature regarding this concept; one is the actual applicability and operationalization of the concept. As we found in the literature, the ES community is continuously preoccupied with the implementation of the ES concept, how to make it more relevant and used by decision makers, and how to involve stakeholders as a way to increase its impact. The second gap relates to the factors influencing diffusion and resistance of the concept within civil society, among organizations, planners, and scientists at different spatial scales (i.e., local, national, and global). In this research, we addressed these gaps in a multiscale analysis of the ES concept.

Firstly, we examined how the application of the concept has played out in a specific ES assessment project. In this project we emphasized stakeholder integration as a tool to operationalize the concept and understand regional environmental challenges, to help the assessment serve real world problems. Then we elucidated through the eyes of stakeholders how the ES assessment can serve them in promoting sustainable management of the Carmel Biosphere Reserve. We observed how ES, as a boundary object, brought stakeholders and scientists from different fields, institutions, organizations, and religions, who would not necessarily meet, to convene and collaborate on projects, and accentuated the need for a transdisciplinary ES research process.

Secondly, we studied the factors influencing the diffusion of the concept nationally using the case study of Israel. We took an historical point of view, focusing on the evolution and diffusion of the concept since its first appearance in Israel. We then analyzed how different land management and nature conservation organizations, government agencies and individual researchers adopted the concept differently and used it for their needs and how ES as a paradigm evolved differently in different contexts. This analysis revealed how, on the one hand, the Israeli ES discourse has developed as a microcosm of the international discourse, where the sources and topics of conflict, the challenges to adoption, and the successes in implementation were similar. On the other hand, we revealed how geographical and organizational factors influenced whether

and how the ES concept was adopted or whether it was rejected by various social actors and organizations. For example, we saw how it became a “punching bag” between organizations that did not agree with each other anyway; for each one, adoption or rejection of the concept only reinforced the differences between them. This exemplifies how the ES concept is a social construction (Ernstson, 2013) that blends with local culture, as we introduced in Section 1.3.

Lastly, we studied the implementation of the concept at the global scale, focusing on global experts’ perceptions and the triggers that catalyzed them to adopt the concept. We found that they perceive ES as increasingly implemented in both science and policy globally and nationally, but on-the-ground examples of ES application that demonstrate the impact are lacking. They recognized several problems in the conceptualization and implementation of the ES concept that generated criticism among both academics and practitioners and inhibited the effectiveness of its implementation. Despite the shortcomings of the concept, respondents generally believed the concept should be further integrated into global and national nature conservation discourse. They further emphasized specific aspects that relate to the conceptualization, methods, and tools associated with application of the concept and research fields that should be developed for the future use of the concept.

We conclude with the following sections:

1. The importance of multiscale analysis including a synthesis of the criticisms of the concept at multiple scales.
2. The contribution of ‘diffusion of innovation’ theory to ES research.
3. A final discussion of ES as a paradigm shift.
4. Insights on the future application of the ES concept

5.1 The importance of multiscale analysis

The importance of the analysis at all three scales for examining adoption and implementation was exemplified in the various ways the concept was applied and perceived by practitioners at different spatial and organizational scales. We emphasize that the goal of our multiscale analysis was complementary (to enrich the scope of our knowledge on the issues examined) rather than comparative. Each scale focused on investigating the ES phenomenon from different angles with specific research questions tailored to fit the scale of analysis; therefore, the methods, the number and types of interviewees, as well as the questions they were asked, were different for each scale. For this final chapter, however, we synthesize the knowledge collected on the perceptions of stakeholders and scientists from all three scales regarding the main critiques, disadvantages, and challenges of the ES concept. This enables us to recommend several directions that application of the ES concept can take in the future to address these critiques and strengthen the impact of ES on nature conservation. We arranged the critiques in Table 5-1, according to four core groups of arguments. Three are the groups identified by Schröter et al., (2014), as already described in the disadvantages Section 4.4.5, and the fourth group is our added group found in this research. The second column describes seven types of critical arguments as found by Schröter et al., (2014) and the final three columns describe how these were exemplified in our research at each

scale. Following the table, we highlighted one major advantage of the ES concept raised in our research and describe how this advantage was apparent at all three scales of analysis.

Table 5-1: Synthesis of the critiques of ES at multiple scales framed in Schröter et al., (2014) critiques of ES

| Three groups of critical Arguments according to Schröter et al., (2014) | Seven critiques according to Schröter et al., (2014) | Results from our research | | |
|-------------------------------------------------------------------------------|------------------------------------------------------|---------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| | | Global scale | National scale | Regional scale |
| Not effective enough as a strategy for nature conservation. | | Not effective enough in changing decisions | Lack of tools and expertise to apply it for decision making | Regional assessments - too general, not focused on specific planning dilemmas |
| | Overemphasis on economic valuation | Overemphasis on economic assessments | Risk of the economic assessment to do damage | Could be misleading to assess ES of a burnt forest as a strategy to conserve it from development |
| | Conflicting with biodiversity conservation | | Not suited for biodiversity conservation in nature reserves, and deserts Too complicated, pompous language | |
| Vagueness of terms and definitions and normative aims | Vagueness of definitions | Technically complex and fussy | Vagueness of definitions and methods were criticized for making the concept not objective / scientific enough | 'Disservices' not mentioned |
| | Normative nature | | | |
| Problematic ethical considerations, which relate to human-nature relationship | Anthropocentric | Distancing from biocentric considerations | Disappearance of moral arguments | |
| | Exploitative human-nature relationship | | Disrespect for nature's inherent values | |
| | Commodification of nature | Social considerations & plural valuations missing | Accounting of nature | |
| Our added group: | | Scientific colonialism | Could be used to plant trees for national goals put behind ecological goals | Could be used to Justify nature reserves on account of local people's land |
| Political use of the term | | | Fussiness of the term allows it to be used wrongly by entrepreneurs to advance their development goals on account of nature | |

