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Pest or Pleasure?

An Evaluation of Urban Insect Conservation Governance – Cases from Hamburg & Malmö

Robin A. Memelink

Supervisor

Dr. Carl Dalhammar

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Tel: +46 – 46 222 02 00, Fax: +46 – 46 222 02 10, e-mail: iiiee@iiiee.lu.se.

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Abstract

Insects play vital roles in almost every ecosystem and have high ecological, social as well as economic value. Human activity -most critical in urban environments- profoundly stress insect populations and habitats, regardless of their known benefits to society. Conserving insects in an urban context remains a topic predominantly for insect enthusiasts and revolves around preferred insects, such as honeybees. In research, translation from natural to applied knowledge is sparse and the gap between the two is widening. Policy is dealing with a limited availability of -often ineffective- tools and instruments.

This paper provides an understanding of the current situation regarding urban insect conservation governance by reviewing existing literature and analysing two case study cities: Hamburg and Malmö. The outcomes aim to deliver main elements and focus areas for a(n) (more) effective, and mainstreaming of, the urban insect conservation governance concept.

The paper concludes that urban insect conservation deals with abundant and complex human and ecological factors. These factors lack applied understanding and locally tailored governance. Conservation in practice is prone to ambiguity due to general conservation goals; large scopes aiming for biodiversity maximisation; and short-term timescales. As a result, insects lack specific; structural; and strategic conservation, complicating the effective application of UICG into practice.

Main identified elements for a(n) (enhanced) urban insect conservation governance effectiveness discussed in this paper are: more applied and social research; the development of tools or guidelines for policy makers and urban planners; raising awareness for perceived insect values and motivations for conservation; utilising available knowledge; closer and structural cooperation amongst conservation stakeholders; defining and allocating clear responsibilities; and matching conservation efforts to available resources.

This research aims to contribute to the UICG knowledge foundation and possibly function as guideline for further applied research; supporting the practical implementation of effective UICG.

Keywords: Insect Conservation, Urbanisation, Governance, Policy Instruments, Applied Research,

Executive Summary

Problem definition and research questions

Humans and their anthropocentric values profoundly stress the habitats and health of insects. Insects are a wildlife group amongst the most affected by human activity and they experience fast declines, impacting biomass and abundance on a large scale (Habel, Samways, & Schmitt, 2019). Globally, a quarter of all insects are seriously threatened with extinction in the upcoming decades (Samways, McGeoch, & New, 2010). Especially in geographical areas where human activity clusters, insect biodiversity is especially under pressure (Hunter & Hunter, 2008; Mata et al., 2017; New, 2015). Regardless of urbanisation trends, where 70% of people on earth will live in cities by 2050 (Elmqvist et al., 2013) highlight its importance, insect conservation governance in an urban context remain underdeveloped. (Shwartz, Turbé, Julliard, Simon, & Prévot, 2014).

This research recognises two key research gaps on which it is positioned. The first gap, is centred around the lack of applied and social research focussing on urban insect conservation. A second gap, acknowledges the limited translation of conservation knowledge into fitting urban specific conservation tools and the incorporation of this knowledge into local governance. Aiming to address these gaps, this research focuses on gaining insight into the application of Urban Insect Conservation Governance (UICG) into practice. Keeping the UICG concept central, special attention was paid to: consolidating latest knowledge and developments; map and interpret the existing policy landscape; create an overview on the available governance instruments; develop an insight on current UICG effectiveness; and identify areas for improvements. The research intends to obtain clear research outcomes in the form of key insights and recommendations contributing to the UICG knowledge foundation supporting its effective application into practice.

The research is centred around the following RQ:
RQ: What are main elements to the development of an effective urban insect conservation governance?
The following three sub questions support the main research question:
SQ1: What are prevalent approaches related to urban insect conservation governance, according to literature?
SQ2: What is the state of affairs regarding urban insect conservation governance?
SQ3: What are next steps towards a more effective urban insect conservation governance?

Research design and methods

As it is amongst the first applied researches attempting to evaluate the application of UICG into practice, an exploratory research type was opted. To underpin the research findings and accurately answer the research questions, a formative evaluation of UICG is applied, as it is in an implementation phase or even under development. Because little quantitative performance data is available, a fully qualitative approach is maintained to support the: interpretation, description, and evaluation of the current state of affairs regarding UICG.

To help understand the emerging and complex UICG concept and develop an understanding of its current application into practice, two case studies were selected: the city of Hamburg (Germany) and the city of Malmö (Sweden). To collect the research data, two secondary and one primary research method were chosen. Method 1, was an extensive literature research, aimed at developing a knowledge foundation around the four themes: urbanisation, urban insect decline, governance instruments and preliminary UICG literature. Method 2, focussed on a document study based on policy documents and grey literature. It investigated the current policy

landscape and governance practices in place on the: international, European, national, and local level. Method 3, aims to obtain primary insights and judgements regarding the state of affairs and focus elements for improvements, by means of semi-structured and open ended email interviews. Interviewees covered a broad range of professional expertise, such as: project leaders, landscape architects, ecologists, researchers, and local politicians.

Research findings & analyses

Overall, the assessed literature indicates that UICG is an increasingly acknowledged concept in natural science, yet a social and applied focus remains sparsely researched. The fitting of natural science into suitable governance instruments to the local situation proves to be a difficult task, as tools and knowledge to do so are very limited. As derived from the document study, the policy landscape around UICG is almost in its totality based on the international CBD and EU Habitat Directive (Directive on the conservation of natural habitats and of wild flora and fauna, 1992; United Nations, 1992). As these pieces of legislation are initiated on a macro level with the intention to control the micro level, they fully depend on actions and policies adopted at lower authoritarian levels. Five types of potential UICG instruments were identified: direct regulation, economic instruments, service instruments, advocacy instruments, and collaborative instruments. Where literature has a strategic focus of regulatory, economic and advocacy instruments, the interviews showed that Hamburg and Malmö predominantly cover a policy mix around advocacy, service and collaborative instruments. However, the structural incorporation and utilisation of tools and knowledge in strategic management by the municipalities is limited. The interviewed experts expressed the absence or vague inclusion of insects in conservation programmes, targets, and urban planning.

When analysing the role of urbanisation towards UICG, the cases confirm similar prominent threats compared to the literature, namely: densification; fragmentation; isolation; alien species; and habitat loss. Particularly habitat loss prevention and the strategic optimisation of habitat quality were perceived main conservation efforts in the cases. The interviewed experts expressed how the prevention of habitat loss is a priority, though for a large extent is subject to reactive management. Insect conservation experts within the municipality consult and lobby in often already initiated urban planning and building projects. Experts regularly do not have a fixed role in such projects yet are only consulted when the need arises. This raises the issue of not structurally incorporating insect conservation into urban planning procedures.

It was found that most conservation programmes maintain general conservation goals and targets. Predominantly, the conservation aims to maximise biodiversity as a whole. Impacts resulting from such large goals, targets -or in this research referred to as conservation scopes- are difficult to isolate specifically for insects. Other preferred animals are valued for their individual valuation, prioritisation, and consideration in trade-offs made in policy making or in urban planning. Insects are mostly dependent on overarching animal groups or highly valued predators that depend on them. Furthermore, the lack of detail in conservation programmes does not provide conservation experts conservation tools nor guidelines as a base for conservation argumentation, discussion, policy process, or agenda setting. Policy makers and urban planners are left with vague conservation aims, limiting the strategic incorporation.

Literature and the investigated case studies show that biodiversity conservation emanates in almost all cases from the function of nature and (or), delivering satisfaction to humans, a so-called utilitarian value. A solely utilitarian focus complicates the creation of a win-win situation for insect and human. The interviewees unanimously motivated how a lacking valuation and awareness amongst the public, private sector and policy makers, is affecting the UICG situation.

Literature claims the essence of basing insect policy making on a dependable knowledge base and tight cooperation between research and practice. In practice, an increasingly hierarchical organisational structure of the municipality was claimed by interviewees to have caused an increasing isolation of department operations and separation of strategic decision making to conservation knowledge. Additionally: an increasing gap between natural and applied UICG research; missing structural consultation of experts; and limited monetary, time and human resources, lead to the lack of utilisation of existing UICG knowledge. Cooperation amongst the conservation stakeholders proved to be performed well. However, a misalignment in conservation agendas and expert views was claimed to restrict cooperative intentions.

Conclusions & Recommendations

By investigating and analysing the cases of Hamburg and Malmö, this research draws four main conclusions from its research findings:

- Urban insect conservation deals with abundant and complex human and ecological factors. These factors lack applied understanding, tailored governance and strategic incorporation.
- There exists controversy around the scope and timeframes of UICG efforts. Detail enhances knowledge and species specific conservation, where biodiversity maximisation in the current system is needed to avoid leaving species out of scope.
- UICG is interdependent with the perceived value of insects by society. Efforts made to influence value or establish governance, influence the currently weak position of insects in their prioritisation, consideration in policy making and urban planning. Especially when trade-offs are to be made.
- Organisational structure, communication channels, conservation agenda's affect UICG effectiveness and knowledge utilisation. There are opportunities for enhanced delineation of responsibilities and alignment of conservation efforts.

Identified patterns and inferences based on obtained insights and expert judgements, resulted in the following recommendations (or possible paths forward) aimed at UICG effectiveness:

Depending on available monetary, time and human resources, strategic and detailed incorporation of insects is to be considered. Such efforts would greatly enhance knowledge development and structurally incorporate insect conservation into strategy. Where resources are limited, the cases proved that a focus on smaller/practical initiatives might be more realistic.

Ineffective, vague, or general UICG should be avoided by reducing ambiguity in conservation programmes. The incorporation of detail by means of an enhanced insect specific focus in conservation: programmes, goals, targets, aims and key performance indicators, might be a method for capturing UICG into strategy. A balance of detailed and general programmes should assure holistic conservation; avoiding species left out of scope. With this enhanced detail, comes the allocation of responsibilities, supporting conservation stakeholders in their activities and providing policy makers and urban planners with clearer policy specifications and guidelines.

To assure the utilisation of conservation knowledge, strategies and policies are to be based on scientific and applied knowledge (Shwartz et al., 2014). A tighter cooperation between research and practice would counter the increasing gap between natural and applied UICG research. The increasing isolation between: 1) urban planners, policy- and strategic decision makers, and 2) conservation experts, like: municipal ecologists, nature conservation organisations, researchers or interest groups, should be reversed. Indirect communication channels should be minimised to establish a continuous crosstalk and fruitful knowledge exchange between conservation experts and policy makers. Focus is to be paid at reaching consensus on tailored conservation with a best interest for an effective conservation strategy on a city level.

