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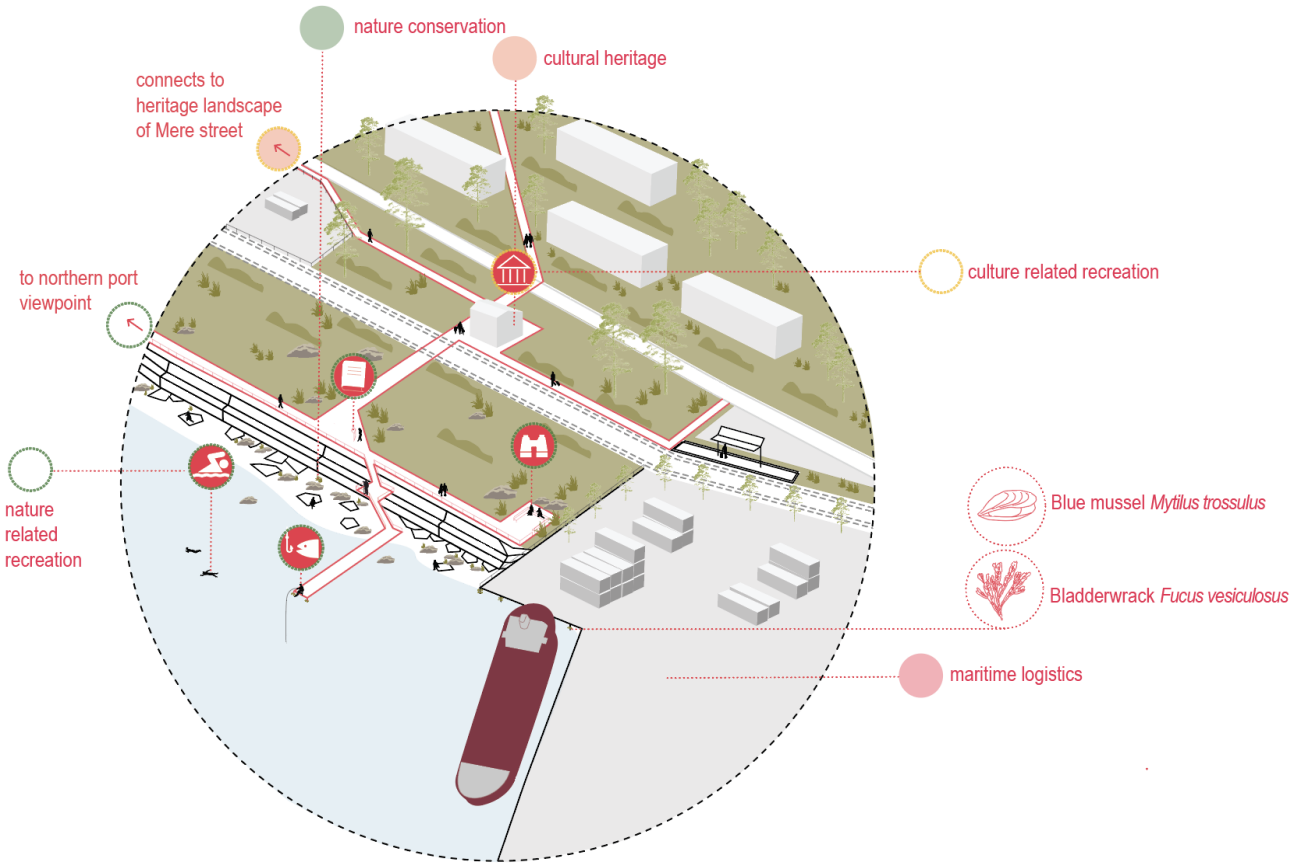
Master's Programme in USP Landscape Architecture

Landscape strategies for resilient coast

Kaie Kuldkepp



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Abstract

The current thesis explores how coastal systems could be managed in a resilient way with the contribution of landscape planning and what kind of added value can a social-ecological systems (SESs) approach offer to the field.

The use of SESs approach enables to examine coastal landscapes as a unified and dynamic system of human and nature relations. These relations are explored through a supporting concept of ecosystem services (ESS). According to the SESs approach, managing coastal landscapes in accordance with resilience principles acquires both - managing properties of SESs as well as properties of governance systems. I apply this viewpoint to a representative site in the north coast of Estonia: from Põhja-Tallinn to Paldiski.

The mixed methodology of the current work is a contribution to a resilient landscape planning process. It consists of complementing field, desktop, participatory and creative research aiming for gaining an understanding of coastal systems, co-creating site-specific knowledge and developing landscape strategies for the resilient coast of the representative site.

In this process a landscape planner is a facilitator who assists the acknowledging, maintaining and strengthening certain properties of social-ecological systems.

I conclude that SESs approach is in itself the resilient way to address coastal challenges.

Keywords Social-ecological systems, Resilience, Ecosystem Services, Coastal landscapes

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Preface

This current thesis is the result of my interest in the core essence of *landscape* itself. J.B. Jackson has analysed the linguistic origin of the word *landscape*: *land* means a space defined by people, *scape* indicates the collective aspects of the environment as well as structure of the system. Therefore, “landscape as a composition of man-made spaces on the land” (Jackson, 1984, p.7) unites the natural and social components, it's a synthetic space with collective character and that makes it fascinating.

Coastal landscapes are interesting, because these are edge landscapes, areas where two systems meet. This land and sea interface creates social-ecological potential as well as challenges, making it very relevant for landscape architects to discuss, plan and design. This thesis is a contribution to the discourse.

I want to thank my supervisor Elisa Lähde for feedback and recommendations; my advisor Joonas Plaan for thinking along with me and offering advice; my dear friend and colleague Keiti Kljavin for being my dialogue partner; Reimo Rivis for sharing your collected gis data with me; Vilja Larjosto for initial inspiring recommendations; all the interviewees and workshop participants for dedicating their time and contributing to this current work; my dear family.

Tallinn, May 2022
Kaie Kuldkepp

1 Introduction

"..interactions between humans, other biological agents, and the physical environment coalesce to create a landscape.."
(Dodaro & Reuther, 2017, p.81)

Importance of the sea is rooted in Estonians. Sea has been part of the culture and identity as well as the source of income as long as people have lived in this area. During the Soviet Era the access to the sea was cut off physically, leading to a deletion of many coastal landscapes from the mental maps. In the surroundings of Tallinn, re-independence brought an increased number of residential developments in coastal areas, with the latest trend in urban waterfront developments in the capital city. Yet, in 2022 Estonians still have to (re)discover our physical and cultural connection to the coastal landscape. Therefore this thesis is triggered by my initial general interest in how we approach the coast and how we plan our coastal landscapes.

These questions become even more relevant when considering the latest ecological trends. Climate change has been visible through an increased number of extreme weather events (storms, flooding, strong winds, higher temperatures etc) globally, making coastal landscapes especially vulnerable to changes. Based on the Estonian Climate Adaptation Development Plan (Keskkonnaministeerium, 2016) one area that is most vulnerable to climate change locally is the densely populated coastal area. One of these is our capital city Tallinn and its surroundings. The current work is based on a representative site from the northern coast of Estonia - a coastal zone from the capital city Tallinn to port town Paldiski (diagram 1).

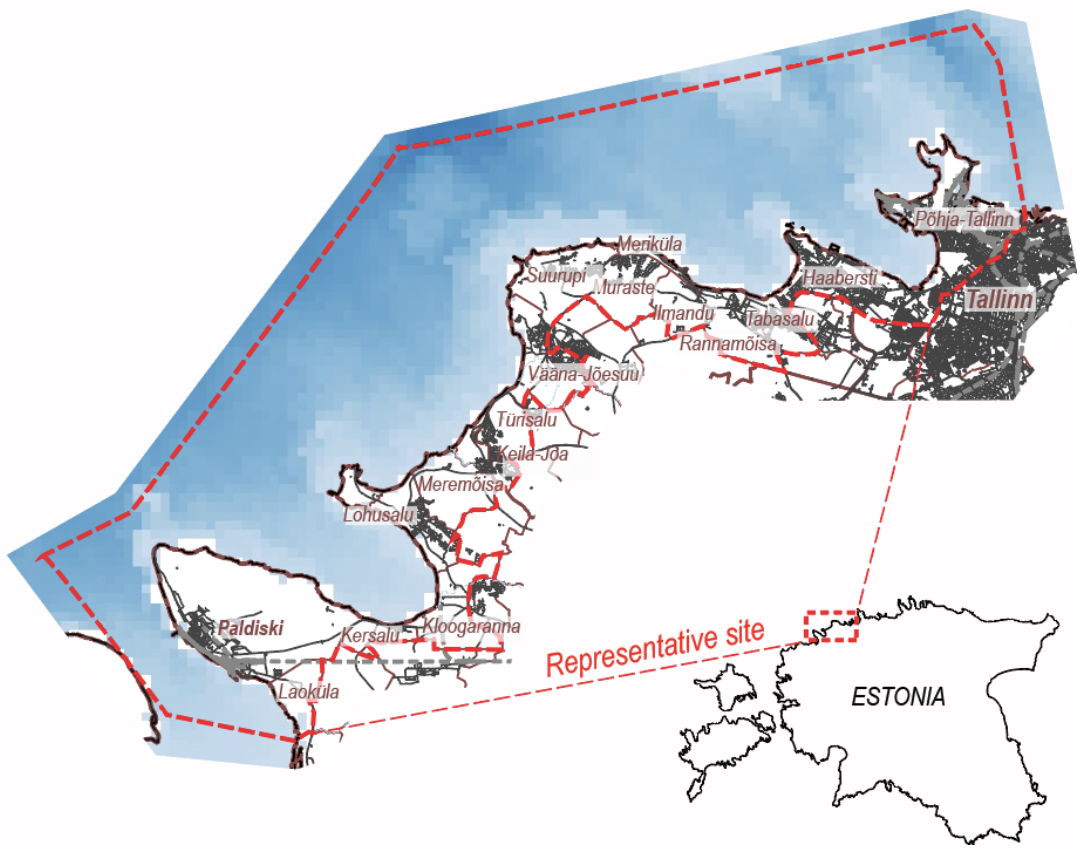


Diagram 1. Representative site: from Põhja-Tallinn to Paldiski.

In this era of Anthropocene, where humans have altered drastically the Earth system (Crutzen & Stoermer, 2000), creating ongoing ecological and socioeconomic changes, it is crucial to approach landscapes as intertwined social-ecological systems, which means examining humans and nature as one interconnected whole. Resilience of the social-ecological systems is an approach to understand the interactions between nature and society and their dynamics (Folke et al, 2016). It offers a framework to assess the capacity of the system to retain its functions in the light of change (Dwiartama & Rosin, 2014).

1.1 Research questions

The main research question for this thesis is:
How coastal systems could be managed in a resilient way with the contribution of landscape planning?
By "managing coastal systems" I mean curating dynamic landscapes in the process of change; working simultaneously with transforming physical landscapes as well as

with various actors. Therefore by “manage” I don’t mean controlling or commanding, but directing and coping.
The main research question is approached through the subquestion of:
What kind of added value can social-ecological systems concept offer to the field?

1.2 Aim and structure

Main aim of this thesis is to create understanding of how coastal systems could be managed in a resilient way with the contribution of landscape planning. In addition, the thesis examines what kind of added value can social-ecological systems theory and approach offer to the field.

The structure of this thesis is divided into two main parts.
First part is the general framework consisting of the overview of the key concepts (chapter 2) as well as context description (chapter 3) relevant for the overall understanding of the theme. This is based on desktop research. This framework offers overall insights of the interrelations between the social systems and ecological systems of coastal landscapes and therefore forms a basis for the other part of the thesis.

In the second (chapter 4) part of the thesis I will apply social-ecological systems (SESs) approach to a representative site from Põhja-Tallinn to Paldiski in Estonian north coast. The study of the site through the lense of SESs approach can be divided into three interconnected sections: understanding, co-creating and developing. All these sections aim to create knowledge for exploring how coastal systems could be managed in a resilient way with the contribution of landscape planning.
Understanding (chapter 4.1) is based on mapping and layering data from different planning and strategic documents, own observations as well as GIS data. It is relevant in order to form a basic understanding of the site and create initial knowledge of its social-ecological systems. This mainly desktop based knowledge creation (accompanied by field research to some extent) is followed by co-creating (chapter 4.2) in order to share knowledge at a local and personal level and with this process co-define resilience deficits and so-called resilience aims. This participatory research is based on a workshop and semi-structured interviews with the members of the local coastal communities. Adding participatory tools to the overall knowledge creation is in accordance to SESs approach that calls for participation, learning and combining sources of knowledge (Biggs et al, 2015).
This is followed by developing (chapter 4.3) generalised landscape strategies for resilient coast for the representative site. This section is based on creative research

that aims to contribute to knowledge creation by connecting layers of social-ecological systems of the coast and its challenges visually.

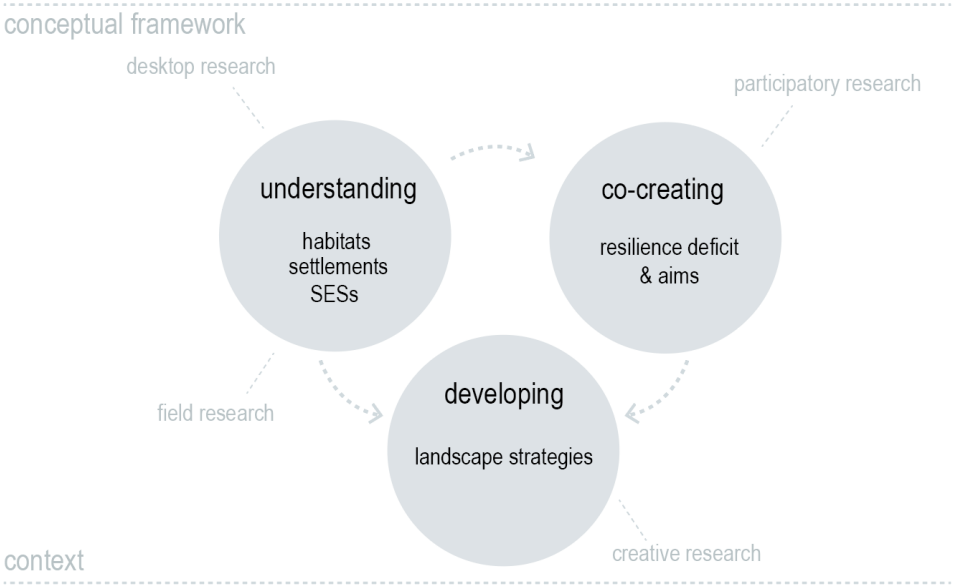


Diagram 2. General structure and workflow

To conclude, I will be using mixed methodology, as these different research methods (desktop (field), participatory and creative research) complement each other and create knowledge relevant for the scope of landscape planning task. Besides, working with these various research approaches is in itself part of understanding how social-ecological systems concept can be applied to landscape planning practice and what kind of value does it therefore add.

2 Conceptual framework

Human - environment interactions have been framed by various researchers in numerous ways. This thesis explores and relies on concepts of Anthropocene, social-ecological systems, resilience and ecosystem services. These concepts are contextualised through a representative site from the Estonian coast.

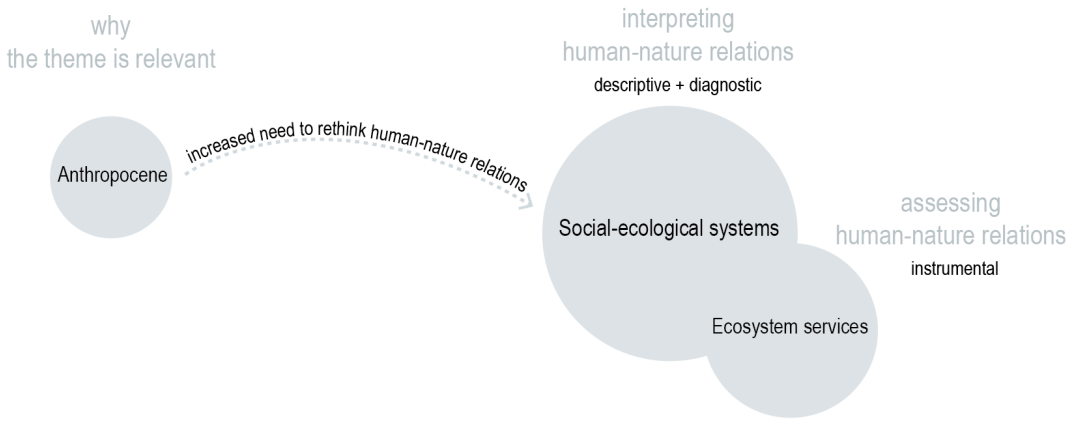


Diagram 3. The interrelated system of the key concepts used for this thesis.

2.1 Anthropocene

We live in the era of the Anthropocene. It is a widely used term that originates from Crutzen and Stoermer (2000) describing a geological period where humans have altered the Earth system drastically and irreversibly. Human activities have impacted the climate, the landscape, the seascape. One of the characteristics of this "age of humans" (Crutzen and Stoermer, cited in Dodaro & Reuther, 2017, p.82) is rapid urbanisation with almost 60% of the world's population living in cities by now (Folke et al, 2016). Cities depend on extensive areas of land to sustain their needs for resources - energy, matter, natural resources, waste disposal, to name some. Some researchers have even concluded that all landscapes are urban as they are influenced by the processes of urbanisation. It is the urban dwellers whose behaviour and decisions alter the landscapes globally (Brenner & Schmid, 2011; Nassauer, 2013; Kareiva et al, 2007).

There are probably no areas on Earth left that wouldn't be directly or indirectly influenced by humans. All landscapes are designed, influenced and modified by humans (Balée, 1998). The intentional as well as unintentional environmental

transformations or human-moderated disturbances (Balée, 2013) can be named as *domesticated landscapes* (Erickson, 2002). Humans have altered the environment in order to increase its usefulness to humans themselves (Erickson, 2002). According to Kareiva et al (2007) the domestication of nature means that humans select desirable ecosystem features and by doing so affect other, not so desirable features. These features, co-called ecosystem services[1], that lead to increased food production and trade, higher productivity and reduced risk are in favour (Kareiva et al, 2007).
Cities are accommodating the most domesticated landscapes, because it is the urban environments, where every characteristic of the environment is chosen to be aesthetically and functionally pleasing for humans. Cities consume most of the ecosystem services globally (Kareiva et al, 2007).
This tamed environment is the ultimate expression of the Anthropocene.
In this context the question relies on the understanding of the compromise between various ecosystem services that are the result of domestication. Some routes of domestication can improve ecosystems for humans as well as other species. Therefore it is relevant to aim for a "more durable stewardship" (Kareiva et al, 2007, p.1869), managing this compromise keeping in mind benefits for both - nature and humans (Kareiva et al, 2007).

2.1.1 Climate change

"Contemporary climate change is one manifestation of a wider domestication and subordination of the non-human world to serve human needs.." (Pokrant, 2017, p.243).

According to Estonia's Climate Change Adaptation Development Plan until 2030 (Keskkonnaministeerium, 2016) climate change manifests itself in Estonia mainly in the rise of temperature that is faster than global average rise. This leads to droughts; changes in vegetation; reduced ice and snow cover; invasion of alien species as well as new plant pests; changes in seasonal energy consumption peaks; health problems etc.
Another main consequence of climate change in Estonia is the increase in precipitation and its seasonal fluctuations. Winters will most likely have up to 80% more precipitation, whereas summers will have 10% less than now. All in all, the yearly average will increase by 20%. This leads to coastal flooding and erosion; increased pressure to drainage systems and ditches, dams as well as even pressure to relocate buildings and infrastructure (Keskkonnaministeerium, 2016).
Rise in sea level as well as the increase in number of storms both influence shore erosion and pose threat to coastal facilities (Keskkonnaministeerium, 2016).

[1] Read more upon ecosystem services in paragraph 2.2.4.

In our region the sea level rise has been compensated by land uplift and although this phenomenon is slowing down, yet the main cause of coastal flooding is the increase in storm events (Mäll et al, 2016; Kudryavtseva et al, 2020).

Based on the Climate Adaptation Development Plan one area that is most vulnerable to climate change is the densely populated coastal area. Increased flow rate of the coastal waters will influence the rise in the coastal water level that is problematic for the buildings and infrastructure at the coast (Keskkonnaministeerium, 2016).
This was well visualised in January 2005, when the storm Gudrun caused extreme flooding in the coastal settlements. For example, in the seaside town of Pärnu the water level was +275cm over long-term average water level (Suursaar et al, 2006, cited in Mäll et al, 2016). This caused devastating consequences to 775 households as well as public amenities. That same storm event also caused extensive coastal erosion in beaches, destroying some of natural landscapes (e.g.decrease in pine forests) (Haanpää et al, no date).

2.2 Social-ecological systems (SESs) concept

Social-ecological systems (SESs) is a concept to interpret relations between society and nature. It offers both, a descriptive as well as diagnostic framework, to approach intertwined social and ecological systems and in this current thesis it is the underlying conceptual framework.

The current thesis relies on Berkes (2017) for the use of the term and therefore I am using social-ecological, instead of socio-ecological, because “social-ecological emphasises that the two subsystems are equally important, whereas socio- is a modifier, implying a less than equal status of the social subsystem” (Berkes, 2017, p.3).

The concept originated in 1988, but it was in 1998 when Berkes and Folke (1998) started to use it in depth in order to examine human and nonhuman components and their relations as one unified system. SESs was first used to explore the local resource management systems and the options to complement processes of institutions to the processes of ecosystems in order to gain benefits for both and increase resilience. The connection between the management practice and the ecosystem was created with local knowledge of the local ecosystem. SESs framework was afterwards applied in connection to adaptability to change in order to work with long-term sustainability questions (Colding et al, 2019).

In social-ecological systems, social refers to economic, political, technological as well as cultural; ecological refers to the whole biosphere. Therefore, social-ecological means that humans (including people, communities, economies, cultures) are parts of the biosphere and shape it, while also being shaped by, depending on and developing with the biosphere. “Humans-in-nature” perspective (Folke et al, 2016, p.41) means that humans co-evolve with the planet and the founding aspects of humanity (e.g. democracy, health, inequality, power, security, peace etc) depend on resilience of the biosphere (Folke et al, 2016).