As we see in Table 5-1, the general critiques found in our research are similar to those found in the literature summarized by Schroter et al., (2014). One important addition is what we identified as the politicized use of the term. At each scale, different examples were given to demonstrate how the ES concept and ES assessments can be used politically for advancing goals that are not necessarily connected to nature conservation goals. These indicate the need to further include social-environmental-injustice issues in the application of the ES concept (as we discussed in Section 4.3.5). We also found that in some cases the different scales shed light on different critiques. For example, the regional scale stakeholders emphasized their concern that the 'disservices' arising from their natural areas that reduce stakeholders' quality of life were not mentioned in the ES assessment (the "normative aspect of the concept" as framed by Schröter et al., 2014). Another issue raised was the concern about how the economic assessment can be used negatively or distract from values-based reasons for conserving nature. This critique, heard often, was embodied in this research in specific examples at the regional and national scales, such as burnt areas in the Carmel and the Negev desert in Israel. Another critique mentioned at the national and regional scales was that ES assessments that were very general were also harder to use for making specific decisions compared to ES assessments that were focused on specific planning/management dilemmas. A final critique was that the ES concept continues to be diffused mostly among the 'green professional circles' – and less among stakeholders from other professional milieus that deal with open spaces, such as engineers, entrepreneurs, government

officials, and the ‘stewards of open space’ e.g., farmers and shepherds, regional council officials etc. This is because the ES discourse is still largely perceived as a high-niche-complex language by non-environmentalists. The global scale analysis provided an additional critique regarding the way developed countries may be imposing their view of nature on developing countries in a way that may not be suited or harmful to indigenous and local people’s needs and perspectives.

Despite these criticisms and the challenges to which they contribute, the concept has been adapted and improved and continues to adapt and dominate land use discourse. As mentioned by Kuhn (1962 in: Herfeld & Doehne, 2019), “early adopters have to adapt, extend, re-combine, and even transform the initial scientific innovation” in order to shape and reconfigure the possibilities for its adoption. Likewise, Potschin et al., (2016b, p. 1) write specifically about ES as a paradigm saying that: “... critiques of what is gained and lost in taking a particular world view are always valuable. As we saw in the national scale analysis, organizations that primarily disliked or rejected the concept also found ways to apply it to benefit their goals. These conflicts and criticisms direct the trajectory of the future evolution of the concept.

A positive attribute of the ES concept that was exemplified at all three scales related to its use as a boundary object. At the regional and national scales, we saw how the holistic aspects of ES language and scope made representatives from different organizations, who do not necessarily work together, collaborate for discussions on these topics and further develop the concept and its use to advance their open space management goals. In the global arena our study emphasized that ES contributed to the development and funding of many international initiatives and research projects that brought together (often mandatorily) interdisciplinary scientists to work together with decision makers and stakeholders. We believe that this is one of the greatest advantages of the ES concept: looking at open space management from a holistic point of view – including consideration of diverse benefits from nature (i.e., ES), which requires transdisciplinary collaborations.

5.2 Contributions of the research with respect to Diffusion of Innovations Theory

Studies of diffusion offer an empirical basis for developing approaches for social change or economic/political development. We believe that exploration of the diffusion, adoption, and rejection of the ES concept in Israel exemplified the change in the way Israeli society views nature as open space that is increasingly threatened and the growing awareness of the need to put nature conservation higher on the agenda (as discussed in Chapter 3). In addition, our analysis using diffusion of innovation theory helped us to develop an approach for understanding the factors that influence adoption of a global scientific concept at the national scale. This analysis contributes to the literature of diffusion of innovation theory, which has not often dealt with diffusion of conceptual scientific innovations, but mainly with diffusion of technologies and policy interventions. We not only examined the diffusion of a scientific conceptual innovation in academic communities as others did (such as Herfeld & Doehne, 2019) but also in stakeholder and decision-making communities. Scott et al. (2018), in their research on how to promote mainstreaming of the ES concept, identified the need to apply diffusion of innovation theory for the ES concept, as we have done here. In our research, we found that the factors influencing the

diffusion of ES (a scientific innovation) in Israel are well aligned with the components identified in diffusion of innovation theory by Wejnert (2002). These are components that relate to the characteristics of the concept, the characteristics of the “champions” that helped diffuse the concept, and the geographical, organizational, and globalization characteristics described in Chapter 3. We hope that our findings about the factors which helped diffuse the ES concept in Israel will be useful for other countries, prompting analyses of diffusion of the concept in other countries and for other scholars theorizing on diffusion of scientific concepts in general.

5.3 Is the ES concept a paradigm shift?

In the introduction of the national scale chapter, we described Kuhn’s identifiers of a paradigm shift, referring to the global diffusion of the ES concept prior to analyzing the genesis and diffusion of the concept in Israel. We used three main key identifiers that according to Kuhn are symbols of a paradigm shift. In the following we summarize how Kuhn’s identifiers are applied in both the national and the global diffusion of the ES concept (Table 5-2). From there we discuss the ES concept as a paradigm shift among other paradigm shifts that are occurring concurrently.

Table 5-2: Global and national diffusion of ES according to Kuhn’ key characteristics of a paradigm shift.

| Kuhn’s characteristics of a paradigm shift | |
|---------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Internationally | In Israel |
| Paradigm shifts occur when anomalies become overwhelming/ crisis is being evoked | |
| Global ecological crisis evoked by the MEA | Loss of open space, habitats, and biodiversity due to construction – emphasized through NOP 35 (2005) |
| New scientific communities adhere to the concept | |
| - Exponential growth in number of peer-reviewed academic publications including ES | |
| 40,000 publications by international scientists | 301 publications by Israeli scientists |
| - Diffusion in academic courses and guidebooks of how to use the concept appear | |
| Courses about ES, and ES taught in classes | Most academic institutions teach ES as part of ecology/environmental studies courses |
| Several guidebooks: e.g., TESSA, TEEB, ESMERALDA, MAES, IPBES and ESP | Two guidebooks for using ES in Hebrew: Campus Teva, 2010; Open Landscape Institute, 2016 |
| - A scientific community emerges around the concept | |
| Ecosystem services partnership – 3,000 members and many more users | The I-NEA created a cohort of 200 scientists and landscape managers that convene periodically |
| Controversies and debates accompany the emerging paradigm | |
| Abundant literature criticizing the concept, leading the IPBES (for example) – to adopt the concept ‘nature’s contribution to people’ | Disputes were apparent between and among scientists and stakeholders from the first ES workshops in Israel, to conferences, and to the |

| | |
|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (Diaz et al., 2018). | disputes associated with I-NEA and strategic planning reports and policy documents. |
| Practitioners approach existing problems in novel ways | |
| Looking at nature through benefits to society. Post-normal science, scientists step out of the neutral science to become nature conservationists. | For example, masterplans for forests based on the ES concept show how the ‘problem’ of how to manage forests is being approached in a different way than before, similarly to plans for river restoration or farmlands that include ES, etc. |

