Mainstreaming ecosystem-based adaptation into municipal planning to foster sustainability transitions

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Abstract

Unprecedented global challenges demand all-encompassing modification of societal realms to ensure life support functions and human development. In the absence of adequate responses to climate change at a global level and the need for place-based adaptation, local governments are gaining increasing attention to govern and implement solution options to foster sustainability transitions. In this context, the importance of ecosystem-based adaptation is increasingly recognized as a place-based and multi-benefit approach. Related solutions utilize ecosystem services to tailor climate change adaptation to contextual features and have the ability to harmonize coupled human-environment systems. While there is an urgent need to mainstream ecosystem-based adaptation to contribute to sustainability transitions, it has yet not been implemented systematically and research on how local authorities can best integrate this new approach into their core work remains vague. Against this background, the purpose of this study is to increase knowledge on the potential ways of mainstreaming ecosystem-based adaptation into municipal planning. I investigate three Swedish coastal municipalities (Malmö, Helsingborg, Lomma) and examine, according to vertical and horizontal integration processes, the key characteristics of mainstreaming strategies. Results show that municipal departments and sections that have mandated natural conservation concerns, advanced ecosystem-based adaptation most strongly. While horizontal mainstreaming strategies depend largely on dedicated administrative staff, support of local politicians can substitute missing guidance from the national level by promoting particular activities. Although ecosystem service and climate change adaptation planning jointly establish the conceptual foundation for ecosystem-based adaptation, practically implemented activities are widely separated and the utilization of nature for adaptation is rarely comprehensive. Finally, I elaborate on key characteristics of mainstreaming strategies that have potential to contribute to sustainability transitions. I argue that sustainability mainstreaming strategies provide promising avenues for initiating and promoting transitions by integrating sustainability into local governments. Since a theoretically sound and standardized approach is needed for the systematic implementation of sustainability mainstreaming, I expand on conceptual essentials to effectively move this approach into meaningful application.

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1 Introduction

On a global level humanity faces unprecedented challenges that demand a fundamental transformation of societal realms to combat the degradation of life support functions and ensure human development (Parris & Kates, 2003; Rockström et al., 2009). While sustainability challenges such as climate change or biodiversity loss are characterized by multiple scales and facets as well as accumulate on a global level, the causes relate to regional and local dynamics (Jerneck et al., 2011; Lüdeke, Petschel-Held, & Schellnhuber, 2004). For example urban growth, which occurs only on a small fraction of Earth's terrestrial surface, accounts for a significant portion of global carbon emissions and energy consumption (Grimm et al., 2008; IEA, 2008) as well as enforces the degradation of ecosystems and biodiversity (Mcdonald, Kareiva, & Forman, 2008; Seto, Güneralp, & Hutyra, 2012).

Compressive approaches to address sustainability challenges need to be placed in local settings to address the underlying drivers and a pivotal role is attributed to local governance for successful implementation. Climate change impacts have called for the urgent need for comprehensive scientific understanding (IPCC, 2007b, 2013) and negotiation toward international agreements to halt global warming (Kyoto Protocol, 1997; UNFCCC, 2009). In addition, compelling evidence of the unavoidable consequences of climate change has shifted the discourse on mitigation of greenhouse gas emissions to adaptation to the adverse effects of climate change (Crane & Landis, 2010; IPCC, 2014; Pielke Jr, Prins, Rayner, & Sarewitz, 2007). However, in the absence of adequate responses to climate change at national and international levels the regional and local context is increasingly considered as being more appropriate to intervene and implement solution options to address the underlying processes (Bulkeley, 2005; Desai, 2008; Forrest & Wiek, 2014; McCormick, Anderberg, Coenen, & Neij, 2013; Roberts, 2008; Wiek, Ness, Schweizer-Ries, Brand, & Farioli, 2012; Zborel et al., 2012); Furthermore, climate change adaptation is inevitably local which draws attention to respective governance arrangements and in particular local governments to play a crucial role in guiding comprehensive responses (Agrawal, 2008; Rauken, Mydske, & Winsvold, 2014; Roberts, 2008; Roberts et al., 2011).

Ecosystem-based adaptation is increasingly recognized as a comprehensive solution to combat climate change impacts, offering multiple co-benefits while being tailored to place-based characteristics (Chong, 2014; Roberts et al., 2011). The burgeoning field of research on

ecosystem-based adaptation aims to systematically harness the services of ecosystems to buffer communities against extreme events and facilitate adaptation to the adverse effects of climate change (Foster, Lowe, & Winkelman, 2011; Gaffin, Rosenzweig, & Kong, 2012; Gill, Handley, Ennos, & Pauleit, 2007; Jones, Hole, & Zavaleta, 2012; Munang et al., 2013). In addition, the use of ecosystem services for adaptation offers the co-benefits of greenhouse gas mitigation, livelihood protection and improvement, creation and conservation of recreation areas, as well as the potential to be more cost efficient than alternative approaches (Doswald et al., 2014; Georgescu, Morefield, Bierwagen, & Weaver, 2014; IPCC, 2012; P. Smith et al., 2013; Uy & Shaw, 2012a). In general, adaptation approaches are commonly characterized as soft measures that focus on institutional capacity and information systems and hard measures that rely on human-built infrastructure and large-scale technology driven interventions (Jones et al., 2012; Sovacool, 2011). Complementary, ecosystem-based adaptation presents a third approach that intends to substitute the limitations of technical solutions by integrating local knowledge for managing creation, restoration and conservation of ecological structures (IPCC, 2014; Jones et al., 2012). The systematic integration of ecosystem services into local planning addresses the inherent linkages between nature and human-well-being and ultimately has the potential to harmonize coupled human-environment systems to foster sustainability transitions (Andersson, 2006; Chong, 2014; Huq, Renaud, & Sebesvari, n.d.; Roberts et al., 2011; Wilkinson, Saarne, Peterson, & Colding, 2013; Wu, 2014).

Ecosystem-based adaptation should be mainstreamed into local governments to aid in combating the impacts of climate change and ultimately advance sustainability transitions. Governmental authorities are traditionally organized according to different sectors and departments with specific tasks and potentially diverging objectives (Derkzen, Bock, & Wiskerke, 2009). As a consequence, cross-departmental integration of new aspects is hindered, the risk of comprehensive approaches to become ineffective increases and the planning process falls short on prioritizing fundamental requirements (Sandström, Angelstam, & Khakee, 2006; Sandström, 2002). In addition, the national level often insufficiently assists local governments with clear policies and financial support, leaving climate change adaptation in direct competition with other non-mandatory tasks (Dannevig, Rauken, & Hovelsrud, 2012; Dymén & Langlais, 2012; Pasquini, Cowling, & Ziervogel, 2013). Since ecosystem-based adaptation is a cross-cutting issue – rooted in ecosystem services and climate change adaptation providing solutions for spatial planning and protection of residents – local government sectors need to collaboratively engage in its coordination (Chong, 2014; Vignola, Locatelli, Martinez, & Imbach, 2009; WWF, 2013). Further, by explicitly harnessing the diversity of benefits derived from ecosystems for

human well-being, ecosystem-based adaptation fosters reassessment of traditional responses to extreme events and natural hazards which, for decades, have been dominated by technical solutions and grey infrastructure (Jones et al., 2012; Knieling & Fellmer, 2013). Thus, mainstreaming ecosystem-based adaptation might be an effective means to modify the dominant paradigm while providing avenues to advance sustainability transitions, which requires the transformation of current institutions, technologies, common practices as well as rules, norms and values (Miller et al., 2013).

Ecosystem-based adaptation lacks systematic implementation, and research on potential avenues to mainstream this new approach into core work of local authorities remains unclear. While the concept suffers from vague definitions and ambiguities in meaning, the integration into adaptation planning in practice is ultimately hampered (Doswald et al., 2014). Although, ecosystem-based adaptation is gaining increasing attention on a project level (Andrade et al., 2011; Doswald et al., 2014; Kazmierczak & Carter, 2010), scientific literature that provides insights for systematic implementation is widely missing. In fact, the integration of ecosystem-based adaptation into governmental bodies remains unclear with only grey literature focusing on national authorities (UNFCCC, 2011; WWF, 2013). Since local governments are rarely being considered (Roberts et al., 2011) it remains an open question how respective mainstreaming strategies can potentially advance sustainability transitions. Insights to implementation and mainstreaming of ecosystem-based adaptation can be potentially draw from the adjacent research fields of climate change adaptation and ecosystem services. However, literature remains scattered focusing mainly at the local level on institutional measures for climate change adaptation and barriers to successful implementation (Dymén & Langlais, 2012; Juhola, 2010; Langeland, Klausen, & Winsvold, 2013; Nilsson, Swartling, & Eckerberg, 2012; Pasquini et al., 2013; Rauken et al., 2014; Storbjörk & Hedrén, 2011; Storbjörk, 2010; Wamsler & Brink, 2014). In addition, mainstreaming of ecosystem services is generally insufficiently covered with little literature focusing on either the international level (Europe: Maes et al., 2013) national level (United States and Canada: Molnar & Kubiszewski, 2012; Young, 2013) or local level (Eden, South Africa: Sitas, Prozesky, Esler, & Reyers, 2013).

Against this background, the purpose of this study is to increase knowledge on the potential ways of mainstreaming ecosystem-based adaptation into municipal planning to foster sustainability transitions. I investigate three municipalities in Sweden to examine the key characteristics of local governments' activities regarding the integration of ecosystem-based adaptation into municipal planning. Since ecosystem-based adaptation is conceptually based on

ecosystem service planning and climate change adaptation planning (e.g. Chong, 2014), I will investigate these research questions accordingly. I examine (i) how ecosystem service planning is currently integrated into municipal planning practice, and (ii) how climate change adaptation planning is currently integrated into municipal planning practice. Furthermore, I analyze the inter-linkages and synergies between, as well as the barriers to the integration of ecosystem services and climate change adaptation planning. On this basis, differences that exist in conceptual foundations and practical integration of ecosystem-based adaptation are discussed.

2 Conceptual framework

In this section I examine the different concepts that built the foundation of this study and develop accordingly the analytic framing for investigating the research subject. I appraise the concept of ecosystem-based adaptation and its foundations, namely ecosystem services planning and climate change adaptation planning. Next, I present the research field of sustainability transitions and examine the importance for related research on local governments (for a conceptual model of this research see figure 1). Subsequently, I investigate the conceptual foundation of mainstreaming and it's relevance for sustainability. The particular needs of mainstreaming ecosystem-based adaptation are presented and, finally, the analytic framing is developed. I draw on the research of environmental policy integration and mainstreaming strategies to advance a coherent framework to research the subject under consideration.

2.1 Ecosystem-based adaptation

The concept of ecosystem-based adaptation is embedded in research on ecosystem services and climate change adaptation (Chong, 2014; Uy & Shaw, 2012a, 2012b). The Convention on Biological Diversity initially defined ecosystem-based adaptation as the "use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change" (CBD, 2009, p. 41). Ecosystem services are defined as "the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfil human life" (Daily, 1997, p. 41). The ecosystem services concept was developed to integrate ecological principles into economic considerations and decision-making (de Groot, 1987; TEEB, 2010) and is considered as an effective means to advance sustainable urban planning of local governments (Ahern, Cilliers, & Niemelä, 2014). Furthermore, distinct services have been identified that have the capacity to regulate local climate, erosion, soil retention, water and air quality, and natural hazards (de Guenni et al., 2005). In response to

current or expected climate change impacts, climate change adaptation focuses on the modification of human-environment features to moderate adverse effects or exploit co-benefits (IPCC, 2007a; Janssen, Schoon, Ke, & Börner, 2006; Thompson, Robbins, Sohngen, Arvai, & Koontz, 2006; Wamsler, Brink, & Rivera, 2013). While adaptation to the adverse impacts of climate change requires a portfolio of different actions, ecosystem-based adaptation is acknowledged for improving livelihoods, combating climate change related hazards as well as being cost-effective and beneficial for biodiversity (Campbell et al., 2009; IPCC, 2012). In addition, the notion of ecosystem-based adaptation has been incorporated into adjacent research fields ranging from natural resource management (Abramovitz et al., 2006) to risk reduction (e.g. priority 4 of the Hyogo Framework for Action: HFA, 2011) and ecosystem stewardship (Chapin et al., 2010).

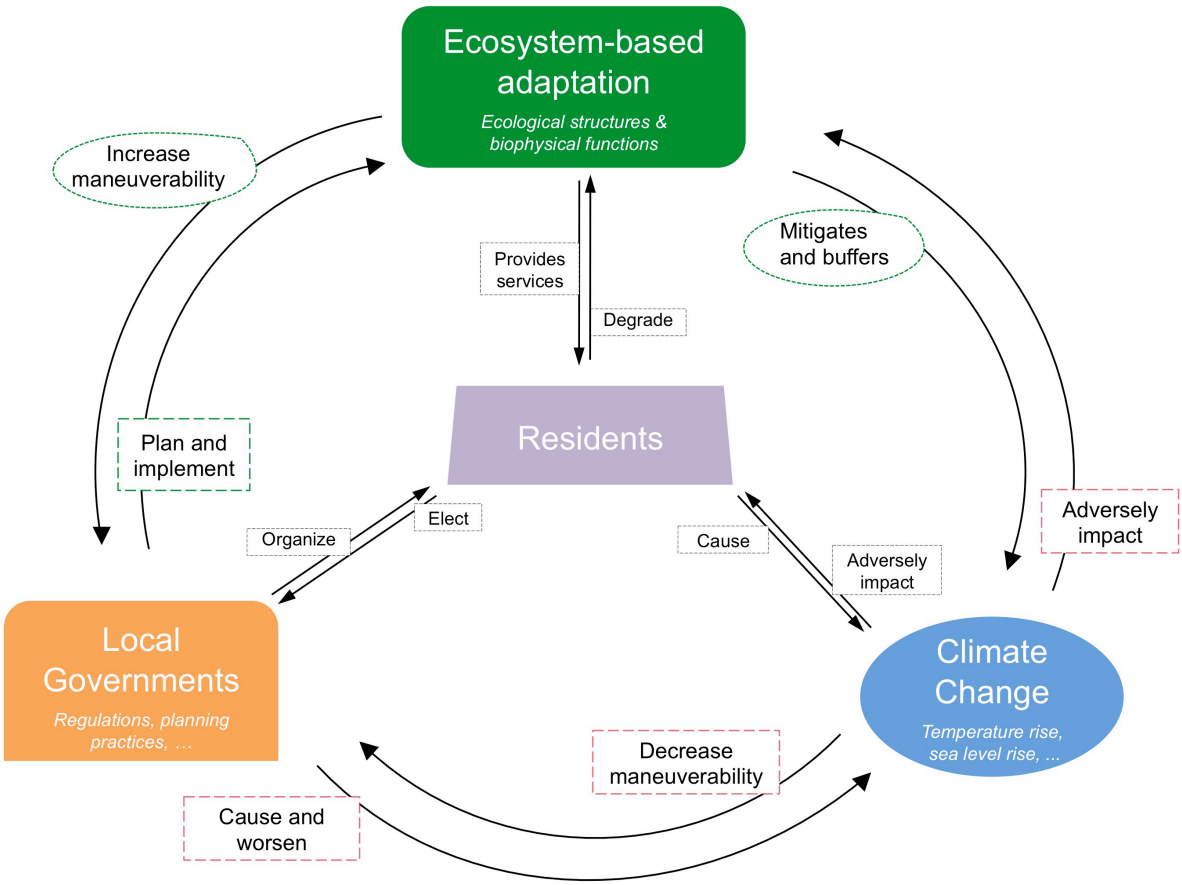

Figure 1: Linkages between local governments, residents, climate change and ecosystems-based adaptation. Local governments are elected by and organize residents as well as plan and implement ecosystem-based adaptation while unsustainable practices (e.g facilities and companies owed by the municipality (directly) as well as legislations and policies (indirectly)) can cause climate change. Ecosystem-based adaptation provides services to residents as well as increase the maneuverability of local governments and mitigates and buffer climate change. Climate change adversely impact the maneuverability of local governments and negatively affect ecosystems as well as residents.

Although ecosystem-based adaptation is gaining increased attention in policy documents and peer-reviewed literature, it is still in its infancy and the concept has yet to be taken up by a wide range of research (Doswald et al., 2014). Although a few guiding documents exist, mainly developed by international organizations[1] it remains unclear how this approach can be taken up by local governments. In fact, for ecosystem-based adaptation to become effective it is argued for "mainstreaming both adaptation and ecosystem services into policies" (Vignola et al., 2009, p. 593), but advice for local governments goes rarely beyond the recommendation of implementing "strategies for ecosystem-based adaptation as part of their local resource planning" (p. 695). It follows that ecosystem-based adaptation can only become an effective strategy if its foundations and 'translation' into practice are clarified – namely ecosystem service planning, climate change adaptation planning and the potential overlaps.

Ecosystem service planning refers to a place-based approach that focuses on the creation, restoration and conservation of ecological structures to gain specific services from nature (Chan, Shaw, Cameron, Underwood, & Daily, 2006; Staes, Vrebos, & Meire, 2010). It additionally assists the assessment of socioeconomic characteristics, ecological structures and combined capacities (Cowling et al., 2008; TEEB, 2011). While the generation of ecosystem services in planning is highly context related and depends on locally managed areas, the knowledge and preferences of stewards are of particular importance (Colding, Lundberg, & Folke, 2006). Ecosystem service planning requires an adaptive planning design that involves new ways of knowledge generation and a setting in which solution options can be explored safely (Ahern et al., 2014; Kato & Ahern, 2008). Hence, it is in contrast to the traditional planning approach that relies on "readily available, existing knowledge and established best practices" (Ahern et al., 2014, p. 2). For decision-making in ecosystem service planning, monetary valuation of ecosystem services is often advocated in order to translate ecological components into a common currency of local government' concerns across competing uses (TEEB, 2011; Turner et al., 2003). However, due to the inherent challenges of ecosystem service valuation in planning (de Groot, Alkemade, Braat, Hein, & Willemen, 2010; Kallis, Gómez-Baggethun, & Zografos, 2013), methods for quantitative and qualitative data gathering are promoted to facilitate discourse-based approaches to reach consensus (Ahern et al., 2014; Cowling et al., 2008; Wilson & Howarth, 2002).

[1] See for example United Nation Environmental Program (Travers et al., 2012), International Union for Conservation of Nature (Andrade et al., 2011), United Nations Framework Convention on Climate Change (UNFCCC, 2011), International Union for Conservation of Nature and Natural Resources Reproduction (Colls, Ash, & Ikkala, 2009), UNEP World Conservation Monitoring Centre (Campbell et al., 2009) and Ecosystem & Livelihoods Adaptation Network (Girot et al., 2012), World Wide Fund For Nature (WWF, 2013).

Climate change adaptation planning assesses contemporary and planned activities, policies as well as the built environment according to the impacts of climate change (Füssel, 2007). Within a spatially defined area, adaptation planning involves knowledge gathering on the adverse effects of climate change and vulnerability assessments while reviewing existing measures and strategies to provide guidance for adapting to contemporary and future climate change (Füssel, 2007; Smit, Burton, Klein, & Wandel, 2000; Wamsler et al., 2013). At the local level, governmental spatial planning is considered to provide a key avenue for adaptation planning (McDonald, 2011; Measham et al., 2011). Related governance arrangements are responsible for organizing the response to impacts, structuring individual and collective action, and securing resource allocation to facilitate adaptation (Agrawal, 2008). However, adaptation is accused of carrying the notion of "inactivity and procrastination" (Thompson et al., 2006, p. 6) put forward by scholars advocating climate change mitigation, since profound changes in behavior and production processes are avoidable if the system simply adapts (e.g. Gore, 1992, p. 240). While mitigation aims to reduce climate change by avoiding greenhouse gas emissions and increasing carbon sinks, adaptation and mitigation are now being viewed as complementary but inevitable linked strategies to move toward sustainability (Crane & Landis, 2010; Swart & Raes, 2007). Further, framing adaptation as a simple, linear process highly underestimates and poorly simplifies the forces at work to bring about adaptation (Wolf, 2011). "Whether harm will be moderated and beneficial opportunities exploited, is contingent on many factors, not just on the adaptive action itself," (Moser & Ekstrom, 2010, p. 22027).

2.2 Sustainability transitions

In order to foster sustainability transitions, the generation of simply more knowledge on sustainability challenges is insufficient, but rather solution-oriented approaches are needed to conceptualize and provide knowledge on how to develop and govern urgently needed transformations (Miller et al., 2013; Wiek et al., 2012). Sustainability as a concept emerged in the early 1980s as response to ongoing environmental degradation and the spreading gap between the rich and the poor (Kates et al., 2001; WCED, 1987). "After lengthy contests over the meaning of 'sustainability' and 'sustainable development', there is now an emerging consensus on the fundamentals of what is needed for progress in the desired direction" (Gibson, 2006, p. 171, original emphasis). Emerging agreement in the literature identifies collective trends that aggregate to form sustainable outcomes, including harmonized human-environment systems, livelihood sufficiency, intra- and intergenerational equity, resources maintenance and efficiency, democratic governance, as well as precaution and adaption (Gibson, Hassan, Holtz, Tansey, &

Whitelaw, 2005, pp. 95–114). Sustainability transitions refer to an all-encompassing transformation of societal realms according to the essential requirements, including technological, economic, institutional and cultural dimensions (Raskin et al., 2002; Schneidewind, 2013; WBGU, 2011; Westley et al., 2011). However, the complex and adaptive interactions of values and norms, social structures, political characteristics, diffusion and initiation of innovations as well as path-dependencies of infrastructure often impede the transition toward sustainability (Fischer et al., 2012; Kinzig et al., 2013).