Social-ecological systems are complex adaptive systems (Folke et al, 2016).
These are characterised by non-linear change, uncertainties regarding this change as well as the scope to self-organise and adapt based on previous experiences (Biggs et al, 2015).
Key SESs features, when it comes to assessing SESs and investigating how SESs react to change, are: vulnerability, adaptability, transformability and resilience (Walker et al, 2004; Refulio-Coronado et al, 2021).
Vulnerability of SESs consists of three subproperties: subjection to disturbances, responsiveness to disturbances and capacity to adapt in the light of these disturbances (Adger, 2006, cited in Refulio-Coronado et al, 2021).
Adaptation and transformation are two responses of SESs to the process of change (Folke, 2006).
Transformability is a SESs feature to show the ability to create a totally new system when current ecological and social conditions are (becoming) unsustainable. It is the capacity “to evolve a new way of living” (Walker et al, 2004, p.5). Transformation is “a qualitative change of the system” (Pokrant, 2017, p.249), shifting development to new and more desirable pathways (Biggs et al, 2005; Zaucha et al, 2016).
Adaptive capacity, on the other hand, refers to SESs ability to adjust and persist in the process of change, to steer its development while choosing between the most suitable alternatives. Adaptability is the capacity of actors to make an impact on resilience by managing the SES for sustaining social and ecological well-being (Walker et al, 2004; Refulio-Coronado et al, 2021, Zaucha et al, 2016).
Adaptability can be referred to the coastal human population and their capability to adjust in the light of climate change, for example, building infrastructure like sustainable urban drainage systems (SUDS) to prevent flooding or constructing wave-breakers to prevent coastal erosion (Landscape Institute, 2021); implementing ecological design to piers and docks (e.g. artificial reefs, submerged breakwater, seawall stairs) (Dyson & Yokom, 2014) to create new habitats; restoring habitats (e.g. planting of seagrass meadow or creating mussel reefs) in order to improve carbon sequestration and water quality as well as offer nursing and spawning area for various

marine species (Kotta, 2019; Angrove, 2020). These are just some examples of what human actors can do in order to adapt and make an impact on coastal resilience.

2.2.1 Social-ecological resilience

Resilience is a complex concept that is interpreted in various ways by different authors (Walker et al, 2004). It is a SESs property as well as planning and management approach (Berkes et al, 2003).
The concept came into wider use in ecology and environmental studies, originating back to the 1970s when ecologist C.S. Holling first formulated the idea of ecological resilience - system's capacity to tolerate disturbance before structural change, a regime shift. This concept offered an understanding of ecosystems' dynamics that is nonlinear. It was then applied in social sciences as well as in holistic studies to ecological as well as social systems (Berkes et al, 2003).
The concept of resilience opened up the "human-in-ecosystem" perspective (Berkes et al, 2003, p.54) and is a way to think about the interactions and boundaries between ecological systems and social systems (Berkes et al, 2003). Therefore the concept is tightly connected to the SESs concept itself.
Resilience is the "organising and scoping device" (Berkes et al, 2003, p.4) to integrate the social and the ecological systems to a holistic social-ecological system, where humans and nature are examined as interconnected whole as humanity is rooted in the biosphere (Folke et al, 2016).

Social-ecological resilience is an instrument to assess and act for the purpose of SESs to keep their original function, structure, identity (Dwiartama & Rosin, 2014; Walker et al, 2004; Refulio-Coronado et al, 2021). This approach explores how the system can be managed when facing disturbances and uncertainty (Stockholm Resilience Center, 2015). It concerns the dynamic aspect of the social-ecological system - tension between persistence and change, adaptation and transformation in line with social values and goals (Folke, 2006; Zaucha et al, 2016).
As an approach in this thesis, resilience is a continuous process rather than an end goal.

Resilience as SESs property is generally considered positive, nevertheless it can also be negative due to certain agency. For example, the capacity of a social-ecological system to sustain benefits from ecological processes can be useful for certain humans but at the same time bad for others (Armitage & Johnson, 2006, cited in Ernstson, 2013). Also, sometimes change is desirable and then it is important to defeat resilience in the system (Walker et al, 2004; Biggs et al, 2015). Therefore it is always

important to ask - “resilience for whom and for what” (Armitage & Johnson, 2006, cited in Ernstson, 2013, p.15).

2.2.2 Building social-ecological resilience

In this thesis resilience is used as a conceptual as well as as an operational framework to explore how the social-ecological systems of coastal landscapes can be approached and planned. In the following chapter I am listing and elaborating resilience building strategies mainly based on two sources: Berkes et al, 2003 & Biggs et al, 2015. In the social-ecological resilience literature these sources have been widely cited.

Based on both of these resources the co-called resilience building strategies deal with both - managing the properties of social-ecological systems as well as managing the properties of the governance and management systems (Berkes et al, 2003; Biggs et al, 2015) (see diagram 4). These strategies refer to acknowledging, maintaining as well as strengthening certain system’s characteristics (Berkes et al, 2003). This resilience of the system means that resilience of the supply of a certain desired set of ecosystem services is achieved (Biggs et al, 2015).

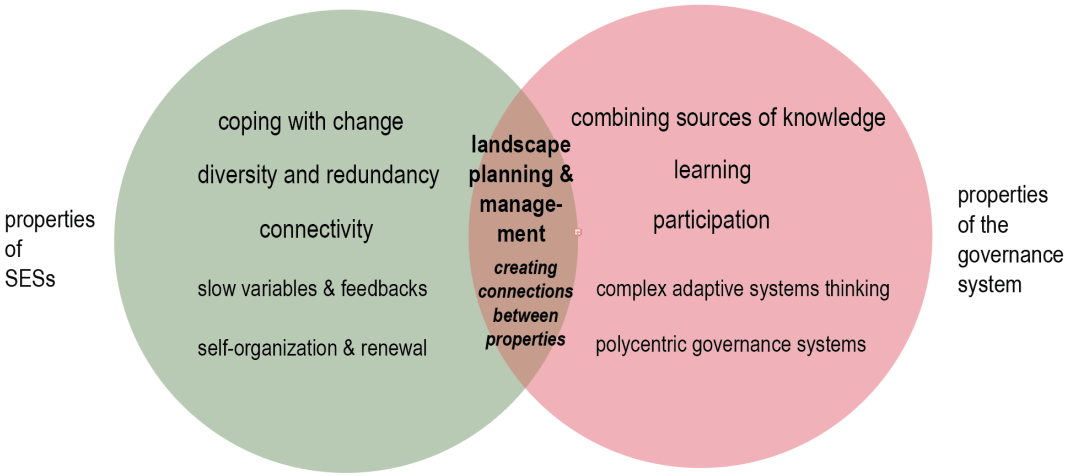


Diagram 4. Resilience building strategies.[2]
Author's interpretation based on Berkes et al, 2003; Biggs et al, 2015.

According to “Navigating Social-Ecological Systems: Building Resilience for Complexity and Change” building social-ecological resilience includes maintaining social and ecological diversity (Berkes et al, 2003).

[2] The ones with the bigger font are seen as more relevant for the thesis.

Diversity of a system means that it consists of a variety of different elements. Biggs et al (2015) extend this in their book "Principles for Building Resilience" by adding redundancy, which means that system's elements perform a certain function similarly. Diversity and redundancy together offer options for the system to deal with uncertainties and respond in the situation of a disturbance and change (Biggs et al, 2015).
Redundancy is most valuable when elements performing similar functional roles differ from their response to disturbance. Redundancy and response diversity are usually higher when the number of elements that are involved in producing ecosystem service is higher. For example landscapes that are spatially heterogeneous accommodating a variety of human and nonhuman actors are diverse and redundant. These landscapes consist of a mix of different species and landscape types as well as knowledge systems, cultural groups and governance institutions. These are ecologically, but also socially heterogeneous landscapes (Biggs et al, 2015).

Living with disturbance, which means the system is able to cope with change, is listed as a separate property of SESs that is important for resilience building (Berkes et al, 2003).
This dynamic aspect of a system is connected to the system's property of self-organisation - ability of system's renewal based on its memory (Berkes et al, 2003).
Further on the dynamics of social-ecological systems, Biggs et al (2015) write that two of the key properties of SESs when it comes to resilience building are: slow variables and internal feedbacks. These properties of social-ecological systems control the configuration of the system (Biggs et al, 2015). When it comes to managing those it is first essential to understand how feedbacks in ecological systems relate and interact with social systems and then approach these holistically. For example, improving the poor state of the marine ecosystem needs understanding of the socioeconomic drivers that have initially facilitated changes in ecological feedbacks, at the same time acknowledging how changes in ecosystems have altered human responses (policy, behaviour) (Nyström et al, 2006).
Fast variables are often connected to ecosystem goods and services, for example providing fish and clean water. These are shaped by slow variables, such as nutrient concentrations in sea sediments. Slow variables influence how a fast variable reacts to changes (Walker et al, 2012), for example changes in nutrient content created by pollution from urban runoff water.

This leads to another important property of SESs for resilience building - connectivity. System's connectivity characterises the way in which various parts of the social-ecological system interact with each other. By interacting (e.g. exchanging

information, transferring material etc) these parts with similar features (e.g. species, landscape patches, organisations etc) form links (e.g. vegetation corridors, food web etc). These links can be present or missing, these can be one-way interactions or mutual - forming the character of the structure of the social-ecological system (Biggs et al, 2015).

Governance is a property of SESs that describes systems' responses to uncertainties and changes. It contains formal as well as informal structures to manage resources as well as people (Refulio-Coronado et al, 2021).
When it comes to properties of the governance and management system for resilience building, Berkes et al (2003) bring out the necessity to combine sources of knowledge in order to inform institutions and management practices (Berkes et al, 2003). This could be seen similar to Biggs et al, (2015) concept of learning - "process of creating new knowledge, re-evaluating values, and articulating and evaluating alternative understandings of a system" (Biggs et al, 2015, p.175). Learning process is facilitated by monitoring the system and experimenting, but also by collaboration and co-production. Two types of learning contribute to the resilience of the social-ecological system - loop learning, what is being learned; and social learning, how the learning process takes place (Biggs et al, 2015). This is closely connected to the resilience building strategy of participation.

Participation means involvement. It is considered essential when building social-ecological resilience as it is about facilitating collective sharing and decision-making, learning and action. Including participation in the governance may have both ecological as well as social outcomes (Biggs et al, 2015).

Biggs et al (2015) add complex adaptive systems (CAS) thinking and polycentricity as resilience building strategies. CAS thinking is an approach that acknowledges the social-ecological system's uncertainties and chances of surprise, admitting that the system consists of interconnected components and is prone to possible non-linear change. Management practices that approach social-ecological systems through CAS focus on holistic approaches, looking at a wide range of spatial and temporal scales, integrating the governance of multiple ecosystem services. CAS based governance is often applying participatory tools (Biggs et al, 2015).

Polycentricity is a form of governance where multiple governing bodies can make rules within specific policy and geography. These autonomous bodies of governance interact across scales in the policy process. Polycentric governance systems can be more inclusive as the authority is given to multiple actors. Also it is more

scale-specific as governance level is matched to the scale of the issue (Biggs et al, 2015).

To conclude, all these principles make a holistic and integrated approach to resilience. They describe the properties of a social-ecological system as well as properties of the governance and management system. Working with both of them in parallel is essential when aiming for resilience of social-ecological systems.

2.2.3 Defining resilience deficit

Applying above listed strategies needs understanding of where and when and how to apply them as well as how these interact with each other. Therefore it is important to define what disturbances are there to consider and where the resilience deficit is (Biggs et al, 2015).
Whose resilience are we aiming for needs also acknowledging (Fabinyi et al, 2014). It is relevant to examine who and what are the actors of the particular social-ecological system and what kind of agency they create while interacting with each other. Furthermore, it is important to explore what combinations of types of actors and agencies are necessary for building resilience (Stone-Jovicich, 2015). Building social-ecological resilience through landscape planning has a spatial perspective. Therefore the question of scale becomes immediately relevant. Resilience can be a feature of ecosystems, human settlements, etc (Oliver-Smith, 2017). Temporal (historical, present, cross generations etc) scale is also essential when building resilience (Fabinyi et al, 2014).

Relying on this, the process of defining resilience deficit (see diagram 4) for the current work consists of including main human actors of the representative site to define the “hotspots” of landscape challenges (that are the areas where most of landscape uses, values and threats collide) in order to then rely on mappings of various SESs layers to decide on the key habitats and settlements that need resilience building.[3]

[3] See chapter 4.2.4 Co-created knowledge: defining resilience deficit.

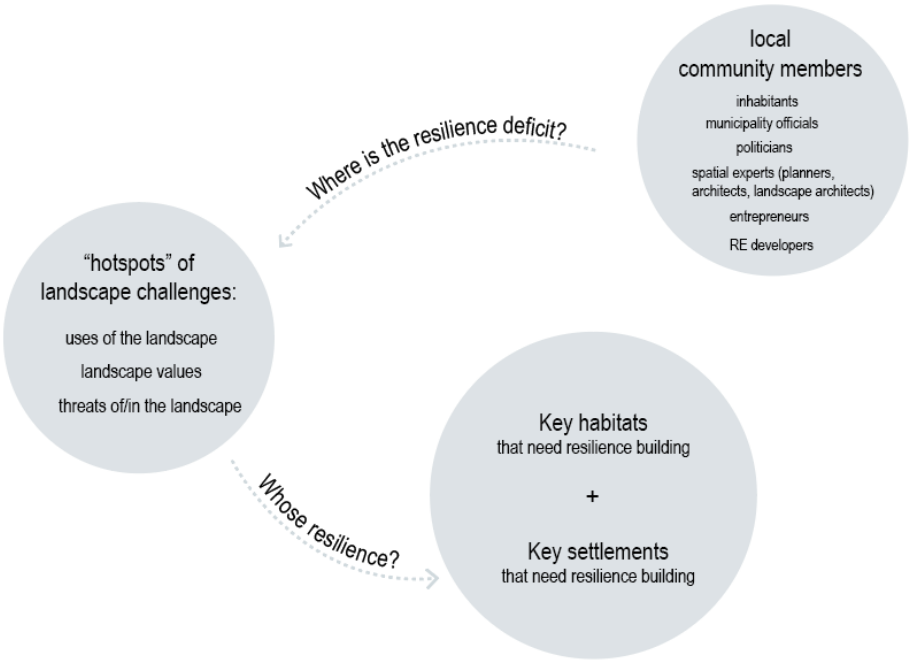


Diagram 5. The process of defining the resilience deficit in landscape planning

The key for contributing to the social-ecological resilience in coastal landscapes is "the inter-temporal arbitration between satisfaction with current and future human needs based on sustainable and adaptive management principles and appropriate timing of interventions" (Zaucha et al, 2016, p.36). This is possible when bringing together different types of interests, expertise, and knowledge in a holistic way, through public debate. The concept of ecosystem services has the potential to translate this temporal arbitration to understandable format and visualise the interdependencies and links for different actors and wider public (Zaucha et al, 2016).

2.2.4 The concept of Ecosystem Services (ESS)

Ecosystem services (ESS) is a concept and an instrument to assess and manage social-ecological resilience (Biggs et al, 2015).
The concept was developed in the late 1990s in order to better describe how and which benefits nature generates for humans (Constaza et al, 1997). ESS can be defined as the benefits people obtain from ecosystems. Originally these have been divided into regulating, provisioning, supporting and cultural services (Millennium Ecosystem Assessment Report, 2005).
Some ESS are the basis for other services and therefore these can also be divided into intermediate services that are the basic ecological processes; final services that are the outcomes of these services and benefits that offer the most comprehensible and

direct value to humans. Intermediate services support final services that deliver direct benefits to human welfare (Fisher et al, 2007; Zaucha et al, 2016).

Main ESS relevant for the Baltic Sea's coastal and marine ecosystem are the following (see diagram 5): underlying ecological processes like primary production, nutrient cycling, habitat maintenance and biodiversity maintenance as supporting services; storage of carbon dioxide, sediment retention and mitigation of eutrophication as regulating services. These influence the outcomes / final services that are: fish, aquaculture, wild species diversity, water quality, space and waterways, energy and raw materials as provisioning services as well as climate regulation, flood protection and coastal erosion prevention as regulating services. These influence directly the so-called resulting benefits like food and energy as provisioning services as well as cultural services like tourism and recreation, education and research, aesthetic benefits and inspiration, spiritual and cultural well-being (Zaucha et al, 2016; Ahtiainen & Öhman, 2014).

Diagram 6. ESS classification. Relevant ecosystem services to Baltic Sea context. Based on Zaucha et al, 2016; Ahtiainen & Öhman, 2014.

ESS concept has been criticised for being human centred. Seeing the environment as a provider of services and a "standing reserve" (Heidegger, 1977, cited in Coeckelbergh, 2017, p.106) is anthropocentric and the environment is constructed "as something that is external to the human" (Coeckelbergh, 2017, p.108). Yet this concept gives a frame to discuss human-nature relations. The benefits ecosystems offer to humans only happen in the interaction of nature and humans, intentional and unintentional. ESS are co-produced by ecological systems and social systems, they are products of social-ecological systems (Ernstson, 2013; Folke, 2014). Therefore, ESS offers an operational framework to assess SESs.
The concept enables to connect natural capital to developmental visions, offering long-term and adaptive approaches (Zaucha et al, 2016). It is a practical platform for actions that might be difficult to justify just through nature's value on its own.

For managing coastal systems, ESS can be used to moderate the decision-making processes, bringing together and engaging various interest groups, experts and knowledge as well as offering a common ground for discussions and experience sharing. Besides, the use of ecosystem services can help to provide information to the public in an understandable format as well as offer clear planning objectives. It is an instrument to visualise the connections between various benefits in a specific social-ecological system (Zaucha et al, 2016).

In this thesis the concept of ESS is a supporting concept to explore the quality of the interrelations of the ecological and social systems in order to define and visualise resilience deficit and aims.

3 Context

3.1 Landscape planning in Estonia

In order to understand the character of the social-ecological systems of the Estonian coastal landscapes as well as discuss how to manage coastal systems it is relevant to explore what is the legal framework of landscape planning.
Landscape planning in Estonia is managed by both, general spatial planning as well as nature conservation instruments (Poom & Sepp, 2019).

3.1.1 Nature conservation instruments

Natural landscapes are influenced by nature conservation instruments like international conventions (for example European Landscape Convention that Estonia has joined), Estonian environmental law and nature conservation management practices (Poom & Sepp, 2019).

The European Landscape Convention is a treaty that defines some of the founding principles when it comes to developing landscape policy. Some of these principles are the following: promoting sustainable development of the landscape based on interrelations of the economic activities, social needs and the environment; acknowledging that landscapes are an important resource to facilitate the economy; acknowledging that landscapes are part of local culture and identity and they are part of European natural and cultural heritage; acknowledging that landscapes are important providers of individual and collective well-being and the conservation, management and planning of landscapes is everyone's right as well as responsibility (Council of Europe, 2000).

Estonian nature conservation policy is aimed to sustain biodiversity, functioning ecosystems as well as preservation of the culturally and aesthetically important landscapes. Public access to natural landscapes is also one of the themes included in the conservation policy (Poom & Sepp, 2019).
Public access to natural landscapes is based on so-called everyman's right. This tradition originates from North-European countries and calls for allowing access to natural landscapes no matter who the land belongs to (Sepp & Lõhmus, 2019). In Estonia there is a 100m wide coastal restriction zone, which besides other restrictions means that building within this 100m wide zone is not allowed (except in densely populated urban waterfronts). Public access as well as possibilities for recreation in this 100m zone have to be guaranteed (Riigikogu, 1995). In some cases this has been a source of a conflict between private and public interests.

3.1.2 Spatial planning instruments

Spatial planning is generally based on EU regulations. However, spatial planning in the EU lacks common planning law. The system is hierarchical and in Estonia this hierarchy is mainly a one-way process (see diagram 8): strategic plans of a larger spatial unit dictate the lower-level spatial plans. Spatial planning at state level is guided by the national spatial plan Estonia 2030+, accompanied by focused thematic plans like the Estonian maritime spatial plan. These feed into county level planning that consists of county spatial plan, development strategy and thematic plans (e.g. Environmental conditions guiding settlement and land use). Local scale spatial planning is done by the local municipality via comprehensive spatial plans and development strategies. Detailed spatial plans for plot(s) are also proceeded by local municipalities (Poom & Sepp, 2019).

According to Poom & Sepp (2019) Estonia is still lacking spatial policy that would approach natural and built environments as one unified whole. Sectoral development strategies do not rely on spatial plans and vice versa, the connection to the national spatial plan is often declarative. The sectoral development strategies' strong spatial impact has increased, whereas the implementation of discretion in planning has decreased. This has resulted in poor representation of local needs and interests in strategic planning documents (Rahandusministeerium, 2019, cited in Poom & Sepp, 2019). The involvement of the wider public is present during different steps of the planning hierarchy (e.g. in the process of comprehensive plans, detailed plans), but yet it can be too late to really contribute as the planning phase is already in a very late stage. The announcements to invite stakeholders to participate in the planning process are often not very visible (e.g. tiny text in the newspaper page) and the plans themselves can be difficult to read and interpret by non-planners.

When discussing coastal landscape planning in Estonian context it is important to acknowledge that there is currently a missing link in the planning system. The marine environment is planned and visioned by the state (Estonian maritime spatial plan), local terrestrial landscapes by local municipalities and counties (comprehensive plans and development strategies).

Furthermore, the public use of coastal landscapes is changing - traditional activities (fishing, transportation) are accompanied by somewhat new sectors of the blue economy (e.g. tourism and energy production) - and therefore, landscape planning is also influenced by strategic development plans of several other fields, e.g. energy, industry, agriculture, forestry, transportation, tourism, nature conservation, residential development etc. All these different sectoral planning documents can

collide and connection to the state level strategic planning can be weak (Poom & Sepp, 2019). Also, the current system of detailed plans that allows small-scale planning plot by plot often creates fragmented outcomes where some of the bigger scale strategic landscape aims can be lost.

Kuusik et al (2018) write that coastal zone planning could be a two-way planning process. It could be a planning level that is a base for a municipality's comprehensive spatial plan as well as development strategy. Besides it could influence the state level planning (e.g. nature conservation plans, maritime plan etc) (see diagram 7).