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Abbreviations

BfN – (German) Federal Agency for Nature Conservation

BMUB – (German) Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

BNSAP – German Nature Conservation Action Programme

CBD – Convention of Biological Diversity

CITES – Convention on International Trade of Endangered Species

COP – Convention Of the Parties

EAP – Environmental Action Plan

EPA – (Swedish) Environmental Protection Agency

EQO – Environmental Quality Objectives

GIS – Geographic Information Systems

IUCN – International Union for Conservation of Nature

LAU – Local Administration Unit

NBSAP – National Biodiversity Strategy and Action Plan

PALM – Potential Allocation of urban development areas for sustainable Land Management

PES – Payment for Ecosystem Services

RQ – Research Question

SCBD – the Secretariat of the Convention on Biological Diversity

SDGs – Sustainable Development Goals

SQ – Sub Questions

TEEB – The Economic of Ecosystems and Biodiversity

UICG – Urban Insect Conservation Governance

UN – United Nations

URBACT – European cooperation programme for urban development

WTA – Willingness to Accept

WTP – Willingness to Pay

1 Introduction

Research has provided evidence for five extreme events of mass extinction of biodiversity (Mckinney & Lockwood, 1999). Sánchez-bayo & Wyckhuys (2019) reason that currently, the sixth event might be well underway. They elaborate that where the first five occurred millions of years before the existence of man, there is significant evidence that the 6th is due to the influence of man. To support their claim, main reasons for biodiversity loss resulting from human activities were found to be hunting and habitat loss. For hunting; mainly larger and individual animals are killed for the consumption or other direct benefit to humans. For habitat loss; larger numbers of animals or whole eco-systems are indirectly exterminated as a result of: deforestation, agricultural expansion and intensification, industrialisation and urbanisation. Insects are a wildlife group which is amongst the most affected by such human activities and experience large declines in populations and biomass (Habel et al., 2019). A quarter of all insect species is heading towards extinction in the upcoming decades (Samways, McGeoch, & New, 2010).

Compared to other "preferred" threatened animal species, insect decline is happening faster and on a much larger scale. By "preferred", Sánchez-bayo & Wyckhuys (2019) mean that *"most scientific and public attention has focused on charismatic vertebrates, particularly on mammals and birds"*. The stereotype that insects have in children books, is a good example of the way humans perceive insects. They are often characterised as hard, day-in day-out workers or as evil sly villains. On top of this, their individual size and the natural services they provide are miniscule and not directly visible to the human eye. Most insects are cursed with the human intrinsically disfavouring them, likely due to a combination of factors such as, large presence, nuisance, and general perception as unattractive or pests (Hunter & Hunter, 2008; Simaika & Samways, 2018). This view creates a negative stereotype and causes their benefits to go unnoticed.

Over the past decade, the scale and thereby essence of the insect decline issue, is increasingly recognised and studied (Samways, 2018). This is partly to do with how speciose insects are as an animal group of about a million defined out of the four million estimated species (Samways et al., 2010). Their disappearance has highlighted their central roles in almost every eco-system thinkable and thereby their enormous importance. Insects have plants, animals and humans depend on them in myriad ways as they interact with species throughout their ecosystems, provide eco-services, and are food for various animals of higher tropic layers in the food web (Habel et al., 2019; Samways et al., 2010). The research of Hallmann et al (2017) indicates the rapid trend of insect decline, as they measured a biomass decrease of flying insects in German natural protected areas of 75% over a period of 27 years up till 2016. Also Nieto et al. (2014) found a significant 37% decline of European bees and 31% of butterfly species, from which 9% of both taxa are seriously threatened. Biesmeijer et al. (2006), approached it from a slightly different angle, by measuring pollinators linked to wild plant species, based on geographical cells. They measured a sharp decrease in bees for the measured cells, as they only increased for 4% and decreased in 67% of the cells. This did not apply to hoverflies, also incorporated in the study. A slight increase in species for 34% of the cells was measured, where for 17% they decreased. These limited but impressive quantitative studies provide insight in the severe insect decline phenomenon that has emerged almost unwittingly over the past decades.

The impact of agriculture, in particular the usage of pesticides and herbicides and logging to free up arable land, is fairly well understood, because of clear sources and responsibility of impact (Elmqvist et al., 2013; Norris, 2008; Sánchez-bayo & Wyckhuys, 2019). Insect conservation in an urban context is however less recognised (Dearborn & Kark, 2009; New, 2015). Especially in geographical areas where human activity clusters, insect biodiversity is extra threatened (Hunter & Hunter, 2008; Mata et al., 2017; New, 2015). With an ever increasing number of people living in urban environments and a growing trend of people moving from rural areas to

cities, it is estimated that over 70% of the people on earth will live in cities by 2050 (Elmqvist et al., 2013). To indicate the speed of urbanisation, 60% of all urban terrain existent in 2030, is expected to be built in the 30 year run-up from 2000 till 2030 (Habel et al., 2019). Cities are likely not designed for such a growth and require new living and public spaces for all these inhabitants. Realising housing and liveable cities, calls for the rethinking of urban planning and growth strategies (Elmqvist et al., 2013).

1.1 Problem Definition

Urbanisation poses a large threat to insects as it -amongst others- leads to intensified disruption of local eco-system structures, stresses the existing habitats, and causes rapid change of land-use (Dearborn & Kark, 2009). Nevertheless, cities still maintain large biodiversity including threatened and valuable native species. For various species, the urban environment is specifically favourable (Elmqvist et al., 2015). Some have exchanged their natural habitat for a life in the city and can no longer be found anywhere else (Schilthuizen, 2018). In some instances the city is a place with more species richness than the natural area which it replaced (McKinney, 2008). However, multiple facets of urbanisation combined with the adaptation of nature, generally have led to the homogenisation of insect species around the world (Hobbs et al., 2019). The thriving of few successfully urbanized species ('winners') and the collapse of many others ('losers') (Mckinney & Lockwood, 1999), together with a rapidly changing urban environment, lack of research and lack of recognition of their central roles, has led to harsh and pressured urban habitats and the unbalancing of their eco-systems (Elmqvist et al., 2013). The species that manage to adapt to the habitat of the human will most definitely thrive if humans will not factor in fellow indigenous species.

The limited recognition around urban insect conservation together with the trends around insect decline and urbanisation, highlight the unawareness for this concept and need for an enhanced conservation governance. Without effective governance, these trends will most definitely mean (even) more habitat loss and abundant other threats stressing the survival of insects in an urban context (Elmqvist et al., 2013). The interest for 'urban greening' and 'liveable cities' offers prospect for enhanced insect governance in cities (Elmqvist et al., 2013). Samways (2018) claims *"insects are increasingly enshrined in policy"*, that is, for countries that respect and value them. Nevertheless, it is still in an early phase with limited performed research and few, but under investigated applied cases. Turning research into actionable measures, proves to be challenging (Mascia et al., 2003; Mata et al., 2017; Norris, 2008).

Even though insect conservation is not a novel concept in research nor practice, this research recognises two research gaps on which it positions itself. The first gap exists around the insect conservation knowledge which is currently available. This knowledge is primarily established by natural science. The more novel social or applied research towards insect conservation remains sparse (Botzat, Fischer, & Kowarik, 2016), causing the two research types to divide further (Honey-Rosés & Pendleton, 2013). A second gap is existent around the translation of conservation knowledge into practical conservation tools and its incorporation into governance. The urban sector, recognised as an area of intense impact to insects, remains underdeveloped when it comes to the conservation of insects (Shwartz, et al, 2014). Rural insect conservation governance instruments, predominantly for the agricultural sector have received more focus, causing it to have gradually matured there (Norris, 2008). Stakeholders involved with the conservation of insects in cities, are not adequately supported in their efforts to get it on the political agenda. (New, 2012).

1.2 Research Aim & Audience

This research contributes to tackling the described problems in the previous section, by identifying the key issues in order to support an enhanced Urban Insect Conservation Governance effectiveness, in this paper further referred to as 'UICG'. It contributes to the UICG knowledge foundation, by providing an understanding of the current state of affairs, latest knowledge and developments, and mapping the supportive policy landscape and available governance instruments. This improved understanding of UICG, supports its application into practice, tackling the insect decline issue and a desired liveable and green urban environment overall.

Ultimately, this research aims to contribute to an improved UICG situation as applied in practice. It intends to raise awareness amongst conservation stakeholders and where possible the public for the insect decline issue specifically in an urban context. The hope is that the cities Hamburg and Malmö especially benefit from the research deliverables, as research findings and recommendations are based off from their respective situation. Hopefully, other urban environments draw learnings from the identified focus elements and make use of this research framework as guideline for own applied research aimed at the development of effective governance instruments and strategic measures. The targeted audience is: strategic governmental/municipal stakeholders, mainly: policy makers, urban planners, and ecologists. Also targeted are further public and private stakeholders or interest groups, first interested in the topic and looking to expand their knowledge on UICG.

Besides, this research helps build an applied research foundation, assisting the translation of natural scientific knowledge into suitable and actionable UICG instruments or tools. This study is one of the first applied studies on UICG, and it seeks to expand recognition for insect conservation in an urban context as research field. It aims to give direction, serve as a point of departure, and motivate further research on the interaction between humans and animals, development of governance instruments and UICG effectiveness. Another aspiration is a closer cooperation and crosstalk between natural and applied stakeholders in research as well as between researchers and public and private stakeholders.

1.3 Research Question

The research topic outlined in the preceding introductory sections, have led to the Research Questions (RQs) stated and elaborated below:

RQ: What are main elements to the development of an effective urban insect conservation governance?
The issue of insect decline as a result of urban anthropogenic areas is known and causes are increasingly recognised. By means of a detailed analysis, this research will identify the elements of most importance to the development and/or improvement of effective urban insect conservation governance. It will help to develop an insight in what can be done to address the decline. To develop an understanding of these elements, this research question will seek to understand: what is already known about it in literature? What does UICG look like, applied in practice? What are expert views towards UICG and main elements for effectiveness?

The intentions of the above stated RQ are supported and investigated in its totality, by breaking it down into the following three sub-questions (SQ).

SQ1: What are prevalent approaches related to urban insect conservation governance, according to literature?
This first question laid the foundation for the research. It was based on existing research and sought to obtain state of the art knowledge and latest developments regarding urban insect conservation. Answering this question, provided background and insight into what was relevant and where focus areas laid. This was essential knowledge required for the design and relevancy of the rest of the research. Primary data obtained in this research, was tested and assessed by comparing it to the findings of this section in order to create inferences and research findings. The expert interviews were structured based on the obtained knowledge to this sub question.

SQ2: What is the state of affairs regarding urban insect conservation governance?
A comprehensive understanding of what is in place or put into practice was developed in this part. An in-depth analysis of two case cities Hamburg and Malmö was maintained as scope for this research. The policy landscape including policy instruments, programmes and conservation initiatives are explored and expert interviews provide insight in the current state of affairs and judgements towards it. This provided insight in what actually happened in practice, compared to what was stated in literature.

SQ3: What are next steps towards a more effective urban insect conservation governance?
The expert beliefs, values, knowledge and judgements were used to obtain the acceptability of the insect conservation governance state of affairs and develop focus areas or improvements. Next steps for the cases towards a more effective UICG situation are presented.

The outputs of SQ1, SQ2, and SQ3 are analysed and consolidated to answer this paper's RQ in the conclusion.