A rich body of literature exists that conceptualizes how to foster and govern sustainability transformations and several major framework approaches have been developed to analyze and manage transitions toward sustainability. Literature on technological innovation systems focuses on technological novelties and required changes in institutions, organizations, and policies to correct system failures and foster technological development (e.g. Hekkert, Suurs, Negro, Kuhlmann, & Smits, 2007; Jacobsson & Bergek, 2011). Research on the multi-level perspective in socio-technical transitions investigates innovation in technology and societal practices while examining the interplay of dominant rule-sets (regimes), the environment in which rule-sets develop (landscapes) and radical innovations that evolve in protected spaces (niches) (e.g. Geels & Schot, 2007; Geels, 2011; A. Smith, Voß, & Grin, 2010). The complex system approach, also known as transition management, uses experiential settings to empower forerunners by using a well-defined framework that consists of the creation of a transition area, establishment of coalitions and envisioning of transition agendas, mobilization of actors and execution of projects, and finally monitoring and evaluating the experiment (e.g. Loorbach, 2010; Rotmans & Loorbach, 2009, 2010). The evolutionary systems approach integrates market policies and institutions to foster more sustainable products while accounting for path-dependencies and lock-ins (e.g. Safarzyńska, Frenken, & van den Bergh, 2012). Grassroots and community movements in transitions are examined to investigate place-based transition guidelines and social learning capacity (Forrest & Wiek, 2014; Seyfang & Smith, 2007). The sustainability solutions agenda focuses on incremental political mechanisms to achieve greater sustainability while integrating science and practice for knowledge generation (e.g. Sarewitz, Clapp, Crumbley, Kriebel, & Tickner, 2012). Environmental policy integration focuses on the incorporation of environmental objectives into policy areas that are not primarily concerned with environmental issues in decision-making (e.g. Jordan & Lenschow, 2010; Lafferty & Hovden, 2003; Persson, 2004).

Although key characteristics and essential aspects can be derived from the differences of

transition conceptualization (e.g. van den Bergh, Truffer, & Kallis, 2011), very little is known of the dynamics at play that initiate change within local governments, how transitions unfold and "the specifics by which such processes contribute to change for sustainable development," (Bos & Brown, 2012, p. 1341). Sustainability transitions are goal-oriented alterations of the dominant paradigm, long-term and multidimensional that require comprehensive guidance in order to harness individual transformation processes for a comprehensive system shift (Markard, Raven, & Truffer, 2012). The majority of transition studies were initially tailored to analyze technological innovations, however, political aspects play a crucial role in successful transitions, in particular policy change is identified as potential trigger and local governments as main actor while institutional aspects can also provide major barriers (Bai, Roberts, & Chen, 2010; Rotmans, Kemp, & van Asselt, 2001). The question of how agencies can potentially contribute or foster sustainability transitions differs significantly from a single technological innovation since it relates to systemic innovation strategies which can neither be deliberatively planned nor will market mechanisms bring about the required change (Westley et al., 2011). Single actors are considered to have a pivotal role in transforming organizations by setting out strategies (Busch & McCormick, 2014; Harris & Ogbonna, 2006), connecting people (Ernstson, Barthel, Andersson, & Borgström, 2010) and providing leadership (Gutiérrez, Hilborn, & Defeo, 2011).

2.3 Mainstreaming ecosystem-based adaptation to foster sustainability transitions

The motivation for mainstreaming originates from the need to influence the dominant paradigm with values and practices of those with lesser power or influence. In fact, mainstreaming is commonly framed as incorporating new aspects into existing core work as it has been used for gender issues (United Nations, 2002), disaster management (Benson, Twigg, & Rossetto, 2007), HIV/AIDS (Holden, 2004), or education and learning (Ferreira, Ryan, & Tilbury, 2007). Although the term mainstreaming is often used without clear definition, it essentially relates to the "deliberate perturbation in the natural order of things" and undermines the status quo to radically expand and enhance the topic under consideration (La Trobe & Davis, 2005; Picciotto, 2002, p. 323). Ultimately, mainstreaming processes will change the rules of the game and accordingly are threading conventional ideas, attitudes, or activities that are considered as mainstream or normal (Oxford Dictionaries, n.d.; Picciotto, 2002).

Sustainability as a concept is challenging conventional practices and from the very beginning it was thought to be mainstreamed to change the dominant paradigm (Gibson et al., 2005; Miller

et al., 2013). The seminal report of the United Nations Conference on Environment and Development highlighted the need to integrate environmental protection into the development process to achieve sustainable development (United Nations, 1992, principle 4). Further, local governments were recommended a “fundamental reshaping of decision-making” as well as urged to put sustainable development “at the centre of economic and political decision-making” and integrate it into “policy, planning and management” (UNCED, 1992, chapter 8). Sustainability was formulated as a response to fundamental concerns originating from environmental degradation and development failures as well as that it fundamentally critiqued the dominant paradigm of economic growth (Gibson et al., 2005). Thus, sustainability calls attention to the urgently needed transformation of unsustainable trajectories that guide decision-making (Gibson et al., 2005; Miller, 2013). Mainstreaming sustainability aspects, such as ecosystem-based adaptation, into local governments can potentially be an effective means to establish sustainability at the core of decision-making (Roberts & O’Donoghue, 2013; Roberts, 2010) and prevent sustainability from becoming “just one item of a list of relevant considerations” (Gibson et al., 2005 p. 60). In relation to sustainability, mainstreaming ecosystem-based adaptation can be defined as processes that lead to the inclusion of related aspects into the decision-making of local governments that are concerned with developing rules, plans, policies and actions.

2.3.1 Mainstreaming ecosystem service and climate change adaptation planning

The need to mainstream the conceptual components of ecosystem-based adaptation into spatial planning is recognized within the scientific literature on ecosystem services (e.g. Cowling et al., 2008; Daily, Kareiva, Polasky, Ricketts, & Tallis, 2011; Petersen & Huntley, 2005a; Seamans, 2013; Young, 2013) and climate change adaptation (e.g. Kok & de Coninck, 2007; Persson & Klein, 2009; Swart & Raes, 2007; Wamsler, 2013). The ecosystem services perspective stresses the urgent need of mainstreaming conservation since ecosystem services are predominantly generated outside of protected areas, requiring safeguarding by other sectors, institutions, and stakeholders that are not primarily concerned with conservation (Castro, 2005; Daily et al., 2009, 2011; Petersen & Huntley, 2005b; Redford, 2013; TEEB, 2010). A key challenge to ecosystem service planning is that ecosystem components are often organized in different policies and legislations with diverging objectives (Scarlett & Boyd, 2013; P. Smith et al., 2013). In addition, policies that are concern with environmental and biodiversity issues fail to comprehensively address drivers and structural causes of ecosystem degradation (Kok et al., 2010; TEEB, 2010). Climate change adaptation frequently focuses on mainstreaming to gain multiple benefits from

different sectoral policies for implementing an efficient and coherent climate change regime (Kok & de Coninck, 2007; Swart & Raes, 2007). Subsequently, adaptation is not a discrete process but ideally framed as an inherent part of "social, urban and regional planning, [and] disaster mitigation", which has to be necessarily mainstreamed to support the transition toward sustainability (Füssel, 2007; Kok & de Coninck, 2007; Preston, Westaway, & Yuen, 2010, p. 426; Rivera & Wamsler, 2014; Wamsler, 2013).

2.3.2 Mainstreaming dimensions within local governments

Drawing on environmental policy integration, mainstreaming approaches can be classified according to horizontal or vertical integration (Lafferty & Hovden, 2003; Persson & Klein, 2009; Rauken et al., 2014). Although the focus of analyzing sustainability transitions might be on a single actor, group or community, mainstreaming of specific aspects is rarely a purely top-down or bottom-up governance exercise but reflect the interplay between the vertical and horizontal dimension (e.g. Busch & McCormick, 2014; Ernstson et al., 2010; Juhola, 2010; Khan, 2013). In general, horizontal and vertical mainstreaming dimensions are distinguished to characterize the quality of governance relations between different actors. These relations include for example, collaboration between sectors, alignment of sectors' objectives with overarching goals, top-down control of a particular matter, the penetration of departmental portfolio by a new topic, or the integration of a new topic into established organizations (Lafferty & Hovden, 2003; Persson & Klein, 2009; Picciotto, 2002). Vertical and horizontal dimensions translate either into cross-governmental and sectoral integration (e.g. Lafferty & Hovden, 2003) or into mainstreaming implemented by rather powerful governmental bodies (such as city councils) and less powerful entities (such as departments) (e.g. Jacob & Volkery, 2004). However, Nunan, Campbell, & Foster (2012) argue that if the focus of research is on a topic, which recently has been started to be integrated, it is most appropriate to define the vertical dimension as conditions that are characterized by strong guidance of the core legislative power or actors during the integration process. Complementary, the horizontal dimension is defined as conditions that are characterized by a single department or actor that nudge for or coordinate mainstreaming but have insufficient possibilities to exercise top-down control (Nunan et al., 2012).

2.3.3 Mainstreaming strategies for local governments

While in the beginning the rhetoric of sustainability has given rise to voluntary initiatives of local governments on climate change, during the last decade authorities have increasingly engaged in

strategic activities for integrating climate change related issues into local government agendas (Bulkeley & Betsill, 2013). A strategy either refers to explicit, persuasive long-term goals and associated activities or emerges gradually alongside decision-making but eventually will serve as guidance for future directions and from “a pattern in a stream of decision,” (Mintzberg, 1978, p. 935; Steurer & Martinuzzi, 2005). With regard to the research focus on local governments, mainstreaming strategies refer to processes and structures that respective actors either utilize to pursue long-term goals or actions that are realized alongside the day-to-day routine but form patterns in activities and decision-making, to create new or transform existing practices, organizational core work and configurations (Lawrence, 1999; Mcgowan, 1983). While strategy development is traditionally thought of as a rational, top-down exercise, organizational staff as well as external stakeholders engage in strategy making processes in a bottom-up manner (O’Shannassy, 2003). This coincides with horizontal and vertical mainstreaming since each dimension contains links to external actors and interest groups as well as directed and coordinated governance approaches are acknowledged (Nunan et al., 2012). Although mainstreaming strategies are topic and organization specific (e.g. Mazey, 2002; Wamsler & Brink, 2014), based on the key attributes they can be classified according horizontal and vertical mainstreaming dimensions. However, literature on organizational mainstreaming strategies is scarce, particular needs of local governments are rarely considered and only a few studies provide topic related insights.

Table 1. Mainstreaming dimensions and related strategies and elements

Dimensions	Mainstreaming Strategies		Author
Horizontal mainstreaming	Add-on mainstreaming	Refers to the establishment of specific projects or programs that are not an integral part of the departments core objectives and directly target ecosystem-based adaptation or related aspects.	Wamsler, 2013, p. 57ff.; Holden, 2004, p. 15; Roberts & O’Donoghue, 2013, p. 14
	Programmatic mainstreaming	Relates to the modification of sections' or departments' core work by integrating aspects related to ecosystem-based adaptation into on-the-ground projects, programs or reports.	Wamsler, 2013, p. 57ff.; Holden, 2004, p. 15; Roberts & O’Donoghue, 2013, p. 14; Pelling et al., 2008, p. 873
	Inter- and intra-organizational mainstreaming	Promotes collaboration of individual sections or departments with other stakeholders, committees, departments or governmental bodies to inform, consult, advise or collaborate for shared knowledge generation, competence development and action-taking for advancing ecosystem-based adaptation.	Wamsler, 2013, p. 57ff., 159, 162; Holden, 2004, p. 16; Roberts & O’Donoghue, 2013, p. 14ff.; Pelling et al., 2008, p. 873
Vertical mainstreaming	Fractional mainstreaming	Refers to the modification of planning procedures and related activities by new or revised regulations, policies and legislations that lead to integration of ecosystem-based adaptation.	Wamsler, 2013, p. 159; Roberts & O’Donoghue, 2013, p. 14;

	Integral mainstreaming	Adverts to the modification of organizational management and working structures including the configuration of sections or departments to better address and integrate aspects related to ecosystem-based adaptation	Wamsler, 2013, p. 159; Holden, 2004, p. 15; Roberts & O'Donoghue, 2013, p. 14; Pelling et al., 2008, p. 873;
	Directed mainstreaming	Supports or redirects the focus on aspects related to ecosystem-based adaptation by providing additional funding, initiating new projects, supporting education of staff, or directing responsibilities.	Wamsler, 2013, p. 159; 161; Pelling et al., 2008, p. 873

Activities that relate to coordination are categorized according to horizontal mainstreaming (add-on, programmatic, and inter- and intra-organizational mainstreaming strategies). Activities characterized by strong guidance are categorized as vertical mainstreaming (fractional, integral and directed mainstreaming). A detail description of the different strategies with regard to the horizontal and vertical dimension is given in text box 1 and 2, Section 3.1.3)

With regard to existing literature mainstream strategies can be identified according to the horizontal and vertical dimensions. Wamsler (2013) provided the most advanced approach for structuring mainstreaming activities, however the core ideas overlap with strategies identified by Holden (2004), Roberts & O'Donoghue (2013) and Pelling et al., (2008). While these approaches have different research foci (see table 8) six distinct aspects are identified and accordingly presented in table 1. Literature calls attention to the (1) initiation of separate projects that focus directly on the topic, (2) alignment of departmental objectives with the topic under consideration, (3) strategic collaboration between relevant stakeholders, (4) integration of the topic into local government's core procedures, (5) modification of the organizational working structures, and (6) directed instructions that directly supports the topic under consideration.

3 Methods

This section provides a detailed description of the methodological procedure as well as an outline of the ontological and epistemological foundations of this research. I follow a transformational research agenda that embraces close collaboration with societal stakeholders to account for the complexity that evolves from interactions between nature and society contrary to descriptive analytic research (Clark & Dickson, 2003; Clark, 2007; Jerneck et al., 2011; Lang et al., 2012; Spangenberg, 2011; Wiek & Lang, in prep.). The applied ontological framework elucidates the research subject as a complex human-environment system to identify essential system entities and the relationships between them (Scholz, Binder, & Lang, 2011). Accordingly, the research approach of this study is based on the assumption that sustainability problems can be understood as adverse effects and causing factors. The causing factors can be conceived as direct influences such as actions and impacts or indirect influences such as formal and informal rules, values and resources (ibid.).

The epistemological framework elucidates what type of knowledge is generated by this study while acknowledging that transformational research is inherently 'trans-epistemic' and different ways of valuable knowing are recognized (Miller et al., 2013; Wiek et al., 2012). A pragmatic way of identifying different types of knowledge is the differentiation between 'analytic-descriptive knowledge', to understand the issue under consideration, 'normative knowledge', that provide orientation with regard to norms an values that define how desirable a situation is, and 'transformative knowledge' that guide strategies to change and transform the analyzed system (Burger & Kamber, 2003; ProClim, 1997; A Wiek & Lang, in prep.; Arnim Wiek et al., 2012; Arnim Wiek, 2007). As the overall research question indicates is the main focus of this research endeavor the generation of transformative knowledge (Pohl & Hirsch Hadorn, 2008). However, all three knowledge types are essential for sustainability transitions. Analytic-descriptive knowledge in the study context has been sufficiently generated[2]. Although the study focus is on transformative knowledge, normative knowledge will inevitably be generated to understand how civil servants' determine and understand the problem and why they engage in ecosystem-based adaptation mainstreaming. The procedural framework elaborates on the research methodology of this study and displays the order in which methods were applied. The following sections provide an in-depth description of the different steps of the methodology.

3.1 Procedural research framework

A procedural framework was developed as a reflexive and iterative process to guide a rigorous research approach and ensure transparency. The following five distinct research phases were indentified as building blocks and performed iteratively: 1) definition of the research focus (Section 1), 2) case study selection and context analysis (Section 3.1.1), 3) data collection (Section 3.1.2) 4) data analysis (Section 3.1.3) and 5) research validation (Section 3.1.4). In a nutshell, this research used a multiple case study approach (Yin, 2009) to analyze key characteristics of local governments' activities regarding the integration of ecosystem-based adaptation into municipal planning. In order to investigate local governments, I identified three municipalities in the Scania region of Sweden as particularly suitable to answer the research questions. I analyzed three different cases, following a 'literal replication' approach (Yin, 2009, pp. 53-60). In order to investigate the empirical evidence of ecosystem-based adaptation mainstreaming a qualitative content analysis was considered to be most appropriate. The unit of

[2] See for example for environmental characteristics SOU, 2007; for climate change adaptation in municipal planning see Dymén & Langlais, 2012; Sonnek, Johansson, & Lindgren, 2013; Storbjörk, 2007; Wamsler & Brink, 2014; for institutionalization of knowledge, policy context, organizational learning and municipal initiatives see Granberg & Elander, 2007; Nilsson, Swartling, & Eckerberg, 2012; Storbjörk & Hedrén, 2011; Storbjörk, 2010).

analysis was the municipal planning context with its planning processes, including planning documents and actions. The units of observation were statements of municipal staff concerned with the planning process as well as planning documents. Data was collected through semi-structured interviews with key informants as well as relevant planning documents were reviewed. A systematic, theory-guided and rule based analyzes procedure was adopted to examine the collected data (Mayring, 2010).

3.1.1 Case study selection and context analysis

This research investigates three local governments in Sweden to examine the research questions. Sweden was chosen since it is described “as a pioneer in environmental governance” (Granberg & Elander, 2007, p. 538) and the national level already acknowledged the importance of ecosystems and their components for climate change adaptation in 2007 (SOU, 2007). In addition, Sweden is predicted to be substantially affected by the changing climate. Temperature will rise more in Sweden and Scandinavia than the global mean, with the average temperature in Sweden rising by 3−5 degrees by the 2080s in comparison with the period 1960−1990 (SOU, 2007). Sea levels are expected to rise by up to 0.2 meters in seas adjoining Sweden (ibid.). In addition, recent high profile climatic events in Sweden include a severe storm 'Gudrun' in 2005, which caused an estimated 21 billion Swedish Crowns (2.23 billion Euro) of damage in southern Sweden (SOU 2007). Sweden has been affected by several major floods in recent years (ibid.), and events like last year's Hurricane Sven point to ongoing vulnerabilities to the increasing risk of frequent and extreme storm events, although there is still uncertainty as to how much more likely these will be (ibid.; Länsstyrelserna, 2012).

Table 2: Environmental and sustainability related performance of selected municipalities

Municipality	Activities raising awareness of environmental and sustainability related performance
Lomma	sustainable urban development projects; endorsed Fairtrade City;
Malmö	LIFE-projects BUCEFALOS and BIOGASSYS on renewable energy; sustainable urban development projects; pledged to become carbon neutral; endorsed Fairtrade City;
Helsingborg	sustainable urban development projects; Member of the ICLEI network; biogas plant; endorsed Fairtrade City;

Purposive sampling was used to choose the case study areas under consideration (Tongco, 2007), due to the exploratory character of the research. Each case represents a municipality and was sampled as a likely ‘extreme’ or ‘successful’ cases prior to fieldwork. This search for ‘successful’ or ‘extreme’ cases is particularly useful if the purpose of research is to “develop new

concepts, variables, and theories" (Flyvbjerg, 2005, p. 307). Accordingly, the findings of this research aid the understanding of the research questions to become the starting point for similar investigations of other cases. The 'success' of the municipalities was defined based on awareness of their environmental or sustainability activities within the region. Based on internet search and initial contacts with persons knowledgeable in the field of research in the Scania region three cases were selected, namely Malmö (geographical reference: 55N 36' 17", 13S 0' 13", Helsingborg (geographical reference: 56N 2' 47'', 12S 41' 40" and Lomma Municipality (geographical reference: 55N 40' 14", 13S 4' 39"). The three municipalities were selected due to their high profile regarding environmental or sustainability related practices as well as they have shown to be proactive due to their participation in two major research projects, namely 'Ecosystem Services as a Tool for Climate Change Adaptations in Coastal Municipalities' (project period 2013 – 2016) and 'Sustainable Urban Transformation for Climate Change Adaptation' (project period 2012 – 2017). An overview of municipalities' environmental and sustainability performance is given in table 2, while table 3 elaborates on characteristics of the selected municipalities. The case study area is located in the most southern part of Sweden, in Scania County (see figure 2 for the location of the municipalities in Scania County). Scania County contains 33 municipalities (Region Skåne, 2014) ranging between 7000 (Perstorp Municipality) and 300,000 (Malmö Municipality) with an average of 38,000 inhabitants (Stattistiska Centralbyrån, 2013).

Table 3: Characteristics of the investigated municipalities

Municipality	**Inhabitants**	**Land area in km^2**	**Inland water in km^2**	**Sea water in km^2**	**Total area in km^2**
Lomma	22496	55,52	0,82	33,86	90,2
Malmö	312994	156,87	1,52	174,25	332,64
Helsingborg	132989	344,01	1,35	78,61	423,97

The table presents an overview of the three municipalities based on data from the Sattistiska centralbyrån (2010, 2013).