Following Kuhn’s description of a paradigm shift (1962, p. 10) as “an unprecedented scientific achievement that is compelling enough to convince adherents from traditional perspectives to shift their allegiance, regroup around the new paradigm, and tackle problems anew”, we conclude that according to our analysis summarized in Table 5-2, diffusion of the ES concept into both the academic and the decision making communities can be described as a paradigm shift according to the general understanding of Kuhn’s theory. Nevertheless, we assert that the ES concept and the worldview it implies is developing concurrently to, and interacting with, several other possible paradigm shifts. As we found, some respondents thought that ES was a ‘repackaging’ of ideas that already existed in the discourse. The Biodiversity–Ecosystem Function Paradigm as defined by Naeem (2002), suggesting ecosystem function is governed, in part, by biodiversity, and the development and proliferation of the ‘whole systems approach’ (Costanza et al., 2017; Mirtl et al., 2018; Section 4.3.4 in our research) are both conceptual frameworks that ES builds upon. Another conceptual framework relating to the ES concept is the ‘social ecology’ disciplinary evolution in which humans and their activities are considered integral to ecological research agenda (Haberl et al., 2006; 2016; Hummel et al., 2019). Ecosystem Services are also part of the paradigm shifts occurring in economic theory as described by Gómez-Baggethun et al., (2010). According to Spash (2020) ES is currently part of Neo Classical Economics (NCE); however, with the recent shift of the ES paradigm towards non-monetary, plural and inclusive valuation methods, the ES concept can gradually be considered as part of the ecological economics paradigm shift in economic theory. The ‘sustainable development’ concept was considered to be a paradigm shift within development studies by Rockström and Sukhdev (2014).

We agree with Haberl (2016, p. 8) that all the diverse concepts mentioned above, including the ES concept, share a basic paradigm that “recognizes that social and natural systems interact, coevolve over time, and impact one another in substantial ways that can be both beneficial and harmful” (Haberl 2016: 8). Specifically, ES emphasizes that humans are dependent on nature for their wellbeing.

Regarding the post-normal aspects of the ES paradigm, as Redford & Adams (2009) wrote, conservation paradigms today are often framed to convince humans of the value of nature. According to Takacs (1996) the biodiversity rhetoric was also invented with the aim of influencing policy, and in that sense, it has supplanted previous conservation paradigms; but the effort did not succeed in strengthening conservation objectives (Takacs, 1996; Daily et al.,

2009). As Pett et al. (2016) found, there is a limited ability of individuals to accurately perceive the biodiversity surrounding them and how it relates to their personal subjective well-being. Therefore, one of the achievements of the scientific revolution of ES is in creating the connection between biodiversity and human well-being, and between science and society, by emphasizing our natural assets as critical components of well-being (as also mentioned by Costanza et al., 2014) in a way that the other concepts managed less to do. In that sense, it has the chance to supplant biodiversity and others as a conservation paradigm.

Naeem (2002) identified the ecological dialectic leading to the biodiversity paradigm shift which concerns “the tension between those who seek to explain nature by studying its parts and those who seek to explain nature by studying whole-system behavior (biodiversity)”. We respond to Naeem based on our results and identify the current dialectic in the ES paradigm to be the tension between those who seek to explain nature by studying whole-system behavior (biodiversity) to those who seek to explain nature by how it serves humans (ES). As we saw, this tension continues to form the base of the arguments about the concept, where some see its adoption as a way forward while others see it as a risk to biodiversity or as non-ethical, but as we see in the following the general trend shows that it will continue to be the way forward.

5.4 Insights on the future use of the concept in Israel and beyond

Finally, we look at the state of open spaces in Israel today, and the global trend of the ES science trajectory and recommend how to improve the capacity of the framework to guide planning and management of open spaces in the future.

Transformation of open space for human needs is considered the most significant contemporary threat to nature worldwide (Sala et al., 2000; Newbold et al., 2015). Since 2018, the transformation of land from open space to built-up and paved areas in the OECD and the G20 countries found that Israel was in third place regarding the rate of decline of open space relative to the total open space of the country and higher than the world average (Haščič & Mackie, 2018). Today, on average, 30 square kilometers of open space in Israel are lost every year for construction, leading to a growing number of ecosystems becoming fragmented and disconnected from each other (Israel State of Nature report, Hamaarag, 2022).

We assert that in the current state of loss of open spaces around the world and specifically in Israel, the ES approach plays a significant role in contributing to the discourse and providing tools for nature conservation vis-à-vis decision makers. It could be used to promote more balanced and efficient management of open spaces in Israel and help protect these open spaces from development. However, as the NPA chief scientist suggested, the concept should be used selectively. As we found in this research, nature conservation is a social issue, every organization or individual sees it differently; and therefore, the ES concept should be constructed to be used differently by different organizations. Not all types of nature conservation efforts and not all ecosystem types are suitable for the use of the ES concept. For example, the concept was found to be less useful for protecting nature reserves (except for planning the parts of the reserves that are made accessible to the public) and in many cases for ecosystems such as

deserts. The concept is very useful and much more used and suited for ecosystems modified and/or damaged by humans, such as streams, afforested ecosystems, farmlands, urban green infrastructure, and marine ecosystems. Similarly, ES is not suited for all organizations or all departments in a certain organization. For example, ES is tailored for use by forest agencies, whereas it may contradict the goals of organizations directly aimed at biodiversity conservation. Assessment tools for ES should also be used selectively; for example, economic assessments can be both an advantage or a disadvantage, in some cases causing damage (even creating antagonism and distance from the concept) while in other cases, such as for compensation for environmental damages, it could be very successful.