1.4 Research Scope

For this research the case studies are geographically based in the City of Hamburg in Germany and the City of Malmö in Sweden. Motivations for this choice are that both cities from a preliminary web search claim to be both green with ambitious targets in line with the Europe's Sustainable Development Goals (SDG's) and numerous liveable initiatives ('Green Hamburg', n.d.; 'Sustainable Malmö', n.d.). Both also have dedicated webpages for nature conservation and even incorporate some information related to insects (Hamburg, n.d.; Malmö Stad, 2018). Out of practical considerations, the geographical location of the cities was considered as they can be reached by train for research purposes on site. Also, partial familiarity with German language and existing contacts in either case city were decisive factors. The following factors were considered as important factors for the choice of cases, as they potentially deliver interesting and varying research results: differing countries, located in northern temperate area, varying sizes, governance structures, and climates.

Considering that the physical activities for agriculture predominantly take place in rural environments, the decision was made to exclude agricultural impacts to insects from the research scope. In the cases where agriculture does take place in an urban environment, it is mostly on the border and adjacent to rural landscapes. It is therefore not considered in the inventory of available policy instruments in *section* 3.2.5 nor in the mapping of the policy landscape in *section 4.1.* However, agriculture is included in several statements concerning the comparison or placing the urban situation in perspective to the rural situation.

When referring to 'insects' in this research, all types of animal groups allocated to the insect family and their life stages are included. To name the main groups of insects incorporated:

beetles, bees, wasps, ants, flies, true bugs, butterflies, moths, grasshoppers, locusts, grasshoppers, dragonflies and damselflies ('Types of Insects', n.d.).

1.5 Ethical Considerations

Ethical considerations to this research were primarily related to the expert interviews. The selection of interviewees, approach to obtaining information and incorporation of opinions and statements were carefully considered and approached with caution to avoid offending or disfavouring any interviewee. Consulted experts participated voluntarily and out of interest to the research.

Any obtained personal data and insights from the interviewees was treated with care and used solely for this research and knowledge development of the researcher. To further assure interviewee privacy, each interviewee was asked for their approval to refer to their name and role, linked to the obtained insights and quotes, in this research. At the end of the interviews the option for follow-up was requested by the researcher. The opportunity to follow-up was used to confirm and obtain approval for the incorporation of statements and quotes. This helped to assure the incorporation of accurate claims. When applicable, interviewees were asked for their approval to record the interview. The recording of interviews was performed to assure accurate transcriptions assuring validity and the minimisation or misinterpretation of claims. It greatly benefitted the researcher in obtaining research findings. Regardless of the interviewee's confirmation for referral to their name, when following up with interviewees, names of other interviewees were anonymised.

1.6 Disposition

This *first chapter* is dedicated to the introduction and provisioning of background to the research topic. The problem definition sets the scene by delineating: what issues revolve around insects in an urban context and where gaps in research exists. The chapter goes on by presenting the research aim and intended audience. It presents how the research will aim to contribute to an applied knowledge foundation by exploring and mapping the current situation around UICG in practice. The research question, substantiated by three underlaying sub questions, together with a section on scoping are presented next as foundation for the chapters to come.

Chapter two explains the methods applied and activities performed in this research. It motivates the approach taken, presumptions to the research and explains the types of research methods applied. It motivates the choice and application of the case studies approach; for detailed analysis of the research problem. Then two methods of secondary research are presented. The first, encompasses a large literature study, covering the four themes: urbanisation, urban insect decline, governance instruments and preliminary UICG literature. It presents models and frameworks from existing research; kept as research foundation. The second, is a grey literature document study for the mapping of the policy landscape around UICG. The primary method of expert interviews, with the purpose to develop an understanding of UICG in practice, judgement towards its effectiveness and highlighting of focus areas for improvement. The last section of the chapter elaborates on the data analysis approach for developing research findings.

Chapter three, demonstrates the reviewed, analysed and synthesised existing literature relevant to the development of a knowledge foundation to this research. This section is divided into two parts: the first section covers relevant concepts and realising patterns around vital factors for UICG; the second part presents an inventory of available UICG instruments.

Chapter four, presents the research findings of the two primary research methods. The document study in the first phase, maps out the policy landscape around UICG, from an international scale down to the two case studies Hamburg and Malmö. The second phase presents: the

analysed and interpreted outcomes of the expert interviews, insights in the current situation, pressing issues, and focus areas for improvement.

Chapter five, interprets the research findings by reflecting upon: the reviewed literature, document study and interviews. It discusses the correlations, patterns, obtained insights, and newly discovered findings. A reflection on the research methods and approach presents possible limitations to the research and findings.

Chapter six, consolidates the research into four main conclusions and presents them as main take-away messages. In connection to each conclusion, recommendations and areas of further research are raised.

2 Methodology

To develop the required insights for answering the research questions, the following chapter presents a general analytical framework applied to structure the research. The research framework presents the sequence of research methods performed for obtaining research. It also comments on the assumptions made and approach taken to analyse the obtained data.

2.1 Research Design

This research positioned itself on the research gap existing around applied UICG research. Focussing on practical UICG implementation, this research aims to contribute to developing an understanding of the current state of affairs around UICG. An exploratory research type was opted to match the developing stage of UICG in research. Qualitative approaches support the interpretation, description, and evaluation of the current state of affairs regarding UICG. Since the research is focussed on the evaluation of a governance situation, which had little available quantitative performance data, Walliman (2006) suggest the qualitative focus on capturing judgements, opinions, beliefs, values and acceptability of the current situation as indicators for explaining the current situation and proxy to identify focus areas for improvements.

This research is positioned in order to contribute to the problem statement by means of a formative evaluation. Applied to governance and policy, such a method evaluates potential effectiveness and aims at identifying areas for improvement at any stage while still under development. Such a method helps to create missing knowledge, and highlight effective or ineffective focus areas (Weiss, 1998). This research seeks to understand and evaluate the current phase UICG is in and seeks to highlight areas for improvement, while it is still in its implementation or even development phase. The whole context of the governance situation is relevant to arrive at conclusions. Weiss (1998) calls it, a policy situation which is still "fluid". She argues that the evaluation and developing of new policies, prevents things from going wrong later and allows for changes when it can still be implemented quickly, cheaply and easily (Weiss, 1998). This formative approach puts less focus on what is right or wrong or the overall impact, and more on what is in place, how it performs more generally, and where areas for improvement lie. "*Formative research… will look at components, attributes, the structure of operation and characteristics of participants"* (Weiss, 1998).

2.1.1 Case studies

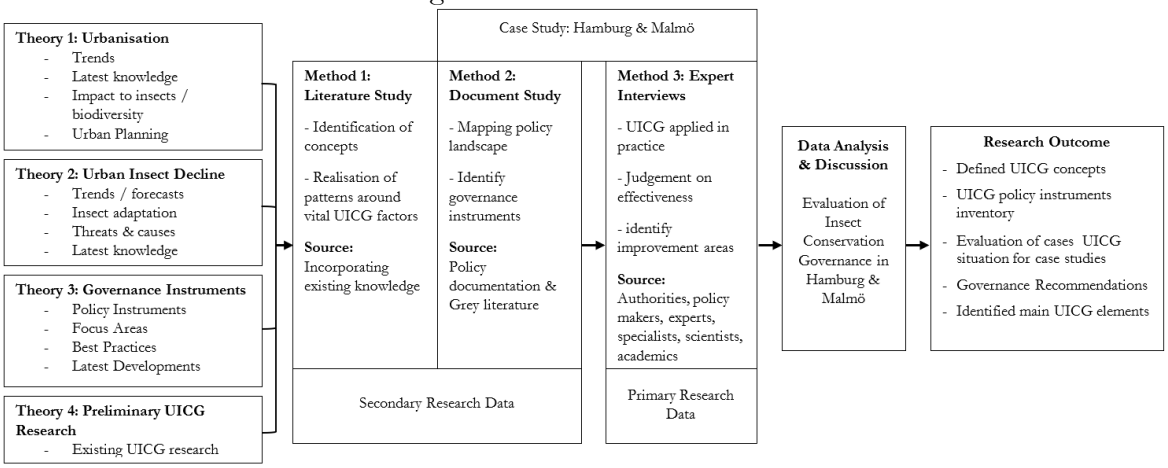
As the defined problems around urban insects and efforts made to conserve them take place in many urban areas around the world, a trade-off in practicality and limitations had to be made. The research scope was set by the conducting of two detailed case studies as samples representing the larger UICG situation. This approach is effective for the collection of empirical material to help understand an emerging and complex phenomenon, allowing for an in depth and holistic evaluation of suitable cases. The purpose for the incorporation of more than one case study, was to improve the validity of research findings. The author considered and tested the usage of three case studies, but due to available resources, three cases was considered unrealistic. The two selected case studies delivered qualitative insights into both urban insect conservation situations. The investigation of two instead of one case study enhanced the comprehensiveness of research results as they returned complementary or conflicting findings. Such findings assisted in the identification of improvement and focus area relevancy (Walliman, 2006). The case studies were compared by means of a general approach, comparing their insect conservation programmes and plans, management approaches, and governance instruments. However, detailed comparison of the cases is avoided, as generalisability issues were realised due to various reasons (i.e. different municipal structures, varying geographical situations, different urban situations and issues, or cultural influences). By applying the case study approach, the researcher aimed to study a new and emerging phenomenon, linked to other and

overarching processes or programmes (i.e biodiversity in cities, ecosystem services) in more detail. The choice for selecting the case studies of the City of Hamburg in Germany and the City of Malmö in Sweden is further reasoned in *section 1.4*.

2.2 Methods for Data Collection

As visualised in *Figure 2-1*, the methods used to perform this study are threefold: comprising a literature research (*secondary research*), document study (*method 1*), and interviews (*method 2*).

Figure 2-1: Research Framework



Source: Author

2.2.1 Secondary Research

As foundation to the research, it was considered necessary to get a complete understanding of what UICG contains. To develop this knowledge foundation an extensive literature study is performed identifying and analysing existing research. Four main themes in literature were scrutinised: urbanisation, urban insect decline, governance instruments, and preliminary existing UICG research.

The literature study helped frame the research point of departure and provide required knowledge, as it creates a clear overview of what has been done and where specifically this research aims to contribute to the larger problem. It identified the research gaps and research aim, as stated in *Section 1.2* In general terms, the literature study covered four main themes: the first theme, '*urbanisation',* revolves around the anthropogenic trends and effective management of land in the areas where humans live and work densely together. An understanding is developed for the interaction between human and nature in these areas. Secondly, '*urban insect decline'*, scrutinised to obtain a comprehensive understanding of trends, threats and causes, latest developments, and expectations or forecasts regarding the environmental problem of diminishing insects in an urban context. This theme is based on the six inter-related UICG themes by Samways (2018), as shown in *Figure 3-1*; adapted seven motivations for UICG from Dearborn & Kark (2009), as shown in *Figure 3-3*; and the UICG conceptual framework adapted from Hamer & McDonnell (2008), in Figure 3-5. Third, the theme *'governance of insects in an urban context'* was explored in existing literature to identify: the available policy instruments, focus areas, best practices and latest developments around UICG. This analysis delivered a holistic UICG instrument inventory, as presented in the five tables of *section 3.2.5*. Furthermore, an analysis and consolidation of the available *'Preliminary UICG Research'*, delivered the knowledge baseline for the primary data research steps.