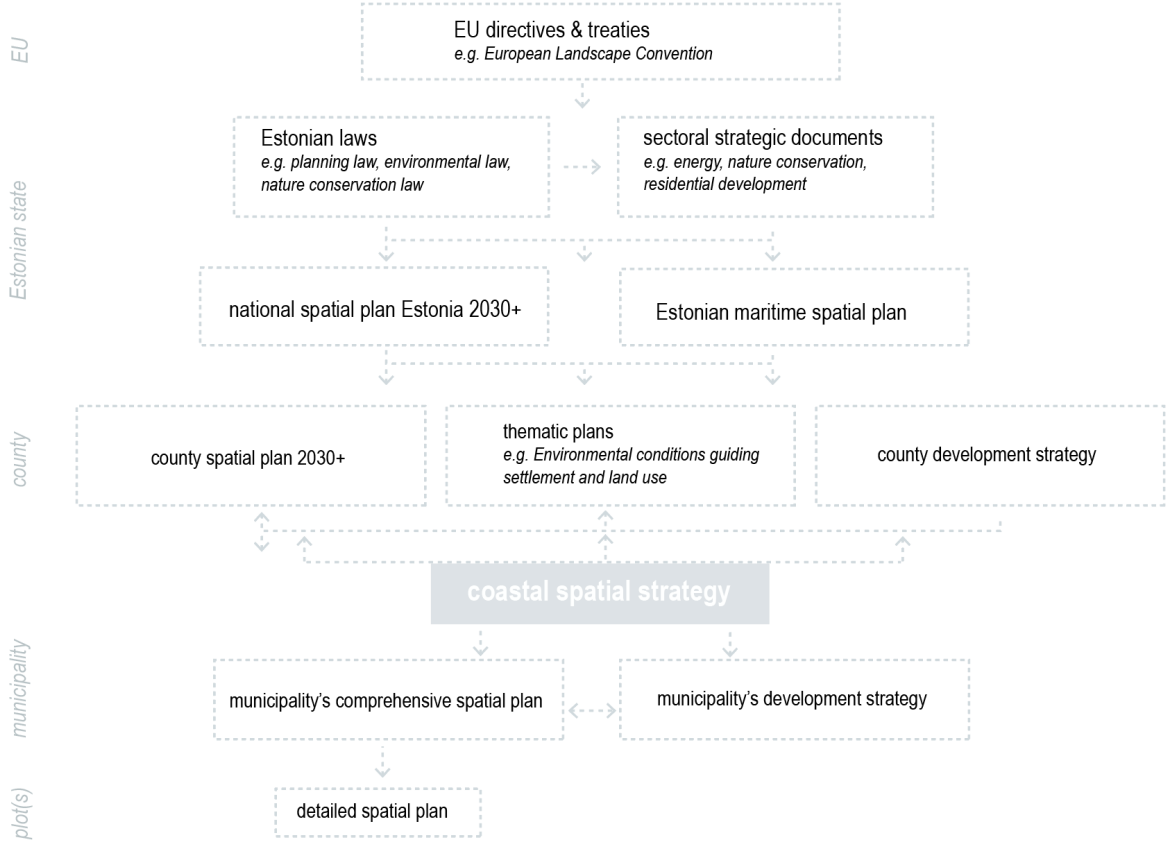


Diagram 7. Landscape planning in Estonia in the context of coastal landscapes. Strategic coastal landscape planning could be placed accordingly.
Author's interpretation based on: Poom & Sepp, 2019; Sepp & Lõhmus, 2019; Council of Europe, 2000; Rahandusministeerium, 2021, 2022; Kuusik et al, 2018.

This thesis does not aim for listing improvements on how to change the overall Estonian landscape planning policy and system into a more coherent one. The current work explores how to manage coastal systems in a resilient way, which

means, based on a social-ecological systems approach[4], working with the properties of a governance system (next to properties of social-ecological systems themselves). This thesis examines the working method(s) of applying SESs approach to landscape planning practice.

3.2 Coastal landscapes

3.2.1 Defining coastal zone

As discussed in the introduction coastal landscapes are a very good case to study when discussing and exploring landscape planning in the context of social-ecological systems approach. These landscapes represent well the spatial interrelations between humans and nature, offering examples of human impact on coastal ecosystems as well as the impact of natural resources and processes on human settlements. These are complex social-ecological systems that rely on natural processes as well as social. Strong historic traditions and identity are rooted to these landscapes, therefore changing development pathways is challenging. Coastal areas offer humans specific ecosystem services (food, recreation, waterways etc), while at the same time enhancing general human well-being (Zaucha et al, 2016).

Coast has specific characteristics, such as higher levels of uncertainties and disturbance as well as complex governance systems due to differences in administrative and management borders (Refulio-Coronado et al, 2021).
In coastal landscapes a variety of socioeconomic, political and ecological processes interact. Land and sea border often separates authorities with different agendas, making the management and planning complicated[5] (Zaucha et al, 2016).

How to define where a coastal landscape starts and ends?
Based on The Baltic Marine Environment Protection Commission (HELCOM) coastal landscapes are areas of land-sea interface, which include 3km of land and 300m of marine area (HELCOM, 1994).
On the other hand, the coastal sea can also be defined by the administrative borders. It is the inner sea between the country's territorial sea's border and coast. The territorial sea's border is an imaginary line connecting the furthest away tips of the mainland, and the furthest away islands, islets, cliffs and rocks (Riigikogu, 1993). Administrative borders can also help to define the coastal area on land, taking into consideration the settlements that have an actual coastal connection (see diagram 8).

[4] See chapter 2.2.
[5] See chapter 3.1 Landscape planning in Estonia.

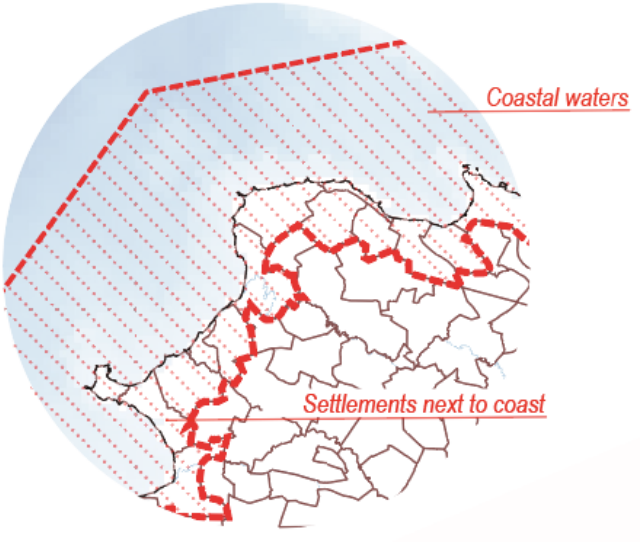


Diagram 8. Defining coastal zone.

However, the exact definition of where the coastal landscape starts and ends is rather abstract and subjective. It is connected to the uses of the sea as well as local identity, it is locally negotiated (Ratas et al, 2002). Therefore the administrative borders are there to help the approximate marking of the coastal landscape. Nevertheless instead of the exact marking of its borders it is important to acknowledge that the coastal landscape is a zone that consists of terrestrial and marine parts.[6]

3.2.2 Baltic Sea and its challenges

In order to discuss the resilience of the Estonian coastal landscape it is important to acknowledge some of the challenges arising from the physical characteristics of the Baltic Sea.

Baltic Sea is a relatively low inland sea and therefore its marine ecosystem faces many challenges (Baltic Marine Environment Protection Commission, 1998). The sea is not well connected to the ocean due to narrow and shallow Danish Straits, at the same time the catchment area of the sea is four times the area of the sea itself. This makes Baltic Sea's salinity very low and therefore it is not suitable for many marine species (Furman et al, 2014).

The Gulf of Finland has one of the lowest salinity levels of the whole sea and therefore the number of marine species here is especially low.

The few marine animals and plants that can inhabit Baltic Sea are therefore irreplaceable, making the whole ecosystem very vulnerable (Furman et al, 2014).

[6] Throughout this thesis the use of "coastal landscape" refers to both - terrestrial and marine parts of it.

The layering of the water is another phenomenon that causes challenges for the Baltic Sea's ecosystem. Saltier water in the bottom and freshwater on top stay in separate layers and do not mix well. The temperature differences add to the layering of the water as the colder groundwater and warmer water on top don't mix well either. The layering doesn't allow oxygen rich water to reach the bottom, causing "dead zones" in the bottom of the Baltic Sea. During the winter the sea freezes over. This wide temperature range also makes it challenging for marine life (*Learn and Study: Unique characteristics*, 2022).

The ecological state of Estonian coastal waters has been assessed "poor". The assessment is based on the quality of phytoplankton and benthic flora (Eesti Keskkonnaagentuur, 2020) that is affected by the high concentrations of Nitrogen and Phosphorus. The high concentrations of these nutrients is the cause for one of the biggest problems in Baltic Sea - eutrophication. Eutrophication decreases the levels of oxygen in the water and therefore causes loss of habitats and depletion of species (Kotta et al, 2020).

3.2.3 Interrelations of the social and ecological systems in Estonian context

Estonians have a long history of settling at the coast. Living by the sea traditionally meant that daily life was deeply connected to the sea. For example, the water fluctuations dictated the placement of harbours and boat sheds right on the coast, whereas residential buildings were built further away and on higher grounds. There was knowledge to live together with the sea (Ratas et al, 2002).
Economy that was mainly based on fishing and animal herding, allowed more diverse coastal landscapes. Nevertheless, some of the valuable coastal landscapes were deeply dependent on human activities - traditional agriculture like mowing and animal herding kept coastal habitats like meadows from overgrowing (Ratas et al, 2002).

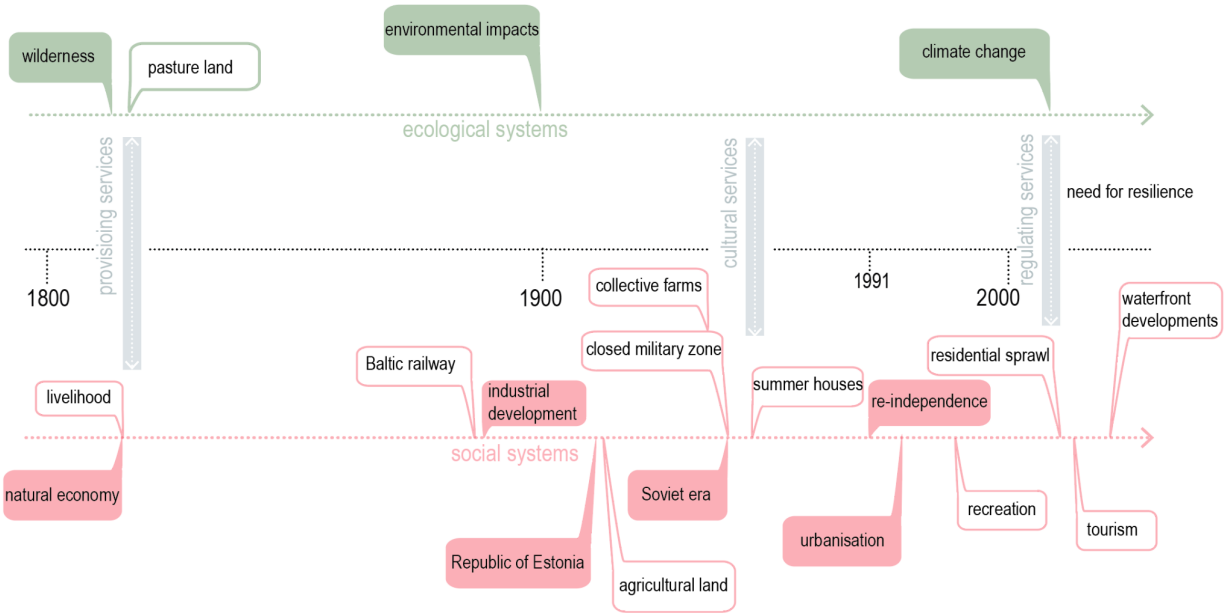


Diagram 9. Generalised timeline of connections between ecological and social systems

Socio-political and economic changes of the Soviet era led to the vanishing of some of the traditional land uses, which meant that some of the habitats also slowly disappeared. Open landscapes like fields and grasslands were replaced by woodland and scrubland by the beginning of the 21. century; former coastal grasslands were replaced by reed beds (Antso et al, 2013).
With this transformation many of the habitats disappeared, landscape patterns became more uniform and some species vanished (Ratas et al, 2002).
Besides these changes in agriculturally dominated coastal landscapes, general industrial development started to put more pressure on the environment.
Many of the Estonian coastal areas were closed off for military purposes, leaving the sea unaccessible physically and culturally. Yet, coastal tourism was increasing in some of the areas where land was dedicated for summer houses. In these areas humans have been consciously and unconsciously modifying the water regime, vegetation, soil content, and terrain. By doing so we have influenced many natural processes (e.g. movement of sediments or change in water regime) as well as contributed to the disappearance of many important habitats. Knowledge of living with the sea somewhat disappeared (Ratas et al, 2002). This has increased the role of nature conservation.

With the re-independence in the 1990s coastal areas have faced the sprawl of built up areas and increase in coastal population. These land use changes together with the changing climate (increased number of storms) pose threat to Estonian coastal

landscapes and its human as well as nonhuman inhabitants (Antso et al, 2013; Ratas et al, 2014) and stress the need for resilience building.

To conclude (see diagrams 9 and 10), the interrelations between the social system and ecological system can be generalised through the concept of ecosystem services, the benefits we gain from nature, as well as human uses of the land and its impacts on the ecosystem. Traditionally humans have been highly dependent on provisioning services, with the change in socio-political system, it shifted towards cultural services. During the era of Anthropocene[7] there is an increasing need for regulating services like climate regulation, mitigation of eutrophication, flood protection and coastal erosion prevention. Resilience building needs to take into consideration these interrelations and their (im)balance.

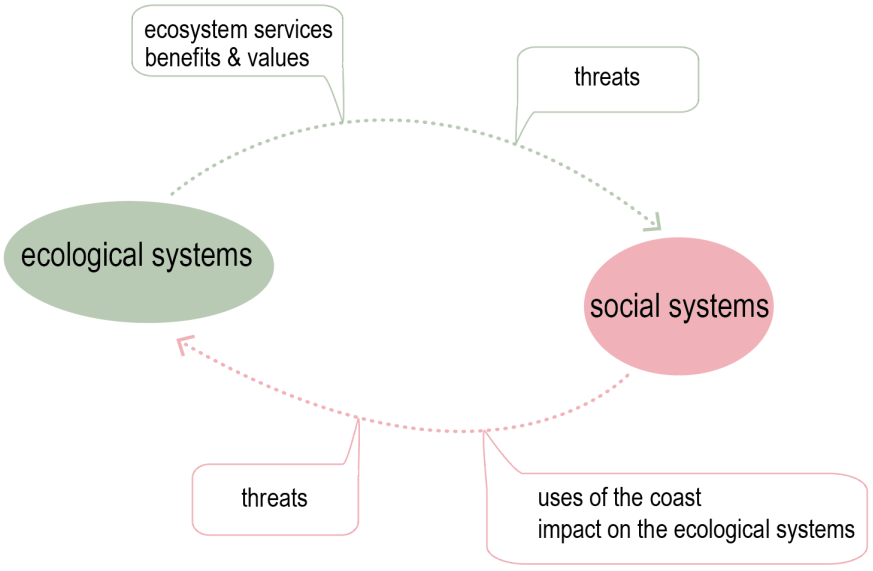


Diagram 10. Connections between ecological and social systems

[7] See chapter 2.1.

4 Approaching representative site through social-ecological systems concept: from Põhja-Tallinn to Paldiski

This chapter is divided into the interconnected sections: understanding the site based on mapping (desktop & field research), co-creating knowledge during the interview sessions and workshop with the local community members (participatory research) and developing landscape strategies for resilient coast in order to visualise social-ecological systems of the representative site (creative research). All this process contributed to knowledge creation.

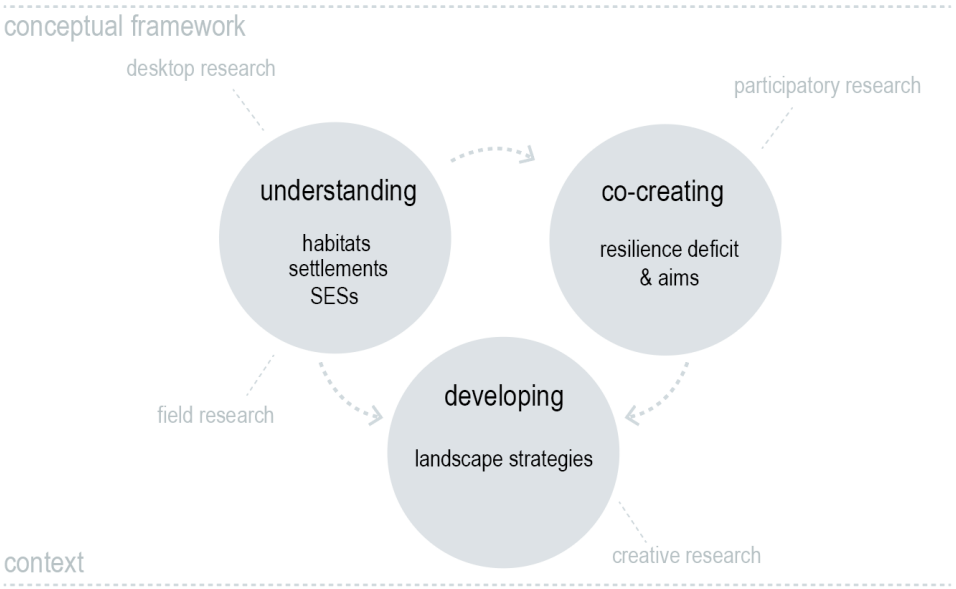


Diagram 11. General structure and workflow

4.1 Understanding // mapping and layering

To achieve the main aim for this thesis - to create understanding of how coastal systems could be managed in a resilient way with the contribution of landscape planning - I will test the application of the social-ecological systems approach in a representative coastal case study site. The following criteria has been implemented to find a project site[8]:

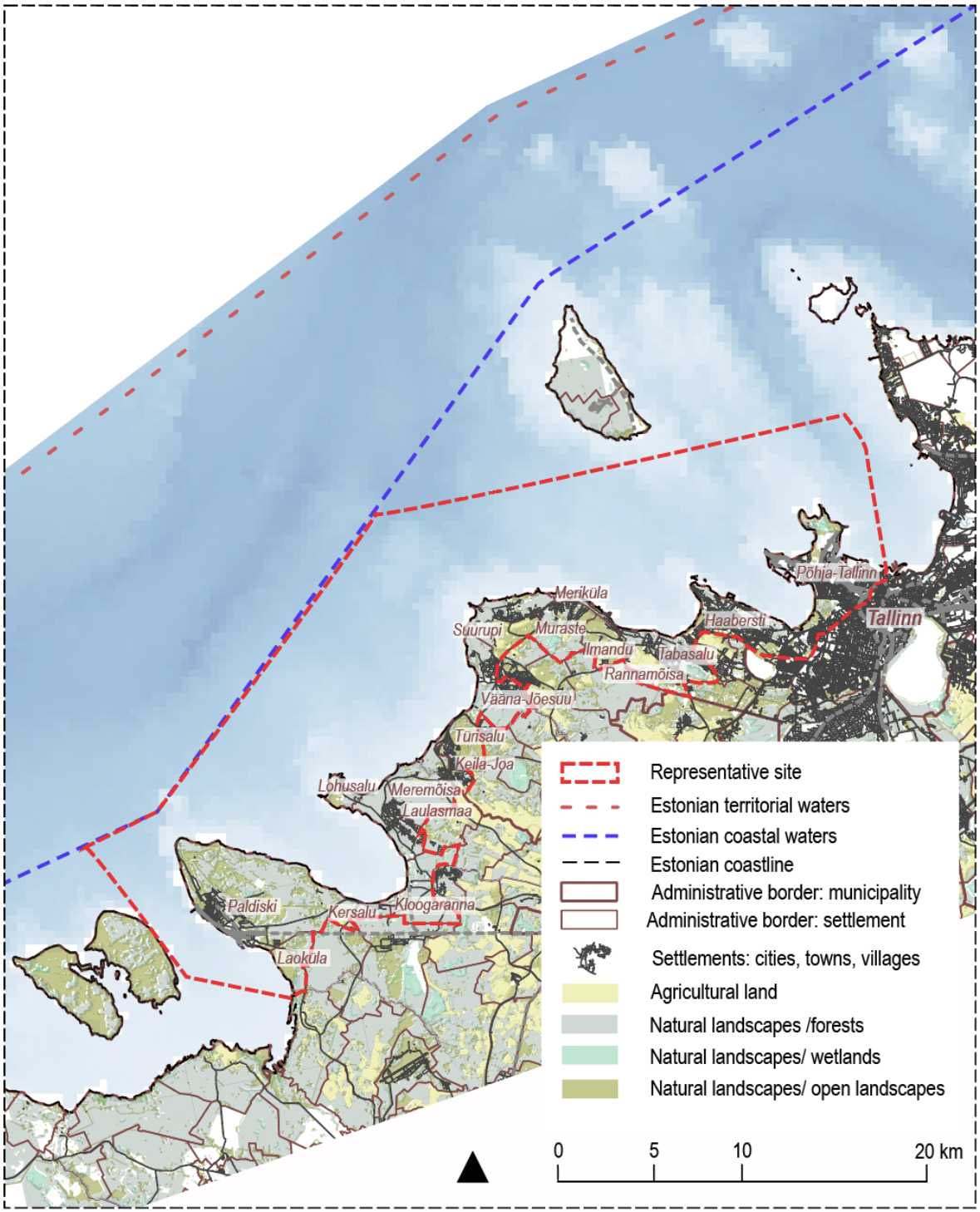
- has to include several municipalities;

[8] See conceptual and context overview in chapters 2 & 3 for reference.

- has to include variety of settlement types;
- has to include valuable natural landscapes;
- has to include the phenomenon of urban sprawl (as the expression of Anthropocene).

Based on those broad principles I have chosen a strip of coastal landscape by the north coast - from Põhja-Tallinn to Paldiski (see map 1). This “port to port” area is well-connected via railway.
The terrestrial area is part of Harju county, consisting of parts of Lääne-Harju, Harku and Tallinn municipalities. The selected area involves north-western part of the capital city, Tallinn; regional centres Tabasalu and Paldiski; local centres Laulasmaa ja Muraste; nearby centre Vääna-Jõesuu (Rahandusministeerium, 2018). Altogether it consists of 18 different settlements.
The whole study site outside of Tallinn is its so-called hinterland - an area that is functionally connected to the capital city (Rahandusministeerium, 2018).
The selected marine part of the site belongs to the Estonian coastal water type 3: western part of the Gulf of Finland[9] (Keskkonnaminister, 2009).

[9] The water types are parts of a water body that differ from the rest based on certain characteristics (biological and physical-chemical) (Keskkonnaminister, 2009).



Site map 1. From Põhja-Tallinn to Paldiski.
Based on: gis data from Maa-amet, 2022; EELIS, 2022; HELCOM, 2022.

The population trends from 2015-2021 show that the number of inhabitants has increased in Tallinn (+4.7%) and in Harku municipality (+20%), whereas it has stayed almost the same in Lääne-Harju municipality (-0.1%) (see diagram 12). Inside

Tallinn, the two districts that are relevant for this thesis have both gained inhabitants - Haabersti + 9.1% and Põhja-Tallinn +3.4%. In Lääne-Harju municipality, port town Paldiski has lost its inhabitants (-7.7%), at the same time other settlements have gained inhabitants (+3.1%) (Statistikaamet, 2022).
Based on Lääne-Harju municipality's comprehensive plan (2020) the number of residents in smaller coastal settlements has increased dramatically over the two first decades of 2000s. For example in Kersalu +69.4%, in Kloogaranna +72.7%, in Laulasmaa +141.7% (Lääne-Harju vald, 2020).