Throughout this research, we were concerned about whether the ES concept may perhaps be a transient concept or whether it will continue to be relevant into the future. We found, according to ES researchers and practitioners, that the idea of ES, as a strategy for conservation, implying that nature should be looked at as something that provides multiple benefits for human wellbeing, will continue. However, as some mentioned there is a chance that in the future it will be renamed, perhaps ‘nature’s contribution to people’ or something else.

For the future, combining the perceptions of respondents from all three scales and our conclusions, we assert that to more effectively apply the concept to decision making, a greater focus on developing practical tools and expertise in assessing ES for plans and as part of environmental impact assessments is needed, as well as regulatory tools and funds to support it. We also recommend focusing more on diffusing the concept beyond the environmental community and professional layer and addressing real-world problems rather than general assessments. Greater consideration for funding payments for ES to farmers, for example, as ‘stewards of open space’ is needed (especially when a fifth of Israel’s land area is agricultural). We advocate for ES research to be more connected to climate change, and climatic-global-environmental-justice. Finally, we assert that ‘successes’ in implementing the ES concept should not only be measured by the instrumental and strategic uses of ES knowledge for decision making (McKenzie et al., 2014), but also by conceptual ES knowledge use such as in raising public awareness of the importance of nature conservation (which will affect decision making in the future), in addition to the contributions of the ES process itself, such as for stakeholder collaborations.

Looking beyond the developments within the ES concept, we add some final words. Today, the scientific literature is calling for another paradigm shift beyond dualistic, anthropocentric and utilitarian representations of human-nature relationships which are among the ultimate reasons behind the global environmental crisis (Muradian and Gómez-Baggethun, 2021; Spash, 2020). This is to be done by aiming toward the goals of efficiency, fairness, and sustainability (Costanza, 2020), including going beyond GDP toward sustainable wellbeing (Costanza et al., 2021) and applying ideas developed through the paradigm of ecological economics such as post-growth, eco-socialism and ecofeminism (Spash, 2020). Moreover, we believe that our society should focus on developing an ethic for nature conservation, including an emotion, love and respect for nature that is unconditional and nondependent on its benefits. We agree with Aldo

Leopold that scientific facts about nature and economic assessments alone will not make a conservation ethic (Leopold, 1949 in: Takacs, 1996). Therefore, we need to find ways to enhance this aspect through the ES concept and beyond.

5.5 A Personal Perspective

Since 2009, the first years of ES implementation in Israel (the beginning of the ‘spreading the gospel’ period), I have been exploring the ES approach under different academic and applied contexts, with a focus on integrating social and cultural considerations into ES analysis and integrating stakeholders in open space management and policy making. After completing a master’s thesis in BGU on cross-cultural perceptions of ES on both sides of the Israeli–Jordanian border (Sagie et al., 2013), I worked as a researcher in Machon Deshe (Open Landscape Institute) on a pilot study examining the ES approach and its usefulness with regard to management and planning dilemmas in the Shikma region of the Negev. One of the outcomes of the project was a guidebook for conducting a productive ES assessment process that includes stakeholders, for enhancing implementation (Sagie and Ramon, 2015). Later, I worked as part of the Israeli National ES Assessment team on the chapter on Israel’s agricultural ecosystems. Subsequently, I was engaged in the regional ES assessment of the Mount Carmel Biosphere Reserve, primarily in charge of the cultural services chapter and later, as part of this PhD research, in charge of stakeholder integration in the assessment process and the dissemination of results. Therefore, I was interested in whether and how adoption of the ES concept can be practical and useful in achieving the goals of improving sustainable management of open spaces and natural resources. I also acknowledge the fact that I am a nature lover, who moved from the big city where I was raised, to a kibbutz in the ‘land of rivers and streams’ in the north of Israel in order to be closer to nature. Currently I work in the Galil Elion Regional Council as Open Space Coordinator, hoping to help the ongoing effort to conserve Israel’s open spaces, while balancing it with the needs of the local populations to develop, as well as addressing climate change considerations.

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7. APPENDICES

Appendix 2-1 – Regional scale - stakeholder interview questionnaire

Questionnaire for key stakeholders in the Carmel Biosphere Reserve Interviews

1. In which city/settlement do you live today?
2. How long have you lived or still live in the Carmel?
3. What is your current position/job?
4. What work experience or research experience, or knowledge do you have about the Carmel? How many years have you been working in a job related to the Carmel?
5. In which other jobs or social activities or studies have you taken part in which relate to the Carmel?

Questions about your relation to the Carmel

6. How does the activity of the institute/workplace/authority that you work in relates or influences the open landscape of the Carmel?

Questions about the ecosystem services that the Carmel provides and their importance

7. Are you familiar with the term “ecosystem services”? (A definition was given to whoever needed).
8. For each service from the list below please specify the level of importance (from 1-5) for the wellbeing of residents of the Carmel and surrounding areas, and the type of contribution that it provides: economic, social or health.
 - Food from agricultural fields
 - Fodder
 - Honey
 - Wild fruit/mushrooms/herbs
 - Medicinal plants
 - Hunting
 - Plants for construction, cooking, heating
 - Recreational activities
 - Tourism
 - Sports
 - Educational and research activities
 - Aesthetic enjoyment of the view
 - Inspiration – spiritual/religious/artistic
 - Sense of place/sense of attachment/identity
 - Regulation of global climate change
 - Pollination of agricultural fields
 - Fire/flood/wind regulation
 - Water percolation
 - Regulation of quality of water
 - Regulation of air control
 - Regulation of temp, shade
 - Regulation of pests and diseases
 - Regulation of soil erosion
9. What are other benefits or services lacking in the list?