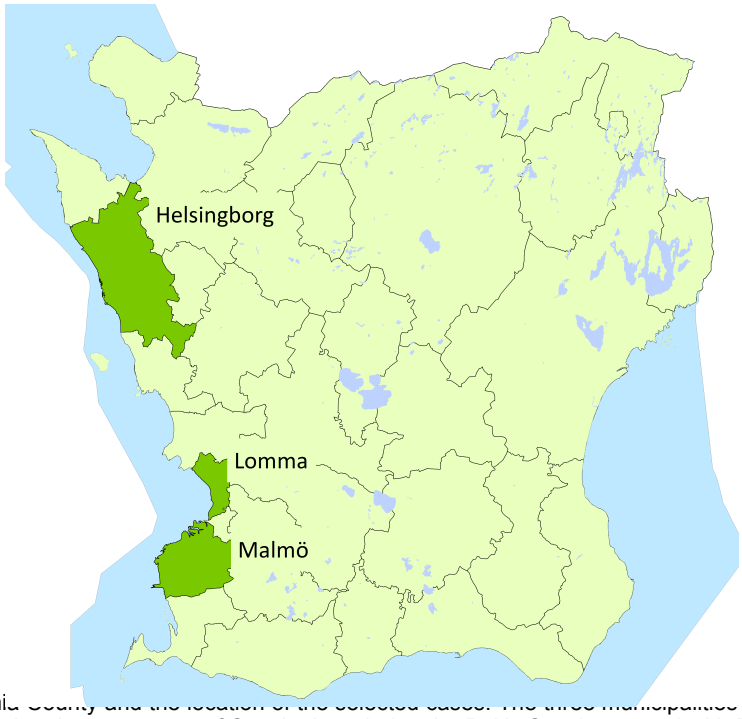

Figure 2: Map of Scania County and the location of the selected cases. The three municipalities (indicated by the dark green color) are located at the west coast of Scania, boardering the Baltic Sea (computed with ESRI (2011) based on data from the Centre for Geographical Information Systems at Lund University (n.d.)).

Table 4: Responsibilities of municipalities and county councils

Municipalities		**County Councils**
Legal or contract based responsibility	Voluntary based activities	
Social services	Leisure activities	Healthcare
Childcare and pre-schools	Cultural activities	Regional activities (such as public transport)
Elderly care	Housing	
Support for the physically and intellectually disabled	Energy	
Primary and secondary education	Industrial and commercial services	
Spatial planning		
Health and environmental protection		
Refuse collection and waste disposal		
Rescue services and emergency preparedness		
Water supply and sewerage		

The table provides and overview of the different areas of accountability according to the local (municipalities) and regional level (county councils) (based on from SALAR, n.d.).

The location of the three cases within the same county ensures a similar planning context for

each municipality with regard to national and regional legislations. Sweden has three democratic levels of governance, namely municipalities, county councils and the national parliament. The principle of self-governance has a long tradition in Sweden, ascribing a pivotal role to municipalities as employers, service providers and supervisory authorities (SALAR, n.d.). Due to the system of financial equation all local governments and regional councils have equal economic conditions for pursuing their activities (ibid.). Table 4 gives an overview of the different responsibility of municipalities and county councils. Traditionally regional development has been associated with the area of accountability of county administrative boards, recently municipalities have increasingly assumed more responsibility in this area, which has led to various forms of cooperation between the two levels (ibid.). With regard to spatial planning the county administrative boards supervise municipal planning and have a right to reject development plans if they insufficiently address health and security as well as since 2008, erosion and flooding (Keskitalo, 2010). The key legislations for municipal planning are the Planning and Building Act, which specifies procedures in spatial planning, and the Environmental Code which concerns environmental aspects in spatial planning. The Planning and Building Act focuses on how planning should be realized and what plans are mandatory, how public interests need to be considered, and ensures that environmental and health interests are included. The planning process is organized in i) comprehensive plans that provide strategic, non-legally binding orientation and ii) detailed plans for built-up areas which are legally binding. In general, comprehensive plans focus on a time horizon between 10 to 25 years and are updated every four years (Sandström, Angelstam, & Mikusiński, 2006). Table 5 provides an overview of the different legislation that Swedish municipalities have to comply with in relation to ecosystem-based adaptation.

Table 5: Overview of important legislations regarding ecosystem-based adaptation

Legislation	**Implication for municipality**	**Source**
The Law of extraordinary events	Identification of how risks and vulnerability will be decreased regarding preparedness for extraordinary events and report to the County Administrative Boards.	Lagen om extraordinära händelser 2006:544
Civil Protection Act		Lagen om skydd mot olyckor 2003:778
Plan and Building Act	Consideration of climate change risk in new development projects; counteract flooding and erosion and building permits should only be given if proactive measures are considered.	Plan- och bygglag (SFS 2010:900)
Environmental Code	For natural protection, building permits for relevant areas require environmental assessments	Miljöbalk (SFS 1998:808)

According to Keskitalo (2010) and Helsingborg (2012) four legislation of particular important were identified

3.1.2 Data collection

Proactive civil servants have been identified as key factors in the mainstreaming of climate change adaptation (Roberts, 2010). Accordingly, the interviewees were selected due to their field of activity within the municipality and their participation in two major research projects on ecosystem services and climate change adaptation. Face-to-face Interviews with 11 municipal staff were conducted within the research project 'Ecosystem Services as a Tool for Climate Change Adaptations in Coastal Municipalities' (see appendix 1 for the interview guide). The conversation language in all interviews was English although the interviewees were Swedish native speakers. The number of municipality staff per interview varied due to suggestions made by interviewees that were contacted initially. The focus on ecosystem-based adaptation and the interest in research on ecosystem service and climate change adaptation planning was clarified at the beginning of each session. An overview of the interviewed municipal staff is given in table 6. The interviews were transcribed according to the protocol developed by McLellan, MacQueen & Neidig (2003). While the initial interviews in each municipality were transcribed closely to the recorded speeches, only relevant passages were transcribed in the follow-up interviews.

Table 6: Overview of the interviewees

Municipalities	**Job title (Swedish)**	**Department (Swedish)**	**Municipality**
Helena Björn	Environmental strategist (miljöstrategiskt ansvarig)	Municipal management office (Planning Section) (kommunledningskontoret)	Lomma
Widar Narvelo	Municipality ecologist (kommunekolog)	City Planning and Technical Services Department (Stadsbyggnadsförvaltningen)	Helsingborg
Fredrik Bengtsson	Municipality ecologist (kommunekolog)	City Planning Department (Stadsbyggnadsförvaltningen)	Helsingborg
Emilie Björling	Water planner (vattenplanerare)	City Planning Department (Stadsbyggnadsförvaltningen)	Helsingborg
Malin Rizell	Comprehensive planning architect (översiktsplanearkitekt)	City Planning and Technical Services Department (Stadsbyggnadsförvaltningen)	Helsingborg
Claes Nihlén	Environmental strategist (miljöstrateg)	Environment Department (Miljöförvaltningen)	Helsingborg
Rasmus Fredriksson,	Project manager (projektledare)	Environment Department (Miljöförvaltningen)	Malmö
Michael Palmgren	Founder and Head marine development (grundare och ansvarig marin utveckling)	Marine Science Centre, Marine Science Centre (SEA-U Marint Kunskapscenter)	Malmö
Annika Kruuse	sustainability strategist (hållbarhetsstrateg)	Environment Department (Miljöförvaltningen)	Malmö
David Snällfot	Project secretary (project secretary)	Environment Department (Miljöförvaltningen)	Malmö
Tyke Tykesson,	Comprehensive planning architect (översiktsplanearkitekt)	City Planning Office (Stadsbyggnadskontoret)	Malmö

The number of interviewees per municipality varied since the selection process focuses on key informants. Besides interviews with first contacts, additional interviews were conducted in the larger municipalities (Malmö and Helsingborg) to capture all relevant perspectives.

Table 7: Overview included municipal documents

Municipality	Year	Name	Mentioned the term 'ecosystem services' or 'ekosystemtjänster'	Mentioned the term 'climate change adaptation' or 'klimatanpassning'
Lomma	2010	Comprehensive plan	x	x
	2010	Marine environmental program	x	-
	2008	Environmental program	x	
Helsinborg	2013	Green structure program	x	-
	2013	City of Helsingborg. Biodiversity Report	x	x
	2012	PM Climate Change Adaptation	-	x
	2011	Environmental Program	-	-
	2010	Comprehensive plan	x	-
Malmö	2013	Environmental Plan	-	-
	2013	Comprehensive plan	x	x
	2012	Nature conservation plan	x	-
	2008	Stormwater strategy	-	-
	2012	Action plan for climate change adaptation	x	x
	2008	Climate, sea level and planning	-	x
	2003	Green plan	-	-

Selection of documents was limited to municipality publications that focused on areas related to (i) ecosystem services, or (ii) climate change adaptation, or (iii) indicated the general spatial planning strategy of the examined municipality. Solely the most recently published documents were included as to evaluate the latest development in municipality practices.

In addition to the interviews, relevant planning documents were identified to substantiate the analysis and provide background information to better understand the contextual setting for each municipality (see table 7 for an overview of the included documents). The analyzed written documents were published by the examined municipalities and reflect the work of individual departments or departmental collaborations. The analyzed documents were neither legally binding nor do they necessarily picture the actual activities correctly since intentions or planned activities were also expressed. The included documents serve the purpose to recommend and inform the development process of legally binding documents and are accessible to the public.

3.1.3 Data analysis

The identification and extraction of relevant text passages from the selected material and the subsequent analysis was organized in four consecutive phases. This four-step procedure combined inductive with deductive data analysis to develop a coherent set of categories that have been applied to the selected material (Rihoux, 2006). The four phases organized activities related to 1) coding scheme development, 2) identification of potentially relevant text chunks

within the selected material, 3) application of the coding scheme to the identified text chunks and 4) development of additional codes according to uncategorized material. Each phase is described in depth in the following sections.

In the first phase, a coding scheme was developed with regard to the literature that focuses on organizational mainstreaming strategies. Table 1 provides and overview of the identified distinct strategies while table 8 presents the research focus of the employed literature. With regard to horizontal and vertical mainstreaming dimensions I defined each strategy as precisely as possible to increase validity but also as broadly as necessary to ensure consistent use (an in depth description of mainstreaming strategies that relate to the horizontal dimension is given in text box 1 while text box 2 provides an detailed description of strategies that relate to vertical mainstreaming). According to the indentified mainstreaming strategies I developed a coding table based on Marying (2000) considering definitions for categories, coding rules and anchor examples (see table 9).

Box 1	**Horizontal mainstreaming strategies**
Horizontal mainstreaming refers to practices that are performed by those with limited top-down support. Accordingly horizontal mainstreaming strategies embrace discrete activities that relate to staff initiatives or departmental coordination that aim at the integration of ecosystem-based adaptation into local government practices (see table 1). Related strategies include, firstly, launching of separate projects, summarized as add-on mainstreaming. More specifically, add-on mainstreaming adverts to projects that are developed and managed in parallel to departmental core objectives. Add-on mainstreaming strategies can be established as municipal staff expand their working area or engage in projects that are not part of their work description (see Wamsler, 2013, p. 57ff.; Holden, 2004, p. 15; Roberts & O'Donoghue, 2013, p. 14). Secondly, tailoring departmental core objectives according to the topic that is to be mainstreamed summarized as programmatic mainstreaming. More precisely, programmatic mainstreaming relates to modification of departments' or sections' core work that are adjusted and refined in order to incorporate aspects of the topic under consideration. This can be done by integrating new aspects into core work or altering and realigning existing objectives (see Wamsler, 2013, p. 57ff.; Holden, 2004, p. 15; Roberts & O'Donoghue, 2013, p. 14; Pelling et al., 2008, p. 873). Thirdly, horizontal mainstreaming relates to collaborations with stakeholders outside of as well as with actors within the local government, summarized as inter- and intra-organizational mainstreaming. Inter- and intra-organizational mainstreaming strategies promote the collaboration of local governmental actors with civil servants, interest groups and practitioners to realize opportunities for advancing the topic under consideration. Related activities can include joint working groups or projects and meetings for shared knowledge generation to inform, consult or advise on relevant matters (see Wamsler, 2013, p. 57ff., 159, 162; Holden, 2004, p. 16; Roberts & O'Donoghue, 2013, p. 14ff.; Pelling et al., 2008, p. 873).	

During the second phase, the selected documents (see table 7) were skimmed and the text chunks potentially relevant to the research question were highlighted and transferred into a single case document. The interviews were fully included in the analysis. The third phase was used to apply the coding scheme to the identified text passages. Text chunks were assigned to the developed categories according to the coding rules (see table 9). In the case of contradiction between documents and interviews the latter was given priority. Single sentences that capture

the expressed meaning without ambiguities were the smallest, while paragraphs were the largest identified unit.

Box 2	**Vertical mainstreaming strategies**
Vertical mainstreaming refers to practices that are performed by those who can exercise strong top-down steering or control. Accordingly vertical mainstreaming strategies embrace discrete activities that relate to revision of local government objectives or working structure that aim at the integration of ecosystem-based adaptation into practices (see table 1). Related strategies include, firstly, modification of planning procedures summarized as fractional mainstreaming. More specifically, fractional mainstreaming focuses of changes in local governmental core objectives that result in the alteration of existing policies, regulation and legislation. With regard to ecosystem-based adaptation this relates to revision of planning procedures that determine approval criteria of development projects and departmental working routines. Revisions of land-use planning procedures can for instance be achieved by modifying existing or implementing new regulations, policies and legislations (Wamsler, 2013, p. 159; Roberts & O'Donoghue, 2013, p. 14;). Secondly, modification of organizational management, procedures and working structures, summarized as integral mainstreaming. More precisely integral mainstreaming relates to the modification of management and working structures that organize the overall organizational functioning as well as departmental configuration and responsibilities. This can be done by assigning existing departments with new emerging tasks and adjust their area of accountability or creating or restructuring new or existing sections and departments (Wamsler, 2013, p. 159; Holden, 2004, p. 15; Roberts & O'Donoghue, 2013, p. 14; Pelling et al., 2008, p. 873;). Thirdly, vertical mainstreaming relates also to support of selected initiatives and practices provided by politicians, summarized as directed mainstreaming. Related activities include support by politicians and chief executives that allocate funding, initiate topic related projects, redirected responsibilities or ensure topic related education of staff (Wamsler, 2013, p. 159; 161; Pelling et al., 2008, p. 873).	

In the fourth and last phase highlighted passages that were considered as relevant to the research question and have not been categorized according to the predetermined codes were given a new code (see Hsieh & Shannon, 2005; Mayring, 2000). These text chucks contained information that clarified the responsibility within the municipality and accordingly established a new category (see table 9). Relevant text passages were sometimes linked to multiple categories, as the coding scheme was not mutually exclusive.

Table 8: Overview of the research focus of literature that focuses on mainstreaming strategies at the local level

Author	**Research focus**
Wamsler (2013)	Developed mainstreaming strategies for integrating climate change adaptation into urban planning with specific consideration of local governments (e.g. Wamsler & Brink, 2014).
Roberts & O'Donoghue, (2013)	Described the mainstreaming process of climate change adaptation and mitigation within local government' operations and investigated the implementation of community ecosystem-based adaptation (Roberts et al., 2011).
Holden, (2004)	Structured the integration of HIV/AIDS into organizational work.
Pelling et al., (2008)	Examined the interplay between individual and collective action to identify pathways toward development of organizational adaptive capacity

3.1.4 Research validation

This research is embedded in sustainability science and accordingly requires a broader range of

quality criteria than the typical criteria of validity, reliability and objectivity applied in the positive research paradigm (Wiek et al., 2012). With regard to the practical relevance of research and its application outside academia, particular importance is given to the quality of salience as well as legitimacy to ensure inclusiveness of different perspectives (Cash et al., 2003). In addition, the research purpose of this study and the outlined assumptions, make quality criteria developed in the realm of interpretive research more meaningful. Accordingly, I use the criteria of credibility, transferability and dependability, to evaluate the quality of this research (Lincoln & Guba, 1985). Credibility (in opposition to validity) adverts to the adequate representation of the socially constructed system that the research is concerned with (Koch, 2006; Zhang & Wildemuth, 2009). Transferability (in opposition to reliability) depends on similarities between different contexts and indicates the extent to which findings can be applied to different settings (Zhang & Wildemuth, 2009; Koch, 2006). Dependability (in opposition to objectivity) indicates the extent to which the same or comparable conclusions can be produced in following the decision tail of research, making auditability a criterion of rigor (Koch, 2006; Guba & Lincoln, 1985).

Table 9: Coding table

Category	Definition	Coding rule	Anchor example
Add-on mainstreaming	Refers to the establishment of specific projects or programs that are not an integral part of the departments core objectives and directly target ecosystem-based adaptation or related aspects.	Assign a text passage if it mentions side project or programs related to ESP, CCAP or EbA but are not related to core objectives of a department.	“we find issues that we want to work with, and then we apply for money, establish a project, and try to involve other departments, partners, and stakeholders … to have more power behind our wishes. We are the one department in Sweden that brought most external money into the municipality … to push our sustainability agenda.”
Programmatic mainstreaming	Relates to the modification of sections' or departments' core work by integrating aspects related to ecosystem-based adaptation into on-the-ground projects, programs or reports.	Assign a text passage if it specifies on on-the-ground projects, programs, or reports that are in line with the core objectives of a department and relate to ESP, CCAP or EbA.	“we discussed the green structure in its wide possibilities, to support us for services, so many wide values. … And then you had a separate chapter [in the Green Structure Plan] who will work with ecosystem services. … [B]ut then we realized that everything is ecosystem services, even the recreational services, and so on. So we changed the structure of [the Green Structure Plan] to talk about ecosystem services in general.”
Inter- and intra-organizational mainstreaming	Promotes collaboration of individual sections or departments with other stakeholders, committees, departments or governmental bodies to inform, consult, advise or collaborate for shared knowledge generation, competence development and action-taking for advancing ecosystem-based adaptation.	Assign a text passage if it specifies on who collaborates with external and internal stakeholders, units, governmental bodies, committees or working groups for informing, consulting, collaborating, or action-taking regarding ESP, CCAP or EbA.	We involve them [stakeholders] “as consultants to make [biological] inventories and so on. That’s a big issue in the ICLEI context, they always want to see collaboration with NGOs.”
Fractional mainstreaming	Refers to the modification of planning procedures and related activities by new or revised regulations, policies and legislations lead to integration of ecosystem-based adaptation.	Assign a text passage if it mentions the modification of organizational management, core objectives and measures, as well as policies and legislation that define the core work of a section or department with regard to ESP, CCAP or EbA.	"we have a new concept now that defines that developers have to compensate. So if you want to build a house, on a plot and there's a tree we say ok you can take down that tree but you have to plant another one here instead"
Integral mainstreaming	Adverts to the modification of organizational management and working structures including the configuration of sections or departments to better address and integrate aspects related to ecosystem-based adaptation	Assign a text passage if it describes modification processes of the organisation’s working structures including the internal formal and informal norms and policies as well as ajustments in work descriptions in relation to ESP, CCAP, or EbA	The Municipal Executive Committee “got the responsibility to work with this action plan for adaptation, because they want to point out what the … [departments] should do, and … you cannot do it here because we do not have influence on these companies, so that’s why you have to lift it up to this higher level because [there], you’re on the highest level in this organization.”
Directed mainstreaming	Supports or redirects the focus on aspects related to ecosystem-based adaptation by providing additional funding, initiating new projects, supporting education of staff, or directing responsibilities.	Assign a text passage if it refers to activities that promote ESP, CCAP or EbA in relation to issued instruction.	“Last year for instance [politicians] asked us [Environment Department] to make a seminar series about ecosystem services so it is now on that level. In particular one politician … really discusses with us and inform us ecologist within the municipality and asks us what we think and tries to inform us and then have strategies, good strategies, and he will probably give us some money, when he can.”
Mandate of ecosystem-based adaptation	Relates to actors, sections, or departments that have formal or informal responsibilities for ecosystem service or climate change adaptation planning.	Assign a text passage if it describes to which area of accountability ESP, CCAP or EbA relate, who has responsibility for one of these topics or is the formal or informal contact person.	The County Administrative Board “requested a contact person for climate change adaptation in each of Scania’s municipalities to facilitate coordination, in Malmö we assigned this responsibilities to the heads of department [at the Environment Department and the City Planning Office] … in effect meaning any work will be delegated downwards [so that does not translate into any particular responsibilities].”

Although the application of this research outside academia (criteria of salience) is the overarching goal of this study, it is beyond the scope of this thesis. The implementation of research findings is not facilitated by solely making this study available to the public but requires close collaboration between scientists and practitioners (e.g. Lang 2012). In order to produce meaningful results, different perspectives represented by different municipal departments, were integrated into this study. However, the legitimacy of this research can only be approved by practitioners consulted during the research process as well as stakeholders excluded from this research (criteria of legitimacy). In order to enhance the credibility of this study all interviewees were consulted after the analysis to review the findings of this study. This procedure is also referred to as 'extended peer review' (Funtowicz & Ravetz, 1993; Wiek & Lang, in prep.; Wiek, 2007). In spite of that only the interviewed municipal staff were contacted and solely three interviewees replied in time, a conclusive assessment of the study's credibility and legitimacy cannot be made. With regard to the transferability the applied sampling method has negative implications for generalizing the findings. This research is concerned with examining and developing a new approach, in particular how ecosystem-based adaptation is mainstreamed into local governments and if this can potentially foster a sustainability transition. Non-the-less, it is hoped that this study becomes the starting point for similar investigations of other cases. Accordingly, the contextual features that I consider to be most important for judging the transferability of this study have been elaborated. In addition, adequate contextualization of the findings is crucial for further research in different settings to avoid panaceas and ultimately contribute to sustainability (Ostrom, Janssen, & Anderies, 2007). As the generated knowledge is context specific, I consider the procedural framework, outlined in this chapter to be a crucial requirement to comply with the criterion of dependability in order to increase the transparency of this study.

4 Results

This section summarizes the findings of the analysis with regard to the research questions. Each case is presented separately to examine them according to ecosystem service planning and climate change adaptation planning. I analyze which department has the primary responsibility for (i) ecosystem service planning and (ii) climate change adaptation planning and subsequently present related mainstreaming activities. The identified activities are presented according to the mainstreaming strategies (see table 1). The last section reviews the three municipalities with

regard to (iii) inter-linkages, the synergies between, and barriers to the integration of ecosystem service and climate change adaptation planning.