To conclude, the increased population in the area of the representative site has put pressure on the coastal ecological systems and impacted the quantity and quality of natural landscapes.

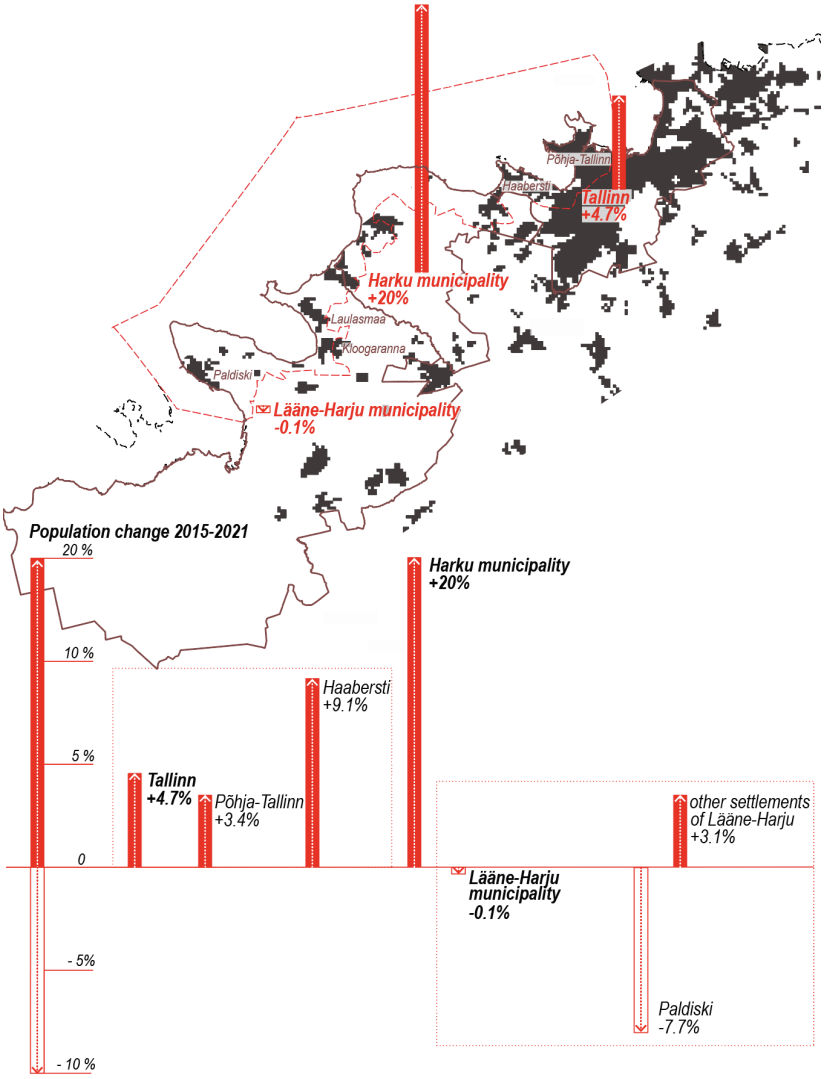


Diagram 12. Population change in the municipalities of the representative site during 2015-2021. Data based on: Statistikaamet, 2022.

Photos 1. From Põhja-Tallinn to Paldiski: glimpses of the representative site. Photos: K. Kuldkepp, taken during the period of May 2021-May 2022

4.1.1 Coastal habitats

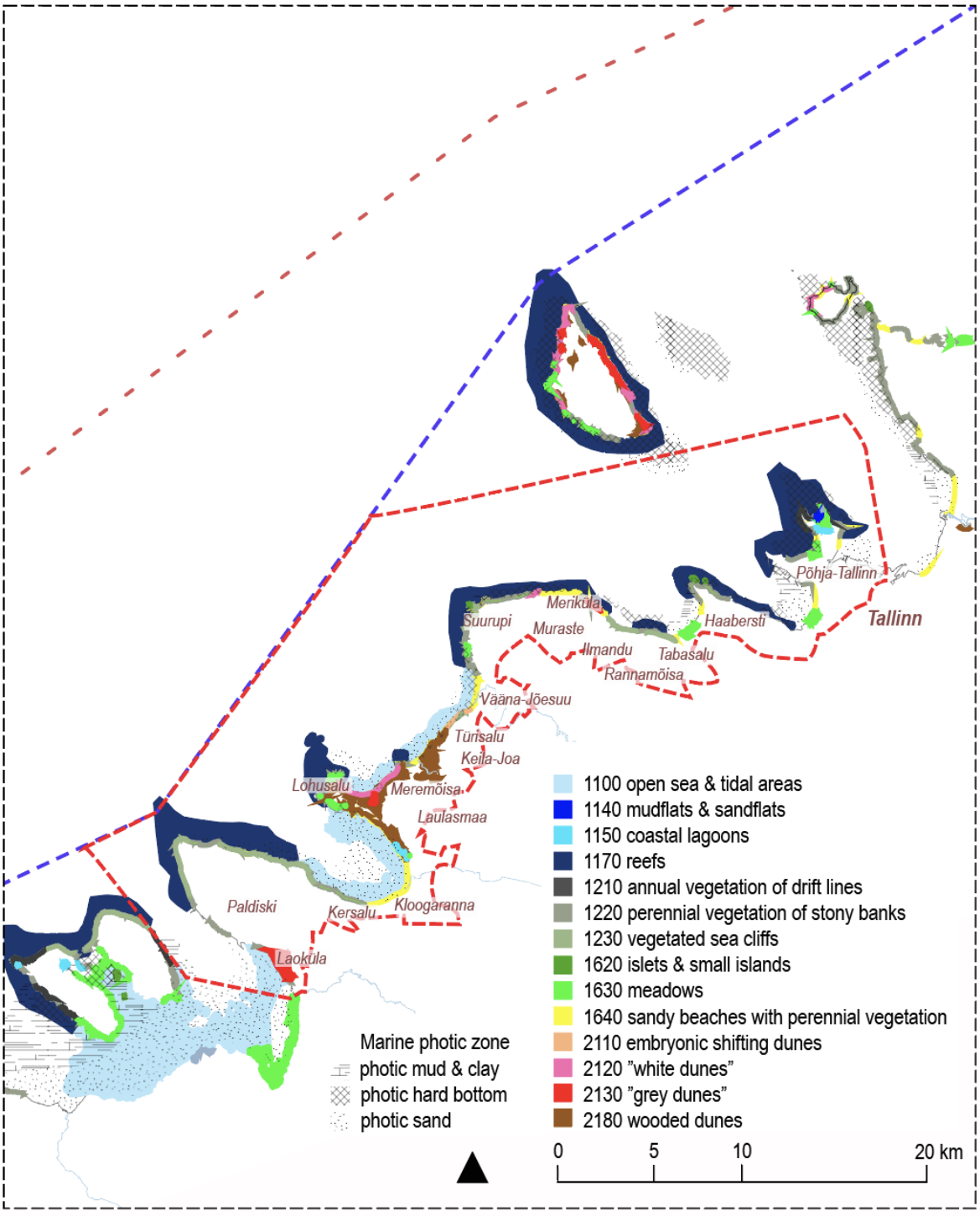
The study site represents well the diverse character of the Estonian coast. The coastline is articulated with six bay areas. Landscapes often vary from a short

distance creating a complementary mosaic of habitats (see map 2).[10] There are stony landscapes (e.g. vegetated sea cliffs, stony banks and drift lines) as well as sandy landscapes (e.g. sandy beaches, wooded dunes, "grey dunes"). The sea bottom changes from hard bottom, mud and clay to sand bottom.
Hard bottom (rock, gravel) offers habitats for macro-algae and sessile macro-epifauna, whereas soft bottom (sand, clay, mud) accommodates cormophytes, infauna and interstitial meso-organisms (Baltic Marine Environment Protection Commission, 1998).

Some of the most valuable and species diverse marine bottom habitats are reefs that can be found in several locations in the tips of the peninsulas. The species rich underwater sandbanks (open sea & tidal areas) are located in protected bay areas (Aps et al, 2015).
Some of the unique and essential[11] terrestrial coastal habitats are coastal lagoons (in Paljassaare in Põhja-Tallinn and in Laulasmaa), coastal meadows (Paljassaare and Stroomi in Põhja-Tallinn, Tiskre in Haabersti, in Lohusalu and in Vääna-Jõesuu) as well as "grey dunes" (e.g. in Laulasmaa, Lauküla, Meriküla) (see map 3) (Paal, 2000).

Paljassaare bay area and Paldiski bay area are both valuable habitats for various valuable bird species (Aps et al, 2015)[12].

[10] Coastal landscape habitats that are based on the EU's official directive "Council directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora" (Paal, 2000).
[11] These are habitats that are in the process of disappearing in their natural range; habitats whose natural range is limited; habitats that represent typical habitat characteristics in an outstanding manner (Paal, 2000).
[12] Furthermore in chapter 4.1.3 under nature conservation.



Site map 2. Coastal habitats
Map based on: GIS data from Maa-amet, 2022; EELIS, 2022; HELCOM, 2022; Rivis, 2022.

4.1.2 Coastal settlement development

When looking at the topographic map from 1937 (see map 4) it is visible that most of the project site is a natural landscape with some rather small settlements. The main infrastructure, railway connection between Tallinn and Paldiski as well as the road network, is already established. There are signs of hierarchy of the settlements.

Tallinn as the capital city is the biggest centre and although most of its western coastline is still a natural landscape it is visible that Põhja-Tallinn is developing and gaining its importance.
This was due to the establishment of the Baltic railway (completed in 1870) that favoured the placement of several big scale factories (train manufactory, cotton manufactory and electrical equipment) to the district. These were followed by three shipyards in order to build military ships for the Russian Empire. The formerly popular recreation and summer tourism area for Tallinn inhabitants was turning into an important industrial area for the whole Empire (Juske, 2015).
Nowadays Põhja-Tallinn is one of the areas in Tallinn affected by gentrification (Pastak, 2021). Previous industrial areas are one by one turning into culture factories or residential neighbourhoods.

The topographic map (see map 3) shows the importance of Paldiski that gained its position due to its port that was established already in 1715 under Russia's tsarist regime. The economic development of the area also benefited from the establishment of the Baltic railway (in 1870) that connected Paldiski port to Tallinn (Eesti Entsüklopeedia, 2011).
Today the strategic value of Paldiski and the whole Pakri peninsula is still acute: the town accommodates two important cargo ports, an LNG terminal and many progressive enterprises focused on green energy and technology research and projects (e.g. PAKRI Smart Industrial City, Pakri wind farm and Energiasalv).

Kloogaranna, Vääna-Jõesuu and Rannamõisa are also presented as somewhat bigger settlements on the map from 1937. These are among the oldest settlements in the study area that also all have an old history of summer tourism (Vääna-Jõesuu külaselts, 2012; Harku Valla Kodanike Ühenduste Liit, 2022). Summer tourism gained its importance already during the first independence and remained popular also during the Soviet Era (Puhkim, 2022). During the past decades there has been a tendency to turn summer houses into permanent all-year-long housing. Also, these small coastal settlements and their natural surroundings have been and are under development pressure to increase the number of new houses.

The same tendencies can be seen also in old fishermen villages Lohusalu, Laulasmaa and Kakumäe (neighbourhood in Haabersti district in Tallinn) (Nerman & Lõhmus, 2013).

Site map 3. Estonian topographic map 1937
Map from: Maa-amet, 2022.

To conclude, the settlements of the representative site can be roughly divided to the following typologies and hierarchy:

- capital city Tallinn;
- industrial port town Paldiski;
- small coastal settlements and the more natural landscapes in between.

The development of these settlement types in their particular locations has relied on the properties of natural landscape. For example, small coastal settlements that are often known for summer tourism are all located next to sandy beaches, whereas ports and their settlements (Tallinn, Paldiski) have been placed in protected bay areas (see diagram 13).

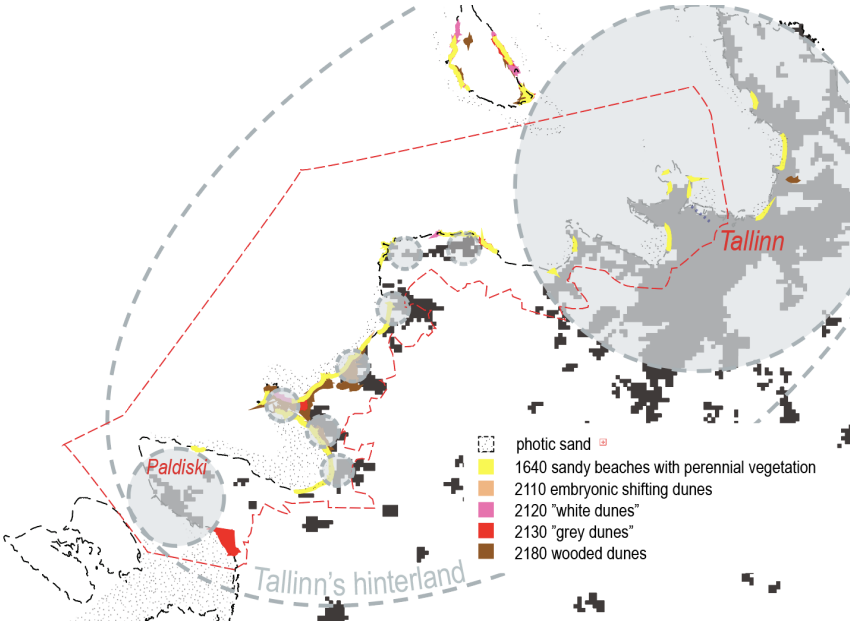


Diagram 13. From Põhja-Tallinn to Paldiski: the hierarchy of the settlements.

4.1.3 Social-ecological systems of the site

In order to explore further coastal social-ecological systems of the representative site, I have looked into main socio-economic sectors that rely on the coastal landscape and its assets. The gathered information is based on various strategic planning documents (e.g. Estonian maritime spatial plan, Harju county spatial plan 2030+, comprehensive plans for Lääne-Harju, Harku, Haabersti and Põhja-Tallinn municipalities) and GIS databases (e.g. EELIS) as well as my own fieldwork. The desktop research showed that for the representative site the relevant social-ecological systems are based on: maritime logistics, fishing, energy, nature conservation, cultural heritage, recreation and tourism. SESs have been gathered to maps 4-8, showing a variety of parallel human interactions with the coastal landscape.

Maritime logistics

Ports and marinas have been developed in landscapes that have the physical characteristics in favour of boating and docking (certain water depths, direction to winds etc). In most cases ports and marinas are located in eastern parts of peninsulas or protected bay areas (see map 4).

Tallinn (districts of Põhja-Tallinn and Haabersti) with its nine ports and three marinas (Noblessner, Lennusadam, Kakumäe) accommodates the most of maritime logistics as well as leisure boating. It is an international passenger and cargo gate to the whole country.

Paldiski (together with surrounding Pakri peninsula) is another important area for maritime logistics. Two cargo and passenger ports have recently been accompanied by an additional LNG terminal.

For leisure boating and recreational fishing, the site offers two marinas outside of Tallinn, one in Lohusalu and one in Meriküla. Two new marinas are planned for Paldiski and Kersalu. There are several additional docking areas along the coast.

The busiest maritime traffic is around Tallinn and Paldiski, close to big ports.

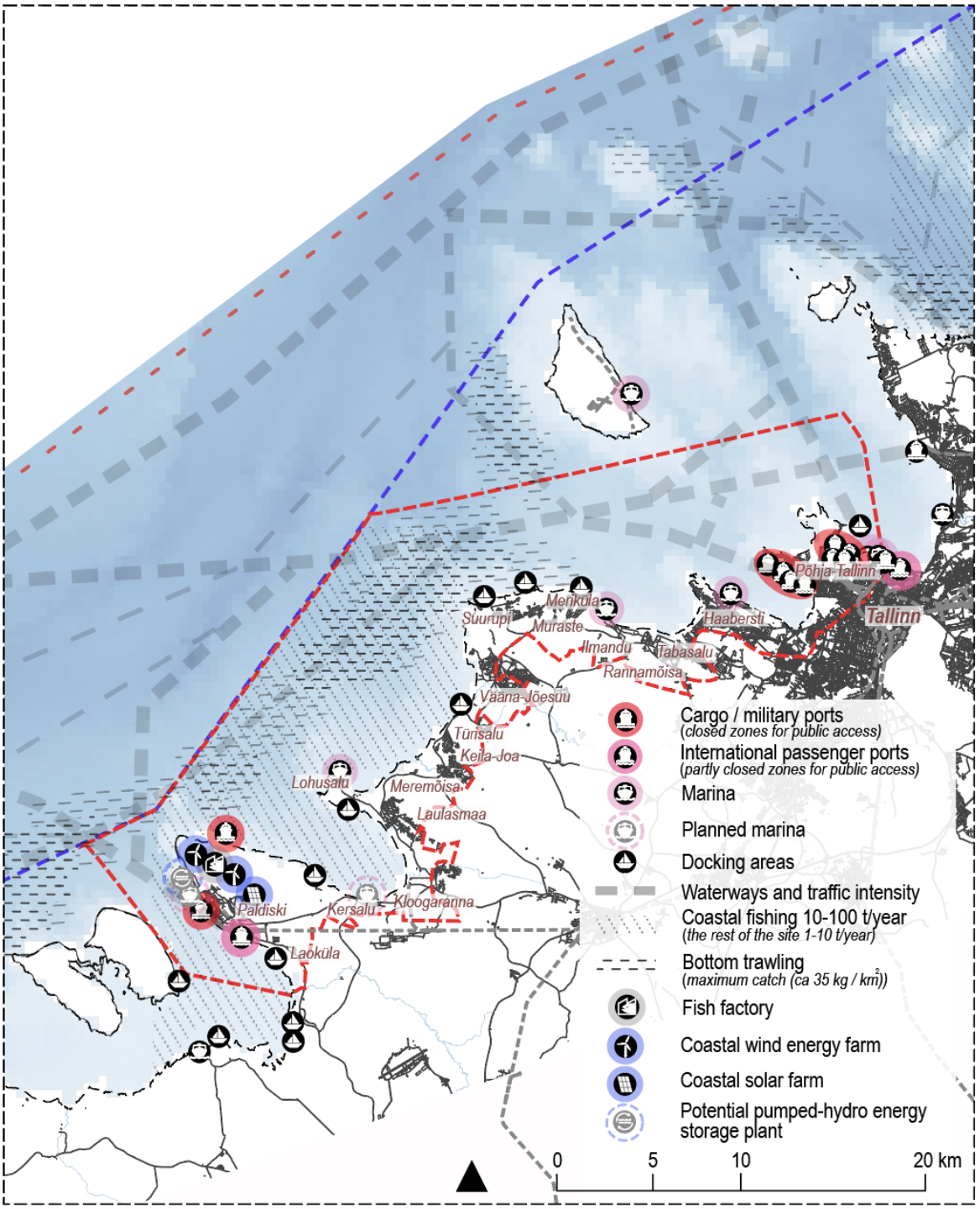
Fishing

Coastal fishing is done along the whole project site. Half of the site, approximately from Tallinn to Vääna-Jõesuu (see map 4), has an average catch of 1-10 tons of fish per year, whereas the other half from Vääna-Jõesuu to Paldiski around 10-100 tons per year. Bottom trawling adds a maximum of 35 kg of fish per km2. Currently there are no fish nor aquaculture farms in the area (Rahandusministeerium, 2022).

Energy

Paldiski and its surrounding Pakri peninsula is a developing renewable energy production area. It accommodates the only wind energy park found in the site. The peninsula also has a solar energy park (see map 4).

There are plans to place a pumped hydro-energy storage plant on the coast to an artificial island (Energiasalv, 2022).

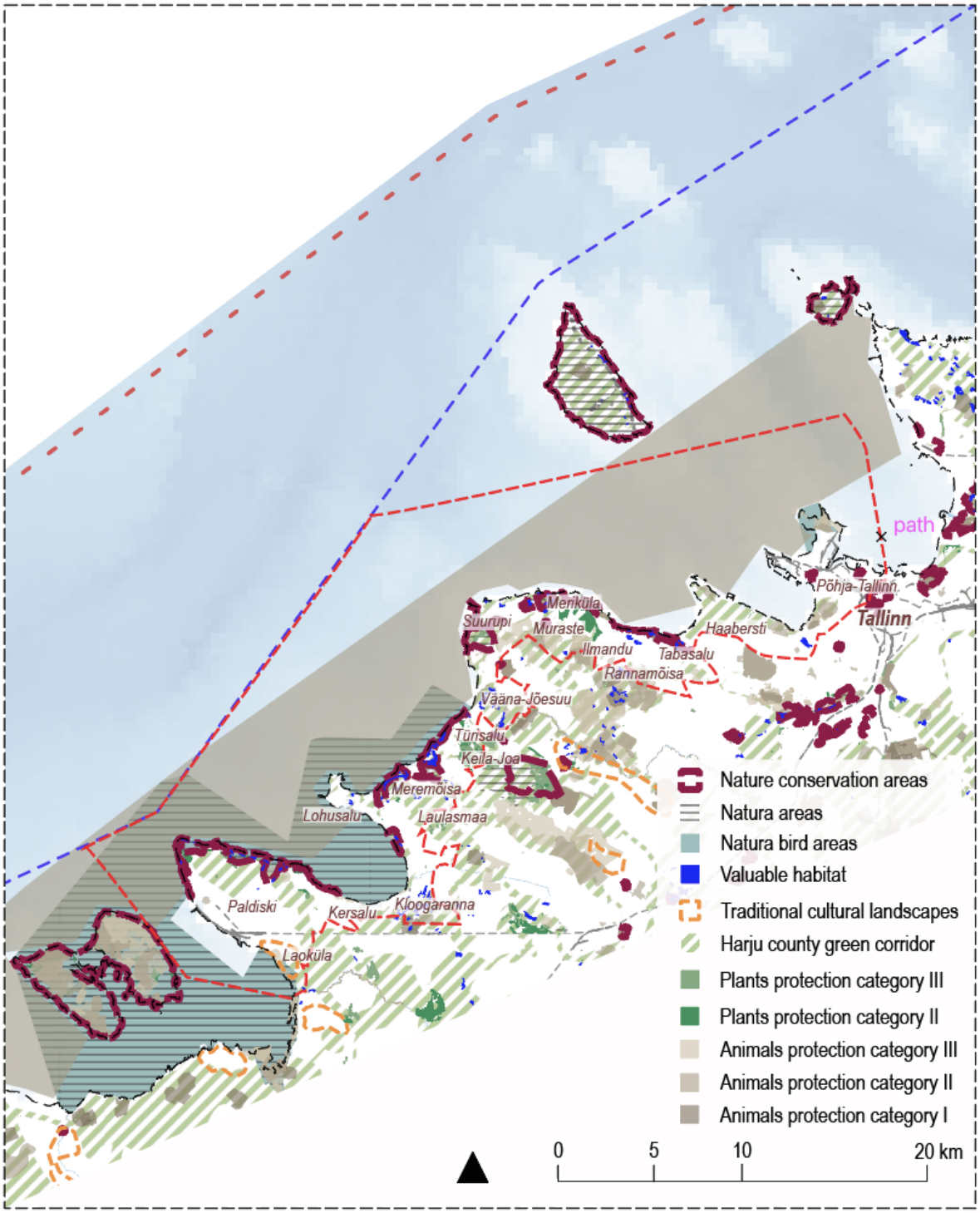


Site map 4. Maritime logistics, fishing and energy
Map based on: Maa-amet, 2022; HELCOM, 2022; Rahandusministeerium, 2022; Lääne-Harju vald, 2022; Harku vald, 2013. Tallinna Linnaplaneerimise Amet, 2022.