10. What can harm the contribution of the open landscape in the Carmel to these services?
What threatens what you get from your environment?
11. What would you change in the environment of the Carmel to improve these services?
12. What is the “hottest” environmental issue in the Carmel nowadays?
13. How do you or the organization you belong to influence the ecosystems and the benefits that we get from them?
14. Who are the other key stakeholders that influence the Carmel open landscapes that you recommend us to talk to?

Appendix 2-2 – Regional scale - list of stakeholders interviewed

List of stakeholders and their professional affiliation groups, who participated in the interviews, focus group discussions, and workshops.

List of affiliations of the stakeholders who participated in different parts of the stakeholder integration process of the Carmel ES assessment; including interviews, focus group discussions and stakeholder workshops and forums. Also noted is the relative influence of the stakeholder in land use management decision making:

| Affiliation groups | National/ Regional | Profession/role/department | Number of participants | High or low influence stakeholders |
|----------------------------------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|------------------------------------|
| Ministry of Environmental Protection (MoEP) | Regional | Planners and various department managers | 8 | High |
| | National | Biodiversity and open landscape department | 3 | High |
| Ministry of Agriculture and Rural Development | Regional | Head of grazing department | 1 | High |
| | National | Head of grazing and open landscape department | 1 | High |
| Volcani Center – Agricultural Research Organization | National | Ecologist expert on agriculture, grazing and fires | 1 | High* |
| River & Drainage Authority | Regional | Manager | 1 | High |
| | | Ecologist | 1 | Low |
| Israel Defense Force | Regional base | Base commander | 1 | Low |
| Nature and Parks Authority (NPA) | Regional | Planner, national park manager and protected area manager | 3 | High |
| | | BR education program manager, district ecologist and tour guide | 3 | Low |
| | National | Chief scientist | 1 | High |
| | | Ecologist | 1 | Low |
| The Jewish National Fund - Keren Kayemeth LeIsrael - Israel's quasi-official forest agency (KKL-forest agency) | Regional | District manager, chief forester | 2 | High |
| | | Education & community department manager and tour guide | 2 | Low |
| Hof HaCarmel Regional Council (Jewish Regional Council) | Regional | Head of the council, Deputy head of the council, Agriculture department manager, environmental department manager and building department manager | 5 | High |

| | | | | |
|-------------------------------------------------------------------------------|--------------------------|---------------------------------------------------------------------------------------------------------------|----|------------|
| Daliyat Al Carmel municipality and Isfiya Municipality (Druze municipalities) | Regional | Head of Daliyat Al Carmel municipality, head of Isfiya municipality and two planners | 4 | High |
| | | Education dep. | 1 | Low |
| Haifa Municipality (adjacent city to the Carmel BR) | Regional | Environmental dep. | 2 | Low** |
| Man and the Biosphere committee in Israel | National | Governmental policy makers, land-use managers, nature conservation organizations representatives and academia | 5 | High & low |
| Society for the protection of nature in Israel (NGO) | Regional | Ecologist and plant taxonomist | 2 | Low |
| Local Environmental NGOs (Jewish and Druze) | Regional | Heads of the NGOs | 2 | Low |
| Tourism NGO | Regional | Manager | 1 | Low |
| Academia: Haifa University, the Technion – Israel Institute of technology | National | Researchers in the fields of tourism, grazing, biology, ecology, agriculture, earth sciences | 6 | Low |
| Tour guides | National | Tour guides of the Carmel BR | 2 | Low |
| Residents (unaffiliated) from Muslim, Jewish and Druze towns of the BR | Local villages and towns | Educators, journalists and others | 6 | Low |
| High school teachers of the Biosphere Reserve | Regional | Environment, nature, and biology teachers | 22 | Low |

- * Although researchers were defined as low influence stakeholders, this specific researcher works closely with decision-makers and therefore has a lot of influence on land-use management in the Carmel BR.
- * Although municipal representatives were defined as high influence stakeholders, the ones from Haifa were defined as ‘low influence’ because they are not responsible for the Carmel BR but for the adjacent city of Haifa.

Appendix 3-1 – National Scale - stakeholder interview questionnaire

Questionnaire for ES practitioners, decision-makers, planners, and environmental scientists central to the application of the ES concept in Israel.

Personal Details:

1. What is your professional background? In which academic institutions did you study? What degrees? in which disciplines? If you conducted a thesis, who were your supervisors?
2. In which land use or academic organization/institution do you work in today, or have worked in previously? In which positions?

Questions about experience and perceptions of the ES concept

1. When was the first time you heard of the term ES? From whom, in what context?
2. What was the historical development of the ES concept in Israel?
3. When and in what ways does the organization/institution in which you work in use the ES concept? What was the trigger for using the concept in your organization?
4. How do you, as part of an environmental/land use management organization or research institution understand and define ES in to your work?
5. From your experience, can you report on the on-ground implementation of an action based on ES assessment and research? (An effect of ES knowledge on decision-making and policy)? Give a few examples.
6. What are the main advantages you see in the theory and application of the framework?
7. What are the main disadvantages/limitations you see in the theory and application of the framework?
8. Were stakeholders involved in ES projects that you took part in? How? Can you give examples of a few projects?
9. How do you see the future of the ES concept? Will the concept continue striving? and how can stakeholders and decision makers and researchers make better use of ES in the future?
10. Is there anyone else that you recommend to interview?