Another form of secondary research is applied in the data collection phase of the research. *Method 2* takes the form of an '*exploratory document study'*, aimed at mapping the existing policy

landscape around UICG. It investigates the current regulation in place on an international, European, and national level. On a city level, it provides an overview of the governance practices established for Malmö and Hamburg. This method included the collection and analysis of policy documents and grey literature as data sources. A web-search was performed to derive most publicly available documentation; complemented by retrieving brochures or documentation from experts that the author engaged with throughout the research.

2.2.2 Primary Research

Where the previous research methods, turned existing data to a useful research foundation, a third method, focussing on obtaining primary research data, took the form of expert interviews. Even though, most documentation around the strategies and governance of both case studies was publicly available online; the triangulation of data methods by conducting interviews was opted for, to allow for the identification of the governance effectiveness. Where grey literature provided the state of affairs regarding the UICG policy landscape, it was unable to provide the possibly existing gap between theory and practice. Documentation was considered insufficient, as it often has the aim to communicate ambitious and ideal situations, instead of a critical view on weaknesses or improvement areas. Interviews, obtaining expert insights and judgements regarding the state of affairs and improvement areas, were considered a suitable and valid source (Walliman, 2006). A community of practice method, defined by Wenger & Lave (2005) as: "*groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly"* was applied for the interviews. This allowed to get a clear insight in the UICG situations of Malmö and Hamburg. The selection of suitable experts was performed based on their roles and experience. The recruiting was performed based on a web-search and by means of a snowball effect, utilising the network of experts. A classification of experts according to their relevancy in a stakeholder list, supported the contacting experts and following-up with them.

Consulted experts in both cases had different disciplines but were well connected and knew one another because of their occupation and interest for insect conservation. For this research a total number of eleven interviews were conducted throughout the period between the 4th of June 2019 and the 9th of September 2019. Six of the interviews took the form of a semi-structured interactive interview in person, per phone call or via videoconference. Two of the in-person interviews were conducted after or during a guided tour relating to inset conservation applied in practice. Another five experts were consulted by means of open-ended questions per e-mail. See *Appendix I* for detailed information regarding the interviewees and interview types. The consulted experts were active in public or private bodies and held the positions of: project leader, landscape architect, ecologist, researcher or local politician. These interviews were conducted with the purpose to obtain normative value based believes, knowledge and opinions regarding the political acceptability of the current governance situation. Initially the experts were consulted by means of a semi-structured expert interviews in-person. However, to match interviewee availability, also open-ended questions per email were used as data gathering method. To guide the interviews, the experts were provided with a set of questions prior to the interview. This list was based on a premade interview guide, which is enclosed in *Appendix III* - Interview Guide,.

2.2.3 Data Analysis and Outcome

For the analysis of research data and the effective development of research findings, a synthesis of data was performed by means of a coding method. The codes used for the secondary research data obtained from the literature study are presented in *Appendix II* – Codes. For the coding exercise, the software NVivo was used, principally for its effective coding function. The codes were created based on identified patterns and themes from the obtained research data (Verschuren & Doorewaard, 2010). The data and patterns used as base for the codes were:

patterns around existing UICG knowledge from the literature research and existing policies as content from the document study. Applying the coding method, supported the researcher in reviewing, storing, and analysing data in a structured way, supporting the development of research findings. This inductive approach helped to identify relevant concepts around UICG and assisted the mapping of available UICG instruments. It allowed keeping a broad perspective with the intention to develop a holistic understanding towards the theories around UICG. Applying this approach, minimised the influencing or guiding of results by the researcher's preconceived ideas or beliefs (Creswell, 2014).

The identified patterns and themes turned to codes, were used as base for the designing of the interviews and analysis of the case studies. This resulted in an interview structure around four identified themes: urbanisation & insect conservation, strategy & policy landscape, urban planning & trade-offs, and focus areas & next steps. Valuing the proficiency of the experts, the development of research findings from the interviews was based on their statements and judgements. Inferences were created by linking expert statements and judgements to the identified patterns and themes of the previously completed literature and document study data gathering activities.

To ensure the valid incorporation of the interviews into the research and avoid strong or false inferences, most of the interviews were recorded (Creswell, John, 2014). Not all were recorded for the fact that they took place outdoor and during an informative tour in which also random participants took part with no connection to the research. Due to long duration and privacy elements, note taking was relied upon as documentation method for these interviews. The recordings and notes were transcribed and documented to allow detailed analysis of the interviews. All interviewees were asked for the possibility to follow up after the interview. This option was utilised for interviews in need of clarification, validation of statements, or further elaboration on findings on a later point in time.

3 Literature Review and Analysis

A review of existing literature relevant to obtain the knowledge foundation for the research focus towards UICG, is divided in two main parts. The first part (*section 3.1*), '*Urban Insect Conservation'* identifies the underlaying concepts on which UICG depends. The second part (*section 3.2*), *'Governance Instruments'* comprises an inventory, outlining the identified governance instruments available for UICG.

3.1 Part I - Urban Insect Conservation

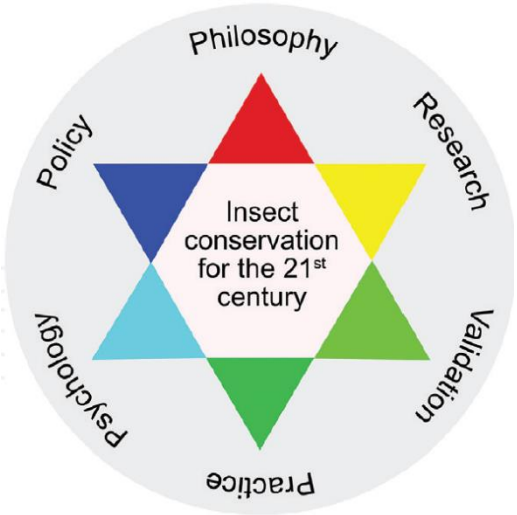
This first part of the literature research identifies and elaborates on the underlaying concepts to UICG. It covers practices, trends and latest developments around values and motivations for conservation, insect conservation in an urban environment and urbanisation impacts.

3.1.1 Insect Conservation Past & Present

The study of insects for scientific purposes under the term 'entomology' dates as far back as the 16th century. As a subset of the overarching 'zoology', research around insects experienced a swift development and expansion. This development was however not as fast as the discovery of new areas of research. Entomology is a great example of, "*The more you know, the more you know you don't know*" (Aristotle, n.d.). Completed research around 'taxonomy' of insects, is an ongoing field of research; identifying new areas of research on a daily basis. Not to speak of underlaying but large fields of research on their own called 'ethology', focussing on the desire to understand the behaviour of these species and 'anthrozoology', examining the interaction between humans and animals (Samways et al., 2010). A more recent form of research is studying the translation of all this natural science research into applied practices for conserving insects.

Europe is the leader in insect conservation research and practices with clearly defined conservation needs and specifically designed practices are developed based on complete and valid investigations (New, 2012). Relative to other regions, research is fairly generalisable and therefore of great benefit to other European countries. Knowledge and documentation are of high quality. Insect research is also frequently linked to other fauna, flora, climate and social research. The relatively long history of insect collection and monitoring, combined with a comprehensive taxonomic foundation, lead to "*reasonable confidence in the species conservation inferences we can draw"* (New, 2012).

Figure 3-1: Inter-related themes to insect conservation



Source: (Samways, 2018)

Urban insect conservation governance is built on the foundation of natural research, but draws in other potentially more complex areas of research, involving human factors. Samways (2018), has identified six themes integral to the insect conservation of the 21st century *(Figure 3-1)*. These themes are outlined in the table below:

Table 3-1: Description of inter-related themes to insect conservation

1	**Philosophy -** involves the conservation values and benefits interchanged between human and insect. Matching to *sections 3.1.2,* about values *and 3.1.3* about motivations.
2	**Research -** the development of a knowledge foundation, including the taxonomy, ethology, anthrozoology of insect species, plus the incorporation of human factors and their ability to develop knowledge on how to conserve insects and manipulate the environment. Covered by the literature study in *chapter 3*.
3	**Policy -** the incorporation of insect conservation into principles of municipal action. This is performed by two possible means. First, as a component of biodiversity. Second, as the provisioning of ecosystem services. This relates to the identified policy instruments in *section 3.2.5*.
4	**Psychology -** is creating an understanding of the relationship between man and insect. It involves creating awareness around human impacts and insect conservation benefits for both nature and humans. This is elaborated on in *sections 3.2.2 till 3.2.4*.
5	**Practice -** the actual conservation activities performed by various stakeholders, designed based on and around all other themes. This takes the form of physical protected land areas or softer management approaches. In *chapter 4*, this research aims to identify the practical situations of UICG for the two case studies Hamburg and Malmö.
6	**Validation of Effectiveness -** involves learning by doing and ex post research, through the evaluation of effectiveness and studying of improvement areas. Validation is a continuous and circular process to understand, refine and thereby balance the six themes (Samways, 2018). This last theme is touched upon as further research in *chapter 6*, as it proved absent in both literature and the cases.

Source: (Samways, 2018)

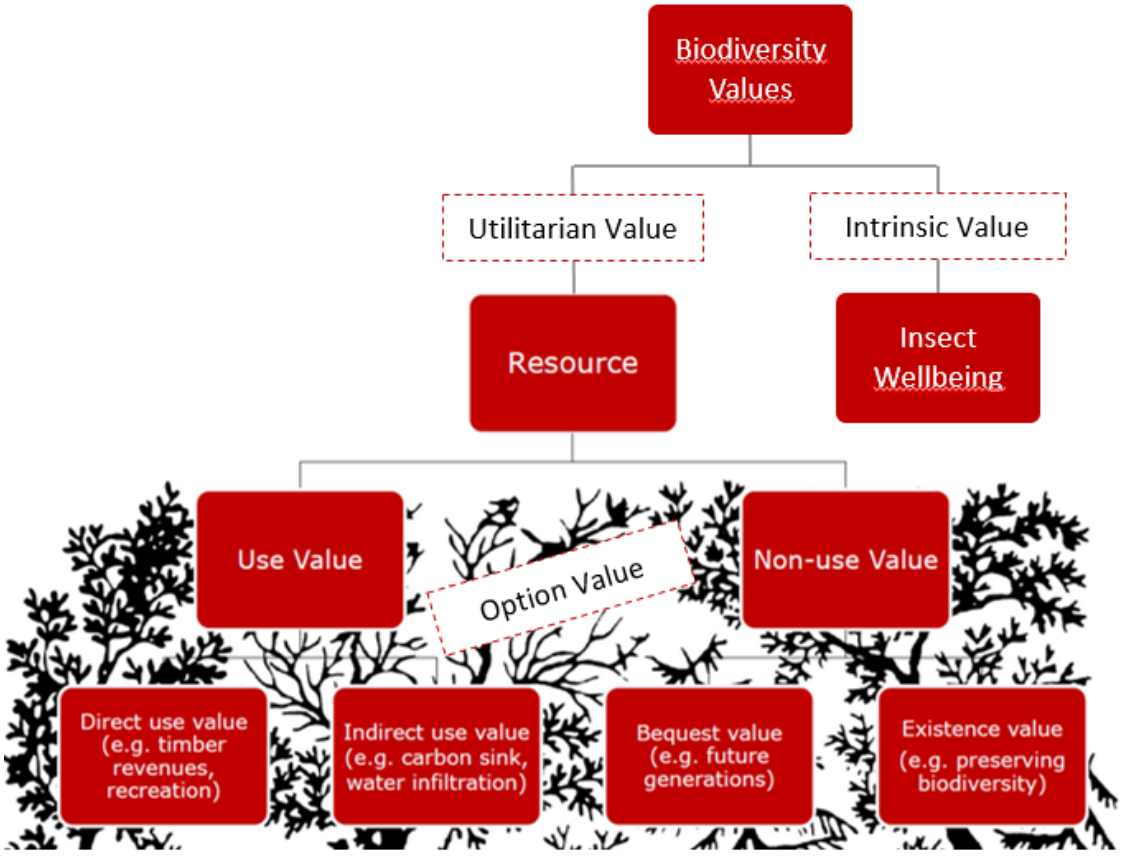
3.1.2 The Value of Biodiversity

The fact that insect conservation is a developing practice and seldomly incorporated into regional conservation policy, has to do with the fact that it is still largely unrecognised. Insects and their roles in most of the world's ecosystems, do not receive appreciation for the services and benefits resulting from their activities. Their benefits are unknown to the majority. Nevertheless, insects are of invaluable ecological as well as economic importance (Habel et al., 2019) providing ample evidence for the essence of their conservation and effective governance.