Nature conservation

The biggest nature conservation area is the Natura habitat protection area in the western part of the representative site, Pakri islands and peninsula. The other habitat protection area is in the northern tip of Põhja-Tallinn, in Paljassaare (see map 5).
The site consists of several mainly linear strips of nature conservation areas along the coast: Pakri, Laulasmaa, Türisalu, Vääna and Rannamõisa. There are nature reserves in Suurupi and Muraste.
Next to these defined nature conservation areas there are several other areas that are habitats for valuable plants and animals.

According to Harju county spatial plan 2030+, these various nature conservation areas have been strategically connected via a county wide network of green (Rahandusministeerium, 2018), nevertheless it is visible that this green corridor has disruptions, for example in Laulasmaa and in Tallinn. There's no coherent ecological zone in the coastal strip (see map 5).



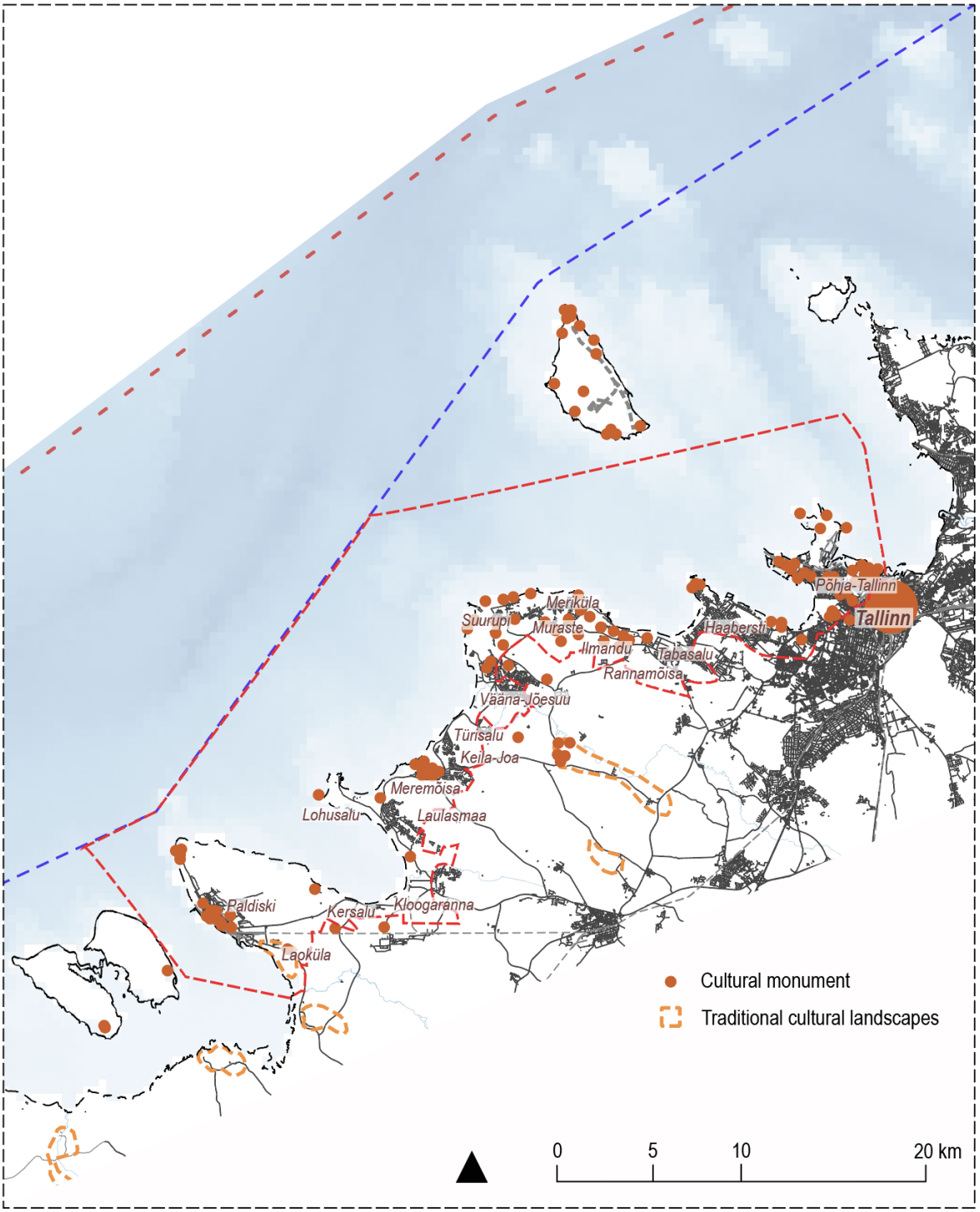
Site map 5. Nature conservation
Map based on: Maa-amet, 2022; EELIS, 2022; HELCOM, 2022; Rahandusministeerium, 2018, 2022.

Cultural heritage

The long history of human settlements on the site is visible in the number of cultural monuments that are spread around the area (see map 6). These cultural heritage objects or sites include archeological sites, historical sites or monuments and building monuments (Maa-amet, 2022).

Archeological sites include, for example, locations of old settlements (e.g. in Laoküla, Rannamõisa), ancient fields (e.g. found in Ilmandu and Muraste), ancient stones (e.g. found in Ilmandu). Historical sites or monuments include, for example, old burial grounds and cemeteries (e.g. found in Põhja-Tallinn, Paldiski). Building monuments include, for example, manor houses and other manor buildings as well as manor parks (e.g. found in Keila-Joa, Kõltsu manor in Laulasmaa, Muraste, Liberty summer manor in Haabersti), churches and their gardens (e.g. found in Paldiski, Rannamõisa); bridges; lighthouses (e.g. in Paldiski, Suurupi); facilities of Peter the Great's Naval Fortress (many of those found in Paldiski, Suurupi, Kakumäe (Haabersti) and Paljassaare (Põhja-Tallinn)); various residential and other buildings (e.g. in Põhja-Tallinn) (Maa-amet, 2022).

Besides, there is a traditional cultural landscape in Laoküla that has a historical settlement structure that is still preserved. According to Harju county spatial plan 2030+ the aim of the protection of these landscapes is to protect the local character (Rahandusministeerium, 2018).



Site map 6. Sites of cultural heritage
Map based on: Maa-amet, 2022; HELCOM, 2022.

Recreation and tourism

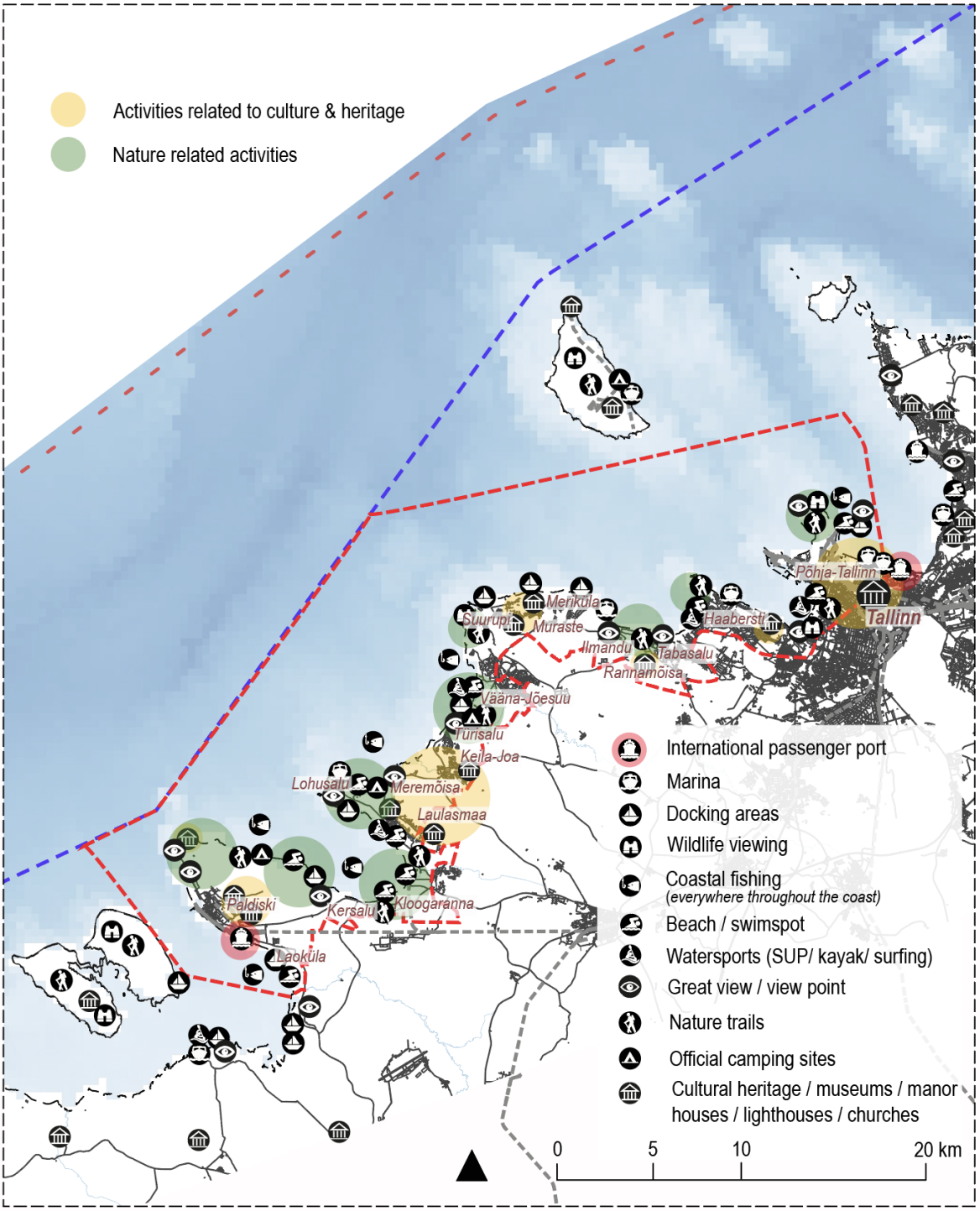
Recreational activities can be roughly divided into culture related activities (visits of museums, galleries, historic buildings like manor houses, lighthouses etc) and nature related activities (trekking, swimming, watersports, camping etc) (see site map 7). Tallinn with its Old Town and many museums and galleries is the centre for culture related recreation, however manor houses, lighthouses, fortress buildings and other interesting cultural heritage sights can be seen in several destinations along the representative site (see previous section). Museums are located in Laulasmaa (Arvo Pärt Centre) and Paldiski (Amandus Adamson Studio Museum). Manor houses are in Muraste, Suurupi (Vana-Pääla manor), Keila-Joa and Laulasmaa (Kõltsu manor house). Churches are located in Rannamõisa and in Paldiski. Lighthouses are in Suurupi (upper and lower lighthouse) and nearby Paldiski in the tip of Pakri peninsula.

Natural landscape is very diverse, often changing after a short distance. This has attracted various recreational activities in most parts of the studied coast. Sandy beaches (habitat 1640) are in use as public beaches for swimming, sunbathing and watersports. Various hiking trails offer options to experience different landscape types - e.g. sea cliffs (1230), vegetated stony banks (1220) and wooded dunes (2180). The site accommodates RMK[13] trails (Keila-Joa, Tabasalu) and camping sites (Leetse, Meremõisa) as well as local nature trails, including Paldiski-Kloogaranna trail, Kloogaranna-Laulasmaa trail, Laulasmaa-Lohusalu trail, Suurupi-Vääna-Jõesuu trail, Stroomi beach promenade, Paljassaare boardwalk and some other unofficial trails and routes along the coast. Official camping sites can be found in Leetse, Meremõisa and Vääna-Jõesuu.
Most of the coastline offers beautiful views. Official viewpoints (with built structures and signage) can be found in Paljassaare and Stroomi (Põhja-Tallinn); on the limestone cliff in Tabasalu and Türisalu and the tip of Pakri peninsula.
Wildlife viewing can be experienced in any natural landscape at the coast, however for bird watching Paljassaare, Pakri peninsula and Suurupi are known.

The representative site has a variety of beaches, some are more maintained and official, the others have remained natural and pristine. The official beaches (Kloogaranna, Lohusalu, Vääna-Jõesuu as well as Kakumäe, Stroomi and Pikakari in Tallinn) offer various extra services and facilities during the summer season. These include changing cabins, toilets, kiosks, but also watersport (surfing, kayaking, SUP) equipment renting and courses.
Recreational fishing is done in almost all areas of the coastal waters.

[13] RMK - Riigimetsa Majandamise Keskus (State forest Management Centre)

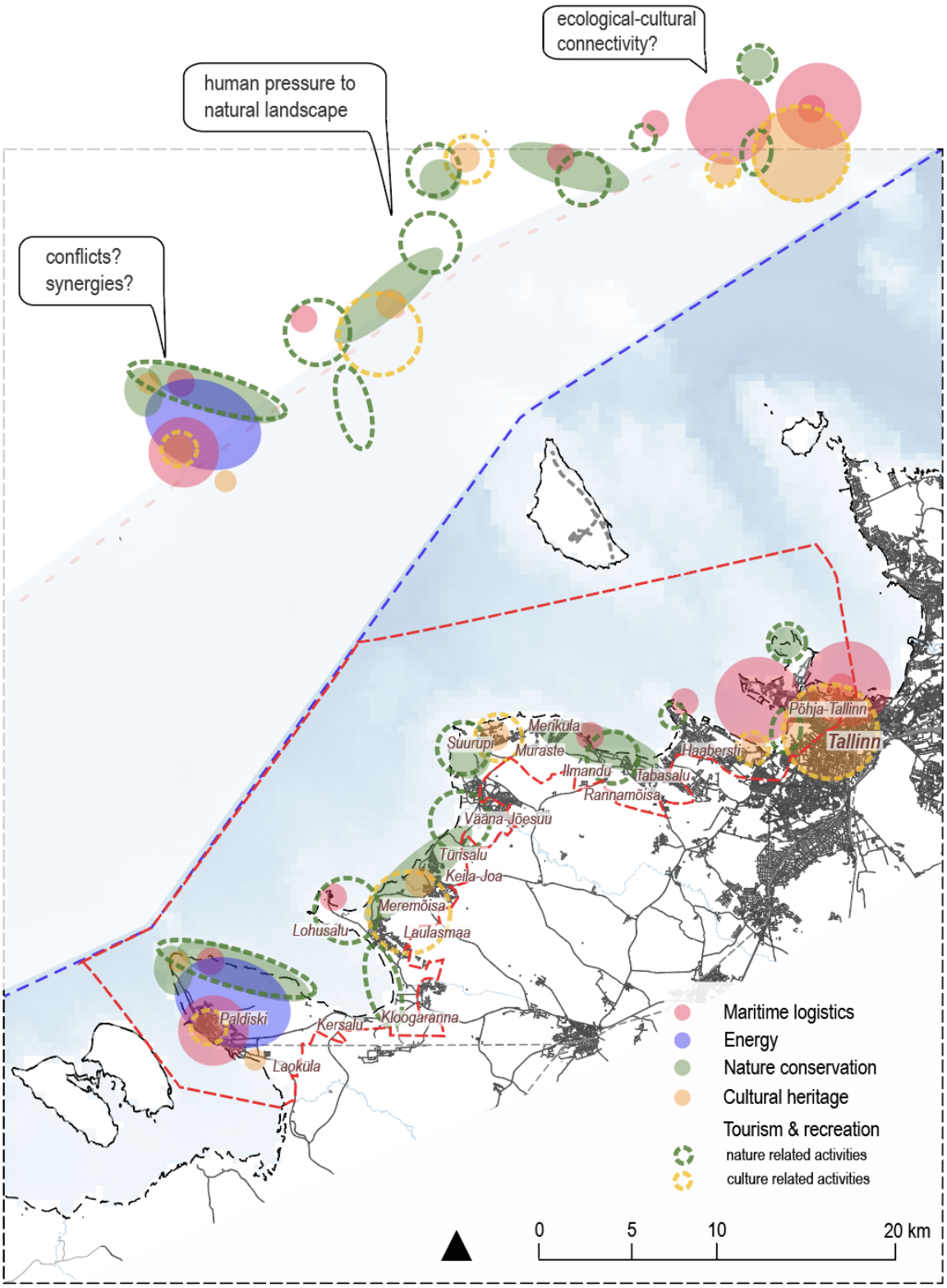
For leisure boating and sailing there are currently five marinas (three in Tallinn, one in Meriküla and one in Lohusalu) as well as several docking piers along the coast. New marinas are planned in Paldiski and in Kersalu. The ports of Tallinn and Paldiski service international passenger ferries.



Site map 7. Recreation and tourism
Data based on: Maa-amet, 2022; HELCOM, 2022; Rahandusministeerium, 2018; Tallinna Linnaplaneerimise Amet, 2022; Tallinna Linnaplaneerimise Amet, 2017; Harku vald, 2013; Lääne-Harju vald, 2022; author's own fieldwork.

To conclude, the coastal landscape from Põhja-Tallinn to Paldiski accommodates a variety of socioeconomic, cultural and natural landscapes (see map 8). Bigger scale maritime logistics (like cargo and international passenger ferries) are clustered in Tallinn and Paldiski. However, when the rest of the area has marinas and docking areas, then Paldiski and Tallinn are lacking those. Renewable energy is produced only in Paldiski.
Tallinn is the main hub for cultural heritage, however there are various cultural heritage sites along the whole site, Keila-Joa manor as well as lighthouses in Suurupi among them.
The variety of the natural landscape makes almost the whole coastline attractive for nature related recreation and tourism: trekking, camping, swimming etc.

Map 8 visualises some of the challenges when it comes to the resilience of coastal landscapes. For example, Paldiski and its surroundings accommodate very valuable natural landscapes that are important habitats. When it comes to cultural heritage, Paldiski has several building monuments as well as a traditional cultural landscape in Laoküla. That makes the area valuable for nature as well as culture related tourism and recreation. Its ports make it an important hub for maritime logistics and attractive for industrial development. Areas of the coastal landscape near Paldiski are used as wind energy and solar energy parks. However these various land uses can be conflicting and make the planning of the coastal landscape challenging.
Based on this diagram another challenging example is the capital city Tallinn. A lot of its coastal landscape in Põhja-Tallinn is taken up by port areas that are closed for public access. The missing connectivity is not only an issue for sociocultural reasons, but also for ecological continuation. Finding balance between various land uses makes the landscape planning in Tallinn challenging.
The area between Tallinn and Paldiski accommodates a variety of naturally and culturally valuable landscapes. This is a much used recreation destination. However, the pressure of seasonal visitors has an effect on the local landscape and its permanent residents.



Site map 8. Social-ecological systems of the coastal landscape.
Author's own interpretation. Base map based on: Maa-amet, 2022; HELCOM, 2022.

This desktop (accompanied by field) research has given an initial understanding of what is characteristic to the coastal social-ecological systems of the representative site. This will be followed by participatory research in order to explore the coastal social-ecological systems on a local and personal level and co-define the resilience deficit as well as resilience aims.

4.2 Co-creating // knowledge sharing

Based on the theoretical overview in chapter 2 it has become clear that in order to aim for the resilience building of the social-ecological systems', it is important not only to work with the properties of SESs, but also with the properties of the governance of these systems. Some of these key properties include combining sources of information; learning based on collaboration and co-production; participation that means collective sharing and decision-making (Berkes et al, 2003; Biggs et al, 2015). In order to explore these governance properties or so-called strategies to SESs resilience building as well as gain more information on the particular characteristics of the coastal SESs of the representative site I have conducted semi-structured interviews and organised a workshop with local community members.

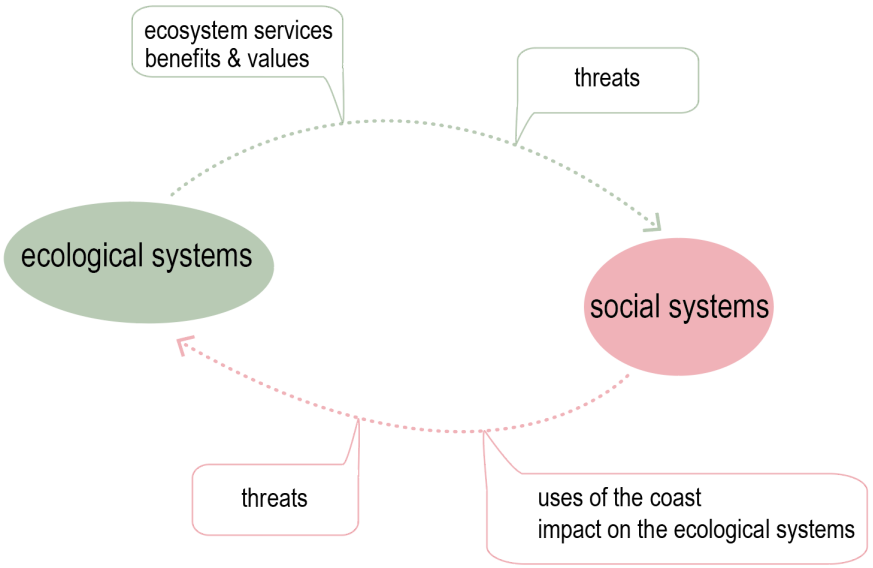


Diagram 14. Connections between ecological and social systems

Aim and structure of co-creating

The aim for the interviews and the workshop is in general the same - to gain site-specific insights to what are the main connections between the ecological systems and social systems of the coast (see diagram 14) at a local and personal level and to use this information in order to co-create a map of landscape challenges that is the core for resilience building strategies. However, if an interview is a one to one information sharing that allows specific questions and in-depth discussion based on respondent's location and background, then the workshop allows to bring different stakeholders together and facilitate collective learning. The participants are sharing their knowledge among the whole group. I have chosen to use both of these collaborative methods, because they complement each other.