Appendix 3-2 – National Scale – list of interviewees and their affiliation

List of interviewees - according to their affiliation groups. Israeli decision-makers, planners, and environmental scientists that have applied the ES concept onto their work.

| Type of Organization/ Institution / Ministry | Name of Organization/ Institution / Ministry | Number of Interviewees from each Organization / Institution / Ministry | Name of interviewee | Department / Position |
|----------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------|
| Governmental Ministries | Ministry of Agriculture and Rural Development | 2 | Roey Egozi | Soil Erosion Research Station. |
| | | | Orit Ginzburg | Director of rangeland and open space management. |
| | Ministry of Environmental Protection | 3 | Anna Trakhtenbrot | Head of Biodiversity Section, Open Space and Biodiversity Department. |
| | | | Menachem Zalutsky | Established the Open Space and Biodiversity Department and former Head of the Department. |
| | | | Noa Steiner | Former Open Space Coordinator, Open Space and Biodiversity Department. |
| Planning Offices | Planning Administration, Ministry of Interior | 2 | Maggi Barton | Open Space director, Department of Integrated Planning. |
| | | | Iris Bernstein | Planning Administration Consultant, Ex-planner of KKL, Ecologist and Landscape Architect. |
| | Kaplan Planners Ltd. | 1 | Moti Kaplan | Planner, specializes in national outline plans and strategic plans. |
| Nature Organizations | Society Protection of Nature | 1 | Alon Rothschild | Biodiversity Policy Coordinator. |
| | Hamaarag – Israel's Nature Assessment Program | 2 | Keren Klass | Former Program coordinator for the National Ecosystem Assessment (I-NEA) - in the preliminary phases. |
| | | | Alon Lotan | Former Head of the Ecosystem Services Department and Director of the National Ecosystem Assessment (I-NEA). |
| | KKL – Forest Agency | 2 | Omri Boneh | Former Chief Scientist, Northern Region Director. |
| | | | Yahel Porat | Forestry Division, Ecology Director. |
| | Nature and Parks Authority | 2 | Yehoshua Shkedy | Chief Scientist, Ecologist. |
| | | | Dotan Rotem | Open Space Ecologist, Science Division. |
| | Society of Ecology & Environmental | | | |

| | | | | |
|------------------------------------|----------------------------------------------------------|--------------------|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Sciences (ISEES) | 2 | Neta Lipman | Former Director. |
| | | | Shachar Bookman (by email) | Editor of Ecology and Environment Journal. |
| | Ramat Hanadiv | 1 | Liat Hadar | Head of Scientific Research Department. |
| | Open Space Institute (OLI) | 2 | Yoav Sagi | Established the OLI Institute and Former Director of the Institute. |
| | | | Uri Ramon | Director |
| Regional Council Center | 1 | Hila Akerman | Head of Agriculture and Environment Unit. | |
| Universities | Tel Aviv University (TAU) | 1 | Emmanuelle Cohen-Shacham | Adjunct Professor in TAU, Former consultant to the MoEP, Lead, Nature-based Solutions Thematic Group, Commission on Ecosystem Management, IUCN. |
| | The Hebrew University of Jerusalem | 3 | Eran Feitelson | Former Head of the new Advanced School for Environmental Studies. |
| | | | Uriel Safriel | Professor Emeritus of the Hebrew University of Jerusalem, Desert Ecologist. Former consultant of the MoEP. |
| | | | José Grünzweig | Faculty of Agriculture, Food and Environment, Ecologist. |
| | Ben Gurion University | 1 | Moshe Shachak | Mitrani Department of Desert Ecology. |
| | Haifa University | 1 | Ido Izhaki | Vice President and Dean of Research, Ecologist. |
| | Technion – Israel's Institute of Technology | 2 | Daniel Orenstein | Faculty of Architecture and Town Planning, Social Ecology Research Group. |
| | | | Yohay Carmel | Civil and Environmental Engineering faculty, Ecologist. |
| | Kibbutzim College of Education, Technology, and the Arts | 1 | Gili Koniak | Adjunct Professor, teaching ES in courses in Kibbutzim College, Reichman University, Tel Hai College and Haifa University. Former Consultant to the MoEP. |
| Reichman University (IDC Herzliya) | 1 | Shiri Zemah Shamir | Environmental economist, School of Sustainability. | |
| Research Institutes | Dead Sea-Arava Science Center (DSASC) | 1 | Elli Groner | Science Director, desert ecologist |
| | Volcani Institute – Agricultural Research Organization | 3 | Yagil Osem | Department of natural resources. Institute of Plant Sciences, sustainable forest management. |

| | | | | |
|------------|-----------------------------------------------------------------------------------------------------|---|-------------------------------------|-------------------------------------------------------|
| | | | Avi Perevolotsky | Plant Sciences, Natural Resources Unit, Ecologist. |
| | | | Oz Barazani (phone interview) | Vegetable and field crops, Israel Plant Gene Bank. |
| Law | Zalul Environmental Association (dedicated to the protection of the seas and rivers) | 1 | Haya Erez | Legal Council |

Appendix 4-1 – Global Scale - stakeholder interview questionnaire

Questionnaire for ES practitioners who are involved in international ES research projects, and science-policy initiatives and were central to the application of the ES concept globally

Personal Details:

1. What is your professional background? In which academic institutions did you study? What degrees? in which disciplines?
2. In which academic/research institution do you work in today and in which international science-policy or research initiatives relating to the ES concept are you involved in? or have been involved previously? In what positions?

Questions about experience and perceptions of the ES concept

1. When was the first time you heard of the term ecosystem services? From whom or in what context?
2. What are the main benchmarks in the historical development of the ES concept as you see it globally?
3. What was the trigger for using the ES concept in the universities/organizations you work in – as you see it? and how do you understand and define ES into your work?
4. From your experience, can you report on the on-ground implementation of an action based on ES assessment and research? (An effect of ES knowledge on decision-making and policy)? Give a few examples of projects - in short – name of the project and how it has influenced decision making.
5. What are the main advantages you see in the theory and application of the framework?
6. What are the main disadvantages/limitations you see in the theory and application of the framework?
7. Were stakeholders involved in ES projects that you took part in? How? Can you give examples of a few projects?
8. How do you see the future of the ES concept? Will the concept continue striving? and how can stakeholders and decision makers and researchers make better use of ES in the future?
9. Is there anyone else that you recommend to interview?