Reasons for biodiversity conservation emanate from the value which it provides in maintaining a balanced ecosystem and supporting other flora and fauna. In conservation, it can be expressed in the value which is created, but mostly the prevented loss of value. Such values have been for a long time, and still are, frequently underestimated (Assessment Millenium Ecosystem, 2005; Elmqvist et al., 2015). People from different backgrounds, disciplines, philosophical views, and schools of thought, value biodiversity conservation differently. There is a common discussion regarding value of nature between people reasoning from different worldviews (Assessment Millenium Ecosystem, 2005). It includes the way they seek to understand the world they live in and the role humans have towards nature, determining their reasoning point of departure. Where for some, humans stand central to nature. Nature facilitates humans in their needs and wants. Others hold dear to a more life or earth centred view, where humans are part of nature. We must not leave any traces and preserve life and nature (Miller & Spoolman, 2016). (Simaika & Samways, 2018) add that there are three views towards the role of humans in the extinction of biodiversity. It can be seen as; a loss of resources, or a mistake; mass extinction, or a crime; or that humans are a cancer affecting the environment; it is inevitable. He goes on by stating that a global recognition is required for the fact that humans do so much damage to the natural systems they depend on so heavily. Humans are the root cause to mass extinction of biodiversity and especially insect decline.

All varying values to biodiversity can be grouped into three overarching types: utilitarian value, intrinsic value and option value (*see Figure 3-2*). 'Utilitarian value' or 'instrumental value' entails the function of nature, delivering satisfaction to humans. It is often used for the maximization of well-being (Hiron, Pärt, Siriwardena, & Whittingham, 2018). This includes the conservation of biodiversity by humans, for humans. Utilitarian value can take the form of 'use-' and 'non-use value'. 'Use-value' has the aim to directly benefit humans. Involving the practical use of biodiversity for products or consumption. Or provide indirect benefit, through the provisioning of natural services (Perlman & Adelson, 1997; Assessment Millenium Ecosystem, 2005). 'Non-use values' are assigned to biodiversity that is not used but valued for their existence. The fact that biodiversity and the ecosystems they thrive in are healthy and still present momentarily, is expressed as 'existence value'. A similar value called 'bequest value' is derived, not for knowing biodiversity is there for an individual him-/herself, but for a longer period of time and for generations to come. Such non-use values often derive from varying ethical, spiritual, historical, cultural, or religious values an individual lives by (Assessment Millenium Ecosystem, 2005). 'Option value' is similar to non-use value, but it goes further in the sense that something could become value while now it is not. This could include a resource becoming of value only after technology, research or scientific developments have discovered purpose for it (Smedby, 2018). Often, option value is fused with bequest value. Another type of value is 'intrinsic value' or 'inherent value'. This includes being of value by itself and not what other organisms derive from it. Each specie is valued equally, with equal right to exist regardless of their value to humans (Perlman & Adelson, 1997). Pearson (2016), states that for viewing nature conservation intrinsically *"It is morally right to conserve nature aside of human interests … nature is valued for what it is, rather than what it does …".*

Figure 3-2: Total Economic Value and Intrinsic Value

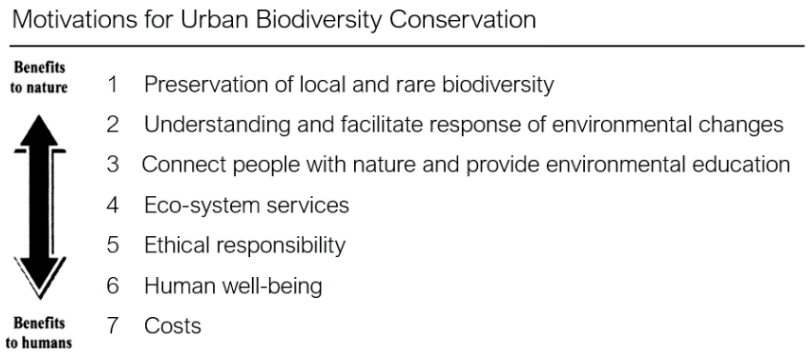


Source: Bettina von Arnim (picture), (Smedby, 2018) (chart), reworked by Author

3.1.3 Motivations for Insect Conservation

Motivations for conservation can have the intention to benefit nature or, since humans everywhere around the world have adopted a dominant role as ecosystem engineers, conservation practices are applied with the motivation to benefit humans themselves (Dearborn & Kark, 2009). This is in line with the classification of values by Perlman & Adelson (1997). Nature benefit links with intrinsic values, where human benefit links with instrumental benefit. For most conservation initiatives, a mix of human and nature benefits exists or is planned for. A one sided focus will almost certainly result in an unilateral gratification, instead of a desired collective well-being (Chan et al., 2016). Based on this range of benefits from nature to human, Dearborn & Kark (2009) have classified urban conservation reasons into seven motivational categories, as outlined in *Figure 3-3*.

Figure 3-3: Motivations for Urban Biodiversity Conservation



Source: Dearborn & Kark, 2009 reworked by author

The next sections will scrutinise these motivations. This range of motivators is slightly adapted from Dearborn & Kark (2009). The by the identified motivation "*Create stepping stones or corridors for natural populations"* is excluded in this research, as in various literature sources the concept of "connectivity" or its antonym "fragmentation" were considered a solution or cause, not a motivation (Jones & Leather, 2012; New, 2015). Instead, costs are considered as another motivation. Insects deliver great contributions to human controlled systems. It would inquire large costs in case of degradation and replacement by human efforts (Haase et al., 2014; Habel et al., 2019). Costs is a motivator fully linked with the human constructed economical system and for this reason positioned as outlying human benefitting motivator.

Preservation of Local and Rare Biodiversity

As insects are at the core of almost all ecosystems, their loss is a direct effect to the functioning of the respective systems. The conservation of insects can mean the direct preservation of local and rare insects or indirectly stabilising ecosystems by virtue of improving conditions for dependent species (Haase et al., 2014). Ollerton, Winfree, & Tarrant (2011) estimated that a 78% average of wild plants in temperate ecosystems are dependent on animal pollination. Bats, some bird species but predominantly insects facilitate this service. A similar high dependency of +/- 60% of birds are insectivorous and dependent on insects for nutrition (Morse, 1971).

The conservation of insect species and their populations purely for the sake of ensuring their healthy presence is in line with the intrinsic values. This type of motivation comes forward from the knowledge and awareness of the barren status of nature and the urge to preserve it (Simaika & Samways, 2018). Humans have the ability and availability of abundance of tools, to assist nature in keeping healthy ecosystems. For this motivation, regardless of species benefits to human or natural processes, they are conserved with the intention to benefit nature in preventing the loss of it (Dearborn & Kark, 2009). This can involve the supporting of nationally

identified rare species, urban unique insect, or International Union for Conservation of Nature (IUCN) Red list threatened or endangered species (Shwartz et al., 2014). This motivation goes with the consideration of finding a balance in letting nature restore and adapt itself or allow human interference with natural processes as ecosystem engineers. Applying the laissez-faire policy approach by leaving nature to restore itself is occasionally the preferred approach. However, owing to severe and continuing damage, this is often not sufficient. In this case a human interference could prevent natural losses (Elmqvist et al., 2015).

Understand and Facilitate Response to Environmental Changes

The conservation of insects in an urban context has proven a complex task by itself due to a wide variety of elements such as rapid change, human competition, trade-offs[1] and high variety in landscapes (Kowarik, 2011). Additionally, it is embedded into a wide variety of disciplines and is subject to the psychology of millions of urban dwellers (Samways, 2018). The development of conservation practices suitably to all these elements requires good research and sound knowledge. The developing of evidence is required to understand the need for insect conservation and how to turn this into suitable actions, equally meeting the needs of human and nature (Cardinale et al., 2012). Developing a better understanding now, leads to the ability to better respond to environmental changes (Dearborn & Kark, 2009). Urbanisation and climate change trends are likely to continue. Tackling such issues now could prevent catastrophic situations in the future.

Insects can play a great role in understanding environmental degradation. Their fast response and adaptation to the local environmental situation can function as proxy indicator for environmental health. With their large abundance and central role in ecosystems, changes can be easily monitored, allowing for trend analysis in their diversity and biomass (New, 2012).

Connect People with Nature and Environmental Education

Urban dwellers are less and less connected to nature as a result of urbanisation. Daily life takes place indoors and technological developments prevent us from having to go outside. New (2012) reasons that this leads to less engagement with nature, which reduces familiarity, takes away experiences, eventually losing peoples interest. He goes on by stating that, the disconnection from nature removes feedback signals from the impacts which human needs have on the environment and the ecological issues it causes, such as insect decline. Public opinion, especially in a democratic system, is vital for the establishment of conservation governance as policy echoes what the public demands. The connection of people to nature therefore equals; creating value for insects or awareness and demand for insect conservation governance through natural experience (Simaika & Samways, 2018).

If disconnection leads to the loss of personal non-use value, it most definitely also means the loss of vital use values including human dependence on insects. Efforts made to, how Simaika & Samways (2018) call it *"rescue the extinction of experience",* are efforts made to influence the psychology regarding insect conservation (Samways, 2018). Especially new generations are the ones prone to disconnection. Besides, societal groups most isolated from nature and strategic decision makers with large influence on insect conservation are of main importance requiring natural experience. Strategic solutions are required in the near future to offer this experience in urban environments. Environmental education is expected to play a vital role in this (Dearborn & Kark, 2009).