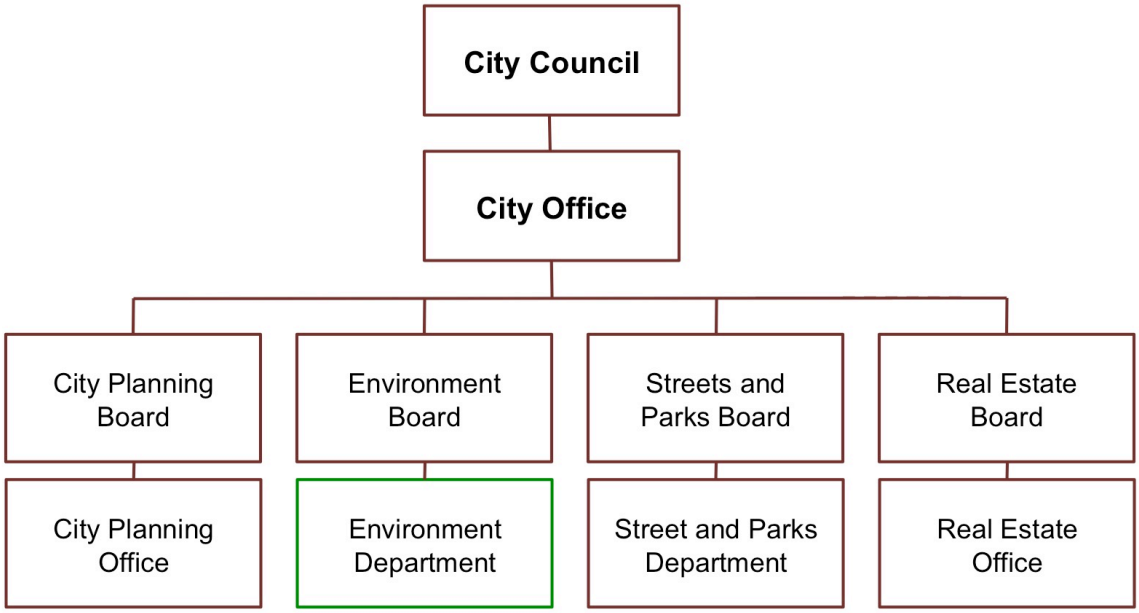

Figure 3: Organizational chart of Malmö Municipality shows the departments relevant to ecosystem-based adaptation. The green border indicates the responsibility for ecosystem service planning. The City Council is the elected, highest decisions-making body, responsible for budgeting and development of Malmö's vision. The City Ofice is the executive board, responsible for coordination of all departments and works on Malmö's strategic placement. The municipal boards have different areas of accountability and supervise the work of the respective department. The City Planning Office is, among others, responsible for compressive and detailed planning and building permission. The Environment Department is responsible for environmental monitoring and environmental concerns in spatial planning as well as for projects related to sustainable development. The area of accountability of the Streets and Parks Department includes the management of the urban environment. The Real Estate Office is responsible for the supply of build-ready plots for housing and business.

4.1 Mainstreaming strategies in Malmö Municipality

The integration of ecosystem-based adaptation into Malmö Municipality's core work is achieved by utilizing horizontal and vertical mainstreaming strategies. While the formal responsibility for ecosystem service and climate change adaptation planning is not clearly defined, different departments and working groups are concerned with the integration of related practices into municipal planning (see for an overview of the municipal organizational structure figure 3). In order to integrate ecosystem service planning externally funded project have been developed, the topic was integrated into core work of the Environmental Department as well as inter- and intra-organizational collaboration promoted its mainstreaming. In addition, changes made in the spatial planning process ensured the recognition of concerns related to ecosystem service planning as well as politicians supported associated activities. Climate change adaption was

integrated into Malmö Municipality through externally funded projects, inter-departmental collaboration as well as politicians promoted related activities (see table 24).

4.1.1 The integration of ecosystem service planning into Malmö Municipality

The Environmental Department is mandated to deal with blue and green infrastructure and in collaboration with other departments published key documents to address related issues (see figure 2). Although the formal responsibility for planning and for natural conservation is accredited to the City Planning Office and the Streets and Parks Department due to the mandate of spatial planning and responsibility for maintenance of related structures, interviewees either stated that no one has the formal responsibility for ecosystem service planning or the Environmental Department was associated with related activities. The Environmental Department has developed strong leadership in ecosystem service planning. However, regular responsibilities and availability of resources constrain the integration of ecosystem service related issues into the working area of municipal staff (see table 10)

Table 10: Quotes Malmö

One interviewee stated: "we have had the fortune to get some projects which allow us to free up time [beside regularly responsibilities] to work with it and to discuss it."

The integration of ecosystem service planning into the Environment Departments area of accountability is achieved by initiating projects that are externally funded and realized in addition to the department's core work (add-on mainstreaming). The acquisition of external funding provides municipal staff with additional resources that are required to engage with the topic (see table 11).

Table 11: Quotes Malmö

One interviewee stated: "we find issues that we want to work with, and then we apply for money, establish a project, and try to involve other departments, partners, and stakeholders … to have more power behind our wishes. We are the one department in Sweden that brought most external money into the municipality … to push our sustainability agenda."

The Environment Department has successfully integrated ecosystem service into the department's objectives (programmatic mainstreaming). For example civil servants are using the concept to support rationales for creation and conservation of ecological structures in key planning documents such as the Comprehensive Plan while being responsible for drafting a particular section. The main reason for integrating ecosystem service planning was the communicative value of the concept (see table 12).

Table 12: Quotes Malmö

One interviewee stated: “term is so very good because it explains very much what we want to work with, it’s very pedagogical.”

The dissemination of the concept into different working areas is related to close inter-municipal collaboration (inter- and intra organizational mainstreaming). Besides working groups that focus on compiling planning guidelines and documents, different departments work together on a project basis for redesigning a particular street or developing an entire neighborhood. In addition, informal networks that consist of municipal staff with similar disciplinary background facilitate close collaboration (see table 13).

Table 13: Quotes Malmö

Interviewees stated: “normally when we do things we establish a working group that consist of all the relevant departments.” “we have a network of ecologists in different departments with different responsibilities.”

While the Environment Department provides the strategic orientation, collaborations with the Streets and Parks Department for example are considered as crucial to implement projects. However, the implementation is not directed to other departments but close collaboration are viewed as crucial for successful projects (see table 14).

Table 14: Quotes Malmö

One interviewee stated: “so it’s not like ‘we have something good for you, please do it’ but it’s more like ‘we want to do something here on this street, so please help us’.”

Ecosystem services are rarely considered in conventional municipal planning procedures because legal documents lack such a focus (fractional mainstreaming). However, the national legislation ensures that the Environment Department has to review spatial plans (see table 15)

Table 15: Quotes Malmö

One interviewee stated: “when the City Planning Office makes a plan, a building plan or whatever plan, they have to send it to us [Environment Department] for us to comment” [due to the Plan and Building Act]. … It doesn’t mention the word ecosystem services but it says that plans should be made to not destroy natural resources.”

In addition to legal requirements the municipality uses a ‘green factor’ tool to ensure green space in new development projects but this tool would be subject to cancellation if contested in court since municipalities are not allowed to enforce environmental standards onto the private sector. One interviewee stated:

Table 15: Quotes Malmö

One interviewee stated: "[u]nfortunately, the [national] government doesn't really see where we're going with [the 'green factor' tool]. They don't really want the municipalities to have their own requirements beside the Planning and Building Act, so even though we have been using this for a couple of years now, it's not really sure whether we're allowed to do this, it could be torn up."

Municipal staff views the elected politicians as being supportive and promoting activities related to ecosystem service planning (directed mainstreaming). Close collaboration with politicians was utilized to communicate the need for support and harmonize activities for developing coherent strategies. In addition, politicians initiated the project Living Malmö by making financial resources available. The project aims to generate knowledge on how to operationalize the city's vision of a green and dense city and create social cohesion (see table 16).

Table 16: Quotes Malmö

One interviewee stated: "[l]ast year for instance [politicians] asked us [Environment Department] to make a seminar series about ecosystem services so it is now on that level. In particular one politician … really discusses with us and inform us ecologist within the municipality and asks us what we think and tries to inform us and then have strategies, good strategies, and he will probably give us some money, when he can." politicians "have given 2 million crowns to the City Planning for a project called Levande Malmö … I'm participating in that working group from the Environment Department, but all departments are involved. The project leader is very much into the social issues, so I'm, somehow we try to push it in a more ecological way."

4.1.2 The integration of climate change adaptation planning into Malmö Municipality

Climate change adaptation is a new topic for Malmö Municipality resulting in a lack of formal responsibility and only few municipal staff have related work description. Interviewees identified the lack of precise framing of climate change adaptation as the main cause for the lack of problem ownership (see table 17).

Table 17: Quotes Malmö

One interviewee stated: "[n]o one has been assigned a formal mandate to structure the work on climate change adaptation in Malmö and it may therefore be unclear where responsibilities lie." "it's a new topic and it depends if you look at it from a security perspective, [there the question is] where are the fire trucks supposed to go first and which big streets are we supposed to protect first with sandbags … but when it comes to where should we build our houses in the next hundred years, then it's a planning process related to the Comprehensive Plan. But when it comes to what bird species are we supposed to have in the city in 50 or 100 years, or where are we supposed to put our drainage water in 20 years maybe or even 5 years, then it becomes a little uneasy."

With the help of external funding the Environment Department established the project 'Green Tools for Urban Climate Adaptation' (GreenClimeAdapt) in 2009 (see table 18).

Table 18: Quotes Malmö

One interviewee described the project's focus as being on: "ponds and ditches and … a former … marshland to retain the storm water. And we built some new types of lightweight green roofs, with the intention that they could be used on private homes, [commercial and public buildings]."

Furthermore, an Action Plan for Climate Change Adaptation was drafted based on a collaborative project between university researchers and municipal staff (inter- and intra-organizational mainstreaming). However the Action Plan, which was scheduled to run from 2012 to 2014, was never implemented due to the lack of financial means. Recently, the City Office established a working group and a steering committee to analyze Malmö's risk profile related to natural hazards and suggest how risk reduction measures are to be coordinated. The Environment Department is represented in this working group in collaboration with the City Planning Office, Streets and Parks Department, and the City Office. Correspondence between Malmö Municipality and the County Administrative Board eventually lead to the appointment of official contact persons for dealing with climate change adaptation (see table 19)

Table 19: Quotes Malmö

One interviewee stated: the County Administrative Board "requested a contact person for climate change adaptation in each of Scania's municipalities to facilitate coordination, in Malmö we assigned this responsibilities to the heads of department [at the Environment Department and the City Planning Office] … in effect meaning any work will be delegated downwards [so that does not translate into any particular responsibilities]."

The municipal staff views interdepartmental collaboration as essential for ecosystem-based adaptation because the utilization of green areas for water drainage requires the water treatment plant (VA Syd), the management of green areas (Streets and Parks Departmental) and the spatial planning (City Planning Office) to work together. However, collaborations have proven to be difficult see table 20).

Table 20: Quotes Malmö

One interviewee stated: "[b]ut I talked to a colleague in VA Syd the other day about this and he said 'oh, it's easier to work by yourself, it's always more complicated to cooperate'. Of course it is, but I mean that he really said it out loud. It's easier to dig a pipe."

The municipality established the new working group in parallel to joining the Resilience Cities campaign of the United Nations Office for Disaster Risk Reduction. While in general the politicians are viewed as being supportive, the driving force to participate in the campaign was also an elected politician (directed mainstreaming) (see table 21).

Table 21: Quotes Malmö

Interviewees stated: "[o]ne of our politicians has heard of this strategy as well as the campaign making and said we should do this, we should work with it." "we have politicians right now that are aware of the need for climate adaptation planning for instance and also the need for good green and blue infrastructure, so they have been supporting us."

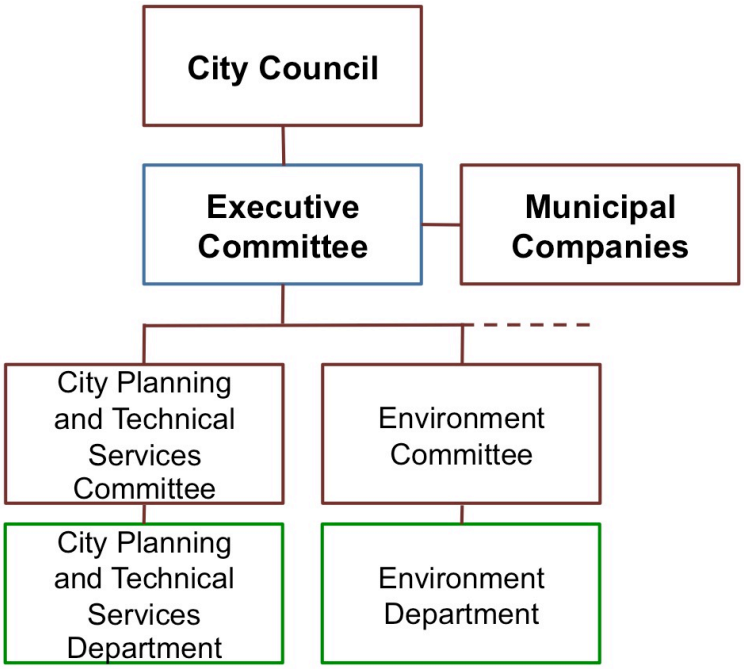

Figure 4: Organizational chart of Helsingborg Municipality shows the departments relevant to ecosystem-based adaptation. The green border indicates the responsibility for ecosystem service planning. The blue boarder indicates the responsibility for climate change adaptation planning The City Council is the elected, highest decisions-making body, responsible for budgeting and development of Helsingborg's vision. The City Office is the executive board, supervising the departments and works on Helsingborg's strategic placement. The municipal companies include, among others, the regional water and sewage company NSVA, the water company Sydvatten, and the regional sewage disposal company NSR. The municipal committees have different areas of accountability and supervise the work of the respective department. The City Planning and Technical Services Department is, among others responsible comprehensive and detail planning as well as building permits and maintenance of the infrastructure. The Environment Department is responsible for environmental monitoring and protection and strategic environmental affairs.

4.2 Mainstreaming strategies in Helsingborg Municipality

The integration of ecosystem-based adaptation into Helsingborg Municipality's core work is related to horizontal as well as vertical mainstreaming strategies. While ecosystem service planning is linked to departmental responsibilities, the mandate for climate change adaptation planning has been eventually located at the highest municipal decision-making level to allow for central coordination and top-down exercised orders to relevant actors (see for an overview of the municipal organizational structure figure 4). Mainstreaming activities related to ecosystem service planning included the integration into departmental core work and collaborations

between departments and non-municipal stakeholders. In addition, changes made in the spatial planning process ensured recognition of related concerns as well as support of politicians has lead to participation in an international city network. Mainstreaming of climate change adaptation planning was related the integration of the topic into departmental core work, departmental collaborations and changes made in the municipal structures (see table 24). The integration of ecosystem service planning into Helsingborg Municipality

The formal responsibility of ecosystem service planning is shared between the Environment Department and the City Planning and Technical Services Department. This is due to the fact that the Environment Department is involved in the review and approval of plans as well as responsible for environment related legislations. The City Planning and Technical Services Department is responsible for spatial planning. Both departments have started to integrate the terminology of ecosystem services in order to better reason for environmental conservation in development projects (see table 22).

Table 22: Quotes Helsingborg

One interviewee stated: the ecosystem service concept provides "some economic valuations for nature, that we have been lacking … all the time, so it is very hard for us … to get others to understand the values, when you talking about building things and we say 'oh no you cannot do this here because it is of very high value' – the nature, rare species and so on – but now if we get some other values, monetary values, perhaps it would be easier to claim those values".

The City Planning and Technical Services Department and the Environment Department have both utilized programmatic mainstreaming strategies to incorporate ecosystem services into the department's core work while pursuing different activities. The City Planning and Technical Services Department focuses in its area of accountability mainly on the integration of the concept into the relevant planning documents. In addition, the Environment Department integrated ecosystem services into spatial planning while being responsible for stormwater management in the scope of a new development project (see table 23).

Table 23: Quotes Helsingborg

Interviewees stated: "we [City Planning and Technical Services Department] discussed the green structure in its wide possibilities, to support us for services, so many wide values. I think that was the key. And then you [addressing another interviewee] had a separate chapter [in the Green Structure Plan] who will work with ecosystem services. In the beginning that was a separate chapter, but then we realized that everything is ecosystem services, even the recreational services, and so on. So we changed the structure of [the Green Structure Plan] to talk about ecosystem services in general." the Environment Department "provided the money to assist the development of … a stormwater pond, but since we had contributed with some money, we obviously had some things to say."

Table 24: Overview of municipality mainstreaming strategy characteristics

Mainstreaming strategies		Results		
		Malmö	Helsingborg	Lomma
Horizontal mainstreaming	Add-on mainstreaming	○△ The ED initiated externally funded projects that are realized in addition to department's core work.		
	Programmatic mainstreaming	○ The ED advanced ES terminology into strategic plans and established the concept within the department.	○ The ED and the CPTSD incorporated ES into their core work as well as streamlined ES planning into strategic plans by tailoring supporting documents accordingly. △ The CPTSD integrated CCA planning into the departments and municipal core work by codifying the prerequisites in strategic documents.	○ The ES terminology has been integrated into departmental core work and strategic plans.
	Inter- and intra-organizational mainstreaming	○ Working groups collaborate in drafting policy documents as well as different departments work together on a project basis for developing a particular area. △ Based on a collaborative project between university researchers and municipality staff the ED published a Action Plan for Climate Change Adaptation. Recently, the CO established a working group to address implementation on CCA in MM.	○ Intraorganizational collaborations are challenging while external stakeholders are involved to incorporate local knowledge into for ES planning. △ Collaboration between departments are limited to working groups that focuses on immediate response to disasters while contacts to the university and water companies are established.	○△ Close collaborations with municipal and non-municipal actors as well as with adjacent municipalities and the regional government are used to promote ecosystem service planning.
Vertical mainstreaming	Fractional mainstreaming	○ MM uses a 'green factor' tool to ensure green space in new development projects.	○ The CPTSD uses a planning tool to balance the development of an area with existing ecological structures.	○ LM established a planning tool to compensate the loss of nature in new developments as well as developed an extensive list of ecological criteria to systematically evaluate new development proposals. △ LM specified that new develop project have to be built three meters above sea level.
	Integral mainstreaming		△ Recently, responsibilities for CCA planning have been located at the highest level of decision-making at to allow for central coordination and directing orders to relevant actors.	○△ LM enforces working procedures based on non-binding agreements and informal rules as well as municipal staff take action on their own account to develop their work focus beside the official job description.
	Strategic mainstreaming	○ Municipal staff views the elected politicians as being supportive as they promoted a seminar series on ES and provided funding for projects related to ES planning. △ MM has start working on CCA because politicians wanted to participate in the Resilient Cities Campaign.	○ The local politicians endorse HM participation in an international city network and projects related to ES planning.	○ The proximity to the highest decision-making level facilitates strongly support PS staff's initiatives related to ES planning.

Legend: ○ = Mainstreaming activities related to ecosystem service planning, △ = Mainstreaming activities related to climate change adaptation planning, ES = Ecosystem services, CCA = Climate change adaptation, MM = Malmö Municipality, HM = Helsingborg Municipality, LM = Lomma Municipality, ED = Environment Department, CO = City Office, CPTSD = City Planning and Technical Services Department, PS = Planning Section

The Environment Department uses an ecosystem-based approach to manage stormwater and simultaneously support biodiversity instead of building a squared concrete pond. By using the ecosystem service concept the department successfully justified the suggested measures against competing approaches (see table 25).

Table 25: Quotes Helsingborg

One interviewee stated: "we tried to find ways to communicate this in terms of money and the cost of cleaning, comparing it with [the treatment plant] and other ways, so for me it was very pleasing to have this helped pull."

The need for close collaboration in projects that address ecosystem service planning was emphasized by interviewees from the Environment Department as well as the City Planning and Technical Services Department (inter- and intra-organisational mainstreaming). However, collaborations with other departments are difficult due to the structure of Helsingborg Municipality (see table 26).

Table 26: Quotes Helsingborg

One interviewee stated: stormwater ponds "were paid for by the Technical Department but as [the ponds] grow more green and more recreative, now there is actually a slight difference between who is going to pay for it". Because technical refers to flood prevention "and no concern about whatsoever either biology or recreation but when you intermix them then they start to say 'uuuh that is not our responsibility to put sit places'. … It's a funny example because when it saves money for the whole society it ends up being a money problem because of two different parts sharing the costs all of a sudden."

The municipality is also a member of the ICLEI City Network which was the reason for publishing a report on biodiversity in Helsingborg. Furthermore, to work on ecosystem services and climate change adaptation the municipality has collaborations with the university, water companies and with a NGO on nature conservation. Collaborations with this NGO are used to engage with stakeholders outside the municipality to integrate local knowledge into the planning process (see table 27).

Table 27: Quotes Helsingborg

One interviewee stated: we involve them "as consultants to make [biological] inventories and so on. That's a big issue in the ICLEI context, they always want to see collaboration with NGOs."

In order to decrease ongoing degradation of green areas during the planning process the City Planning and Technical Services Department uses a planning tool to balance the development of an area with existing ecological structures (fractional mainstreaming). However, because of methodological ambiguities and since the municipality is not allowed to put demands on private developers, the tools was difficult to develop and is now solely being applied to public areas. Support by politicians to integrate ecosystem services (directed mainstreaming) is also related

to the ICLEI membership, as it was a political decision after discussions with municipal staff to participate in projects related to ecosystem services (see table 28).