Appendix 4-2 – Global Scale – list of interviewees and their affiliation

List of interviewees and their main affiliation. ES practitioners who are involved in international ES research projects, and science-policy initiatives and were central to the application of the ES concept globally.

| Name | Affiliation |
|------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The Founding Generation | |
| 1. Bob Costanza | Co-chair Ecosystem Services Partnership, Crawford University Australia, before Portland, Gund Ins. Vermont, Sweden, Florida |
| 2. Leon Braat | Co-Editor-in-Chief- Ecosystem services Journal, Wageningen University-Holland, Alterra Research Center |
| 3. Rudolf de Groot | Chair Ecosystem Services Partnership, The Netherlands. Wageningen University |
| 4. Leena Kopperoinen | Head of Unit, Senior Researcher at the Finnish Environment Institute SYKE - Land Use and Urbanisation. |
| 5. Uriel Safriel | Professor Emeritus of the Hebrew University of Jerusalem. |
| The second generation - early adopters' | |
| 6. Francis Turkelboom | Senior researcher at the Institute for Nature and Forest Research (INBO, Brussels). |
| 7. Berta Martín-López | Junior professor for Sustainability Science at the Leuphana University of Lüneburg, Co-Editor in Chief of the 'Ecosystems and People' journal and Co-Chair of the Programme for Ecosystem Change and Society (PECS). Involved in the IPBES. |
| 8. Benjamin Burkhard | Professor for Physical Geography at Leibniz Universität Hannover, Chair of the ESP10th conference, Professor at Humboldt University, Berlin. |
| 9. Daniel Orenstein | Associate Professor in the Faculty of Architecture and Town Planning at the Technion – Israel Institute of Technology. |
| 10. Andrea Ghermandi | Associate Professor at the Department of Natural Resources and Environmental Management at the University of Haifa (Israel) and an alumnus of the Global Young Academy. |
| 11. Dagmar Haase | Professor at the Humboldt Universität zu Berlin, Germany, and Guest Scientist at the Helmholtz Centre for Environmental Research - UFZ. |
| The emerging - early career generation | |
| 12. Johannes Langemeyer | Institute of Environmental Science and Technology (ICTA), Universitat Autònoma de Barcelona (UAB). |
| 13. Emmanuelle Cohen-Shacham | Nature-based Solutions Thematic Group Lead, (previously ES thematic group for 4 years), Commission on Ecosystem Management (CEM), IUCN - International Union for Conservation of Nature. |
| 14. Yaella Depietri | Post doc in the Faculty of Architecture and Town Planning at the Technion – Israel Institute of Technology. |
| 15. Arjan de Groot | Institute of Physical Geography and Landscape Science. Young Ecosystem Services Specialists – Executive Team (YESS). GIZ (German International Development Agency) (former). |
| 16. Stefano Solomonidis | MA in Environment and resource management–specialization in ES, in Vrije Universiteit Amsterdam . Now working in Ecosystem Services Partnership. |

The founding generation includes those that had an influential role in the development of the concept and pushing it forward, internationally and or in their own countries and they had been using the concept since the 1990's or before.

Second generation or the early adopters' generation were those that adopted the concept early and that made it at the center of their careers and had an important role in the more recent developments of the concept's definitions and methodological tools.

The emerging – early career generation were those who began their academic careers with studying and working with the ES concept academically and in international initiatives and via NGOs that provide training in the ES concept and method.

לפני כן). עם זאת, ראינו גם איך המונח הפך ל'שק חבטות' והדגיש את הקונפליקט בין ארגוני סביבה שונים שממילא לא הסכימו זה עם זה, וכיצד נעשה שימוש שונה במושג על ידי ארגונים, בעלי עניין, וחוקרים שונים.

הניתוח שערכנו במחקר זה התבסס על תובנות שנגזרו מתיאוריית 'פעפוע של חידושים', שדנה בגורמים המשפיעים על התפשטות חידושים במערכות חברתיות, וכן על התיאורה של תומאס קון בנושא 'שינוי פרדיגמה' שדנה בגורמים המלווים את ההתפתחות של פרדיגמה חדשה והתהליך 'המהפכני' המלווה במתח של התפשטותה בקהילה.

בהסתמך על מקרי בוחן אלו, אנו נותנים מספר המלצות לגבי השימוש העתידי במושג שמ"א. כמו כן, אנו מראים על החשיבות בהמשך השימוש במונח שמ"א לשמירה על השטחים הפתוחים במיוחד בעידן זה של גידול אוכלוסין מוגבר, צמצום שטחים פתוחים, הרס של מערכות אקולוגיות ושינויי אקלים. אך זאת, תוך כדי מתן נקודת מבט ביקורתית על אופן השימוש במונח. אנו סבורים כי יש להשתמש במונח באופן סלקטיבי. למשל המונח נמצא כיעיל במיוחד בשטחים המאופיינים על ידי ניהול אינטנסיבי של האדם, כמו שטחים חקלאיים, נחלים, טבע עירוני ומערכות אקולוגיות ימיות ופחות בשמורות טבע. לסיום, יחד עם השימוש בגישת שמ"א, יש לשים דגש גם על טיפוח אתיקה של שמירת טבע המבוססת על רגש ואהבה לטבע.

תקציר

בעידן האנטרופוקן, המאופיין בהשפעה חסרת תקדים של האדם על הטבע, ואיומים על המערכות האקולוגיות, התפתחו שורה של ביטויים שמנסים לתאר את התלות של האדם בשלמות האקולוגית כמו קיימות, מגוון ביולוגי ושירותי המערכת האקולוגית (שמ"א). המונח שמ"א, בו בחרנו להתמקד במחקר זה, פותח כדיסציפלינה מוכוונת מטרה ליידע את הציבור ומקבלי ההחלטות שהטבע מספק "שירותים" התורמים לרווחת האדם. כפי שנמצא במחקרים, מצד אחד, המונח שינה באופן ניכר את השיח הבינלאומי של שמירת טבע וניהול שטחים פתוחים (ש"פ), אך מצד שני, עדיין לא קיבל אחיזה משמעותית בזירות המדיניות ותהליכי קבלת ההחלטות בניהול שטחים פתוחים בפועל, וכן התפיסה ממשיכה לקבל ביקורת מהמשתמשים בה. המחקר הנוכחי בחן את ההטמעה והיישום של תפיסת שמ"א בניהול ותכנון שטחים פתוחים, ובשיח ויוזמות של סביבה ושמירת טבע, בקרב מדענים, מקבלי החלטות ובעלי עניין שונים במטרה לשפר את היכולת של המונח לתמוך בתכנון וניהול בר קיימא בעתיד. המחקר גם מספק דוגמה לאופן שבו מונח גלובלי מתורגם להקשרים לאומיים ואזוריים, וכיצד הוא מתפתח ומשתנה עם הזמן.