New (2015) presents a set of priorities which increasingly stand central to the raising of

[1] Defined in section 3.2.3

awareness and creation of value towards urban insect conservation amongst the public. The following views towards UICG are elements for education and connecting people to nature:

- The realisation that insects are vulnerable to urbanisation impacts and that their loss may affect ecological functions and thereby impact humanity.
- Awareness for the vital role of green spaces[2] towards humans and insects.
- Even urbanised dense areas contain bountiful opportunities for the creation of habitats.
- Ethical behaviour positively affects insect conservation.
- Ecosystem and insect valuation should be perceived as standard in urban project procedures.
- The urban insect conservation situation needs researching. The urban context is convenient for research, as it affects many people and is close to universities.

Ecosystem Services

Ecosystem services are *"the benefits people obtain from ecosystems"* (Costanza, 2015). This definition contradicts with the before described intrinsic value as it excludes the value of ecosystem services by itself. For his research, Costanza (2015) therefore focused on the utilitarian or human derived benefits. Widely acknowledged are the four types provisioning, supporting, regulating and cultural, into which the various ecosystem services can be grouped. These four types were defined by Assessment Millenium Ecosystem (2005) and elaborated below. *Figure 3-4*, presents a comprehensive overview of the various ecosystem services.

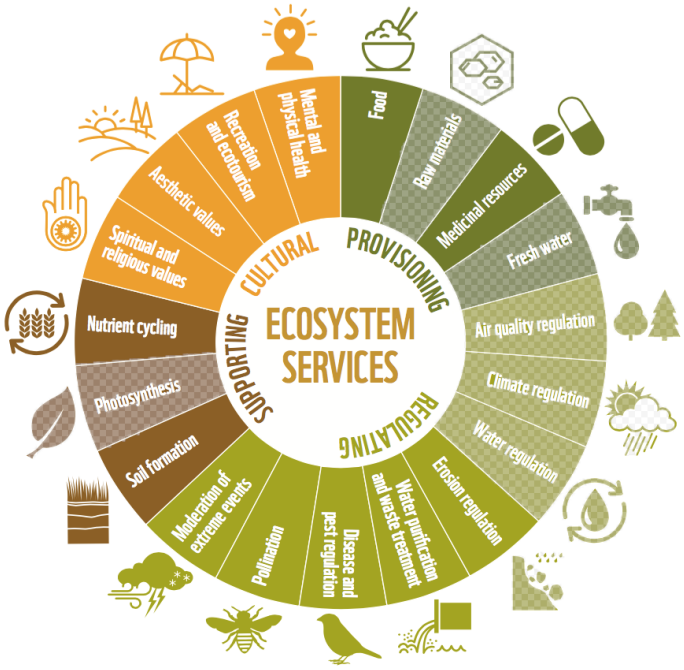
Provisioning services are the most visible as they represent the physical products derived from ecosystems. (Examples are: food, fresh water or fuels). Regulating services, are services that result from the regulation of ecosystem processes of various natural aspects. To do so, ecosystem processes are closely connected to the planetary systems. Other than Provisioning services, regulating services are indirect, but of great value to society. (Examples are: air quality management, water purification or climate regulation). Cultural services are the benefits obtained from ecosystems that are of non-material form. It is personal and subjective and formed by spiritual, cognitive or recreational and aesthetic experience. And supporting services, are underlaying services not of direct benefit on their own, but essential for the development and maintenance of the other three ecosystem service groups. They are also referred to as ecosystem functions and are used as proxies for services in the other categories (Assessment Millenium Ecosystem, 2005).

"Insects are a key component of urban biodiversity, and the ecological functions they perform, translate into a wide array of ecosystem services as well as disservices" (Haase et al., 2014). The ecosystem services mentioned by literature were matched with the ecosystem services overview as provided by (Oerlemans, Strand, Winkelhagen, Barrett, & Grooten, 2016). *Figure 3-4,* highlights the ecosystem services delivered specifically by insects in urban environments. For provisioning: insects provide food for other trophic layers (M. D. Hunter, 2011) and are in various ways used as treatment or for the production of medicine (Prather & Laws, 2018). Regulating: pollination (Biesmeijer et al., 2006), water filtration (Schowalter, Noriega, & Tscharntke, 2018), and the regulation of floods, drought, pest and diseases (Davis, Scholtz, Dooley, Bham, & Kryger, 2004). Supporting: soil formation and nutrient cycling (Jones & Leather, 2012). Cultural: recreational, aesthetic, mental and physical health, spiritual and religious values (Fu & Jones, 2013). Overall, insects play an indispensable role in the contribution of urban biodiversity towards social and economic development, as well as to natures systems and tackling climate change by providing mitigating ecosystem services.

[2] Green space is defined on page 30

Additionally, research and further science focussed on insects, helps humans understand natural processes or adaptation towards a changing climate (Elmqvist et al., 2013). Biomimicry looks a lot at insects and helps humans adapt to climate challenges by learning and applying their techniques (Prather & Laws, 2018). Unfortunately, there are also insect species which are invasive to others, pests to human grown food or gardens, or cause harm to human health by means of diseases and perhaps most known of all, stings (R. M. Hunter & Hunter, 2008; New, 2015). These and plenty of other elements lead to negative views and stereotypes of the way humans see insects.

Figure 3-4 Ecosystem services types provided by insects



Source: (Oerlemans et al., 2016) reworked by author to indicate insect specific ecosystem services

Ethical

This is a motivation more in line with the intrinsic value of insects, yet linked to human benefit, as conservation through ethical consideration is a form of self-gratification. Ethics strongly correlates to the philosophy theme and perception of value resulting in multiple levels of ethics, which have varying outcomes of human or nature benefits (Samways, 2005). These levels range from complete human domination, where ethical motivation comes down to the preservation of the utilitarian values and humans being in control of the decision what is, and what is not conserved. Fully intrinsic ethical motivations are in the trend of preserving nature for the sake of nature. It involves the "doing well" and "leave no traces" mentality. It is considered morally right to preserve nature for what it is. This more extreme form of ethics requires a detachment of nature from human values as they are considered different or conflicting (Pearson, 2016). Utilitarian values of insects on this level are viewed to benefit human constructs and allow monetisation or possession; leading to unethical treatment of nature. In practice and especially in policy, this detachment is not so present. On the contrary, a utilitarian or intermediate ethical view is common as it must consider human values. Here, future generations, an environment for all, fairness, appropriate support to insects, and durable solutions are common ethical standards (TEEB, 2009).

Human wellbeing

Contact with nature is good for health. This relationship has been "*well defined*" according to the IPBES (2018) regional assessment report on biodiversity and eco-system services. They state

that insects contribute by means of their direct and indirect ecosystem services to short- and long-term human health and well-being. This is a fully utilitarian reason for insect conservation. Health derived from insect abundance can take a physical as well as mental form (IPBES, 2018). Physically, insects help maintaining healthy environment for citizens and the provisioning of healthy foods and clean drinking water. Air quality regulating ecosystem services prevent asthma and other respiratory illnesses. Mentally, the exposure to a healthy biodiversity of insects triggers a positive state of mind. Also, the greenspaces[3] which insects pollinate are essential for human health. Such health benefits are of increasing importance in an urban environment (Simaika & Samways, 2018).

Overall, insects are of value by delivering health or well-being through emotional, cultural and spiritual aspirations. These health benefits are likely to affect the way people perceive insects, causing a potential value feedback loop that reduces human induced impact on them (IPBES, 2018). Recognising insects for their health benefits is therefore important.

Costs

Preserving nature with the motivation to save money, is indisputably an intention to benefit humans. Ecosystem services provided by insects can have high monetary value. For example, the health benefits, have the potential to deliver great reductions on medical spending as medical costs are high (Simaika & Samways, 2018). Other examples of such services are pollination or natural pest control (Habel et al., 2019). These activities, if performed by human labour, would be costly. Incurred costs for replacement, can be expressed as the economic value of insect pollination services. Proactive conservation could in the longer-term save a lot of money by preventing the loss of eco-services as well as the costs required for the difficult restoration process to return natural areas fully or partly into their original state (Haase et al., 2014).

3.1.4 Insect Conservation in an Urban Context

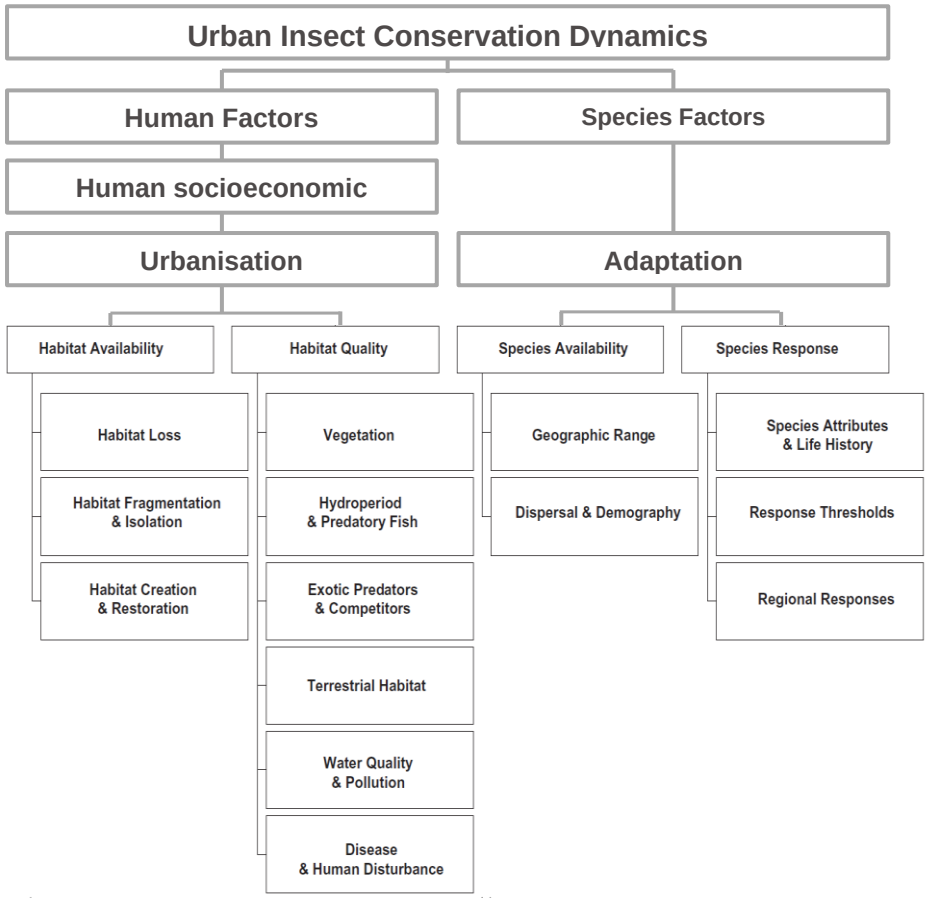
When humans changed their way of life from a nomadic to an agrarian existence, they started settling down and living jointly together. They chose their spots wisely based on water availability or shelter, but moreover based on the fertility of the ground for agriculture and species richness (Dearborn & Kark, 2009). Such settlements gradually grew to the first form of cities. Population growth and migration from rural to urban, combined with an increasing quality of life fuelled urbanisation exponentially, causing insects and humans to compete for land (Elmqvist et al., 2013). Humans are however advantaged in this competition, having the ability to shape their environments to their benefit and liking (Samways, 2009).