Table 28: Quotes Helsingborg

One interviewee stated: "[w]e have always been discussing with the politicians that we should take part in some project. […] This Local Action for Biodiversity project, it is three years and one part of it is that the city should sign the Durban commitment and that say that you should acknowledge the ecosystem services."

4.2.1 The integration of climate change adaptation planning into Helsingborg Municipality

In the early stages of addressing climate change adaptation planning within the municipality, related issues were located in the City Planning and Technical Services Department. However, since the topic was understood as a cross-cutting issue that different departments need to address, recently, the responsibility was transferred to the Municipal Executive Committee to facilitate top-down guidance. In the beginning the City Planning and Technical Services Department was assigned to draft the Action Plan for Climate Change Adaptation with the main focus being on flooding, sea level rise, urban areas and the urban fringe. With this report the City Planning and Technical Services Department also lobbied for replacing the responsibility at a higher decision-making level to facilitate to top-down control and to direct particular departments to engage in the related activities.

The City Planning and Technical Services Department engaged in programmatic mainstreaming activities to integrate climate change adaptation planning into core work. The publication of the national report on climate change adaptation was used to initiate related activities (see table 29).

Table 29: Quotes Helsingborg

One interviewee stated: "[w]e had some information in the city hall here, and then we started to make some research about it to fit it into the [Comprehensive Plan]. After that, its mentioned also in the [Comprehensive Plan] to make a special PM [Action Plan for Climate Change Adaptation], so that was done after the [Comprehensive Plan] was adopted"

Interviewees emphasized the need of different departments and sections to collaborate in order to harness ecosystem services for climate change adaptation (Intra- and inter-organizational mainstreaming). Outside the municipality the departments collaborate with the university and water companies to integrate relevant knowledge for climate change adaptation. However, interdepartmental continuous collaborations happen rarely since a greater focus of collaborations is on immediate response to unexpected events. In addition, recommendations

brought forward by the Action Plan for Climate Change Adaptation are not controlled for implementation (see table 30).

Table 30: Quotes Helsingborg

Interviewees stated: there is "a [departmental] section which designs public spaces, and that section also built it in one way and then we have a section which maintains the spaces, so if we want to use ecosystems for climate adaptation, we have to convince them that it is important to try to get in some trees and green areas, but they are not very used to getting that input from us." "[w]e have the working group for the ongoing action plan [Action Plan for Climate Change Adaptation] but" communication and working groups between different departments for climate change related issues "mainly happens when there is an accident, and [the working group] will govern how shall we manage this situation. … [For example] "the tunnel where the train comes up, it was nearly that the sea water was coming into that tunnel in 2011, so there was a group gathering for discussing how to adapt to prevent water coming into that, so right now, it could come up special situations where you discuss physical actions. But right now it's just the planning, with technical investigations and so on." "but if they do it [implementing recommendations] I cannot really tell. In some departments they try to follow it, but perhaps not always and everywhere."

The integration of climate change adaptation can be related to integral mainstreaming strategies since the responsibility has been relocated to the Municipal Executive Committee. This will lead to modification of working structures since the Municipal Executive Committee, as the highest level of decision-making, has the mandate to direct orders to lower levels such as departments or municipal owned companies (see table 31).

Table 31: Quotes Helsingborg

One interviewee stated: the Municipal Executive Committee "got the responsibility to work with this action plan for adaptation, because they want to point out what the municipality companies should do, what [departments] should do, and … you cannot do it here [at the City Planning and Technical Services Department], because we do not have influence on these companies, so that's why you have to lift it up to this higher level because [there], you're on the highest level in this organization."

4.3 Mainstreaming strategies in Lomma Municipality

The integration of ecosystem-based adaptation into Lomma Municipality's core work benefited from proximity to decision-makers and uncomplicated working structures supporting horizontal and vertical mainstreaming strategies. The responsibility for ecosystem services and climate change adaptation planning has the Planning Section[3] of the Management Office. Unlike the other municipalities the Planning Section is directly linked to the City Office, displaying the characteristics of a smaller municipality (see for an overview of the municipal organizational structure figure 5). Mainstreaming activities related to ecosystem service planning include the

[3] Note that spatial planning of Lomma Municipality relates to the responsibility of the Management Office, which is located within the City Office. The term 'Planning Section' is used to ease the understanding of the municipal structure in Loma and indicate to what activities of the Management Office the text is referring as well as to facilitate a better cross-case comparison.

integration into core work and inter- and intra-organizational collaborations. In addition, changes made in the spatial planning process ensured the recognition of related concerns as well as uncomplicated working structures promoted its integration, and the proximity to the decision-making body established support of activities associated with ecosystems service planning. The integration of climate change adaptation planning benefited form inter- and intra-organizational collaborations, changes made in regulations ensured its recognition during the planning process as well as uncomplicated working structure supported mainstreaming efforts (see table 24).

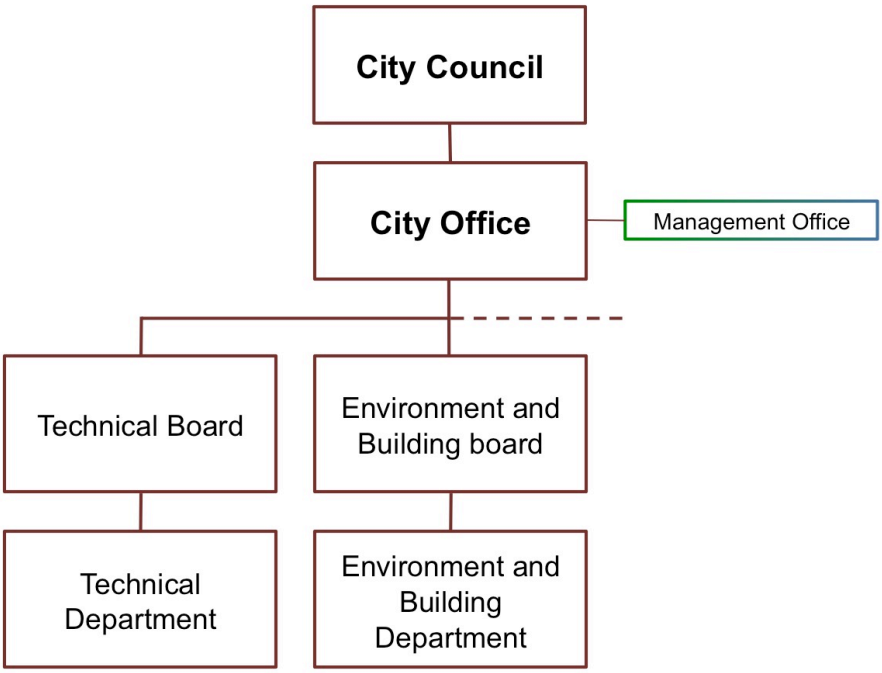

Figure 5: Organizational chart of Lomma Municipality shows the departments relevant to ecosystem-based adaptation. The green/blue border indicates the responsibility for ecosystem service and climate change adaptation planning. The City Council is the elected, highest decisions-making body, responsible for budgeting and development of Lomma's vision. The City Office is the executive board, supervising the departments, works on Lomma's strategic placement and oversees the municipal owned companies. In addition, its area of accountability includes comprehensive planning, environmental strategic issues and availability of housing, which are overseen by the Management Office. The municipal committees have different areas of accountability and supervise the work of the respective department. The Technical department is responsible for maintenance of municipal infrastructure as well as water and sewage. The Environment and Building Department is responsible for environmental monitoring and protection, as well as building permits and city's building issues.

4.3.1 The integration of ecosystem service planning into Lomma Municipality

The Planning Section of the Management Office has the mandate for ecosystem service planning. While general environmental concerns are managed by the Environment Department, the Planning Section represents environmental concerns related to spatial planning. Local politicians engaged with the ecosystem service concept after the Regional Board (Region

Skåne) published a report on green infrastructure and introduced the concept in 2011. The Planning Section integrated ecological structures in its planning approach (programmatic mainstreaming) to protect the coast from erosion as well as terrestrial green infrastructure is harnessed to better deal with flooding. The main reason for incorporating the new topic into departmental core work was the educational notion of the concept and the possibility do describe complex ecological relations in a way that other professions could understand (see table 32).

Table 32: Quotes Lomma

One interviewee stated: “I'm using ecosystems [eelgrass meadows] in the ocean as a measure … to prevent erosion. …The more we have, the better for the coastline. If we do coastal planning and you sort of define different areas for different purposes, you really want to make sure that you are careful with those areas and make sure that you do not have activities here that can damage that ecosystem”. “[o]ne of the hardest things ever is to say why do we have to be careful with nature, because it’s a moral thing in the end. But if you use ecosystem services you get away from the moral aspect. And if I talk to someone who does not care about nature and does not understand why the person cannot just chop down the whole forest … [with] the concept of ecosystem services I can sort of turn it around to being not about moral but about ‘you have to live here as well, and you need these sort of things to be able to survive’, and then you have another power somehow and then they understand it better”.

Collaborations with municipal and non-municipal actors are used to promote ecosystem service planning (inter- and intra-organizational mainstreaming). For example, contacts to the university were used to host a session on ecosystem services. In addition, the Planning Section works together with Technical Department but also promote intradepartmental collaboration for example between civil servants responsible for comprehensive those responsible for detail planning. In addition, networking activities of the County Administrative Board are considered to support better connections between civil servants of different municipalities that working on ecosystem service planning (see table 33).

Table 33: Quotes Lomma

One interviewee stated: “it was not always like that [close collaborations], and you can see that in the city somehow that you were not used to involve the green knowledge into the planning.” “I think [the County Administrative Board] actually had quite a good sense for who should be [involved] but of course we [civil servants from different municipalities] also promote each other.”

Lomma Municipality established a planning tool that requires new developments to compensate for the loss of ecological structures to prevent the constant degradation of ecosystem services (fractional mainstreaming). However, the implementation of this planning tool is difficult (see table 34).

Table 34: Quotes Lomma

One interviewee stated: “it [the planning tool] does not always work since we don’t have the law behind us, so people can actually say ‘I do

not want to do that'."

In addition the Planning Section developed an extensive criteria list to systematically evaluate new developments, besides other attributes the checklist also includes criteria related to ecosystem service planning. In order to stop slowly reducing the green infrastructure by new development projects relevant planning documents and specifically the environmental objectives report have been revised to give the planners stronger mandate to protect green areas. The benefits of the small municipality come into play with regard to working structures (integral mainstreaming). A particularity of Lomma Municipality is that the Planning Section is directly linked to the Municipal Executive Committee, the highest decision-making level. During the interview it was pointed out that contrary to the situation in Lomma, larger municipalities have often difficulties to implement non-legally binding documents. In addition, municipal staff have the possibility to engage in projects that are beyond their working description (see table 35).

Table 35: Quotes Lomma

One interviewee stated: "[b]ut in Lomma we follow it [non-legally binding documents such as the Comprehensive Plan] and as I said to someone the other day when the person said well I do not have to follow it because it's not a legal document and I said 'well it's legal for you because you work here and this is what we have to follow, we work in a political organisation and this is what the politicians have decided."

The proximity to the decision-making body is acknowledged as an important lever to lobby for support of politicians (directed mainstreaming). In general the politicians are considered to support initiatives of the Planning Section and promote the shift toward a stronger focus on ecosystem-based planning. Politicians have stated regarding suggested ecosystem service planning measures: "yes, do that, we have to!". Politicians expressed their disappointed with regard to the fact that many development projects have not become what they have promised and Lomma's green infrastructure decreased significantly over the years. Based on this the politicians established the objective to reverse this effect (see table 36).

Table 36: Quotes Lomma

One interviewee stated: the politicians want "to be able to say in 10 years that we have more [green infrastructure]. … And then with the politicians saying this, of course I have more power, because then I say 'well, we have to work as they say'."

4.3.2 The integration of climate change adaptation planning into Lomma Municipality

Climate change adaptation was put on Lomma's political agenda due to heavy flooding in 2007.

The formal responsibility with adaptation planning is associated with the Planning Section because of a lack of leadership by other municipal staff (see table 37).

Table 37: Quotes Lomma

One interviewee stated: "[n]o one did (climate change adaptation) when I came, and I was like why is no one doing this, we have to rush this now, so I took it."

Beside being located at the sea, Lomma Municipality is divided by a river that cuts through Lomma village making inter-municipal collaboration crucial for water management (inter and intra-organisazional mainstreaming). However, the topic used to be dominated by the search for hard, construction based solutions and most of the working groups approach related issues from an engineering perspective (see table 28).

Table 38: Quotes Lomma

One interviewee stated: "[w]e have a cooperation between Lund and Staffanstorp to work within this whole area with many different topics sort of related to water. … As well as board of politicians connected is to this group … from all the three different municipalities". "in groups dealing with adaptation regionally, I am usually the only ecologist and it's all engineers. … [But] it's started to be more planners, it was not in the beginning when I started going to those meetings, and it was all [about] risk and concrete, landslides [and more emergency focused] but it's starting to change, but I would say still that … national documents talk very little about ecosystem services when they talk about adaptation."

In addition to inter-municipal collaboration the municipality organizes stakeholders of Lomma Bay in a coastal group and invites them for hearings on spatial plans as well as for information sharing. As well as on the regional level, Lomma Municipality engages in collaboration with the County Administrative Board (see table 39).

Table 39: Quotes Lomma

One interviewee stated: "when we had the coastal plan we had two meetings a year so they could discuss all the borders and that was ok with them, and last time we met, our focus was actually erosion, so the Swedish Geotechnical Institute [government agency] was invited to talk about techniques and things like that". "[t]he good thing here is that Länsstyrelsen [the County Administrative Board] gets [the importance of ecosystem service for climate change adaptation. The County Administrative Board is quite supportive and the people working there] are interested, and we have quite a lot of seminars and sort of trying to get the same language as well."

Due to revision of the Plan and Building Act Lomma Municipality defined that new buildings should be constructed three meters above sea level (fractional mainstreaming). This gave the County Administrative Board the possibility to reject plans that are in conflict with this base line. (see table 40).

Table 40: Quotes Lomma

One interviewee stated: "we have one paragraph. … If you made a detailed plan based on that and you sort of planned houses under the level of three meters, Länsstyrelsen [the County Administrative Board] would not accept that because of the change in [the Plan and Building Act]. So that single paragraph makes it possible for them to say no."

4.4 Inter-linkages, the synergies between and barriers to the integration of ecosystem service and climate change adaptation planning

In all of the three municipalities, ecosystem service and climate change adaptation planning is integrated independently from each other into to municipal planning. With both topics overlap in many planning related areas, actors increasingly recognize inter-linkages. While different administrative entities have distinct responsibilities, activities related to climate change adaptation can potentially affect ecosystem service planning or vice versa. For example, one third of Malmö's wastewater and stormwater is managed in combined pipes. These pipes are particularly sensitive to heavy precipitation and prone to flooding. The water management authority advocates an open storm water management since that does not require changing to a duplicate system where storm and wastewater are managed in separated pipes. In addition, the Streets and Parks Department, which is responsible for the management of green areas would need to engage in ecosystem service planning to support an open stormwater management and collaborate with the City Planning Office which is responsible for planning (see table 41).

Table 41: Quotes Malmö

One interviewee stated: "it's a nice cost-cutting measure from the water management utility to say 'let's have open stormwater systems' because this implies cost sharing. No need to change pipes and costs can be shared with the Streets and Parks Department"

Synergies between ecosystem service and climate change adaptation planning are contextually dependent and exploitation differs between the investigated municipalities. For example, due to heavy flooding in Lomma, politicians were pressured for immediate action, which shifted the attention from the costs to the concrete measures. Due to the focus on extreme weather events, ecosystem-based adaptation measures emphasize flood prevention instead of other co-benefits (see table 42).

Table 42: Quotes Lomma

One interviewee stated: in the aftermath of the flooding "everyone was like 'how much money do you need?'" "I sort of use flooding more because it's easier [to communicate] but biodiversity is one of the ecosystem services that benefit from this as well"

Contrary, in Helsingborg greater attention is on biodiversity, which might relate to the ICLEI project on Local Action for Biodiversity. Accordingly municipal staff, focus on biodiversity to advocate ecosystem-based adaptation measures (see table 43).

Table 43: Quotes Helsingborg

One interviewee stated: “[t]he main purpose [of the green plan] was perhaps not climate change but it was more recreation and biodiversity and so on, but it is really important for climate adaptation … to green the city.”

In Malmö a single project was used to draw attention to both topics. On the one hand the project served as a test bed to explore possibilities to map and value ecosystem services while on the other hand the project supposed to become a national showcase how to deal with the cross-cutting characteristics of climate change adaptation. Taken together, both topics open up possibilities to continuously putt pressure on the same issue (see table 44).

Table 44: Quotes Helsingborg

One interviewee stated: “[i]sn’t it sort of a matter of always putting pressure on those issues in every plan, and it’s always a bit of a struggle. … It’s not something that ‘this is our plan and we’ll do this’ it’s always a matter of discussion.”

Barriers to exploit synergies and effectively link ecosystem service and climate change adaptation planning for ecosystem-based adaptation are often rooted in municipal structures. For example in Helsingborg combining measures related to ecosystem services and climate change adaptation for increasing co-benefits while simultaneously reducing costs are ultimately hampered by municipal working structures and departmental responsibilities (see table 45).

Table 45: Quotes Helsingborg

One interviewee stated: since “the stormwater pond is paid by the water user collective but the recreational area is paid by the common taxpayers … it ends up being a money problem because two different parts share the costs all of a sudden.”

Barriers to mainstream ecosystem-based adaptation result from conflicts between economic interest and natural conservation as well as from the need for readily available knowledge. The conflict is inherent to the municipal structure as different departments advocate divergent interest. In addition, evidence based data on the effectiveness of ecosystem-based adaptation is widely lacking but imperatively required to suit the planning process (see table 46).

Table 46: Quotes Malmö

Interviewees stated: “[t]here are conflicts … primarily with the real estate department which owns all the land and actually makes a lot of money renting it out … or by selling it. And if we want to change that in any way every small change in their procedures makes a huge difference in the budget. If we say no we want to keep these areas as a natural reserve or as like a buffer zone or something, that means a lot of areas that they cannot sell, and they cannot make revenue from, so if that’s 5 million, then it’s 5 million less into the municipality’s budget, and that’s a lot of money”. the department is “known for not being supportive. They have this mandate, to earn money by selling land. End of story. “[i]f [ecological structures are] to fill a significant function of stormwater management you need to be able to quantify and model its contribution to the whole system as an integrated component and conduct sensitivity analysis. In particular, uncertainties about these measures’ capacity at different levels of saturation should be accounted for and efforts made to make this measurable and predictable.”

Furthermore, barriers originate also from attitudes of municipal staff toward change as well as regarding intra-municipal collaboration. Furthermore, disciplinary differences might hamper effective collaboration between different municipal departments (see table 46).

Table 46: Quotes Lomma and Helsingborg

Interviewees stated:
"a lot of the civil servants are doing what they have been doing since '72 and they do not want to be told that they should maybe accept more of a 'use the nature for our purposes' approach." (Lomma)
"planners "are just used to looking at this flat map and thinking 'what can we do there and what can we do here' and they do not really connect it." (Lomma)
strategic plans, such as the Comprehensive Plan, are not legally binding and if they are translated into detailed plans is "sometimes due to if whether people want to collaborate or not." (Helsingborg)

In addition, decision-making processes display tensions between municipalities' long-term orientation and short-term actions as well as between ecosystem service planning and climate change adaptation planning. For example Malmö and Helsingborg are promoting the vision of a dense and green city but interviews in both municipalities criticized politicians for not taking decisions accordingly. The strong focus of climate change adaptation planning on hard, construction based measures is considered as being contradictory to the ecosystem service planning approach (see table 47).

Table 47: Quotes Malmö, Helsingborg and Lomma

Interviewees stated:
"[d]igging underground parking for the cars is not affordable, so you have to put parking in the existing green areas and then you lose them, that's the effect. You don't adapt to climate change doing that but no one wants to pay to get rid of the cars, so it's a challenge." (Helsingborg)
"[b]ut nobody really knows, I mean, it's difficult enough to densify a city, then you want to greenify it, on top of it, it's really complicated". (Malmö)
"because adaptation in Sweden is engineering based somehow, and everything we learn, we learn from Holland, and there everything is concrete" (Lomma)

5 Discussion

5.1 Differences between conceptual foundations and practical integration of ecosystem-based adaptation

The integration of ecosystem-based adaptation into the examined municipalities is to a large extent compartmentalized according to its conceptual foundation and depends on departments that are concerned with the conservation of nature. Ecosystem-based adaptation is conceptually framed as a comprehensive approach that systematically facilitates transformations of traditional responses to the adverse effects of climate change and ultimately harmonizes couple human-environment systems (Chong, 2014; Jones et al., 2012). However, the examined

mainstream strategies were either related to the concept of ecosystem services or climate change adaptation. Ecosystem service planning was in all cases associated with departments that were by concerned with the conservation of nature. Although the concept of ecosystem services was originally invented to link ecology with economics (e.g. Daily, 1997; de Groot, 1987) at the local level it was only recently adapted and is solely used by departments that have conservation as an overarching goal. Accordingly, ecosystem services that support climate change adaptation are only one aspect of the departments' work description and not per se a priority objective. Similar, climate change adaptation is a new topic for the investigated municipalities, however, it is less clearly associated with particular departments. Either departments that are concerned with natural conservation, are mandated with security issues or have a greater top-down control are authorized to deal with climate change adaptation. Thus, climate change adaptation competes at the same level as other non-mandatory tasks for resources (e.g. Dannevig, Rauken & Hovelsrud, 2012).