בקנה המידה האזורי, בחנו את שילובם של בעלי עניין בפרויקט הערכת שמ"א במרחב הביוספרי בכרמל. חקרנו את נקודות המבט של בעלי העניין לגבי האופן שבו ידע לגבי שירותי המערכת בכרמל עשוי לסייע להם באתגרים שעומדים בפניהם בניהול בר קיימא של השטחים הפתוחים. זאת על ידי ניתוח של ראיונות, ודיונים שנערכו בקבוצות מיקוד, וסדנאות עם בעלי העניין. מצאנו כיצד המונח שמ"א כאובייקט גבול, הביא בעלי עניין ומדענים מתחומים שונים, מוסדות, ארגונים ודתות, שלא בהכרח היו נפגשים, להתכנס ולשתף פעולה בפרויקטים. כמו כן הדגשנו את החשיבות והצורך בתהליך מחקר טרנס-דיסציפלינרי עבור מחקרי שמ"א.

בקנה המידה הלאומי, חקרנו את האבולוציה והיישום של המונח שמ"א בישראל תוך שימת דגש על הפרשנויות והשימושים השונים של המושג על ידי ארגוני סביבה, רשויות ממשלתיות ומוסדות אקדמאיים. לשם כך ערכנו שלושים-וארבעה ראיונות עומק עם חוקרים, מתכננים ונציגי ארגונים ומשרדי ממשלה שונים, המנהלים ופועלים למען השטחים הפתוחים בישראל. את המידע מהראיונות שילבנו עם ניתוח תוכן של דוחות, תכניות אסטרטגיות, אתרי אינטרנט, סדנאות וכנסים רלוונטיים וכן ניתוח סיסטמטי של מנועי חיפוש של פרסומים אקדמאיים. הניתוח ההיסטורי מראה על ארבע תקופות שונות באימוץ המונח שמ"א בישראל משלב 'הזרעים', 'הפצת הבשורה', 'אימוץ ראשוני וגיוון', לשלב 'ההתמסדות וביקורת'. בכל שלב רואים עדויות לכך שמצד אחד, המונח התפתח כמיקרו-קוסמוס לשיח העולמי: מקור הקונפליקטים, האתגרים לאימוץ וההצלחות היו דומים, ומצד שני מצאנו כיצד גורמים גיאוגרפיים, ארגוניים, ואישיים ספציפיים, השפיעו על האופן שבו תפיסת שמ"א אומצה או נדחתה על ידי החברה. ממצא זה מצביע על האופן שבו המושג שמ"א הינו הבנייה חברתית המתמזגת עם התרבות המקומית. בנוסף, פרק זה מספק נקודת מבט מעניינת על הסיפור של שמירת טבע בישראל דרך המונח שמ"א.

לבסוף, בקנה המידה הבינלאומי, הסיפור הושלם על ידי שישה-עשר ראיונות עם מומחי שמ"א בינלאומיים המעורבים ביוזמות מדיניות בינלאומיות של שמירת טבע, לגבי התפתחות המונח שמ"א והיישום שלו בעבר ובעתיד. מצאנו שהם תופסים את המונח שמ"א כשגור בשיח הבינלאומי של שמירת טבע בקרב מדענים וקובעי מדיניות, אך עם זאת היו חסרות להם דוגמאות המראות על ההשפעה בפועל של השימוש במונח בשטח. כמו כן, מניתוח תפיסותיהם למדנו שעל אף שהם מזהים חסרונות מסוימים במונח, הם מאמינים שיש להמשיך ולשלב את השימוש במושג בתהליכי קבלת החלטות גלובליים למען שמירת טבע וכן הדגישו היבטים ספציפיים שיש לפתח עבור המשך השימוש במונח כמו הערכות פלורליסטיות של שמ"א וכן החיבור לשינוי אקלים שעדיין לא מספיק מבוסס כיום.

כפי שאנו מראים, בכל שלושת סקאלות המחקר, הודגש היתרון במונח שמ"א כ'מושג הוליסטי' אשר מחבר בין מקבלי החלטות, בעלי עניין והציבור לשיתוף פעולה בנושאים של שמירה על שטחים פתוחים. בנוסף, הוא נמצא כמאפשר הרחבה של הדיון בניהול השטחים הפתוחים לכלול סל רחב יותר של שמ"א ומגוון ביולוגי (מעבר למה שהיה נכלל בדיון

המחקר נעשה בהנחיית פרופסור חבר דניאל אורנשטיין בפקולטה לארכיטקטורה ובינוי ערים.

תודות

אני מודה מקרב לב לסיוע הכספי הנדיב של הטכניון, למלגת ההצטיינות שקיבלתי מארווין וג'ואן ג'ייקובס, למלגה שהוענקה לי מקרן גלס-בלבן, לתמיכה מהמשרד להגנת הסביבה [מענק מס' 147-1-2], וכן למענק שניתן לדניאל אורנשטיין מהקרן הישראלית למדע [מענק מס' 1835/16].

האבולוציה והטמעת הרעיון המדעי שירותי המערכת האקולוגית ברמה האזורית, הארצית והגלובלית

חיבור על מחקר
לשם מילוי חלקי של הדרישות לקבלת התואר דוקטור לפילוסופיה

הילה שגיא

הוגש לסנט הטכניון - מכון טכנולוגי לישראל
אב תשפ"ב, חיפה, אוגוסט 2022

**האבולוציה והטמעת הרעיון המדעי שירותי המערכת האקולוגית ברמה האזורית,
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הילה שגיא