What classifies an area as urban is dependent on the degree of urbanization. This is an indicator of population per Local Administration Unit (LAU). LAUs are small areas of larger territories allocated by cell or clusters of cells per 1 km^2. This way urban clusters are indicated by a population density of at least 300 inhabitants per km^2 and urban centres by a minimum density of 1500 inhabitants per km^2 (Eurostat, 2019). Urbanization in the context of biodiversity, is *"the process by which urban ecosystems are created"* (McIntyre, Rango, Fagan, & Faeth, 2001). Just like ant colonies, humans cluster and interact together with the intention to ease life. This is possible by means of specialisation and dedicated roles. However, even though the areas where humans or ants settle down are predominantly inhabited by them, this does not mean that they are the only ones there. Amongst them are still abundant other species who equally so reside there and most likely interact and depend on each other (Schilthuizen, 2018). It is increasingly recognised that urban environments are not just human inhabited. Just like rural areas, they accommodate bountiful ecosystems with considerable conservation potential (New, 2015).

[3] Green space is defined on page 30

In their study, Hamer & McDonnell (2008) construct a conceptual framework on urban amphibian conservation, identifying key factors for population persistence under urbanisation threats. They identify the two core elements 'urbanisation impacts' and 'adaptation to urbanisation'. These two elements are just as applicable to insects, as urbanisation impacts to insects are increasingly studied (Dearborn & Kark, 2009; Fattorini, 2011; Habel et al., 2019; Samways, 2018; Sánchez-bayo & Wyckhuys, 2019) and adaptation is less studied but confirmed as a key component (Jarošík, Konvička, Pyšek, Kadlec, & Beneš, 2011; Mata et al., 2017; Varet, Burel, & Pétillon, 2014). Considering the similarities of identified dynamics in urban insect conservation literature, the conceptual framework based on Hamer & McDonnell (2008) is taken as a basis for this study (as visualised in *figure 3-5*).

Figure 3-5: Urban insect conservation key factors



Source: (Hamer & McDonnell, 2008) reworked by author

3.1.5 Urbanisation Factors

Humans dictate urban ecosystems and biodiversity by the aggregated effects of their activities. Whereas the issue of insect decline has a few clear point source causes, mainly from agriculture through habitat loss, intensive land management or pollution from pesticides or herbicides, the urban context predominantly has causes with less clear sources. This contributes to research being less developed around urban insect decline and conservation (New, 2015).

Kowarik (2011) identified and grouped causes for urban insect decline as: direct threats, placing stress upon insect and its habitat; indirect threats, altering environmental systems on which insects depend; and socioeconomic or cultural threats, varying interaction between humans and insects depending on the interaction of human social, economic, and cultural factors. A major direct impact is habitat loss. This includes the loss of high quality insect habitat or other forms

of natural area, to urban structures or other intensive landscaping purposes (Habel et al., 2019). Habitat loss is a pressing issue as it is directly linked to urbanisation. Urban plans to tackle sprawl regularly focus on the densification of cities. This leads to the disappearance of green paces and increase of concrete (Scolozzi & Geneletti, 2012). Cities are characterised by their mosaic design of various terrain patches such as: green spaces (recreational spaces or parks), blue spaces (water ways or lakes), grey spaces (housing or industry), and brown spaces (ruderal or construction sites (Elmqvist, et al, 2015; New, 2015). Bender, Contreras, & Fahrig (2017) state fragmentation as a separate, yet less drastic version of habitat loss. This involves the separation of greenspaces as a result of habitat break-up or loss, leading to scattered and unattached patches around the city. Such a tighter mosaic where green spaces are increasingly separated, creates smaller islands containing pressurised breeding sites, sporadic pollination, separation of interdependent species and the detachment of species causing them to live beside instead of amongst each other. This phenomena is called isolation (Scolozzi & Geneletti, 2012).

Habitat quality is an equally important element to insect conservation related to urbanisation. If an area lacks or due to urbanisation depresses its favourable insect habitat, insects will have difficulty sustaining themselves and the area will eventually depauperate. This involves a lacking in numbers or variety of ecosystems, flora or fauna (Lexico, 2019). Many elements influence the health and suitability of urban insect habitats. Important elements for quality are amongst others the design of the patch, its structure, density and type of vegetation, its micro climate and hydrologic processes, predators and competitor species, human disturbances, and pollution (Elmqvist et al., 2013). Besides the physical characteristics of urban green spaces, aspects related to the management and maintenance of such spaces are an equally important focus area for insect conservation. Green space management practices greatly influence the habitat quality. What may be a suitable habitat for one species, may repel another (Habel et al., 2019). Habel et al. (2019) have identified management practices around nitrogen accumulation & fertilisers (nitrogen accepting plants), pesticides (mortal agent) & insecticides (host plant reduction), herbicides (reduced wild herbs), or intensification (agrarian machinery precision). They also state that land management is often performed with the prioritisation of plants or vertebrates. Insects take a lower rank in prioritisation engendering less insect tailored urban spaces. Such management practices interact with the physical conditions including impact to soils, hydrology, biochemical cycles and the urban climate overall; changing urban green spaces and the ecosystems within (Kowarik, 2011).

Another frequently recurring theme, is the management of invasive animal and plant species (Bender et al., 2017; IPBES, 2018; Kowarik, 2011; New, 2015). In a globalised world, plants and animals tend to travel with people intentionally and unintentionally. Invasive species has also due to climate change become an increasing threat, as species migrate into other areas (Samways, 2005). Such invasive species can form serious threats to the new area. They can be pests or competitors to native plant and animal species in various trophic layers around insects (IPBES, 2018). This often occurs, because the invasive species don't have a natural enemy in the area they migrated to, are 'skilled generalist', or 'cosmopolitan' species. Where some 'sensitive species' require larger and more natural habitats, specialist species do well in smaller and more urbanised areas (Elmqvist et al., 2013). The habitat availability and quality resulting from human shaping of urban ecosystems, has favoured specific species and contributed to the homogenisation of urban areas (Hobbs et al., 2019). In most cities around Europe, the same species can be found as they blend in best with human dominated habitats. Schilthuizen (2018) goes a step further and analyses how humans on a large-scale influence evolution of such specialised species. Invasive species can deregulate ecosystems and threaten native insect species.

A component not included in the research of Hamer & McDonnell (2008) is the fact that the socioeconomic differences amongst the urban population varies. Such socioeconomic traits

influence values and beliefs towards conservation and thereby their impacts to insects. This is a little, but increasingly studied field, highlighted as gap (Botzat et al., 2016; IPBES, 2018; Kowarik, 2011). What is perceived as beautiful in urban planning and landscaping is subjective and varied. This also affects the management style of green spaces. Another is affluence (Botzat et al., 2016). Wealth is expected to be correlated to intensive landscaping, the planting of exotic species, and traveling behaviour; increasing the spread of invasive species (Kowarik, 2011). The market availability and price of ornamental and non-native plant species, with the potential to escape into insect habitats, can be another impactful factor (Kowarik, 2011). As insect value is culturally dependent, linking the biological and cultural diversity in a conservation strategy is promising. This would require detailed knowledge of the socioeconomic factors and not just human-insect interactions, but an interaction of differing cultural groups and insects (Botzat et al., 2016). This is an area not yet covered by research (Haase et al., 2014).

The identified impacts and rapid change of urban environments have a critical impact on the abundance and health of urban insects. It is of great importance to ensure the proactive incorporation of these factors into the creation of governance to assure the health of insect populations and their ecosystems. To do so, central roles are for authorities and municipalities and especially policy makers, ecologists and urban planners to incorporate the identified human and species factors in strategic responses as visualised in *Figure 3-5*: Urban insect conservation key factors. Besides, psychologists, researchers, and philosophers have vital roles for the development of knowledge. Additional vital stakeholders are active in practice, as actual conservation of insects is often performed by preservation organisations, motivated and progressive farmers, private companies or individuals (Samways, 2018).

3.2 Part II - Governance Instruments

In this section a large body of literature was analysed regarding the available UICG instruments. The section starts off with the identified concepts: 'valuation', 'trade-offs', 'prioritisation', 'rebound-effects' & 'acceptability' in *sections 3.2.1 till 3.2.4*, essential to be considered for the development of effective governance. It proceeds by presenting an inventory of available UICG instruments in *section 3.2.5*. The instruments are classified according to five types: direct regulation, economic instruments, service instruments, advocacy instruments, and communicative instruments.

3.2.1 Trends Around Governance

Even though, insect conservation efforts in an urban context has been advancing (Samways, 2018), the available governance instruments devised for different taxa are still to be developed and guidance for the application of such instruments into practice remains limited (Mata et al., 2017; Norris, 2008). Habel et al., (2019) stresses the essence of basing insect policy making on a dependable knowledge base and tight cooperation between research and practice. A negative trend was discovered towards this, in the research of Honey-Rosés & Pendleton (2013). They highlight an increasing gap between natural and applied research. There is a lack of applied research focussing on the development of suitable tools, actions and policy adapted to the local situation (Verburg, Selnes, & Verweij, 2016). This is especially important in contemporary society where environmental change is rapid. The large human influence on these rapidly developing and emerging novel ecosystems, causes much debate around the management of it (Hobbs et al., 2019). At the core of this debate stand the different values towards conservation. Incorporation and the weighing of these different values in policy and strategy making is critical (Hiron et al., 2018). An element not widely incorporated into research, is the limited available resources to conservation (Hobbs et al., 2019). When comparing the immense conservation needs to the available resources, it becomes apparent why prioritisation and the management of

resources in conservation is of high importance. Hobbs et al. (2019) communicate the need for rethinking the way humans and animals interact.

3.2.2 Valuation

Sections 3.1.2 and 3.1.3 identify values and motivations as foundation to UICG. This is necessary for raising awareness, economic accounting, setting priorities, developing incentives, and creation of legislation (Elmqvist et al., 2013). Value and benefits are abstract terms and in practice are can be benefitted by quantification. The process of valuation is subjective and complex as it incorporates many natural, social, and economic factors (Small, Munday, & Durance, 2017). Because of this, valuation can be performed in an ecological, economical and socio-economic way using indicators as proxies to arrive at biodiversity and ecosystem service values (Andrés, Mir, van den Bergh, Ring, & Verburg, 2012). Bartkowski et al. (2015) state in their extensive literature research on biodiversity valuation that about 80% of the studies used a "choice experiment method", stating preference of clearly defined scenarios or alternatives; or "contingent valuation method", asking stakeholders to express their value towards the preservation of an experience with nature or nature by itself. These two methods mostly intent to value species, habitats or biodiversity. Other methods are "market-based valuation", where value is derived from a selling price or transaction cost. This method moreover focusses on the valuation of ecosystem services or functions (Bartkowski et al., 2015; Pearce, 2002).