The compartmentalized integration of ecosystem-based adaptation enables the realization of synergies and ultimately puts more emphasis on the use of ecological structures for climate change adaptation. While research on the effectiveness of ecosystem-based adaptation approaches has shown that related measures are not necessarily labeled accordingly (Doswald et al., 2014), the findings of this study indicate that this might be contingent with the rationale for particular interventions. In order to exploit synergies between ecosystem service and climate change adaptation planning municipal staff draw attention to distinct co-benefits or particular circumstances that offer the best justification for utilizing nature within the contextual setting. While in Lomma Municipality flooding events support more strongly related measures, in Helsingborg Municipality the focus on biodiversity cogently justifies ecosystem-based adaptation in relation to ongoing efforts. Based on the results ecosystem-based adaptation itself is not a label that provides vindication for the integration of natural features in municipal planning but links particular ecological structures with distinct functions and resulting multiple-benefits (Potschin & Haines-Young, 2011). For example, ecological structures like wetlands or forests have the capacity or function to retain water and slowing down surface water. This provides ecosystem services to humans ranging from flood and erosion prevention to mitigation of doughtiness but can also create recreational areas or support biodiversity. With regard to the contextual setting these services are valued differently, depending on what is considered as being beneficial (Haines-Young & Potschin, 2010; P. Smith et al., 2013) This relation between ecological structures and multiple-benefits allow municipal staff to adjust the reasoning for

ecosystem-based adaptation according to the socio-political context and lobby for the same end with different means.

5.2 Mainstreaming strategies for integrating ecosystem-based adaptation at the local level

The analyzed mainstreaming strategies are comprehensively applied considering the different municipalities collectively. While strategies to integrate ecosystem service planning into municipal work are more advanced (each municipality deployed five out of six strategies), climate change adaptation planning related to a fewer number of applied mainstreaming activities (each municipality deployed three out of six strategies). Since strategies that relate to ecosystem service and climate change adaptation planning overlap (see table 24) it appears to be reasonable to assume advantages of 'economy of scale' for mainstreaming activities. That implies, that actors that champion mainstreaming of a particular topic might also be able to promote cross-topic related integration (see table 24). The following section provides three examples of how the integration of different topics can cross-support each other.

The Environment Department in Malmö is known as the Department that has secured the most external funding of all Swedish municipalities for projects related to biodiversity, green infrastructure and ecosystem services. With the structure in place and equipped with the knowledge of how and where to apply for external funding the Environment Department initiated a project to develop green tools for climate adaptation with financial support of the European Union (GreenClimeAdapt, 2014). The City Planning and Technical Services Department in Helsingborg Municipality called attention to climate change adaptation by conducting research to integrate the topic into the Comprehensive Plan (Helsingborg, 2010). In a similar way the City Planning and Technical Services Department approached ecosystem service planning by restructuring the Green Structure Program to comprehensively focus on ecosystem services (Helsingborg, 2013) in order to develop a basis for the following Comprehensive Plan. The working structures in Lomma Municipality support municipal staff to develop their area of accountability alongside personal interest beside the official job description. While this enabled staff to engage in activities related to ecosystem service planning, it also facilitated the integration of climate change adaptation planning into the field of work of dedicated staff. Scholars have draw attention to the risk of "mainstreaming overload" at the national and international level because different topics compete for attention in governmental agencies

(Agrawala & Van Aalst, 2008, p. 188; Kok & de Coninck, 2007, p. 588). At the local level mainstreaming of similar topics can potentially result in synergies. In fact, ecosystem-based adaptation provides the basis to simultaneously address sustainability challenges such as biodiversity loss and climate change while enable local actors to tailor mainstreaming strategies according to contextual specifics.

The different mainstream strategies complement and reinforce each other (Wamsler, 2013) as well as have the potential to collectively balance inherent shortcomings or possible drawbacks of single activities. The interviewed civil servants in Malmö Municipality put most emphasis on the scarcity of resources to incorporate a new topic into departmental objectives (programmatic mainstreaming). This was counterbalanced by securing external grants to realize additional projects (add-on mainstreaming). The motivation is, as an interviewee stated, “to have more power behind our wishes … [and] push our sustainability agenda”. Based on the findings, difficulties in inter- and intra-organizational collaboration originated from differences in disciplinary education and diverging departmental objectives. Civil servants approached this by either increasing collaboration with likeminded staff or lobbing at a higher decision-making level for support, as an interviewee stated, “of course I have more power [with the support of politicians], because then I say [to my colleagues] ‘well, we have to work as they say’”. Interviewees in all municipalities emphasized the lack of supportive legislation to ensure higher priority on environmental goals. Dependent on the context, internal mainstreaming is potentially able to compensate a lack of formal by informal rules as well as close collaboration with the City Council can support civil servants to apply additional tools in the planning processes. Taken together, the possibility to compensate strategy specific barriers by other complementary strategies relate to the importance of different mainstreaming dimensions as well as diverse pathways to target desired features.

The three different cases shed light on the importance of horizontal and vertical mainstreaming dimensions. The significance of vertical mainstreaming is to initiate the integration of a new topic into core work while horizontal mainstreaming facilitates streamlining of the new topic with adjacent activities and ensures overall evaluation of the integration, making both dimensions equally important (Nunan et al., 2012; Rauken et al., 2014). While for governments at the local level the two dimensions potentially coincide with devoted politicians (vertical dimension) and dedicated civil servants (horizontal dimension) the examined municipalities provided a more comprehensive but complex picture. First, municipal staff are equally capable of integrating a new topic into municipal work. For example in Malmö Municipality civil servants successfully

integrated ecosystem service and climate change adaptation planning through add-on mainstreaming. Similar, civil servants in Helsingborg Municipality utilized the usual procedures of municipal strategy development to incorporate both topics first into key policy documents and subsequently translated them into strategy objectives of the comprehensive plan. Even without support from higher decision-making levels and although the national level fails to provide supporting legislations, based on strong leadership ecosystem-based adaptation can be integrated into core work (Roberts, 2008, 2010). Second, politicians have a similar interest in actively streamlining new objectives with existing regulation and strategic orientation. Although national legislations prevent Swedish municipalities from introducing additional demands on developers all municipalities tried to establish new planning tools to preserve existing greenery in new development projects. For example in Lomma Municipality the integration of ecosystem service planning has only been possible because politicians explicitly took actions to halt and reverse the ongoing decrease in green infrastructure. However, in order to foster comprehensive mainstreaming and fully utilizes existing efforts supporting legislations are crucial (Pelling & Holloway, 2006). This calls attention to close collaborations between actors and adjusting activities that relate to a particular dimensions to integrate new practices or agree on comprehensive transformations of existing structures (e.g. Khan, 2012). Taken together, the investigated cases confirm the importance of both dimensions as complementary strategies to reinforce and balance the effeteness of the respective other approach (Nunan et al., 2012; Rauken et al., 2014).

5.3 Mainstreaming to foster sustainability transitions in local governments

Sustainability mainstreaming strategies that integrate new practices into local governments to promote comprehensive transformations cannot be deliberative planed nor will they successfully translate pre-determined ideas into practice (Bos & Brown, 2012, Westley et al., 2011). The examined cases did not reveal ‘success strategies‘ that could be used as well-defined pathways to nudge local governments toward sustainability. While other studies have highlighted that municipalities’ ability to integrate climate change adaptation is contingent with a range of factors (e.g. Dannevig, Rauken & Hovelsrud, 2012; van den Berg & Coenen, 2012) the results of this study underpin the need for contextualized strategies to approach mainstreaming of sustainability issues. Accordingly, grand planning for sectoral integration that ensures linear and predictable implementation by top-down control will fall short. Contrary, sustainability mainstreaming requires flexible strategies that account for the cross-cutting features of the topic

under consideration and utilize network governance to move from readily available knowledge to learning-by-doing (Kato & Ahern, 2008; Steurer & Martinuzzi, 2005; Williams, 2002). Consequently, determination of success factors in a sustainability transition will at the most reveal important contextual features but will not enable general insights of how transformation processes are to be governed in other cases (Forrest & Wiek, 2014).

The evaluation of combined sustainability mainstreaming strategies to foster transformations depends ultimately on whether sustainability requirements have a greater emphasis in decision-making (e.g. Gibson et al., 2005). Over two decades after the seminal report on sustainable development (United Nation, 1992) and it's operationalization for local governments (UNCED, 1992) the long-standing conflict between the environmental imperative and economic objectives prevails. In fact, the result suggests that use of nature for adapting to climate change clashes with municipal needs to ensure revenue from selling and renting land. The conflict manifests in diverging interest of municipal departments advocating environmental interest and real estate management. While inter- and intra-organizational mainstreaming strategies have shown to be widely ineffective to reach agreement, the ecosystem service concept was integrated into departmental core work with the intended purpose to provide a more effective rationale for natural conservation. While the concept has been critiqued for it's narrow economic perspective and commodification of nature (Gómez-Baggethun, de Groot, Lomas, & Montes, 2010; Jax et al., 2013; Norgaard, 2010; Turnhout, Waterton, Neves, & Buizer, 2013) others have highlighted its potential as a boundary object in mainstreaming strategies to facilitate discourse-based approaches and consensus among stakeholders to foster sustainability (Abson et al., 2014; Cowling et al., 2008; Daily et al., 2009). However, transition processes are by definition long-term and hasty conclusions on the effectiveness of sustainability mainstreaming strategies' ability to ultimately anchor sustainability requirements at the core of decision-making might result in false interpretation.

Besides integrating sustainability into decision-making, mainstreaming strategies need to be evaluated against the overarching goal of creating possibilities for implementing new and transforming existing practices. Sustainability mainstreaming ultimately aims at the deliberative disturbance of conventions to promote alternative procedures and foster transformations of related social realms. While it is difficult to examine individual strategies separately, ecosystem-based adaptation by definition challenges conventional ideas as it questions the traditional approaches to natural hazards (e.g. Jones et al., 2012). In accordance, activities in Lomma Municipality suggest that combining ecosystem service and climate change adaptation planning

challenge the common approach to spatial planning. As highlighted by an interviewee “[a] lot of the civil servants are doing what they have been doing since '72 and they do not want to be told that they should maybe accept more of a ‘use the nature for our purposes’ approach”. Similar, the integration of nature into stormwater management in Helsingborg questions the common separation between environmental conservation and construction based planning. While a comprehensive sustainability transition requires a plethora of different stakeholders and necessarily span various areas of society (e.g. Khan, 2012; Forrest & Wiek, 2014) mainstreaming ecosystem-based adaptation into local governments provides a promising strategy to initiate sustainability transitions.

5.4 Advancing mainstreaming theory for sustainability transitions

Sustainability mainstreaming strategies provide fruitful avenues for levering urgently demanded transformation in local governments. Promising approaches to operationalize mainstreaming exist (e.g. Wamsler, 2013) and the concept has gained popularity in adjacent fields of environmental policy integration or climate change policy integration (ref). In addition, approaches in the field of sustainability transitions have made substantial progress in identifying the key drivers and explaining the forces at play in transformation processes. Inspired by the empirical research of Ostrom (2009) increasing efforts focus on the systematic description of sustainability transition initiatives (e.g. Forrest & Wiek, 2014). Although sustainability transition examples of entire communities, regions, and sectors (Forrest & Wiek, 2014; Khan, 2013; Loorbach & Rotmans, 2010; Nevens, Frantzeskaki, Gorissen, & Loorbach, 2013) are gaining increased attention, the question remains how change can be initiated within existing structures and what dynamics at play will ultimately contribute to transformational processes. Complementary to post evaluation of more or less successful initiatives, more attention needs to be drawn to processes that actively initiate and foster sustainability transitions.

For future research on sustainability mainstreaming strategies needs to comprehensively elaborate the theoretical foundation of mainstreaming, focus on new experimental approaches for implementation and new ways of knowledge production. A comprehensive sustainability transition requires a range of different actors at the local level, including public and private organizations as well as civil society at large (Markard, Raven & Truffer, 2012). While this study identifies mainstreaming strategies for municipalities that have the potential to pave the way for moving sustainability into the core of decision-making, the overarching conceptual framing lacks substantial theoretical backing. First, the concept of mainstreaming remains a vague concept

that is highly used in literature but poorly defined. A comprehensive theoretical foundation that signifies core objectives and key actions to move toward sustainability as well as to scrutinize the dynamics and drivers at work to initiate and consolidate the required changes is missing. I have elaborated on potential objectives and categorized prospective actions in local governments, however it remains a question of further research whether the identified mainstreaming strategies are applicable beyond the study focus. Second, moving sustainability mainstreaming into execution requires new approaches that facilitate "save-to-fail" experimentation. My findings indicate that initiating sustainability mainstreaming strategies is less strategic as the term might suggest but key actions evolve along-side decision-making. While new approaches such as ecosystem-based adaptation question the conventional procedures but do not provide readily available knowledge experimental settings are required to test and learn during the integration process. This put emphasis on adaptive design frameworks (e.g. Ahern et al., 2014) that eventually facilitates learning-by-doing (Roberts et al., 2011). Third and finally, sustainability mainstreaming as a research approach that rooted in sustainability requires new ways of knowledge production. The findings underpinned the need for close collaboration between scientists and practitioners to substantiate new concepts with shared knowledge generations for place-based application of solution options. In order to promote social learning "to navigate the transition to sustainability" (Miller et al., 2013, p. 240) implementing sustainability mainstreaming strategies require joint knowledge production in a truly transdisciplinary manner (Lang et al., 2012).

6 Conclusion

This study investigated potential ways of mainstreaming ecosystem-based adaptation into municipal planning to foster sustainability transitions. Through purposive sampling I selected three municipalities (Malmö, Helsingborg and Lomma) in southern Sweden and by means of semi-structured interviews and review of planning documents, I examined the municipal activities with regard to the conceptual foundation of ecosystem-based adaptation, namely, ecosystem service planning and climate change adaptation planning. The results show, first, that integration of ecosystem-based adaptation into municipal planning is to a large extent compartmentalized according to its conceptual foundation and depends on departments that are concerned with the conservation of nature. While ecosystem services that support climate change adaptation are only one aspect of the departments' work description, climate change

adaptation competes often at the same level as other non-mandatory tasks for resources. Second, ecosystem-based adaptation enables the realization of synergies and ultimately puts more emphasis on the use of ecological structures for climate change adaptation. However, ecosystem-based adaptation itself is not a label that provides vindication for the integration of ecological features into local planning but provides municipal planners with different lines of argument to reason for particular co-benefits. Accordingly, at the local level ecosystem-based adaptation has the potential to simultaneously address sustainability challenges such as biodiversity loss and climate change and enable local actors to tailor mainstreaming strategies according to contextual specifics. Third and finally, the investigated mainstreaming strategies provide promising avenues to foster sustainable planning as different strategies have the potential to complement and reinforce each other and collectively balance inherent shortcomings or possible drawbacks of single activities. This calls attention to the importance of pursuing combined strategies and emphasize the significance of the horizontal and vertical dimension for successful integration of ecosystem-based adaptation into local planning.

This research has shown that mainstreaming strategies have the potential to promote the integration of sustainability practices into local governments and initiate transformational processes. Further research needs to establish meaningful ways to evaluate strategies during the implementation process to examine whether sustainability requirements have become more important in decision-making and the implementation of new or transformation of existing practices is fostered. Meaningful evaluation is crucial to identify effective practices and adjust established strategies as well as specify the dynamics at play that will ultimately initiate and consolidate sustainability transitions. In order for sustainability mainstreaming strategies to become a successful transition pathway future research need to further elaborate the theoretical foundation of the concept signifying core objectives and key actions that are required to move toward sustainability. In addition, more emphasis needs to be placed on new approaches that facilitate ‘save-to-fail’ experimentation in order to enable transition actors to develop their activities along-side decision-making and encourage learning-by-doing. Finally and most importantly, social learning processes that initiate and navigate sustainability transitions do not evolve from disciplinary-bounded research but require joint knowledge generations in a truly transdisciplinary manner. Mainstreaming sustainability that initiate and nourish transformational processes requires actors’ long-term engagement in the local context and advanced collaboration between all areas of life and in particular between scientists, practitioners and the civil society.

7 Literature

Abramovitz, J., Banuri, T., Girot, P. O., Orlando, B., Schneider, N., Spanger-Siegfried, E., … Hammill, A. (2006). *Adapting to Climate Change: Natural Resource Management and Vulnerability Reduction. Background Paper to the Task Force on Climate Change, Adaptation and Vulnerable Communities*.

Abson, D. J., von Wehrden, H., Baumgärtner, S., Fischer, J., Hanspach, J., Härdtle, W., … Walmsley, D. (2014). Ecosystem services as a boundary object for sustainability. *Ecological Economics*, *103*, 29–37. doi:10.1016/j.ecolecon.2014.04.012

Agrawal, A. (2008). *The Role of Local Institutions in Adaptation to Climate Change*. Washington.

Agrawala, S., & Van Aalst, M. (2008). Adapting development cooperation to adapt to climate change. *Climate Policy*, *8*(2), 183–193. doi:10.3763/cpol.2007.0435

Ahern, J., Cilliers, S., & Niemelä, J. (2014). The concept of ecosystem services in adaptive urban planning and design: A framework for supporting innovation. *Landscape and Urban Planning*, 1–6. doi:10.1016/j.landurbplan.2014.01.020

Andersson, E. (2006). Urban landscapes and sustainable cities. *Ecology and Society*, *11*(1).

Andrade, A., Córdoba, R., Dave, R., Girot, P., Herrera-F, B., Munroe, R., … Vergara, W. (2011). *Draft Principles and Guidelines for Integrating Ecosystem-based. Ecosystem-based Approaches to Adaptation in Project and Policy Design: A Discussion Document*. Turrialba.

Bai, X., Roberts, B., & Chen, J. (2010). Urban sustainability experiments in Asia: patterns and pathways. *Environmental Science & Policy*, *13*(4), 312–325. doi:10.1016/j.envsci.2010.03.011

Benson, C., Twigg, J., & Rossetto, T. (2007). *Tools for Mainstreaming Disaster Risk Reduction: Guidance Notes for Development Organizations.* Geneva.

Bos, J. J., & Brown, R. R. (2012). Governance experimentation and factors of success in socio-technical transitions in the urban water sector. *Technological Forecasting and Social Change*, *79*(7), 1340–1353. doi:10.1016/j.techfore.2012.04.006

Bulkeley, H. (2005). Reconfiguring environmental governance: Towards a politics of scales and networks. *Political Geography*, *24*(8), 875–902. doi:10.1016/j.polgeo.2005.07.002

Bulkeley, H., & Betsill, M. M. (2013). Revisiting the urban politics of climate change. *Environmental Politics*, *22*(1), 136–154. doi:10.1080/09644016.2013.755797

Burger, P., & Kamber, R. (2003). Cognitive integration in transdisciplinary science: Knowledge as a key notion. *Issues in Integrative Studies*, *73*(21), 43–73.

Busch, H., & McCormick, K. (2014). Local power: exploring the motivations of mayors and key success factors for local municipalities to go 100% renewable energy. *Energy, Sustainability and Society*, *4*(1), 5. doi:10.1186/2192-0567-4-5

Campbell, A., Kapos, V., Chenery, A., Kahn, S. I., Mariam Rashid, Scharlemann, J., & Dickson, B. (2009). *The Linkages Between Biodiversity and Climate Change Adaptation*. Cambridge.

Castro, G. (2005). Biodiversity in the GEF Portfolio: The Role of Mainstreaming. In C. Petersen & B. Huntley (Eds.), *Mainstreaming Biodiversity in Production Landscapes* (pp. 12–17). Washington DC: Global Environment Facility.

CBD. (2009). *Connecting Biodiversity and Climate Change Mitigation and Adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change* (p. 126, Technical Series No. 41). Montreal.

Centre for Geographical Information Systems at Lund University. (n.d.). Geographical Data for Everyone. *GIS Centre*. Retrieved March 10, 2014, from http://www.gis.lu.se/english/geodataPublic.htm

Chan, K. M. A., Shaw, M. R., Cameron, D. R., Underwood, E. C., & Daily, G. C. (2006). Conservation Planning for Ecosystem Services. *PLoS Biology*, *4*(11). doi:10.1371/journal.pbio.0040379

Chapin, F. S., Carpenter, S. R., Kofinas, G. P., Folke, C., Abel, N., Clark, W. C., … Swanson, F. J. (2010). Ecosystem stewardship: sustainability strategies for a rapidly changing planet. *Trends in Ecology & Evolution*, *25*(4), 241–9. doi:10.1016/j.tree.2009.10.008

Chong, J. (2014). Ecosystem-based approaches to climate change adaptation: progress and challenges. *International Environmental Agreements: Politics, Law and Economics*. doi:10.1007/s10784-014-9242-9

Clark, W. C. (2007). Sustainability science: a room of its own. *Proceedings of the National Academy of Sciences of the United States of America*, *104*(6), 1737–8. doi:10.1073/pnas.0611291104

Clark, W. C., & Dickson, N. M. (2003). Sustainability science: the emerging research program. *Proceedings of the National Academy of Sciences of the United States of America*, *100*(14), 8059–61. doi:10.1073/pnas.1231333100

Colding, J., Lundberg, J., & Folke, C. (2006). Incorporating green-area user groups in urban ecosystem management. *Ambio*, *35*(5), 237–244.

Colls, A., Ash, N., & Ikkala, N. (2009). *Ecosystem-based Adaptation: a natural response to climate change*. Gland.

Cowling, R. M., Egoh, B., Knight, A. T., O'Farrell, P. J., Reyers, B., Rouget, M., … Wilhelm-Rechman, A. (2008). An operational model for mainstreaming ecosystem services for implementation. *Proceedings of the National Academy of Sciences of the United States of America*, *105*(28), 9483–8.

Daily, G. C. (1997). *Nature's services. Societal dependence on natural ecosystems*. Washington, DC: Island Press.