The main questions remained the same for all the interviewees as well as the workshop. These were divided in two blocks. First one included personal approach to coastal landscape uses and values:
Where do you use the coastal landscape and why?
What are the most important values of coastal landscapes?
What are the most important threats and challenges of coastal landscapes?
All the participants were asked to place the answers on a map. During the workshop participants gathered in groups of 1-3 and worked on a map together, whereas during the interviews respondents pointed out specific locations, which were then marked on the map by myself.
The second block was a step further to define the resilience deficits and aims. The participants were asked to choose three (or more) most important ecosystem services for them in their particular coastal landscape and give an example why this is important. The list of relevant ecosystem services was provided to them as well as explanations of what they mean. However, the aim was not to discuss the concept of ecosystem service itself, but to use this list as a tool to give a personal value to the landscape and define the key themes for resilience building.

4.2.1 Workshop

For the workshop I intended to find one settlement that would accommodate a diverse mix of social-ecological systems - including various landscape types as well as diverse human activities connected to the coastal landscape. I also aimed to find a somewhat comprehendable community, so I excluded the capital city Tallinn. Based on the mapping of the SESs[14], I then chose the industrial port town Paldiski with its surroundings (Pakri peninsula) to be the site for the workshop (diagram 15).

[14] See chapter 4.1.

The criteria for the participants was that they would either live or do business in Paldiski (and/or in its surrounding Pakri peninsula). I sent out personal invitations to local municipality officials, business owners as well as representatives of the local inhabitants (active members of the community, various age groups). The invitation was also shared in the local community's public Facebook page.

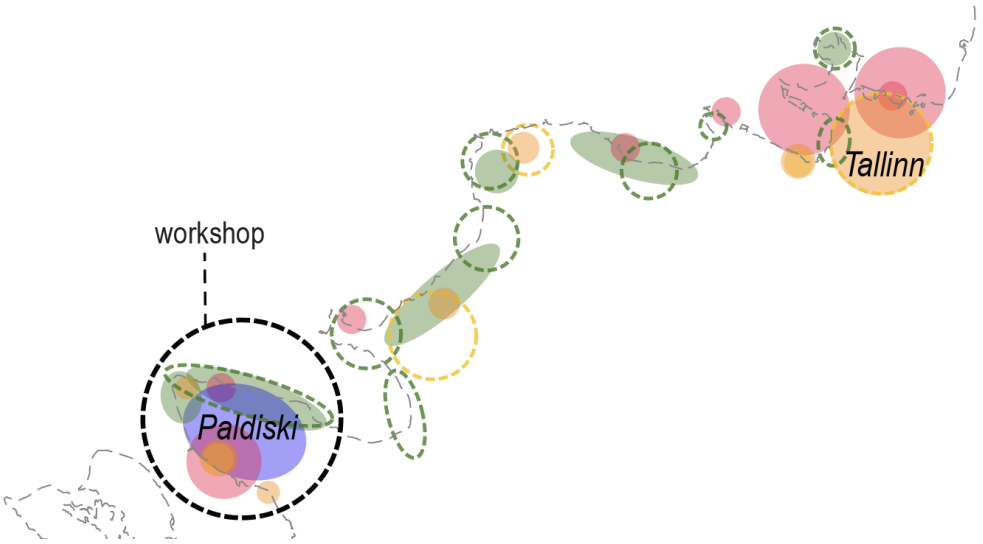


Diagram 15. Site selection for the workshop

The workshop took place on 15th of February 2022 in Paldiski town hall. The event lasted two hours. 10 people participated: 4 municipality officials, the representative from the port and 5 active community members. The participants gathered into three groups, two participants preferred working alone.

I introduced the participants to some of the initial concepts of the current thesis - coastal landscapes and resilience - in order to familiarise them with the relevance of the topic. Participants were then asked to individually answer the questions regarding coastal landscape uses, values, threats and mark the answers on a printed map of Paldiski and its surroundings. They were then asked to choose three (or more) most important ecosystem services for them from the list provided to them and give an example of why it is important. The answers were asked to be placed on the map (if can be localised). For the groups the map was shared, so that the personal answers formed a mutual diagram as well as the mapping activity itself was accompanied by inner group discussions.

Photos 2. Paldiski workshop. Photos: K. Kuldkepp

The workshop ended with the general discussion, mainly on the public access to the coastal landscape in Paldiski town. The site-specific conflict between harbour activities and the economic benefits on one hand, and the protection of valuable natural landscapes with their recreation value to the wider public on the other, provoked debates. I took the role of the observant without moderating the discussion too much. I can conclude that all in all almost everyone saw the importance of access to natural coastal landscapes and the contribution of nature in increasing the attractiveness of the local environment (for new residents and for tourists).
The knowledge co-created during the workshop is presented together with knowledge from the interviews in chapters 4.2.3, 4.2.4 and 4.2.5.

4.2.2 Interviews

The interviewees[15] were selected based on their location of residence. I aimed to complement the workshop and therefore I searched for a representative from different settlements along the study site (see diagram 16). Besides, I wanted to

[15] See the full list of the interviewees in Appendix at the end of the thesis.

interview people with different backgrounds and include some of the professions that are familiar with the planning of the coast. Therefore the ten selected respondents represented inhabitants from seven different settlements of the study site. Among these residents of the coastal communities were two municipality's urban planners, a landscape architect, waterfront neighbourhood developer and a local politician.

The interviews were semi-structured, meaning that the focus and additional questions were based on the particular coastal landscape and the interviewee himself. The interviews were held in February 2022. I conducted interviews with ten people, one of the interviews was held face to face, whereas 9 of the interviews were held online via Teams meeting. The average duration of an interview was around 45 minutes.
The knowledge from the interviews is presented together with co-created knowledge of the workshop in chapters 4.2.3, 4.2.4 and 4.2.5.

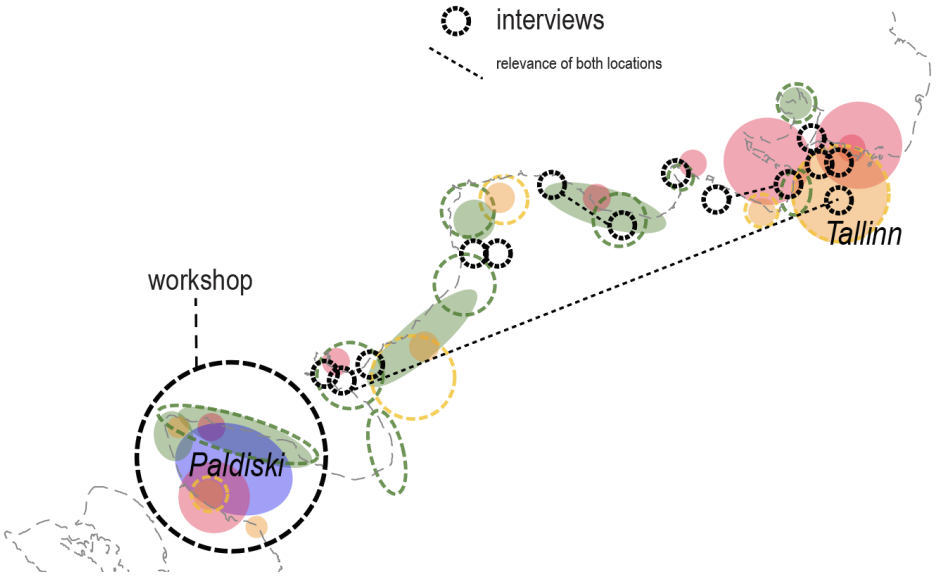


Diagram 16. Locations of interviewees and the workshop.
Four of the interviewees were connected to two relevant locations of the representative site.

4.2.3 Co-created knowledge: coastal landscape uses, values & threats

In order to see how ecological and social systems are connected on an everyday personal level, I have asked the participants of the workshop and interviewees about coastal landscape uses, values and threats (see table 1).

Most visits of the coastal landscape were related to the so-called active recreation: walking (including nordic walking and trekking) and swimming (including winter swimming), as well as generally doing sports (running, kickbiking). Leisure boating and fishing also received a number of mentions as well as camping (including picnicking and using the RMK rest areas).
Many respondents mentioned also passive forms of recreation that can be categorised as aesthetic benefits and inspiration that people gain from nature: *"enjoying the evening sun"*, *"enjoying the sunset"*, *"enjoying the view"*, *"throwing stones in the sea"*, *"putting toes in the water"*, as well as more generally: *"going to the beach"*, *"going to nature"* that explains the importance of the particular landscape (whereas the activity you do there is not the most important one).

The interconnections of the ecological and social systems were analysed through the question of coastal landscape values. It is natural that most of the coastal landscapes that are widely used also got ranked as valuable, therefore many of the landscape values mentioned were connected to certain qualities of the landscape that allow certain human use and experience of the landscape. These qualities of the landscape were for example: view ("*of the sea"* or *"wide open view"*), privacy, wide space *("to be in distance to other people"*), wind ("*surfing"*), sand ("*safe to do a bonfire"*), trees ("*to get shade during summer"*). Under this I have also placed qualities of urban landscapes:

> *"Stroomi beach (in North-Tallinn) is genuine and complete when it comes to recreation in Tallinn"*
> *- inhabitant of Põhja-Tallinn / urban planner*

> *"Mere street (in Paldiski) is a historic-architectural route"*
> *- inhabitant of Paldiski*

Respondents also valued more general natural landscape elements: *the sea*, *fine sand*, *forest*, *large boulders*, *limestone cliff*, as well as generally just the quality of *"being natural"*:

> *"The contact with nature is still here: here is the forest, the sea, birds, animals"*
> *- inhabitant of Kakumäe, Haabersti / local politician*

Specific natural habitats were also mentioned as valuable: *Kakumäe bog, Kakumäe alder forest, Türisalu cliff, Laulasmaa landscape protection area, sandy beach, dunes, two islands next to Kakumäe as bird sanctuaries.*

In addition to the positive impact of ecological systems to social systems (uses and values[16]) the workshop and interviews also approached the negative interrelation of these systems.
Most of the mentioned threats were connected to the negative human impact on the natural landscape. Settlement (incl. ports) expansion was often mentioned as a threat to habitats. Inhabitants of Põhja-Tallinn were concerned with the decrease of naturally diverse areas in Tallinn - the monotonous new urban waterfronts were seen as a threat to ecological as well as sociocultural systems. Over-designing nature was mentioned as a threat also in smaller coastal settlements:

> *"There shouldn't be cafes and marinas everywhere!"*
> *- inhabitant of Vääna-Jõesuu*

Another threat to both, humans and nature, was connectivity. The participants were worried about the privatisation of the coast and the lack of access to the coastal landscape. Fencing was seen as a threat also to various animal species. The respondents mentioned the need for a coherent ecological and sociocultural corridor along the coast.

> *"Local municipalities seem to have no understanding that planning is the only legal means to protect public interest (incl. animals, nature, humans), currently it is merely based on inviolability of private property and economic benefits."*
> *- summer resident of Lohusalu/ urban planner in Tallinn*

Water and soil pollution as well as visual pollution from industrial sites on the coastal landscape were mentioned as threats.
Human habits of littering and using motor vehicles like ATV-s on coastal landscapes were mentioned as a threat to the natural habitat as well as local settlement.
Next to these direct human impacted threats, the respondents pointed out indirect human impacted threats caused by climate change: coastal erosion, flooding and strong storms. These were mainly seen as threats to settlements.

To conclude, respondents interact with the coastal landscape through various activities on the coast as well as in the sea. Walking along the coast seemed to be the most important activity for the participants of the workshop as well as the interviewees. When it comes to the use of coastal landscapes, coherent public access

[16] This thesis does not further elaborate on landscape values, nor discusses its theory. Nevertheless, these questions have been important to ask in order to understand what makes the specific coastline and its social-ecological systems resilient.

to the coast was mentioned as an important quality. Furthermore, respondents mainly valued natural coastal landscapes, often preferring landscapes that feel "wild" and secluded. The variety of the coastline with its mix of habitats and settlement types was often mentioned as the biggest asset. People valued the mosaic of urban and natural beaches, forested cliffs and sandy dunes, open views towards the sea and wind protected areas, meadows and forests.

> *"The contrasts of nature in coastal areas are high!"*
> *- inhabitant of Meremõisa/ architect*

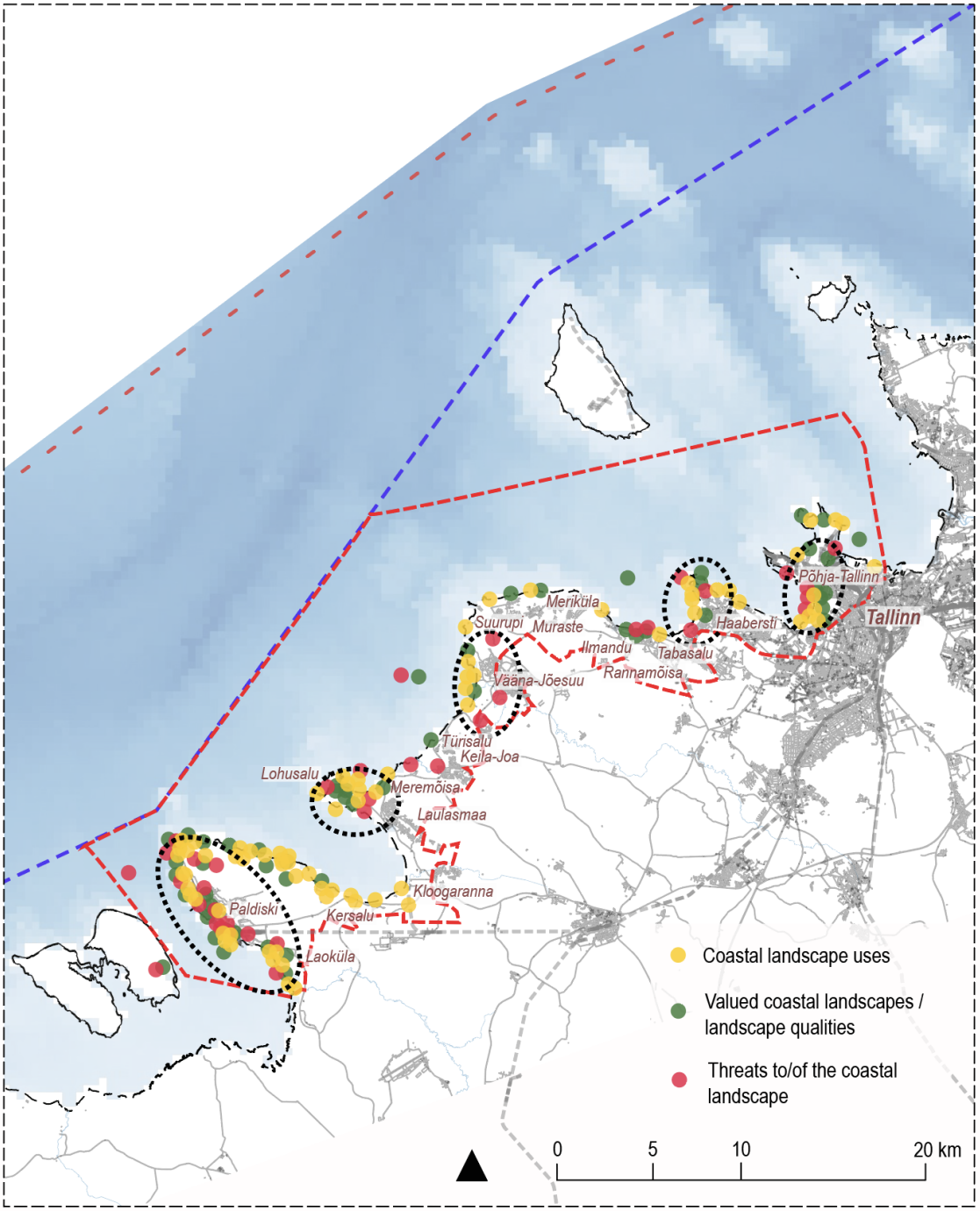
Most of the threats to coastal landscapes were considered to be social systems' negative impact on ecological systems. The biggest challenge was seen in the preservation of natural landscapes from expanding human needs. This risk was often associated with the threat to one's own experience (use) of the nature:

> *"I can enjoy the natural landscape when I know that it's in good health!"*
> *- inhabitant of Meremõisa/ architect*

	capital city Tallinn	port town Paldiski	small coastal settlements
Uses	swimming (incl. winter swimming) walking running leisure boating going to beach enjoying sunset	swimming walking fishing trekking camping leisure boating enjoying sunset "putting toes in the sea" "throwing stones to the sea" having a picnic	swimming going to beach trekking walking (incl. nordic walking) leisure boating fishing kickbike riding
Values	urban beaches with recreation facilities natural landscape with its variety (incl. dunes, bog, forests, islands) sea views pockets of nature	cultural heritage (building monuments) natural landscape with its variety (incl. limestone cliff, meadows, sandy beaches, forests, stony beaches) sea views	natural landscape with its variety (incl. sandy beaches, forests, cliff) privacy
Threats	potential settlement expansion - loss of habitats gentrification - monotonous landscapes + loss of habitats erosion flooding pollution - soil & sea water strong wind	port & industries expansion - limited access to coastal landscapes for public + loss of habitats erosion destruction of cultural heritage (building monuments)	potential settlement expansion - loss of habitats privatisation - limited access to coastal landscapes for public (incl. animals) seasonal population

Table 1. Landscape uses, values and threats by settlement type.
Data based on interviews and the workshop, 2022.

I have collected the knowledge of coastal landscape uses, values and threats on a map (see map 9) in order to define the "hotspots" of landscape challenges, indicating locations, where managing coastal landscapes should rely on resilience principles.



Site map 9. Personal interaction with the coastal landscape and clusters of landscape challenges: uses, values and threats.
The workshop influences the higher number of dots in Paldiski area.
Data based on interviews and the workshop, 2022. Base map based on: Maa-amet, 2022; HELCOM, 2022.

4.2.4 Co-created knowledge: defining resilience deficit[17]

In order to define resilience deficit, it is important next to locations (see map 9), explore whose resilience needs building[18]. Based on the desktop and participatory research I have categorised resilience deficits to intertwined habitat threats and settlement threats (see map 10). The map shows key issues to deal with when offering landscape strategies based on social-ecological resilience.

In the capital city green spaces are generally pressured by real estate developers, especially the areas along the coastline that are desired for settlement expansion. That has led to decrease in the surface of natural landscapes and interruptions in green connections. Some of the valuable habitats (for example coastal lagoons (habitat 1150) and meadows (habitat 1630) in Paljassaare or forest (habitat 1680) and coastal meadow (habitat 1630) in Kakumäe) are facing further threats due to negative impact from urban development (map 10).
Coastline has fragmented public access in Tallinn. Many parts of Põhja-Tallinn's coast are still inaccessible for the public due to its several cargo and military ports. In the future these areas will most likely be gentrified and turned into new residential neighbourhoods, the question is how to do it in a resilient way?

> *"The design for these new residential developments is repeating, making Tallinn monotonous. Not everything should be like the new Noblessner quarter with its well-defined uses and users. City also needs places for natural shore and green pockets."*
> *- inhabitant of Põhja-Tallinn/ urban planner*

Living right by the coast means that these areas are most prone to flooding and erosion risks.

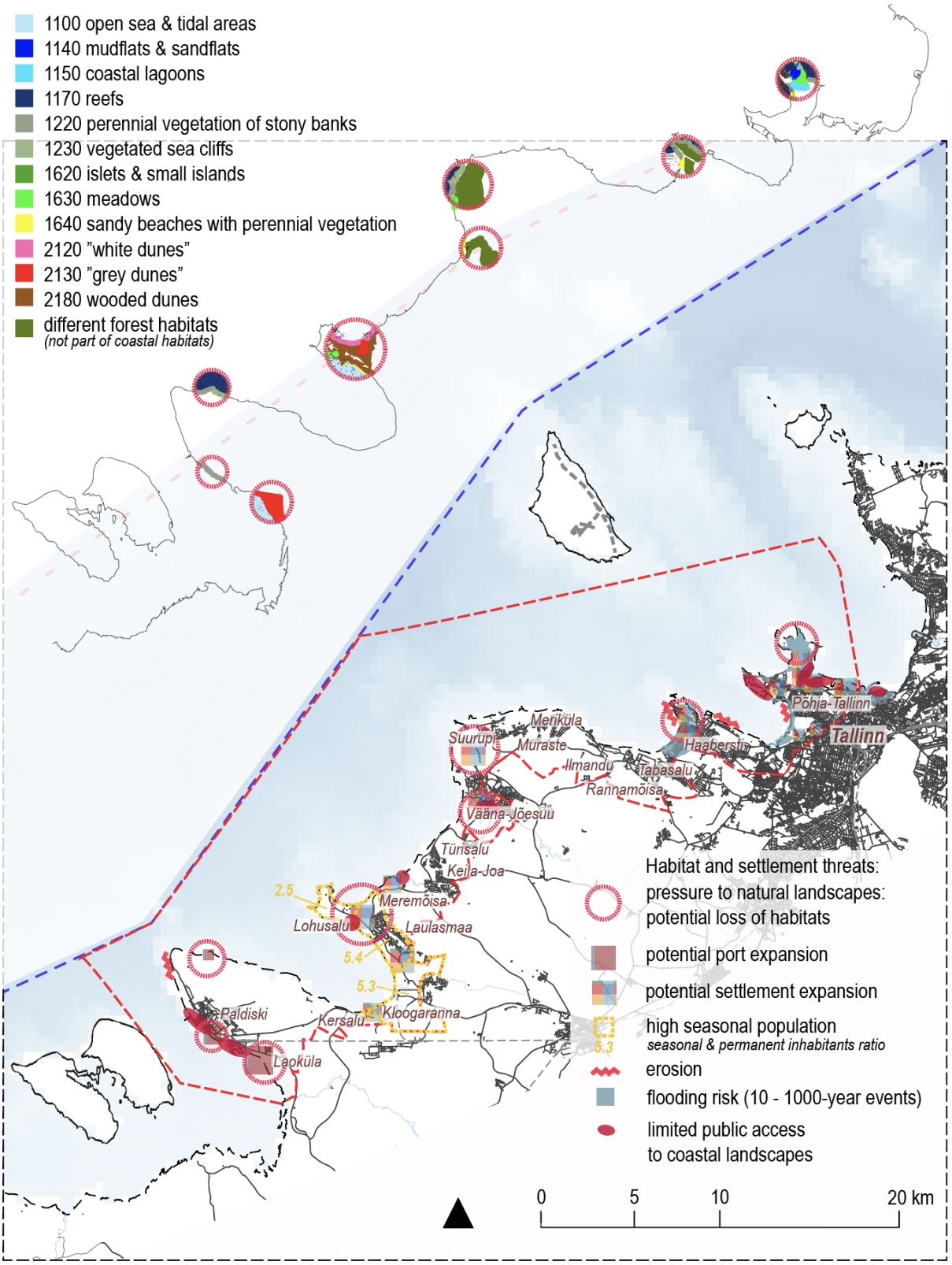
The most urgent resilience deficit in coastal port town Paldiski is the limited physical as well as visual public access to the coast mainly due to ports (map 12). The future threat is the complete closure of the coastal zone as the port is planned to expand. The only natural habitat - stony bank (habitat 1220) - yet still present in the central part of coastal Paldiski has been mentioned to be:

> *"The most exciting and unique coastal landscape."*
> *- inhabitants of Paldiski*

[17] Also see chapter 2.2.2 and 2.2.3 for reference.
[18] See diagram 5 in chapter 2.2.3 Defining resilience deficit.