Daily, G. C., Kareiva, P. M., Polasky, S., Ricketts, T. H., & Tallis, H. (2011). Mainstreaming natural capital into decisions. In P. Kareiva, H. Tallis, T. Ricketts, G. Daily, & S. Polasky (Eds.), *Natural capital: theory and practice of mapping ecosystem services* (pp. 3–14). Oxford: Oxford University Press.

Daily, G. C., Polasky, S., Goldstein, J., Kareiva, P. M., Mooney, H. a, Pejchar, L., … Shallenberger, R. (2009). Ecosystem services in decision making: time to deliver. *Frontiers in Ecology and the Environment*, *7*(1), 21–28. doi:10.1890/080025

Dannevig, H., Rauken, T., & Hovelsrud, G. (2012). Implementing adaptation to climate change at the local level. *Local Environment*, *17*(6-7), 597–611. doi:10.1080/13549839.2012.678317

De Groot, R. S. (1987). Environmental functions as a unifying concept for ecology and economics. *The Environmentalist*, *7*(2), 105–109. doi:10.1007/BF02240292

De Groot, R. S., Alkemade, R., Braat, L., Hein, L., & Willemen, L. (2010). Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. *Ecological Complexity*, *7*(3), 260–272. doi:10.1016/j.ecocom.2009.10.006

De Guenni, L. B., Cardoso, M., Goldammer, J., Hurtt, G., Mata, L. J., Ebi, K., … Norgaard, R. (2005). Regulation of Natural Hazards: Floods and Fires. In R. Hassan, R. Scholes, & N. Ash (Eds.), *Ecosystems and Human Well-being: Current State and Trends* (pp. 441–454). Oxford: Oxford University Press.

Derkzen, P., Bock, B. B., & Wiskerke, J. S. C. (2009). Integrated Rural Policy in Context: A Case Study on the Meaning of “Integration” and the Politics of “Sectoring.” *Journal of Environmental Policy & Planning*, *11*(2), 143–163. doi:10.1080/15239080902920126

Desai, P. (2008). Creating Low Carbon Communities: One Planet Living Solutions. *Globalizations*, *5*(1), 67–71. doi:10.1080/14747730701587462

Doswald, N., Munroe, R., Roe, D., Giuliani, a., Castelli, I., Stephens, J., … Reid, H. (2014). Effectiveness of ecosystem-based approaches for adaptation: review of the evidence-base. *Climate and Development*, *0*(0), 1–17. doi:10.1080/17565529.2013.867247

Dymén, C., & Langlais, R. (2012). Adapting to Climate Change in Swedish Planning Practice. *Journal of Planning Education and Research*, *33*(1), 108–119. doi:10.1177/0739456X12463943

Ernstson, H., Barthel, S., Andersson, E., & Borgström, S. T. (2010). Scale-crossing brokers and network governance of urban ecosystem services: The case of stockholm. *Ecology and Society*, *15*(4).

ESRI. (2011). ArcGIS Desktop: Release 10.1. Redlands, CA, USA.: Environmental Systems Research Institute.

Ferreira, J.-A., Ryan, L., & Tilbury, D. (2007). Mainstreaming education for sustainable development in initial teacher education in Australia: a review of existing professional

development models. *Journal of Education for Teaching*, *33*(2), 225–239. doi:10.1080/02607470701259515

Fischer, J., Dyball, R., Fazey, I., Gross, C., Dovers, S., Ehrlich, P. R., … Borden, R. J. (2012). Human behavior and sustainability. *Frontiers in Ecology and the Environment*. doi:10.1890/110079

Flyvbjerg, B. (2005). Case Study. In N. K. Denzin & Y. S. Lincoln (Eds.), *The Sage handbook of qualitative research* (3rd ed., pp. 301–316). Thousand Oaks.

Forrest, N., & Wiek, A. (2014). Learning from success—Toward evidence-informed sustainability transitions in communities. *Environmental Innovation and Societal Transitions*. doi:10.1016/j.eist.2014.01.003

Foster, J., Lowe, A., & Winkelman, S. (2011). *The Value of Green Infrastructure for Urban Climate Adaptation*. Washington, DC 20002. Retrieved from http://www.ccap.org/ docs/resources/989/Green_ Infrastructure_FINAL.pdf

Funtowicz, S. O., & Ravetz, J. R. (1993). Science for the post-normal age. *Futures*, *25*(7), 739–755. doi:10.1016/0016-3287(93)90022-L

Füssel, H.-M. (2007). Adaptation planning for climate change: concepts, assessment approaches, and key lessons. *Sustainability Science*, *2*(2), 265–275. doi:10.1007/s11625-007-0032-y

Gaffin, S. R., Rosenzweig, C., & Kong, A. Y. Y. (2012). Adapting to climate change through urban green infrastructure. *Nature Climate Change*, *2*(10), 704–704. doi:10.1038/nclimate1685

Geels, F. W. (2011). The multi-level perspective on sustainability transitions: Responses to seven criticisms. *Environmental Innovation and Societal Transitions*, *1*(1), 24–40. doi:10.1016/j.eist.2011.02.002

Geels, F. W., & Schot, J. (2007). Typology of sociotechnical transition pathways. *Research Policy*, *36*(3), 399–417. doi:10.1016/j.respol.2007.01.003

Georgescu, M., Morefield, P. E., Bierwagen, B. G., & Weaver, C. P. (2014). Urban adaptation can roll back warming of emerging megapolitan regions. *Proceedings of the National Academy of Sciences of the United States of America*, *111*(8), 2909–2914. doi:10.1073/pnas.1322280111

Gibson, R. B. (2006). Sustainability assessment: basic components of a practical approach. *Impact Assessment and Project Appraisal*, *24*(3), 170–182.

Gibson, R. B., Hassan, S., Holtz, S., Tansey, J., & Whitelaw, G. (2005). *Sustainability assessment: Criteria and Processes*. London: Earthscan.

Gill, S. ., Handley, J. ., Ennos, A. ., & Pauleit, S. (2007). Adapting Cities for Climate Change: The Role of the Green Infrastructure. *Built Environment*, *33*(1), 115–133. doi:10.2148/benv.33.1.115

Girot, P., Ehrhart, C., Oglethorpe, J., Reid, H., Rossing, T., Gambarelli, G., … Phillips, J. (2012). *Integrating Community and Ecosystem-Based Approaches in Climate Change Adaptation*. Retrieved from http://www.careclimatechange.org/files/adaptation/ELAN_IntegratedApproach_150412.pdf

Gómez-Baggethun, E., de Groot, R. S., Lomas, P. L., & Montes, C. (2010). The history of ecosystem services in economic theory and practice: From early notions to markets and payment schemes. *Ecological Economics*, *69*(6), 1209–1218. doi:10.1016/j.ecolecon.2009.11.007

Gore, A. (1992). *Earth in the Balance: Ecology and the Human Spirit*. Boston, MA: Houghton Mifflin.

Granberg, M., & Elander, I. (2007). Local Governance and Climate Change: Reflections on the Swedish Experience. *Local Environment*, *12*(5), 537–548. doi:10.1080/13549830701656911

GreenClimeAdapt. (2014). *Green Tools for Urban Climate Adaptation. Final Report. LIFE07 ENV/S/000908*.

Grimm, N. B., Faeth, S. H., Golubiewski, N. E., Redman, C. L., Wu, J., Bai, X., & Briggs, J. M. (2008). Global change and the ecology of cities. *Science*, *319*(5864), 756–60. doi:10.1126/science.1150195

Gutiérrez, N. L., Hilborn, R., & Defeo, O. (2011). Leadership, social capital and incentives promote successful fisheries. *Nature*, *470*(7334), 386–9. doi:10.1038/nature09689

Haines-Young, R., & Potschin, M. (2010). The links between biodiversity, ecosystem services and human well-being. In D. Raffaelli & C. Frid (Eds.), *Ecosystem Ecology: A New Synthesis. BES Ecological Reviews Series* (pp. 110–139). Cambridge: Cambridge University Press.

Harris, L. C., & Ogbonna, E. (2006). Initiating strategic planning. *Journal of Business Research*, *59*(1), 100–111. doi:10.1016/j.jbusres.2005.02.003

Hekkert, M. P., Suurs, R. a. a., Negro, S. O., Kuhlmann, S., & Smits, R. E. H. M. (2007). Functions of innovation systems: A new approach for analysing technological change. *Technological Forecasting and Social Change*, *74*(4), 413–432. doi:10.1016/j.techfore.2006.03.002

Helsingborg. (2010). *Öp 2010. En strategisk översiktsplan för Helsingborgs utveckling*. Helsingborg.

Helsingborg. (2013). *Grönstrukturprogram för Helsingborg*. Helsingborg.

HFA. (2011). *Compilation of National Progress Reports on the implementation of the Hyogo Framework for Action (2009-2011). Priority 4: Reduce the underlying risk factors.*

Holden, S. (2004). *Mainstreaming HIV/AIDS in Development and Humanitarian Programmes*. Oxford.

Hsieh, H.-F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, *15*(9), 1277–88. doi:10.1177/1049732305276687

Huq, N., Renaud, F., & Sebesvari, Z. (n.d.). *Ecosystem based adaptation (eba) to climate change integrating actions to sustainable adaptation*. Retrieved from http://www.climate-impacts-2013.org/files/cwi_huq.pdf

IEA, International Energy Agency (2008). *World Energy Outlook 2008*. (R. Priddle, Ed.). International Energy Agency. Retrieved from http://www.worldenergyoutlook.org/2008.asp

IPCC. (2007a). *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, United Kingdom: Cambridge University Press.

IPCC. (2007b). *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, United Kingdom: Cambridge University Press.

IPCC. (2012). *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change* (p. 582). Cambridge, UK, and New York, NY, USA: Cambridge University Press.

IPCC. (2013). *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, United Kingdom: Cambridge University Press.

IPCC. (2014). *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Summary for policymakers*. Retrieved from http://ipcc-wg2.gov/AR5/images/uploads/IPCC_WG2AR5_SPM_Approved.pdf

Jacob, K., & Volkery, A. (2004). Institutions and Instruments for Government Self-Regulation: Environmental Policy Integration in a Cross-Country Perspective. *Journal of Comparative Policy Analysis: Research and Practice*, *6*(3), 291–309. doi:10.1080/1387698042000305211

Jacobsson, S., & Bergek, A. (2011). Innovation system analyses and sustainability transitions: Contributions and suggestions for research. *Environmental Innovation and Societal Transitions*, *1*(1), 41–57. doi:10.1016/j.eist.2011.04.006

Janssen, M. A., Schoon, M. L., Ke, W., & Börner, K. (2006). Scholarly networks on resilience, vulnerability and adaptation within the human dimensions of global environmental change. *Global Environmental Change*, *16*(3), 240–252. doi:10.1016/j.gloenvcha.2006.04.001

Jax, K., Barton, D. N., Chan, K. M. a., de Groot, R. S., Doyle, U., Eser, U., … Wichmann, S. (2013). Ecosystem services and ethics. *Ecological Economics*, *93*(May 2011), 260–268. doi:10.1016/j.ecolecon.2013.06.008

Jerneck, A., Olsson, L., Ness, B., Anderberg, S., Baier, M., Clark, E., … Persson, J. (2011). Structuring sustainability science. *Sustainability Science*, *6*(1), 69–82. doi:10.1007/s11625-010-0117-x

Jones, H. P., Hole, D. G., & Zavaleta, E. S. (2012). Harnessing nature to help people adapt to climate change. *Nature Climate Change*, *2*(7), 504–509. doi:10.1038/nclimate1463

Jordan, A., & Lenschow, A. (2010). Environmental policy integration: a state of the art review. *Environmental Policy and Governance*, *20*(3), 147–158. doi:10.1002/eet.539

Juhola, S. (2010). Mainstreaming Climate Change Adaptation: The Case of Multi-Level Governance in Finland. In E. C. H. Keskitalo (Ed.), *Developing Adaptation Policy and Practice in Europe: Multi-level Governance of Climate Change* (pp. 149–187). Dordrecht: Springer Netherlands. doi:10.1007/978-90-481-9325-7_4

Kallis, G., Gómez-Baggethun, E., & Zografos, C. (2013). To value or not to value? That is not the question. *Ecological Economics*, *94*, 97–105. doi:10.1016/j.ecolecon.2013.07.002

Kates, R. W., Clark, W. C., Corell, R., Hall, J. M., Jaeger, C. C., Lowe, I., … Svedin, U. (2001). Sustainability Science. *Science*, *292*(5517), 641–642. Retrieved from http://www.jstor.org/stable/3083523

Kato, S., & Ahern, J. (2008). “Learning by doing”: adaptive planning as a strategy to address uncertainty in planning. *Journal of Environmental Planning and Management*, *51*(4), 543–559. doi:10.1080/09640560802117028

Kazmierczak, A., & Carter, J. (2010). *Adaptation to climate change using green and blue infrastructure. A database of case studies.* Malmö.

Keskitalo, E. C. H. (2010). Adapting to climate change in Sweden: national policy development and adaptation measures in Västra Götaland. In E. C. H. Keskitalo (Ed.), *Developing Adaptation Policy and Pracitce in Europe: Multi-level Governance of Climate Change* (pp. 189–232). Dordrecht: Springer Netherlands. doi:10.1007/978-90-481-9325-7

Khan, J. (2013). What role for network governance in urban low carbon transitions? *Journal of Cleaner Production*, *50*, 133–139. doi:10.1016/j.jclepro.2012.11.045

Kinzig, A. P., Ehrlich, P. R., Alston, L. J., Arrow, K., Barrett, S., Timothy, G., … Ostrom, E. (2013). Social Norms and Global Environmental Challenges: The Complex Interaction of Behaviors, Values, and Policy. *BioScience*, *63*(3), 164–175. doi:10.1525/bio.2013.63.3.5

Knieling, J., & Fellmer, M. (2013). Climate Adaptation in Metropolis Hamburg: Paradigm Shift in Urban Planning and Water Management towards “ Living with Water ”? In P. Schmidt-Thomé & J. Klein (Eds.), *Climate Change Adaptation in Practice: From strategy development to implementation* (pp. 83–93). Chichester: Wiley-Blackwell. doi:10.1002/9781118548165.ch7

Koch, T. (2006). Establishing rigour in qualitative research: the decision trail. *Journal of Advanced Nursing*, *53*(1), 91–100; discussion 101–3. doi:10.1111/j.1365-2648.2006.03681.x

Kok, M. T. J., & de Coninck, H. C. (2007). Widening the scope of policies to address climate change: directions for mainstreaming. *Environmental Science & Policy*, *10*(7-8), 587–599. doi:10.1016/j.envsci.2007.07.003

Kok, M. T. J., Tyler, S., Prins, A. G., Pintér, L., Baumüller, H., Bernstein, J., … Grosshans, R. (2010). Prospects for mainstreaming ecosystem goods and services in international policies. *Biodiversity*, *11*(1-2), 49–54. doi:10.1080/14888386.2010.9712647

Kyoto Protocol. (1997). *The Kyoto Protocol to the United Nations Framework Convention on Climate Change.* Kyoto.

La Trobe, S., & Davis, I. (2005). *Mainstreaming Disaster Risk Reduction: A Tool for Development Organizations*. London.

Lafferty, W., & Hovden, E. (2003). Environmental policy integration: towards an analytical framework. *Environmental Politics*, *12*(3), 1–22. doi:10.1080/09644010412331308254

Lang, D. J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., … Thomas, C. J. (2012). Transdisciplinary research in sustainability science: practice, principles, and challenges. *Sustainability Science*, *7*(S1), 25–43. doi:10.1007/s11625-011-0149-x

Langeland, O., Klausen, J. E., & Winsvold, M. (2013). Climate Change Adaptation Policy in Bergen: Ideals and Realities. In *Climate Change Adaptation in Practice: From strategy development to implementation* (pp. 95–109). doi:10.1002/9781118548165.ch8

Länsstyrelserna. (2012). *Klimatanpassning i fysisk planering - vägledning från länsstyrelserna*.

Lawrence, T. B. (1999). Institutional Strategy. *Journal of Management*, *25*(2), 161–188. doi:10.1177/014920639902500203

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic Inquiry*. Beverly Hills: Sage Publications.

Loorbach, D. (2010). Transition Management for Sustainable Development: A Prescriptive, Complexity-Based Governance Framework. *Governance*, *23*(1), 161–183. doi:10.1111/j.1468-0491.2009.01471.x

Loorbach, D., & Rotmans, J. (2010). The practice of transition management: Examples and lessons from four distinct cases. *Futures*, *42*(3), 237–246. doi:10.1016/j.futures.2009.11.009

Lüdeke, M. K. B., Petschel-Held, G., & Schellnhuber, H.-J. (2004). Syndromes of Global Change: The First Panoramic View. *GAIA*, *13*(1), 42–49.

Maes, J., Hauck, J., Paracchini, M. L., Ratamäki, O., Hutchins, M., Termansen, M., … Bidoglio, G. (2013). Mainstreaming ecosystem services into EU policy. *Current Opinion in Environmental Sustainability*, *5*(1), 128–134. doi:10.1016/j.cosust.2013.01.002

Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. *Research Policy*, *41*(6), 955–967. doi:10.1016/j.respol.2012.02.013

Mayring, P. (2000). Qualitative Content Analysis. *Forum Qualitative Social Research*, *1*(2).

Mayring, P. (2010). *Qualitative Inhaltsanalyse. Grundlagen und Techniken* (11th ed.). Weinheim: Beltz.

Mazey, S. (2002). Gender mainstreaming strategies in the E.U.: delivering on an agenda? *Feminist Legal Studies*, *10*, 227–240.

McCormick, K., Anderberg, S., Coenen, L., & Neij, L. (2013). Advancing sustainable urban transformation. *Journal of Cleaner Production*, *50*, 1–11. doi:10.1016/j.jclepro.2013.01.003

McDonald, J. (2011). The role of law in adapting to climate change. *Wiley Interdisciplinary Reviews: Climate Change*, *2*(2), 283–295. doi:10.1002/wcc.96

Mcdonald, R. I., Kareiva, P., & Forman, R. T. T. (2008). The implications of current and future urbanization for global protected areas and biodiversity conservation. *Biological Conservation*, *141*(6), 1695–1703. doi:10.1016/j.biocon.2008.04.025

Mcgowan, R. P. (1983). Managerial Strategies in Municipal Government Organization. *The Academy of Management Journal*, *24*(5), 527–534.

McLellan, E., MacQueen, K. M., & Neidig, J. L. (2003). Beyond the Qualitative Interview: Data Preparation and Transcription. *Field Methods*, *15*(1), 63–84. doi:10.1177/1525822X02239573

Measham, T. G., Preston, B. L., Smith, T. F., Brooke, C., Gorddard, R., Withycombe, G., & Morrison, C. (2011). Adapting to climate change through local municipal planning: barriers and challenges. *Mitigation and Adaptation Strategies for Global Change*, *16*(8), 889–909. doi:10.1007/s11027-011-9301-2

Miller, T. R., Wiek, A., Sarewitz, D., Robinson, J., Olsson, L., Kriebel, D., & Loorbach, D. (2013). The future of sustainability science: a solutions-oriented research agenda. *Sustainability Science*. doi:10.1007/s11625-013-0224-6

Mintzberg, H. (1978). Patterns in Strategy Formation. *Management Science*, *24*(9), 934–948.

Molnar, J. L., & Kubiszewski, I. (2012). Managing natural wealth: Research and implementation of ecosystem services in the United States and Canada. *Ecosystem Services*, *2*, 45–55. doi:10.1016/j.ecoser.2012.09.005

Moser, S. C., & Ekstrom, J. A. (2010). A framework to diagnose barriers to climate change adaptation. *Proceedings of the National Academy of Sciences*, *107*(51), 22026–22031. doi:10.1073/pnas.1007887107

Munang, R., Thiaw, I., Alverson, K., Mumba, M., Liu, J., & Rivington, M. (2013). Climate change and Ecosystem-based Adaptation: a new pragmatic approach to buffering climate change impacts. *Current Opinion in Environmental Sustainability*, *5*(1), 67–71. doi:10.1016/j.cosust.2012.12.001

Nevens, F., Frantzeskaki, N., Gorissen, L., & Loorbach, D. (2013). Urban Transition Labs: co-creating transformative action for sustainable cities. *Journal of Cleaner Production*, *50*, 111–122. doi:10.1016/j.jclepro.2012.12.001

Nilsson, A. E., Swartling, Å. G., & Eckerberg, K. (2012). Knowledge for local climate change adaptation in Sweden: challenges of multilevel governance. *Local Environment*, *17*(6-7), 751–767. doi:10.1080/13549839.2012.678316

Norgaard, R. B. (2010). Ecosystem services: From eye-opening metaphor to complexity blinder. *Ecological Economics*, *69*(6), 1219–1227. doi:10.1016/j.ecolecon.2009.11.009

Nunan, F., Campbell, A., & Foster, E. (2012). Environmental mainstreaming: the organizational challenges of policy integration. *Public Administration and Development*, *32*(3), 262–277. doi:10.1002/pad.1624

O'Shannassy, T. (2003). Modern strategic management: balancing strategic thinking and strategic planning for internal and external stakeholders. *Singapore Management Review*, *25*(1).

Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. *Science*, *325*(5939), 419–22. doi:10.1126/science.1172133

Ostrom, E., Janssen, M. a, & Anderies, J. M. (2007). Going beyond panaceas. *Proceedings of the National Academy of Sciences of the United States of America*, *104*(39), 15176–8. doi:10.1073/pnas.0701886104

Oxford Dictionaries. (n.d.). Mainstream. *Oxford University Press*. Retrieved March 13, 2014, from http://www.oxforddictionaries.com/us/definition/american_english/mainstream

Parris, T. M., & Kates, R. W. (2003). Characterizing and Measuring Sustainable Development. *Annual Review of Environment and Resources*, *28*(1), 559–586. doi:10.1146/annurev.energy.28.050302.105551

Pasquini, L., Cowling, R. M., & Ziervogel, G. (2013). Facing the heat: Barriers to mainstreaming climate change adaptation in local government in the Western Cape Province, South Africa. *Habitat International*, *40*, 225–232. doi:10.1016/j.habitatint.2013.05.003

Pelling, M., High, C., Dearing, J., & Smith, D. (2008). Shadow spaces for social learning: a relational understanding of adaptive capacity to climate change within organisations. *Environment and Planning A*, *40*(4), 867–884. doi:10.1068/a39148

Pelling, M., & Holloway, A. (2006). *Legislation for Mainstreaming Disaster Risk Reduction.* London.

Persson, Å. (2004). *Environmental Policy Integration: an Introduction*. *PINTS – Policy Integration for Sustainability. Background Paper*. Stockholm.

Persson, Å., & Klein, R. J. T. (2009). Mainstreaming adaptation to climate change into official development assistance: challenges to foreign policy integration. In P. Harris (Ed.), *Climate Change and Foreign Policy: Case Studies from East to West* (pp. 162–177). London: Routledge.

Petersen, C., & Huntley, B. (2005a). *Mainstreaming Biodiversity in Production Landscapes*. Washington DC: Global Environment Facility.

Petersen, C., & Huntley, B. (2005b). What is Mainstreaming Biodiversity? In C. Petersen & B. Huntley (Eds.), *Mainstreaming Biodiversity in Production Landscapes* (pp. 2–11). Washington DC: Global Environment Facility.

Picciotto, R. (2002). The Logic of Mainstreaming: A Development Evaluation Perspective. *Evaluation*, *8*(3), 322–339. doi:10.1177/135638902401462420

Pielke Jr, R., Prins, G., Rayner, S., & Sarewitz, D. (2007). Climate change 2007: lifting the taboo on adaptation. *Nature*, *445*(7128), 597–8. doi:10.1038/445597a

Pohl, C., & Hirsch Hadorn, G. (2008). Methodological challenges of transdisciplinary research. *Natures Sciences Sociétés*, *16*(2), 111–121. doi:10.1051/nss:2008035

Potschin, M. B., & Haines-Young, R. H. (2011). Ecosystem services: Exploring a geographical perspective. *Progress in Physical Geography*, *35*(5), 575–594. doi:10.1177/0309133311423172

Preston, B. L., Westaway, R. M., & Yuen, E. J. (2010). *Climate adaptation planning in practice: an evaluation of adaptation plans from three developed nations*. *Mitigation and Adaptation Strategies for Global Change* (Vol. 16, pp. 407–438). doi:10.1007/s11027-010-9270-x

ProClim. (1997). *Researchers Research on Sustainability and Global Change – Visions in Science Policy by Swiss Researchers* (p. 32). Bern.

Raskin, P., Banuri, T., Gallopin, G., Gutman, P., Hammond, A., Kates, R., & Swart, R. (2002). *Great transition: The promise and lure of the times ahead.* (No. 1). Boston.

Rauken, T., Mydske, P. K., & Winsvold, M. (2014). Mainstreaming climate change adaptation at the local level. *Local Environment*, *0*(0), 1–16. doi:10.1080/13549839.2014.880412

Redford, K. H. (2013). *Mainstreaming Biodiversity Conservation. A Framing Paper for the Scientific and Technical Advisory Panel of the Global Environment Facility*. Retrieved from http://www.stapgef.org/stap/wp-content/uploads/2013/09/Mainstreaming-Biodiversity-at-GEF-V.-May-13.pdf

Rihoux, B. (2006). Qualitative Comparative Analysis (QCA) and Related Systematic Comparative Methods: Recent Advances and Remaining Challenges for Social Science Research. *International Sociology*, *21*(5), 679–706. doi:10.1177/0268580906067836

Rivera, C., & Wamsler, C. (2014). Integrating climate change adaptation, disaster risk reduction and urban planning: A review of Nicaraguan policies and regulations. *International Journal of Disaster Risk Reduction*, *7*, 78–90. doi:10.1016/j.ijdrr.2013.12.008

Roberts, D. (2008). Thinking globally, acting locally – institutionalizing climate change at the local government level in Durban, South Africa. *Environment and Urbanization*, *20*(2), 521–537. doi:10.1177/0956247808096126

Roberts, D. (2010). Prioritizing climate change adaptation and local level resilience in Durban, South Africa. *Environment and Urbanization*, *22*(2), 397–413. doi:10.1177/0956247810379948

Roberts, D., Boon, R., Diederichs, N., Douwes, E., Govender, N., Mcinnes, A., … Spires, M. (2011). Exploring ecosystem-based adaptation in Durban, South Africa: “learning-by-doing” at the local government coal face. *Environment and Urbanization*, *24*(1), 167–195. doi:10.1177/0956247811431412

Roberts, D., & O'Donoghue, S. (2013). Urban environmental challenges and climate change action in Durban, South Africa. *Environment and Urbanization*, *25*(2), 299–319. doi:10.1177/0956247813500904

Rockström, J., Steffen, W., Noone, K., Persson, A., Chapin, F. S., Lambin, E. F., … Foley, J. A. (2009). A safe operating space for humanity. *Nature*, *461*(7263), 472–5. doi:10.1038/461472a

Rotmans, J., Kemp, R., & van Asselt, M. (2001). More evolution than revolution: transition management in public policy. *Foresight*, *3*(1).

Rotmans, J., & Loorbach, D. (2009). Complexity and Transition Management. *Journal of Industrial Ecology*, *13*(2), 184–196. doi:10.1111/j.1530-9290.2009.00116.x

Rotmans, J., & Loorbach, D. (2010). Towards a Better Understanding of Transitions and Their Governance. A Systemic and Reflexive Approach. In J. Grin, J. Rotmans, & J. Schot (Eds.), *Transitions to Sustainable Development. New Directions in the Study of Long Term Transformative Change* (pp. 105–222). New York: Routledge.

Safarzyńska, K., Frenken, K., & van den Bergh, J. C. J. M. (2012). Evolutionary theorizing and modeling of sustainability transitions. *Research Policy*, *41*(6), 1011–1024. doi:10.1016/j.respol.2011.10.014

SALAR. (n.d.). *Levels of local democracy in Sweden*. Stockholm.

Sandström, U. G. (2002). Green Infrastructure Planning in Urban Sweden. *Planning Practice and Research*, *17*(4), 373–385. doi:10.1080/02697450216356

Sandström, U. G., Angelstam, P., & Khakee, A. (2006). Urban comprehensive planning – identifying barriers for the maintenance of functional habitat networks. *Landscape and Urban Planning*, *75*(1-2), 43–57. doi:10.1016/j.landurbplan.2004.11.016

Sandström, U. G., Angelstam, P., & Mikusiński, G. (2006). Ecological diversity of birds in relation to the structure of urban green space. *Landscape and Urban Planning*, *77*(1-2), 39–53.

Sarewitz, D., Clapp, R., Crumbley, C., Kriebel, D., & Tickner, J. (2012). The sustainability solutions agenda. *New Solutions*, *22*(2), 139–51. doi:10.2190/NS.22.2.c

Scarlett, L., & Boyd, J. (2013). Ecosystem services and resource management: Institutional issues, challenges, and opportunities in the public sector. *Ecological Economics*. doi:10.1016/j.ecolecon.2013.09.013

Schneidewind, U. (2013). Transformative Literacy. Framework for a Knowledge-based Approach to Coping with the „Great Transformation". *GAIA*, *22*(2), 82–86.

Scholz, R. W., Binder, C. R., & Lang, D. J. (2011). The HES framework. In R. W. Scholz (Ed.), *Environmental Literacy in Science and Society* (pp. 453–462). Cambridge: Cambridge University Press.

Seamans, G. S. (2013). Mainstreaming the environmental benefits of street trees. *Urban Forestry & Urban Greening*, *12*(1), 2–11. doi:10.1016/j.ufug.2012.08.004

Seto, K. C., Güneralp, B., & Hutyra, L. R. (2012). Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools. *Proceedings of the National Academy of Sciences of the United States of America*, 1–6. doi:10.1073/pnas.1211658109

Seyfang, G., & Smith, A. (2007). Grassroots innovations for sustainable development: Towards a new research and policy agenda. *Environmental Politics*, *16*(4), 584–603. doi:10.1080/09644010701419121

Sitas, N., Prozesky, H. E., Esler, K. J., & Reyers, B. (2013). Opportunities and challenges for mainstreaming ecosystem services in development planning: perspectives from a landscape level. *Landscape Ecology*. doi:10.1007/s10980-013-9952-3

Smit, B., Burton, I., Klein, R. J. T., & Wandel, J. (2000). An anatomy of adaptation to climate change and variability. *Climatic Change*, *45*, 223–251.

Smith, A., Voß, J.-P., & Grin, J. (2010). Innovation studies and sustainability transitions: The allure of the multi-level perspective and its challenges. *Research Policy*, *39*(4), 435–448. doi:10.1016/j.respol.2010.01.023

Smith, P., Ashmore, M. R., Black, H. I. J., Burgess, P. J., Evans, C. D., Quine, T. a., … Orr, H. G. (2013). The role of ecosystems and their management in regulating climate, and soil, water and air quality. *Journal of Applied Ecology*, *50*(4), 812–829. doi:10.1111/1365-2664.12016

Sonnek, K. M., Johansson, B., & Lindgren, J. (2013). Risk and vulnerability analysis: A feasible process for local climate adaptation in Sweden? *Local Environment*, *18*(7), 781–800. doi:10.1080/13549839.2012.732048

SOU. (2007). *Sweden facing climate change - threats and opportunities. Final report from the Swedish Commission on Climate and Vulnerability*. Stockholm.

Sovacool, B. K. (2011). Hard and soft paths for climate change adaptation. *Climate Policy*, *11*(4), 1177–1183. doi:10.1080/14693062.2011.579315

Spangenberg, J. H. (2011). Sustainability science: a review, an analysis and some empirical lessons. *Environmental Conservation*, *38*(03), 275–287. doi:10.1017/S0376892911000270

Staes, J., Vrebos, D., & Meire, P. (2010). A Framework for Ecosystem Services Planning. In P. H. Liotta, W. G. Kepner, J. M. Lancaster, & D. A. Mouat (Eds.), *Achieving Environmental Security: Ecosystem Services and Human Welfare* (pp. 53–72). Amsterdam: IOS Press.

Stattistiska Centralbyrån. (2010). Localities 2010. Area, population and density in localities 2005 and 2010 and change in area and population. Retrieved May 09, 2014, from http://www.scb.se/Statistik/MI/MI0810/2010A01Z/01_Localities2010_land_area_pop_density_2005_2010.xls

Stattistiska Centralbyrån. (2013). Befolkningsstatistik. Retrieved May 06, 2014, from www.scb.se/sv_/Hitta-statistik/Statistik-efter-amne/Befolkning/Befolkningens-

sammansattning/Befolkningsstatistik/25788/25795/Helarsstatistik---Kommun-lan-och-riket/159277/

Steurer, R., & Martinuzzi, A. (2005). Towards a new pattern of strategy formation in the public sector: first experiences with national strategies for sustainable development in Europe. *Environment and Planning C: Government and Policy*, *23*(3), 455–472. doi:10.1068/c0403j

Storbjörk, S. (2007). Governing Climate Adaptation in the Local Arena: Challenges of Risk Management and Planning in Sweden. *Local Environment*, *12*(5), 457–469. doi:10.1080/13549830701656960

Storbjörk, S. (2010). "It Takes More to Get a Ship to Change Course": Barriers for Organizational Learning and Local Climate Adaptation in Sweden. *Journal of Environmental Policy & Planning*, *12*(3), 235–254. doi:10.1080/1523908X.2010.505414

Storbjörk, S., & Hedrén, J. (2011). Institutional capacity-building for targeting sea-level rise in the climate adaptation of Swedish coastal zone management. Lessons from Coastby. *Ocean & Coastal Management*, *54*(3), 265–273. doi:10.1016/j.ocecoaman.2010.12.007

Swart, R., & Raes, F. (2007). Making integration of adaptation and mitigation work: mainstreaming into sustainable development policies? *Climate Policy*, *7*(4), 288–303. doi:10.1080/14693062.2007.9685657

TEEB. (2010). *The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB.*

TEEB. (2011). *The economics of ecosystems and biodiversity: TEEB manual for cities – Ecosystem services in urban management*. Retrieved from www.teebweb.org

Thompson, A., Robbins, P., Sohngen, B., Arvai, J., & Koontz, T. (2006). Economy, Politics and Institutions: From Adaptation to Adaptive Management in Climate Change. *Climatic Change*, *78*(1), 1–5. doi:10.1007/s10584-006-9095-5

Tongco, M. (2007). Purposive sampling as a tool for informant selection. *Ethnobotany Research & Applications*, *5*, 147–158.

Travers, A., Elrick, C., Kay, R., Vestergaard, O., Olhoff, A., Mills, A., … Hills, T. (2012). *Ecosystem-based adaptation guidance: Moving from principles to practice.*

Turner, R. K., Paavola, J., Cooper, P., Farber, S., Jessamy, V., & Georgiou, S. (2003). Valuing nature: lessons learned and future research directions. *Ecological Economics*, *46*(3), 493–510. doi:10.1016/S0921-8009(03)00189-7

Turnhout, E., Waterton, C., Neves, K., & Buizer, M. (2013). Rethinking biodiversity: from goods and services to "living with." *Conservation Letters*, *6*(3), 154–161. doi:10.1111/j.1755-263X.2012.00307.x

UNCED. (1992). *Agenda 21*. New York.

UNFCCC. (2009). *Copenhagen Accord*. Copenhagen.

UNFCCC. (2011). *Ecosystem-based approaches to adaptation: compilation of information. FCCC/SBSTA/2011/ INF.8.* Retrieved from http://unfccc.int/resource/docs/2011/sbsta/eng/inf08.pdf

United Nations. (1992). *Rio Declaration on Environment and Development 1992*. New York.

United Nations. (2002). *Gender Mainstreaming. An Overview.* New York.

Uy, N., & Shaw, R. (2012a). Overview of Ecosystem-Based Adaptation. In N. Uy & R. Shaw (Eds.), *Ecosystem-based adaptation* (pp. 3–17). Bingley: Emerald Group Publishing Ltd.

Uy, N., & Shaw, R. (2012b). The Role of Ecosystems in Climate Change Adaptation and Disaster Risk Reduction. In N. Uy & R. Shaw (Eds.), *Ecosystem-based adaptation* (Vol. 12, pp. 41–59). Bingley: Emerald Group Publishing Ltd.

Van den Bergh, J. C. J. M., Truffer, B., & Kallis, G. (2011). Environmental innovation and societal transitions: Introduction and overview. *Environmental Innovation and Societal Transitions*, *1*(1), 1–23. doi:10.1016/j.eist.2011.04.010

Vignola, R., Locatelli, B., Martinez, C., & Imbach, P. (2009). Ecosystem-based adaptation to climate change: what role for policy-makers, society and scientists? *Mitigation and Adaptation Strategies for Global Change*, *14*(8), 691–696. doi:10.1007/s11027-009-9193-6

Wamsler, C. (2013). *Cities, Disaster Risk and Adaptation. Routledge Series on Critical Introduction to Urbanism and the City*. London: Routledge.

Wamsler, C., & Brink, E. (2014). Planning for Climatic Extremes and Variability: A Review of Swedish Municipalities' Adaptation Responses. *Sustainability*, *6*(3), 1359–1385. doi:10.3390/su6031359

Wamsler, C., Brink, E., & Rivera, C. (2013). Planning for climate change in urban areas: from theory to practice. *Journal of Cleaner Production*, *50*, 68–81. doi:10.1016/j.jclepro.2012.12.008

WBGU. (2011). *World in Transition. A Social Contract for Sustainability [Flagship Report]*. Berlin: German Advisory Council on Global Change (WBGU).

WCED. (1987). *Our Common Future*. Oxford: Oxford University Press.

Westley, F., Olsson, P., Folke, C., Homer-Dixon, T., Vredenburg, H., Loorbach, D., … Leeuw, S. (2011). Tipping Toward Sustainability: Emerging Pathways of Transformation. *Ambio*, *40*(7), 762–780. doi:10.1007/s13280-011-0186-9

Wiek, A. (2007). Challenges of Transdisciplinary Research as Interactive Knowledge Generation, *1*, 52–57.

Wiek, A., & Lang, D. J. (in prep.). *Transformational Research for Sustainability. A Practical Methodology*.

Wiek, A., Ness, B., Schweizer-Ries, P., Brand, F. S., & Farioli, F. (2012). From complex systems analysis to transformational change: a comparative appraisal of sustainability science projects. *Sustainability Science*, *7*(S1), 5–24. doi:10.1007/s11625-011-0148-y

Wilkinson, C., Saarne, T., Peterson, G. D., & Colding, J. (2013). Strategic Spatial Planning and the Ecosystem Services Concept – an Historical Exploration. *Ecology and Society*, *18*(1).

Williams, P. M. (2002). Community strategies: mainstreaming sustainable development and strategic planning? *Sustainable Development*, *10*(4), 197–205. doi:10.1002/sd.197

Wilson, M. a, & Howarth, R. B. (2002). Discourse-based valuation of ecosystem services: establishing fair outcomes through group deliberation. *Ecological Economics*, *41*(3), 431–443. doi:10.1016/S0921-8009(02)00092-7

Wolf, J. (2011). Climate Change Adaptation as a Social Process. In J. D. Ford & L. Berrang-Ford (Eds.), *Climate Change Adaptation in Developed Nations: From Theory to Practice, Advances in Global Change Research*. Dordrecht: Springer.

Wu, J. (2014). Urban ecology and sustainability: The state-of-the-science and future directions. *Landscape and Urban Planning*, 1–13. doi:10.1016/j.landurbplan.2014.01.018

WWF. (2013). *Mainstreaming Ecosystem-based Adaptation in Vietnam. Policy Note*. Hanoi: NonProfitNews.

Yin, R. K. (2009). *Case Study Research: Design and Methods* (Fourth Edi.). Thousand Oaks: Sage Publications.

Young, R. F. (2013). Mainstreaming urban ecosystem services: A national survey of municipal foresters. *Urban Ecosystems*, *16*(4), 703–722. doi:10.1007/s11252-013-0287-2

Zborel, T., Holland, B., Thomas, G., Baker, L., Calhoun, K., & Ramaswami, A. (2012). Translating Research to Policy for Sustainable Cities. *Journal of Industrial Ecology*, *16*(6), 786–788. doi:10.1111/j.1530-9290.2012.00565.x

Zhang, Y., & Wildemuth, B. M. (2009). Qualitative analysis of content. In B. M. Wildemuth (Ed.), *Applications of Social Research Methods to Questions in Information and Library Science* (pp. 308–319). Westport: Libraries Unlimited.

8 Appendix

Interviewer guide:
Ecosystem Services Planning, Climate Change Adaptation, and Ecosystem-based Adaptation

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1. Block I
(*Purpose: reception)*
1.1. Reception by Christine; introducing the project and the Master's theses
Reasons for taking part in the project:

Increasing knowledge on the possible ways and potential benefits of combining:
(a) ecosystem services planning; and
(b) adaptation planning to foster sustainable city development

1.2 Within this interview we would like to cover...introduce the concepts and diagram of overlap

For the following sections, we would like to ask certain questions regarding how the approaches outlined above are planned for and implemented. For each question, we would like you to relate your answers first to ecosystem services planning, then to adaptation planning, and finally to address the overlap between these two areas, which we refer to as 'ecosystems-based adaptation'

2. Block II
(*Purpose: introduction to the participant and their work, overview of departments and responsibilities)*
2.1. What is your background, core working field and responsibilities?

3.1 Understanding / definition

- Do you have a working definition of/what is your understanding of the term:

I) Ecosystem Services Planning	II) Climate Change Adaptation Planning	III) Ecosystem-based Adaptation

  - (re 1) how does this interrelate (if at all) with the term 'blue and green infrastructure'?
  - (re 2) how does this interrelate with the term 'risk reduction'
  - how do any of these terms relate to the idea of 'sustainable cities'?

I) II) III)

3.2. Institutional responsibilities (order flexible)

- In your municipality who/which department is responsible for doing

(*Overview of departments in the municipality, size, linkages, who is responsible for e.g. bridging work, who is on different committees, working groups*)

I) II) III)

- Since when and why do they work on

(where does the primary motivation come from with regard to implementing the approaches) *(related changes, mainstreaming strategies, changing mandates and restructuring?)*

I) II) III)

- What are the key policies, laws, frameworks etc. that are important for your work with regard to (possible areas of support or conflict?)

I) II) III)

3.5 Projects and measures

- What projects are currently being undertaken by the municipality with regard to

(What are goals pursued)

I) II) III)

- What tools are you using or developing and what procedures are you following with regard to

I) II) III)

3.6 Actor dimension

- With whom outside your municipality do you work, under what circumstances (project based)/for what reasons (knowledge flow/legislation) with regard to

(e.g. citizens, groups/association, other municipalities, national, international or sub-municipal government levels, the public, private actors, NGOs etc; What mandate do actors within and outside your department have?)

I) II) III)

- Which groups/person do you see as supporting your work in relation to

I) II) III)

- Which groups/person do you see as potentially in conflict with your work on these approaches?

I) II) III)

3.6 Benefits

- In your view, what are the benefits of I) II) III) approach to planning?

I) II) III)

3.7 Challenges

- What are the difficulties or challenges that you have experienced with an I) II) III) approach to planning and how do you view the future potential of III?

(From your point of view how can existing challenges be overcome; How does III relate to the sustainable cities approach?)

I) II) III)