Besides carrying an important sociocultural meaning for the locals, it is also an important natural habitat.
Port expansion poses a threat also to the southern coastline of this settlement in Laoküla that is a valuable habitat of grey dunes (habitat 2130) as well as a favourable beach area for local residents, among them fishermen.
The tip of the peninsula that is a beloved view point for locals as well as tourists, and a habitat of vegetated sea cliffs (habitat 1230), is endangered by erosion.

Many of the small coastal settlements in between Tallinn and Paldiski are destinations for summer tourism with their population doubling (or even more) during the three summer months. Summer tourism is concentrated on the beaches and with the high concentration of activities, noise and waste it puts a lot of pressure on some of the fragile natural landscapes (for example white dunes 2120, grey dunes 2130 and wooded dunes 2180 in Lohusalu) as well as local permanent residents.
These coastal settlements and the natural landscapes are facing real estate development pressure. Often new developments do not take into consideration the existing natural and sociocultural typology (e.g. no fences, no vast areas of lawn etc), cutting through coastal access for humans as well as animals.



Site map 10. Defining resilience deficit: habitat and settlement threats
Data based on interviews and the workshop, 2022; Lääne-Harju vald, 2020; Maa-amet, 2022; HELCOM, 2022; Tallinna Linnaplaneerimise Amet, 2017; Paal, 2000.

4.2.5 Co-created knowledge: defining resilience aims

In order to understand the key themes for resilience building and address the issues of resilience deficit, I asked the participants to vision the future and finish the following sentence (by choosing at least three most important ecosystem services from the list provided to them[19]): " When I think about the future of this particular coastal landscape, it is important to me.."

For the representative site the combined cultural service: tourism/ recreation got the most mentions. Aesthetic benefits/ spiritual & cultural well-being was considered another very important benefit humans gain from coastal landscapes. This was followed by water quality / mitigation of eutrophication and then biodiversity / habitat maintenance. Nevertheless the current methodology is not valid to do any kind of quantitative conclusions, therefore all of the mentioned ecosystem services are valuable (see table 2 where these are presented by settlement type).

Based on the discussions over ecosystem services and their functions and components, the participants would like to have public access to the coast in the majority of areas. Coherent coastal green corridor was mentioned to be important for the ecology as well as socioculturally. Untouchable nature was valued and even in cities and towns pockets of "wild" nature should be preserved, according to the respondents. Nevertheless coastal natural landscapes could occasionally offer more program, activities for recreation. Private landowners could contribute to the network of green by allowing biodiversity to their gardens. Marine biodiversity and habitats were mentioned to need more focus and one of the solutions to allow less terrestrial pollution to the sea was seen to be the use of sustainable urban drainage systems[20]. Habitats like meadows, pasture land were important to be restored.
This knowledge is all co-created by the participants of the workshop and interviews and later categorised and in some occasions rephrased by myself (see table 2). This knowledge is integrated to landscape strategies in chapter 4.3.

[19] See chapter 2.2.4 The concept of Ecosystem Services.
[20] Sustainable urban drainage systems (SUDS) were mentioned by local community members who are professionals in the field. These are not further elaborated in this thesis.

	capital city Tallinn		port town Paldiski		small coastal settlements	
ESS	functions & components	comments	functions & components	comments	functions & components	comments
recreation & tourism	PUBLIC ACCESS TRAILS NATURAL POCKETS VARIETY	*restorative effect: walking in the nature* *natural areas accompanied by urban beaches*	PUBLIC ACCESS PRESERVE NATURAL LANDSCAPES RESTORE CULTURAL MONUMENTS	*benefits for mental health* *restorative effect: walking on the coast* *attractiveness of the settlement* *cultural monuments add potential uses*	ACTIVITIES FOR VISITORS	*"Clear function of the coast reduces littering"*
aesthetic benefits / inspiration & spiritual / cultural well-being	NATURAL LANDSCAPE PUBLIC ACCESS	*nature experience: "Sitting on the stone means much more than sitting on the bench of the mall."*	NATURAL LANDSCAPE PUBLIC ACCESS	*benefits for mental health* *attractiveness of the settlement*	CLEAN WATER: LESS EUTROPHICATION PUBLIC ACCESS "WILD" NATURE	*"I can enjoy the natural landscape when I know that it's in good health!"* *personal well-being*
water quality & mitigation of eutrophication	SUSTAIABLE URBAN DRAINAGE SYSTEMS	*use of variety of plants to support ecosystem as well as clean urban runoff water* *"Clean sea water contributes to higher biodiversity!"*	–	–	CLEAN WATER PRESERVE MARINE HABITATS & BIODIVERSITY	*"people can swim in clean sea"* *"water is consumable and livable"*
biodiversity & habitat maintenance	GREEN CORRIDOR PASTURE LAND MEADOWS BIODIVERSITY IN PRIVATE GARDENS	*"Urban green spaces should be connected"* *"semi-natural landscapes (e.g. coastal pastures) are unique and should be preserved / restored"* *human-nature synergy*	–	–	natural landscape preserve current variety of habitats	–
food	DOCKING AREAS	*areas for fishermen in coastal waters*	DOCKING AREAS	*areas for fishermen in coastal waters*	–	*"I live close by the sea and I cannot find a fisherman who would sell fish."*
climate regulation	NATURAL LANDSCAPE TREES & VEGETATION	*"Preserve vegetated surfaces in cities - not only asphalt"*	–	–	–	–
space & waterways	–	–	EXISTING PORTS EXPAND NEW MARINA(S)	*economy* *jobs* *connectivity*	–	–
flood protection	VEGETATED AREAS TO RETAIN FLOODWATER	–	–	–	–	–
coastal erosion prevention	STRUCTURES TO PROTECT SHORES	*protect settlements, but also natural landscapes*	–	–	–	–
energy	WIND TURBINES	*produce renewable energy locally (also in cities)*	–	–	–	–

Table 2. Key themes for coastal landscapes' resilience building / resilience aims
Based on ecosystem services relevant in the Baltic sea context.
Data co-created during the workshop and interviews in February 2022.

4.3 Developing // visualising landscape strategies

The last step in the process of applying SESs approach to representative site was the connecting of (co)-created knowledge on visuals - diagrams of landscape strategies.

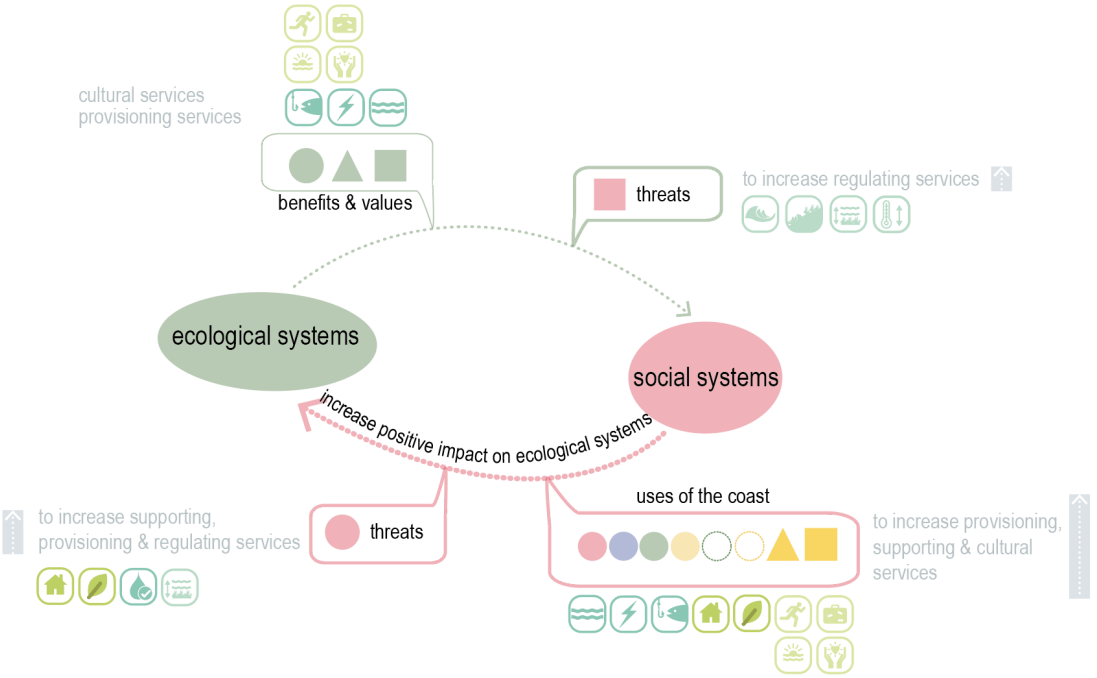


Diagram 17. Landscape strategies for resilient coast.
Abstract integration of knowledge based on the research done for the representative site: data from desktop (mapping) and participatory (workshop, interviews) research.

The following strategies are giving insights into how different benefits in the social-ecological system are connected and what objectives and pilot actions could be applied in order to direct coastal change towards a more resilient future - to increase the positive human impact on ecological systems in order to reduce the threats to ecological habitats as well as human settlements (see diagram 17).
Nevertheless, these landscape strategies have not been the main end goal of this thesis, but these are just one part of the exploration of how to manage coastal systems in a resilient way with the contribution of landscape planning.

The strategies were combined on a sketch for the whole representative site (see diagram 18) and then discussed and visualised by settlement type addressing some of its specific landscape challenges (chapters 4.3.1, 4.3.2 and 4.3.3). Generally, all of

these landscape strategies were based on acknowledging, maintaining as well as strengthening certain system's characteristics (Berkes et al, 2003)[21].

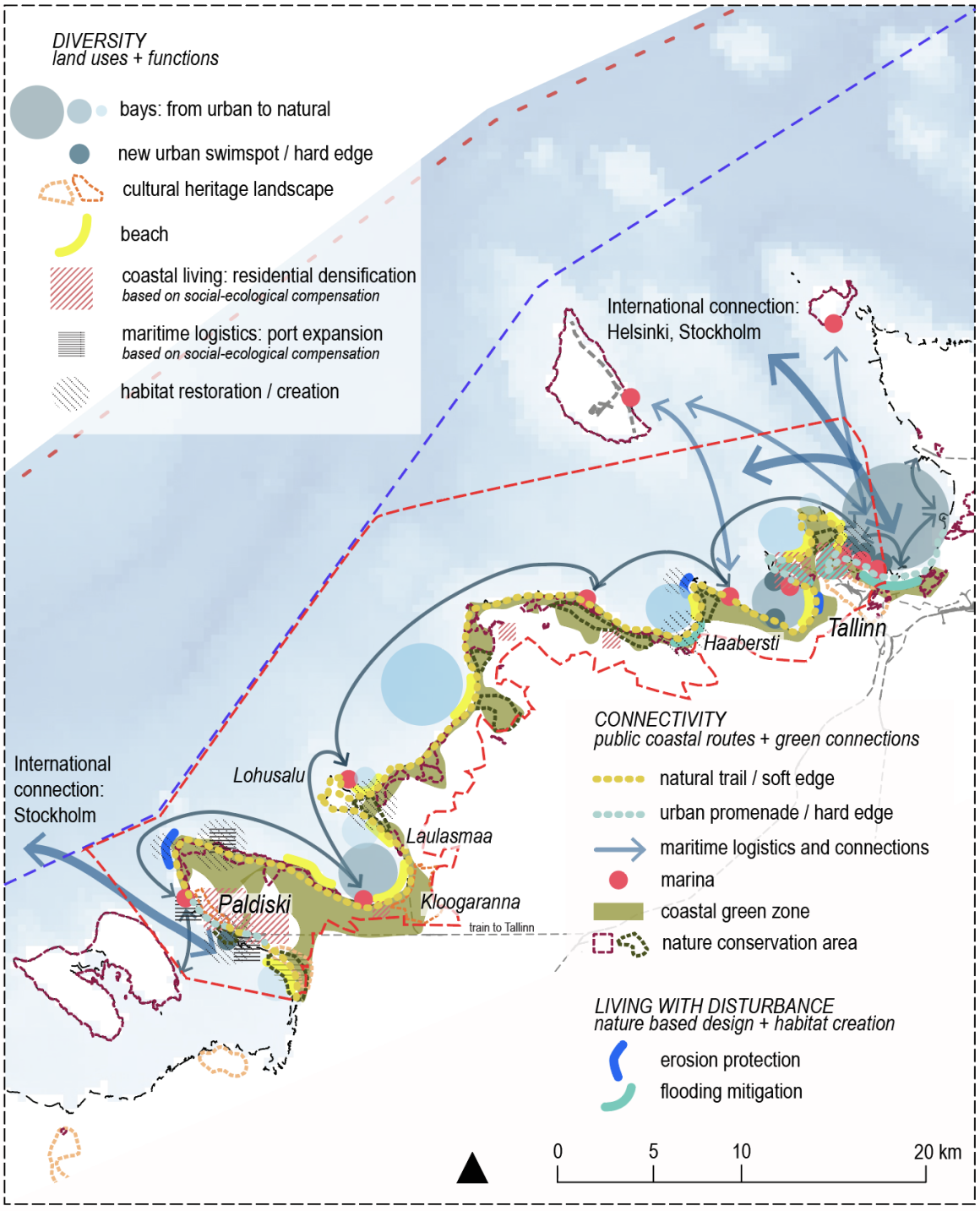


Diagram 18. Landscape strategies for resilient coast.
Base map based on: Maa-amet, 2022; HELCOM, 2022.

[21] See chapter 2.2.1 for reference.

4.3.1 Capital city Tallinn

Based on previous analysis the “hotspots” that need resilience building in Tallinn are Kakumäe-Tiskre areas in Haabersti and the whole Põhja-Tallinn. I have zoomed in to Kakumäe-Tiskre area to visualise a landscape strategy. This mainly residential area needs resilience building as it is facing risks of erosion and flooding at the same time development pressure for new residential areas.
Key habitats that need resilience building are: coastal meadow (habitat 1630) that has disappeared due to lack of traditional land use and taken over by reeds; stony bank with its perennial vegetation (habitat 1220) that is facing a risk of erosion; alder forest and Kakumäe bog that are facing further real estate development pressure.

The landscape strategy for a resilient coast for this urban neighbourhood conveys these objectives (see diagram 19):

1. **Connectivity** of ecological habitats as well as human settlements and routes;
2. **Diversity** of ecological habitats and human activities;
3. **Living with disturbance** - coping with **change**.[22]

Pilot actions to achieve these objectives could be the following (see diagram 19):

1. Restore and/or preserve valuable habitats:
Tiskre coastal meadow has almost disappeared and the reeds have taken over the coastline. Although reeds offer valuable habitats to many bird species, meadows are habitats for other bird species as well as amphibians (some of the potential meadow species are visualised on diagram 18) and a variety of plant species. Besides, reducing the area for reeds decreases eutrophication of the sea (Rannap et al, 2021).
Based on ecological inventory done for the area (Rannap et al, 2021) I suggest restoring the coastal meadow of Tiskre, preserving also an area for reeds as bird habitats. The maintenance of the meadow could be managed via re-introducing herding (Rannap et al, 2021) like it has been done for example in Pärnu city in Estonia.
In order to preserve Kakumäe bog and Kakumäe alder forest residential development should be prohibited to take over these natural landscapes.
Seagrass meadows are an important marine habitat that have decreased in Estonian coastal waters (Martin, 2012; Kotta, 2019). Seagrass (Eelgrass *Zostera marina*) meadows act as ecosystem engineers, offering habitats to many marine species, at the same time reducing eutrophication (Angrove, 2020; Kotta, 2019). I suggest restoring

[22] See diagram 4 in chapter 2.2.2 (Building social-ecological resilience) for reference.

seagrass meadows in sandy Kakumäe bay area in order to contribute to better sea water quality.[23]

Restoring and preserving valuable natural landscapes provides ecosystem services (see table 2) like habitat maintenance and biodiversity maintenance; aesthetic benefits-inspiration and spiritual-cutural well-being; recreation-tourism; coastal flood protection as well as better water quality and mitigation of eutrophication.

2. Add and/or preserve social-ecological connections:

Coastal landscape needs a coherent green corridor[24] that would offer a variety of interconnected ecological habitats as well as sociocultural connections and public access to the coast. In Kakumäe-Tiskre area some of the current green corridors (for example Tiskre creek or the connection between Kakumäe bog and alder forest) are essential in providing ecological connections and should be preserved and enhanced. Tiskre coastal area is currently not well accessible for people. I would suggest (agreeing with Rannap et al, 2021) adding a boardwalk with educational information in order to provide coastal access and additional recreational activities, yet delicately interfere with the natural landscape.

Adding (and preserving) social-ecological connections provides ecosystem services (see table 2) like recreation-tourism; habitat maintenance and biodiversity maintenance; aesthetic benefits-inspiration and spiritual-cultural well-being as well as access to food (fishing).

3. Mitigate climate threats through nature-based solutions:

In order to cope with changing climate, and therefore weather conditions like an increased number of strong storms, densely populated coastal landscapes need to be protected. I would suggest adding nature-based solutions in order to protect coastal settlements like Tiskre against flooding and coastal settlements and habitats like Kakumäe against erosion (Landscape Institute 2021). This nature-based solution for limiting the erosion process could be a wave-breaker that also creates habitats (for example, Bladderwrack and Blue mussel that act as ecosystem engineers, offering habitats to many marine species, at the same time reducing eutrophication) (Dyson & Yokom, 2014; Angrove, 2020). Flooding risk in Tiskre could be mitigated through integrating sustainable urban drainage systems to public and private areas. Areas for storing bigger amounts of floodwater should be preserved in the meadows close to the

[23] Read upon challenges of the Baltic Sea in chapter 3.2.2.
[24] See chapter 4.1.3 Nature conservation.

coast, whereas inside residential quarter bioswales, infiltration trenches and rain gardens could be implemented[25] (Landscape Institute, 2021).

Mitigating climate threats through nature-based solutions provides ecosystem services (see table 2) like coastal erosion prevention; flood protection; habitat maintenance and biodiversity maintenance as well as food (new habitats for fish).

4. Encourage public-private cooperation and initiatives:

There is a need to encourage public-private cooperation when working towards a resilient coast. Much of the coastal land (or nearby) is owned privately and therefore changes of the landscape and its maintenance cannot succeed without private land owners on board. This means changing the attributes of the governance system towards a more polycentric governance system. For example local Tiskre community association could be provided means to encourage private landowners to integrate sustainable urban drainage systems and biodiverse vegetation to their gardens through educational and co-constructing events as well as funding.

This pilot action provides ecosystem services (see table 2) like habitat maintenance and biodiversity maintenance; aesthetic benefits-inspiration and spiritual-cutural well-being; flood protection.

[25] This thesis is not touching upon the theory of sustainable urban drainage systems, but rather recommends the use of certain nature-based design options in order to fulfil the resilience objectives.

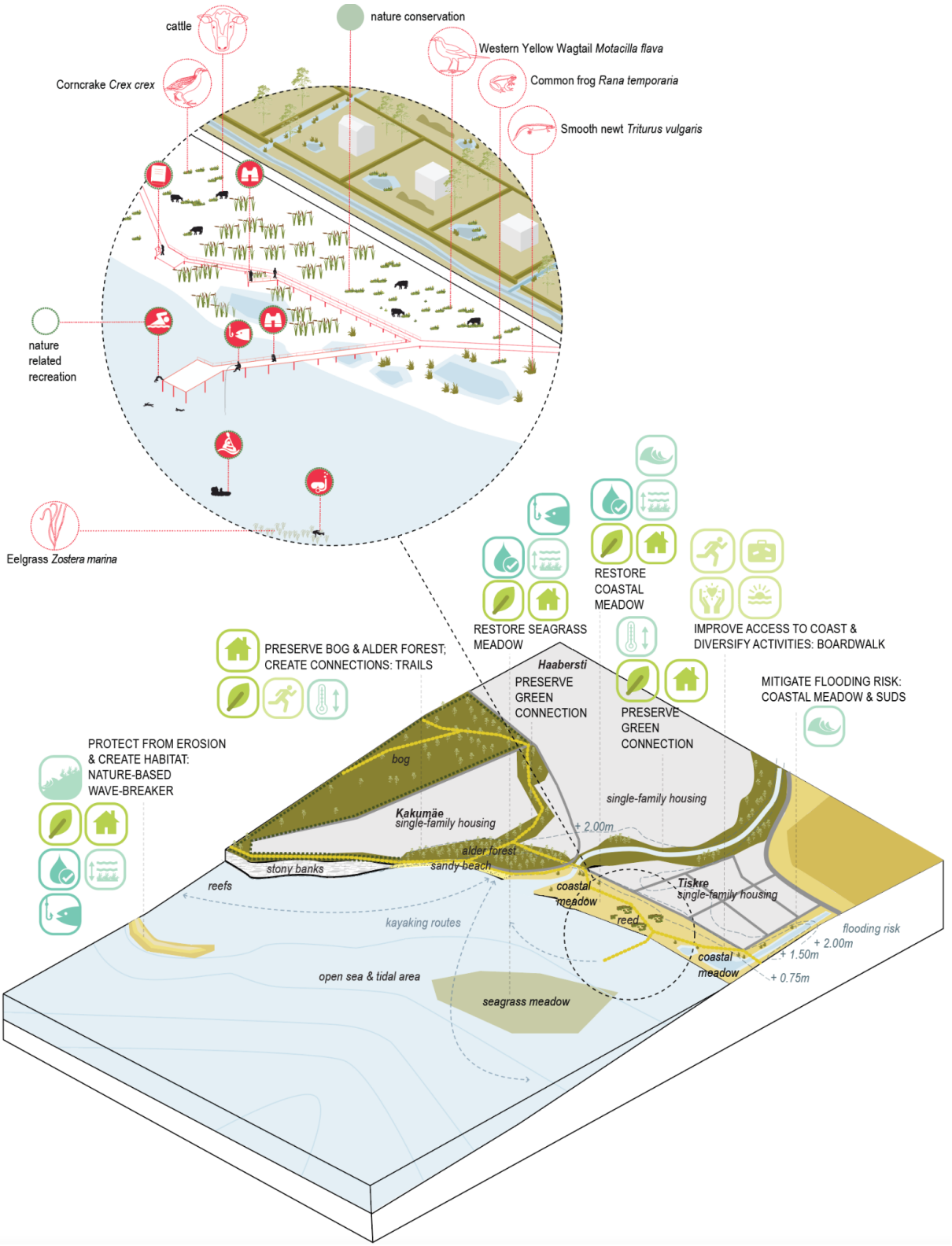


Diagram 19. Landscape strategy for resilient coast of Kakumäe-Tiskre neighborhoods in Tallinn. Knowledge based on workshop & interviews; Martin, 2012; Rannap et al, 2021; Dyson & Yokom, 2014; Landscape Institute, 2021.

4.3.2 Port town Paldiski

Based on previous analysis one of the essential "hotspots" that needs resilience building is Paldiski. The settlement is facing the risk of losing public access to natural coastline (due to the planned port expansion).
Key habitats that need resilience building are: grey dunes (habitat 2130) that are pressured by port expansion; stony bank with its perennial vegetation (habitat 1220) that is also pressured by port expansion as well as vegetated sea cliffs (habitat 1230) that are endangered by erosion in the northern tip of the peninsula. Marine habitats of reefs (habitat 1170) and open sea and tidal areas (habitat 1100) also face increased pressure due to port expansion.

The landscape strategy for a resilient coast for port town Paldiski (and its surroundings) conveys these objectives (see diagram 20):

1. **Connectivity** of ecological habitats as well as human settlements, routes and activities;
2. **Diversity** of ecological habitats as well as socioeconomic and -cultural landscapes.[26]

Pilot actions to achieve these objectives could be the following (see diagram 20):

1. Add social-ecological connections:
For the social-ecological resilience of Paldiski the coastline needs physical and visual access. This could be a natural trail in preserved natural landscapes and urban promenade through and/or pass by port areas. The access to the sea in the central part of the town could be a landmark, providing urban swimspot as well as access for fishermen. The habitat of stony bank and its perennial vegetation could be connected to other natural landscapes via a green corridor.
The planned marina would contribute to Paldiski's connectivity. Besides leisure boats, it could offer a spot for kayaking and sailing courses. Paldiski could be better connected to the other coastal areas (including Pakri islands) through a seasonal public transport.

Adding social-ecological connections provides ecosystem services (see table 2) like recreation-tourism; aesthetic benefits-inspiration and spiritual-cultural well-being; habitat maintenance and biodiversity maintenance; space and waterways; access to food (fishing).

2. Preserve valuable habitats and cultural heritage landscapes:

[26] See chapter 2 (building social-ecological resilience) for reference.

The stony bank in the centre of Paldiski is the green pocket that is extremely relevant in order to preserve the social-ecological diversity. The workshop confirmed that besides being a unique natural habitat, it is very important for the local community's cultural and spiritual well-being. This well-being and local identity could also be supported by the protection and restoration of Mere street and its architectural monuments and defining the area among cultural heritage landscapes.
Grey dunes in Laoküla are a valuable habitat (Paal, 2000) and in order to preserve it, I would suggest adding it to nature conservation areas.

Preserving valuable natural habitats provides ecosystem services (see table 2) like habitat maintenance and biodiversity maintenance; aesthetic benefits-inspiration and spiritual-cultural well-being; recreation-tourism as well as access to food (coastal access for fishermen).

3. Social-ecological compensation:

Paldiski has big importance in Estonia's maritime logistics and therefore it is inevitable that ports need space. Based on the knowledge of this thesis I would suggest that the port could expand towards the sea and not along the natural coast. Besides, the port could also contribute to public space design (promenade through and/or passing by) as well as habitat creation, for example, allowing strips of green and trees on their land or compensating their vast asphalted areas by contributing to habitat restoration elsewhere. Shallow water and intertidal habitat areas could be increased via special quay design (e.g. seawall stairs that offer habitat, for example, for Bladderwrack and Blue mussel that besides offering habitat for other species, act as ecosystem engineers and clean sea water)(Dyson & Yokom, 2014; Angrove, 2020).[27]

Paldiski with its empty plots is an area suitable for residential densification. Nevertheless the outdoor space should contribute to habitat creation and biodiversity, allowing green connections as well as attractive public space for the local community.

These residential and port expansions based on "social-ecological compensation" provide ecosystem services (see table 2) like habitat maintenance and biodiversity maintenance; space and waterways; aesthetic benefits-inspiration and spiritual-cultural well-being as well as recreation-tourism.

[27] These designs are not elaborated in this thesis, but rather to indicate that there are possibilities for ecological designs also for port areas.

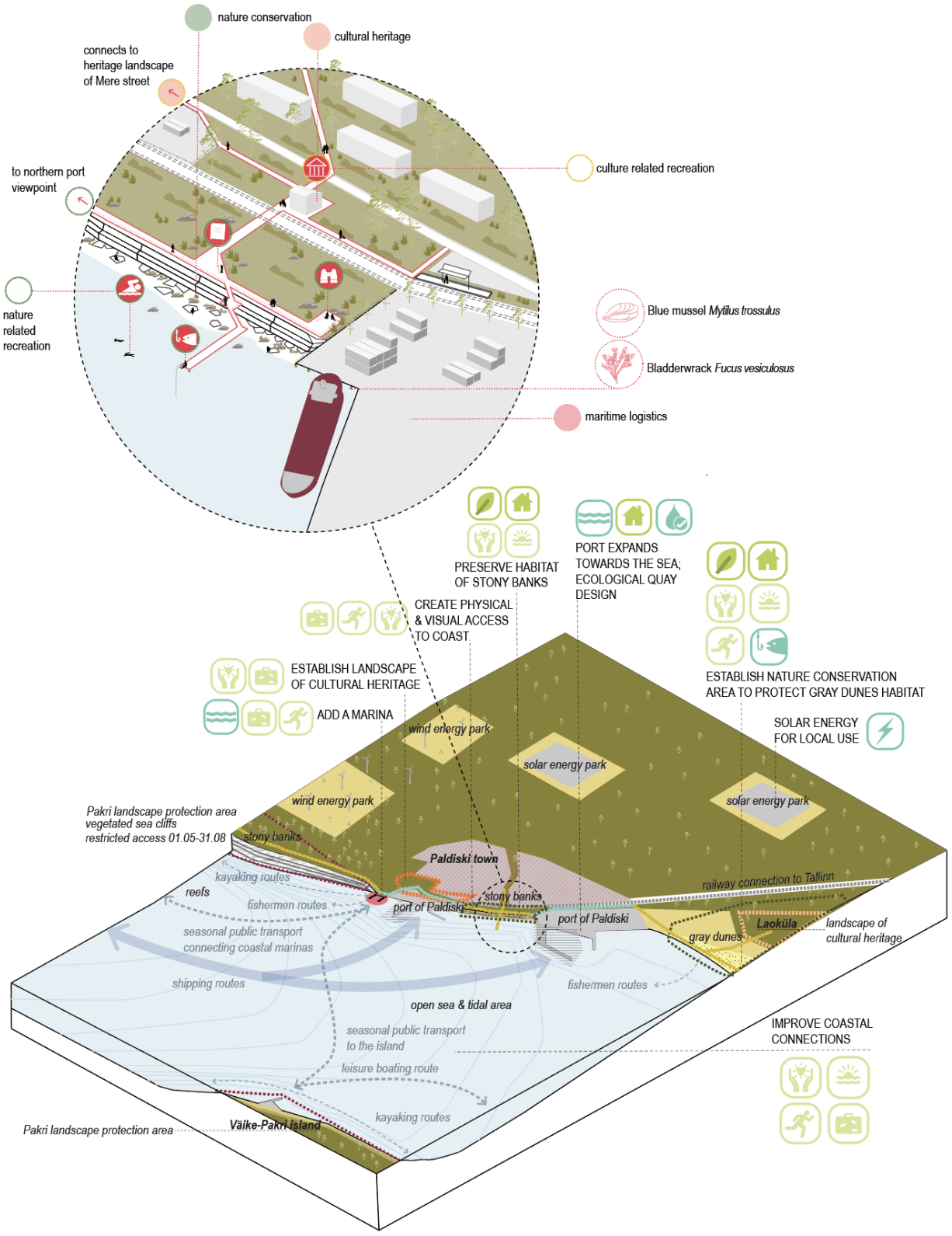


Diagram 20. Landscape strategy for resilient coast of port town Paldiski.
Knowledge based on workshop & interviews; Martin, 2012; Rannap et al, 2021; Dyson & Yokom, 2014; Landscape Institute, 2021.

4.3.3 Small coastal settlements

Based on previous analysis the “hotspots” that need resilience building in the coastal area between Tallinn and Paldiski are Lohusalu-Laulasmaa-Kloogaranna area and Vääna-Jõesuu-Suurupi area. I have zoomed in to Lohusalu-Laulasmaa-Kloogaranna area to visualise a landscape strategy. The settlements in this area are all very much affected by fluctuations in population (during the summer months the population is more than double) (see map 10).
Key habitats that need resilience building are: white dunes (habitat 2120), grey dunes (habitat 2130) and wooded dunes (habitat 2180) vulnerable to mainly seasonal human impact (littering, tramping, use of motor vehicles) as well as overall residential development pressure.

The landscape strategy for a resilient coast for small settlements that experience high peaks of summer tourism conveys these objectives (see diagram 21):

1. **Connectivity** of ecological habitats as well as human settlements and activities;
2. **Diversity** of ecological habitats as well as recreation and tourism program.

Pilot actions to achieve these objectives are the following (see diagram 21):

1. Create hierarchy of the beaches:
One of the opinions of the interviewees was:

“We should develop recreation and offer more activities for tourists. This would contribute to a cleaner environment as people would litter less when they have a specific aim for their visit.”
- inhabitant of Vääna-Jõesuu

I extend this thought to create a so-called “urban-natural” hierarchy of beaches so that some of the beaches are more “urban” consisting of more facilities and seasonal programs, whereas some others are kept natural and pristine. This idea was also co-created during an interview with the summer resident of one of these small coastal settlements and urban planner by profession. These “urban” beaches are well connected via public transport, reducing the need to use a private car and therefore pressuring local landscapes with a concentrated need for seasonal parking. Therefore, for this particular zoom in area I would develop Kloogaranna, that has a train connection to Tallinn, to an “urban” beach that would offer more facilities and recreation activities to tourists, whereas Laulasmaa and Lohusalu could remain beaches that are pristine and relaxing.

Creating hierarchy of the beaches with different levels of diverse activities as well as human impact provides ecosystem services (see table 2) like recreation-tourism; habitat maintenance and biodiversity maintenance as well as aesthetic benefits-inspiration and spiritual-cultural well-being.

2. Strengthen the connections among different recreation/tourism activities:

In order to reduce the seasonal pressure (particularly for beaches), the connections between different tourism sectors need to be further enhanced. The area is already known for its cultural tourism, mainly through Arvo Pärt centre and Keila-Joa manor house, but some of the other cultural monuments along the coast are not that well known. For example, Suurupi is not that famous yet for seasonal tourists. The manor houses, churches and lighthouses of that area could attract culturally oriented tourists. Also, Paldiski with its cultural heritage holds a lot of potential for cultural tourism. Seasonal visitors could spread out along the coast, leaving less pressure to Lohusalu-Laulasmaa-Kloogaranna area.

One option to further diversify the tourism program (in order to get more people to go beyond sandy beaches) is to offer more activities in and on water. Kayaking, leisure boating and wind-surfing have already become popular and are offered in some of the beaches along the coast. Additionally, underwater cultural heritage as well as ecological assets could be more accessible via scuba diving options. This would educate people about the "hidden" habitats like under water meadows.

Seasonal coastal public transportation route would connect marinas along the coastline, offering a whole new perspective to many of the Estonians to rediscover the connection with the sea.

Strengthening connections among different recreation/tourism activities provides ecosystem services (see table 2) like recreation-tourism, but also habitat maintenance and biodiversity maintenance as well as aesthetic benefits-inspiration and spiritual-cultural well-being, because some of the areas could receive less number of tourists and their impact.

3. Extend the landscape conservation area:

Extending the landscape conservation area is relevant for the resilience of the coast as currently the green zone (including Laulasmaa landscape protection area) is fragmented. The additional nature conservation area could contribute to providing habitat for various species (for example, Narrow-mouth whorl snail *Vertigo angustior* that is under protection category III and found in the area (Keskkonnaamet, 2018)).

it would require public as well as private landowners to follow certain landscape principles. Among these principles are for example:
ensuring public access along the coast, but also towards the sea; ensuring access for wild animals, restrictions to use fences around the plot as these cut off the trajectories of different animals; restrictions to use lawn and alien species in vegetation, rather natural vegetation of the area to provide habitat for various species. In some of the more fragile landscapes (for example dunes) some activities need to be prohibited, this includes the use of ATV-s and other motor vehicles, but also mere walking in some parts as tramping is a threat to some habitats.

Extending landscape conservation area provides ecosystem services (see table 2) like habitat maintenance and biodiversity maintenance; aesthetic benefits-inspiration and spiritual-cultural well-being as well as recreation-tourism.

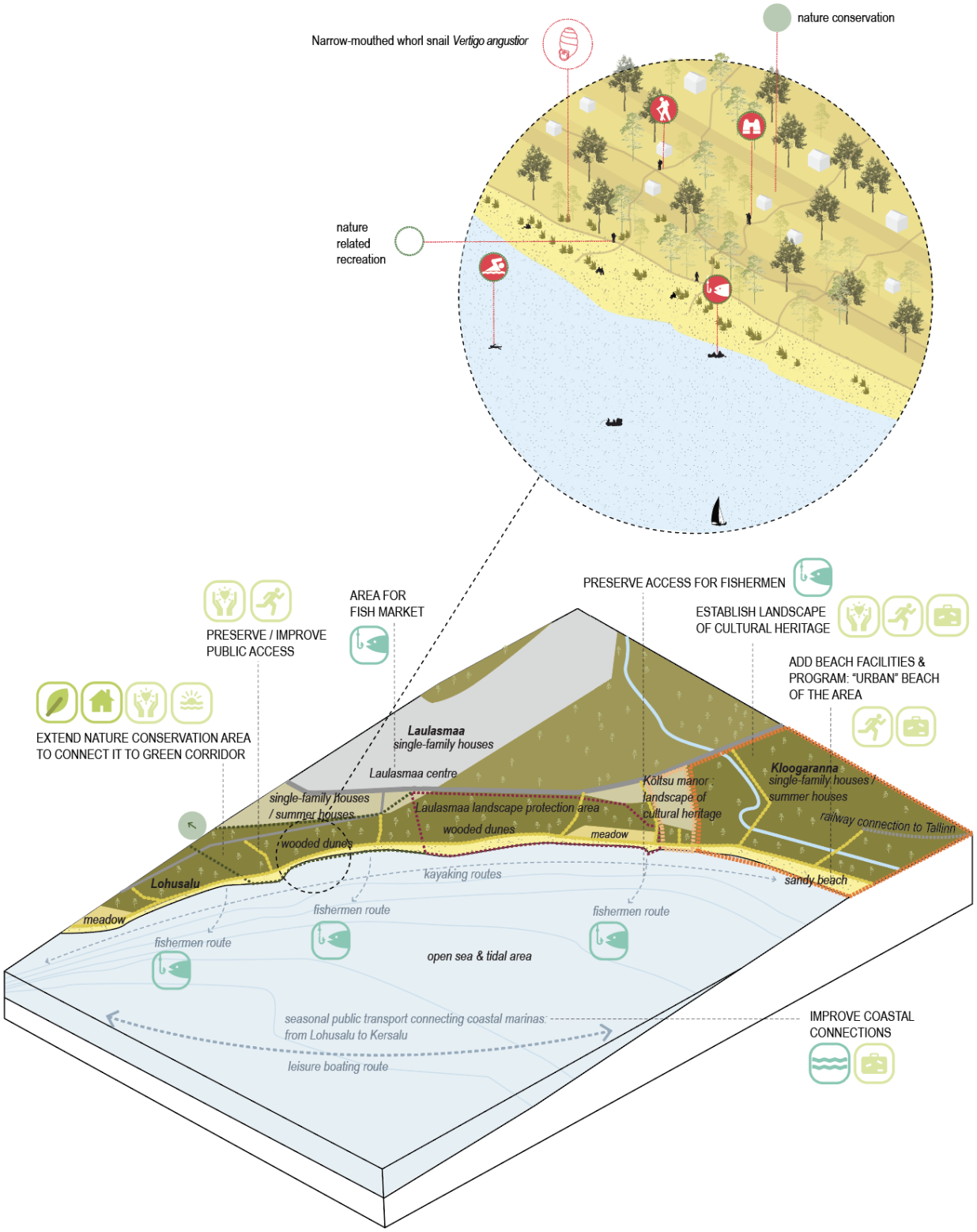


Diagram 21. Landscape strategy for the resilient coast of Lohusalu, Laulasmaa and Kloogaranna settlements.
Knowledge based on workshop & interviews; Martin, 2012; Keskkonnaamet, 2018.

5 Discussion

The current thesis has explored the question of how to manage coastal systems in a resilient way and what added value could social-ecological systems concept add. Therefore the methodology of the work has been key to approach these questions. The workflow of applying SESs concept proved appropriate for the scope of coastal landscape planning tasks.
Doing first the mapping gave me as a landscape planner an initial understanding of the site and therefore the basis to facilitate the co-creating process.
Co-creating process itself added value to the process as it is visible that the conclusions after mapping are lacking some of the information that is then gained through participatory research. Nevertheless, if this was just a glimpse to participatory research, for future research I would recommend expanding the process, for example, by having a workshop that includes representatives of various communities along the representative site. That could lead to beyond-settlement-borders discussions. I would also suggest having several workshops in various phases of the workflow. For example, after the creative phase of visualising strategies, it would be useful to let the participants reflect on these ideas.
Adding ESS contributed to knowledge creation. Although landscape values and threats had been mapped beforehand, approaching the site through the concept of ecosystem services, triggered new responses and helped to place some of the issues to comprehendable categories. The application of ESS has been criticised to be human centred and quantitative (for example Coeckelbergh 2017), nevertheless, based on this work, I can conclude that it can be a useful qualitative tool for planners, offering a public platform to discuss landscape challenges.
Developing and visualising strategies gave a closure to the process, combining previously (co)-created knowledge and translating it to an understandable format, visualising the benefits in an interrelated social-ecological system. For further research I would recommend testing what kind of visualisations (isometric drawings, sections, etc) would work the best to convey key themes to a wider audience.

This work has confirmed that, first of all, the topic is relevant in Estonian context and there is a need to address coastal challenges and rethink how we do this. I have suggested that coastal planning could be done at a specific planning level for the coastal zone (relying on Kuusik et al, 2018) including marine and terrestrial parts beyond the municipality's borders. Furthermore, this thesis confirmed the interrelations of social and ecological systems and therefore that the resilient way to manage coastal systems is to approach the coast as unified social-ecological systems (SESs). The application of SESs approach has shown that the main added value to

landscape planning from the SESs concept is that it calls for managing the properties of SESs as well as the properties of governance systems. In the process of the thesis I became a facilitator, whose role was to connect these different properties. I can only agree with Berkes et al (2003) who claims that building social-ecological resilience is about acknowledging, maintaining and strengthening certan system's qualities (Berkes et al, 2003). In this process I experienced that, for example, during the participatory events, when helping to point out certain system's properties, but allowing participants to express their ideas. When developing landscape strategies I relied on this principle as well. Besides, I based these strategies on the theoretical and contextual framework as well as knowledge from mapping, whereas the co-created knowledge had the most essential part. I can conclude that the managing of coastal systems in a resilient way based on landscape planning practice relies on the balance of facilitating, curating and designing.

6 Conclusions

The current thesis confirmed the added value of the social-ecological systems concept to landscape planning - it offers a theoretical framework as well as a working method to explore the layers of social and ecological systems as one interconnected whole. The value relies in acknowledging that managing coastal landscapes needs both - managing the systems' properties as well as the management process itself.
In order to explore the process of applying this wide and complex concept (SESs) to planning of the representative site, this thesis relied on mixed methodology. The workflow of gaining initial understanding through mapping (GIS analysis), followed by co-creating site-specific knowledge during the participatory events (interviews, workshop) and finished by creative research to develop landscape strategies in order to tie the knowledge all together, proved appropriate for the scope of landscape planning tasks. All these steps of the workflow complemented each other, whereas including participatory research to the workflow proved especially valuable in co-creating knowledge of and for particular coastal SESs. Based on the process of this thesis I can conclude that the methodological choices of landscape planning are part of SESs resilience. The resilient way to manage coastal systems as a landscape planner is to mainly facilitate and curate the process of planning and management, connecting different properties of SESs as well as governance systems. This thesis confirmed the role of a landscape planner as a facilitator, helping to acknowledge, maintain and strengthen certain landscape qualities with the aim to increase positive human impact on ecological systems in order to reduce the threats to ecological habitats as well as human settlements.

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Appendix

Interview list and interview questions

List

Interview 1 - interview with the representative from Wolfscape urban district developer in Hundipea (Põhja-Tallinn); also an inhabitant of Põhja-Tallinn, 03.02.2022

Interview 2 - interview with local politician and inhabitant of Kakumäe (Haabersti, Tallinn), 07.02.2022

Interview 3 - interview with the inhabitant of Lohusalu and urban planner in Tallinn, 07.02.2022

Interview 4 - interview with the local inhabitant of Vääna-Jõesuu, 18.02.2022

Interview 5 - interview with the local inhabitant of Tabasalu, previous inhabitant of Muraste, 18.02.2022

Interview 6 - interview with the local inhabitant of Kakumäe (Haabersti), previous inhabitant of Pelgurand (Põhja-Tallinn), landscape architect by profession, 20.02.2022

Interview 7 - interview with local inhabitant of Lohusalu, 21.02.2022

Interview 8 - interview with local inhabitant of Vääna-Jõesuu, 21.02.2022

Interview 9 - interview with local inhabitant of Põhja-Tallinn, urban planner by profession, 23.02.2022

Interview 10 - interview with local inhabitant of Meremõisa, architect by profession, 23.03.2022

Interview questions

1. Where do you use the coastal landscape / the sea and why / what do you do there? Please point out exact locations on the map.

2. What are the most important values in this particular coastal landscape?

3. What are the most important threats and challenges in this particular coastal landscape?

4. What are the most important potentials in this particular coastal landscape?

5. Please finish the following sentence:

“ When I think about the future of this particular coastal landscape, it is important for me..”

by choosing three most important themes for you from the list[28].

[28] The interviewees were given a list of ecosystem services and examples of what a certain ESS could mean: e.g. aesthetic benefits & inspiration (e.g. access to coast).