Generally, an economic method, expressing the monetary value of insects, is required by policy makers, as projects are evaluated and managed based on costs. The balancing of costs and benefits is a conventional method; generally applied in contemporary valuation attempts (Pearce, Atkinson, & Mourato, 2006; Ring & Schröter-Schlaack, 2011). Elmqvist et al. (2015) criticise the cost-benefit approach for its *"confined improvements",* because it prioritises human benefits and insufficiently captures natural values. Supporting tools frequently used to arrive at an economic value are the "Willingness to Pay" (WTP) or "Willingness to Accept" (WTA). They are often derived from stated preferences, travel-cost method or contingent valuation. It involves expressing: the acceptance of a change in nature, travel costs willing to incur, or the valuation of experiencing nature, in a monetary value (Bartkowski et al., 2015; Pearce, 2002).

Following the trend of paying more attention to the intrinsic valuation of nature, a wider range of ecological valuation methods, increasingly incorporating non-monetary valuation**,** have gradually been developed (Haase et al., 2014). Such methods are based on including civic preferences and attitudes, ecosystems benefits, and species populations. Methods applied for this type of valuation are 'decision science', decision making based on science; 'biophysical ranking methods', the classification and prioritisation of environmental conditions; or "indicators", components of nature expressed in a measurable unit, used to track its status (Andrés et al., 2012). Often a combination of monetary and non-monetary as well as instrumental and intrinsic valuation methods is demanded by policy makers or used by specialists to inform strategic decision makers on insect values (Haase et al., 2014).

3.2.3 Trade-offs, Prioritisation & Rebound Effects

While in research, the reasons for insect conservation are generally unanimously defined, in practice they vary greatly amongst the involved stakeholders. A win-win situation for both city-dwellers and insects is what is sought for, but as much as policy makers would like to satisfy all stakeholders, this is often not realistic (Shwartz et al., 2014). Developing urban insect conservation governance instruments is a complex process; subject to reaching decisions on many trade-offs. Trade-offs in this research are defined as: "A balance achieved between two desirable but incompatible features; a compromise (Lexico, 2019). To place this definition in the context of this research, these features are the motivations for conservation, as defined in *section 3.1.3,* to the social, economic or ecological opportunity costs. This mostly results in how

Verburg et al. (2016) define it as the economy-ecology trade off: "*environmental impacts of economic growth"*. But can also be the ecology-ecology trade-off where Haase, Schwarz, Strohbach, Kroll, & Seppelt, (2012) define it as: *"the increase of the provisioning of one ecosystem service or species and the simultaneous decline of another service at the same location"*.

Considering the conservation of insect species, it could be the case that species have high intrinsic value, yet low utilitarian value or visa-versa. This raises the trade-off situation whether: the insects right to exist, insects benefit to humans, or existence of insects for future generations, weigh up against the monetary and alternative opportunity costs on the other side of the trade-off. A decision for this dilemma is to be carefully considered by means of defining values and prioritisation of such values by policy makers and government officials (Hiron et al., 2018). Lyles-chockley (2008) argues that policy makers and urban planners often lack experience or tools for the valuation of conservation, jeopardising accurate conservation trade-off prioritisation. Lyles-chockley (2008) identifies *"promoting social equity, preserving open space, developing public housing and providing necessary public infrastructure"* as main factors for tension towards land-use planning goals. Dearborn & Kark (2009) explore the frequent insect conservation oppositions of: expensive urban land, including many owners with strong interests; or the need to offer recreational services, contradicting the aim for protecting that natural site from visitor damage. Ingram, Redford, & Watson, (2012) shine light on trade-offs regarding ecosystem services-based conservation. They express their concern for biased prioritisation, including the focus on favoured ecosystem services, rather than reaching a balanced trade-off between a wide range of considered ecosystem services. In practice, best for both is seldomly realised and trade-offs need to be carefully considered using an accurate valuation and prioritisation process.

If trade-offs and prioritisation are not performed adequately, it is very likely that the resulting governance instruments and corresponding strategies will have unintended consequences. Set targets might not be met or worse, the unintended effects will *"partly undo the direct conservation benefits"* (Andrés et al., 2012). Maestre Andrés et al. (2012) have identified five types of rebound effects affecting governance instrument effectiveness. They define rebound-effects as *"potential unwanted, avoidable effects of biodiversity policies on various types of diversity, ecosystem functions and services, values and biodiversity protection policies"* (Andrés et al., 2012). These rebound effects are presented in *Table 3-2*: Rebound effects. The careful and proactive consideration of these rebound effects along the wide range of social, economic and ecological factors is essential for the development of effective UICG instruments.

Table 3-2: Rebound effects

	Rebound Effect	**Description**
(1)	Spatial policy spill overs	Conservation of one area, triggering the same or overruling behaviour in another.
(2)	Incongruence between protection of different types of biodiversity	Conserving one species causes negative impacts on other biodiversity. The dependency of species and their balance could cause conflict and needs consideration in trade-offs.
(3)	Ecological rebound	Like (2) but focussing on ecosystem functioning. The governing of one function, could severely impact others.
(4)	Service rebound	Conservation intentions based on ecosystem services management might not be in line with what biodiversity conservation requires. This results from a misunderstanding or mismatch due to missing evidence on their relationship
(5)	Environmental rebound	Intentions to tackle one environmental issue have cascading effects, shifting to another problem. It involves governing intentions of harmful behaviour to cause a shift towards equally so harmful substitute

Source: (Andrés et al., 2012)

3.2.4 Acceptability

Policy instruments are to be designed to incentivise desired behaviour and minimise resistance or avoidance behaviour towards the policy. The success of the delivered policy highly depends on the public's and private sector's acceptability and adherence towards the policy. It is the task of the policy maker to incorporate the valuation of the private sector or the public as policy addressees. The recognition of private or public attitudes, values, and behaviours, but also trade-offs, prioritisation and rebound effects, influence policy acceptability and influence policy effectiveness, transaction costs and complaints (Ring & Schröter-Schlaack, 2011). The success of proactively incorporating these elements, will determine the acceptability of the policy addressee towards the delivered policy instrument and thereby its effectiveness. Nature conservation associations or insect interest groups are often experienced on a certain valuation aspect and consulted for the framing and execution of the policy instruments. The same goes for the public; an increasing realisation is the opportunity for public participation in assuring policy effectiveness (Ring & Schröter-Schlaack, 2011).

3.2.5 Inventory of Governance Instruments

A variety of instruments are available for the governing of insect conservation. These instruments are to be fitted to the local physical and social situation. Five types of policies: 'direct regulation'; 'economic instruments'; 'service instruments'; 'advocacy instruments'; and 'collaborative instruments' were identified from literature. These subgroups were based on, but adapted from Carter's framework (2007). Where Carter (2007) approaches collaboration as an underlaying personal and cultural dependent element to policy making, it is classified as its own subgroup of policy instruments in this research, as insect conservation literature adequately states its importance (R. M. Hunter & Hunter, 2008; TEEB, 2009; Verburg et al., 2016).

The policy types and instruments elaborated on in the following paragraphs are each able to influence urban insect conservation in their specific way; having their respective benefits and drawbacks. Just like other governance areas, a mix of various policy instruments is required to tackle the issues around urban insect conservation (Ring & Schröter-Schlaack, 2011).

Direct Regulation (Command and Control)

The first subset of instruments is also referred to as the command-and-control of urban processes, as it involves the creation of rules backed up by legislation or the sovereign control of urban spaces. It involves species or habitats protection, through the determination of what is or what is not allowed. Direct regulation instruments for UICG, can be grouped under 'regulation of technology', 'regulation of performance' and 'urban planning' (Schröter-schlaack & Blumentrath, 2011).

Table 3-3: Direct Regulation Governance Instruments

Governance instruments	Description	Source
Regulation of technology	Developing legislation around good practices and prohibiting the use of harmful substances.	(Schröter-schlaack & Blumentrath, 2011)
Regulation of performance	Developing legislation around the status of the environment or species.	(Schröter-schlaack & Blumentrath, 2011)
Urban planning	Incorporating insect conservation into the planning and design of urban areas by considering and prioritising insect friendly habitats. This involves the allocation of nature protected areas.	(Dearborn & Kark, 2009; Grêt-Regamey, Altwegg, Sirén, van Strien, & Weibel, 2017; R. M. Hunter & Hunter, 2008; Lyles-chockley, 2008; Mata et al., 2017)

Source: Author

Where regulation of technology and regulation of performance generally have concrete goals and are mostly of immediate effect, urban planning has longer-term intentions. Mitigating the decline of species threatened with extinction (Habel et al., 2019) or establishing regulation focussed on the reduction of a specific threat (Ingram et al., 2012) are common regulating practices. Urban planning maintains a future perspective as awareness and protection of native biodiversity now, leads to great benefits in the future (Dearborn & Kark, 2009). Urban planning incorporates a large palette of tools to influence the social, urban and its natural environments, in which landscape and architecture are equally important. On a strategic level, social and natural issues are rooted into urban planning, making architects and urban planners, architects of social change (Lyles-chockley, 2008). On a practical level, it is known that green space management, including vegetation structure, diversity and native species, have a positive impact on insect biodiversity. What tailored management practices of varying urban green spaces impact specific animal biodiversity, is however reasonably unknown (Mata et al., 2017).

A core practice of urban design to benefit biodiversity is the creation of protected areas. In such areas conservation has main prioritisation, exempting the area from possible insect harming trade-offs (Ingram et al., 2012). Another, is the creation of so called corridors or stepping-stones. This involves city design in which rings or connecting plots of land, tackle fragmentation and allow insects to migrate (Dearborn & Kark, 2009). Such practices are part of long-term planning and vulnerable to high land costs and densification trends.

Economic Instruments

The rewarding and punishment of harmful behaviour by means of economic incentives is widely applied in varying disciplines and a strong tool for influencing desired environmental behaviour (Maestre Andrés, Calvet Mir, van den Bergh, Ring, & Verburg (2012). The designing of economic instruments is fully based on the economic valuation of nature. The valuation accuracy required gets more importance when moving from a high policy level, down towards its integration into accounting. Accuracy is especially important for penalties, charges, or when expressing natural damage or benefit in a single amount of money. The application of economic instruments and assuring its compliance for the micro management of biodiversity is therefore a resource intensive and difficult task (Costanza, 2015). Identified economic instruments for UICG are presented in *Table 3-4*: Economic governance instruments.

Table 3-4: Economic governance instruments

Governance Instruments	Description	Source
Environmental taxation	Incentivisation of favourable environmentally friendly behaviour, by means of fiscal incentives. Can take the form of a levy or relief of taxes.	(Schröter-schlaack & Blumentrath, 2011; TEEB, 2009)
Environmental subsidies	Incentivisation of favourable environmentally friendly performance by means of financial assistance.	(Habel et al., 2019)
Penalty or charge	Discouraging environmental harm by reactively punishing the offender. Penalties or charges can include the monetary or non-monetary compensation for the caused damage.	(TEEB, 2009)
Ecological fiscal transfer	Involves the transfer of capital amongst governmental bodies or departments in the same body, destined for insect conservation purposes. Based on the interdisciplinary and interconnectedness of insect conservation.	(IPBES, 2018; Schröter-schlaack & Blumentrath, 2011; TEEB, 2009)

Payments for Ecosystem Services (PES)	Financial support to land and natural resource managers in the form of payment for ecosystem preservation. This includes schemes of payment for ecosystem services to the provider of the ecosystem service by the beneficiary.	(IPBES, 2018)
Biodiversity-offset and trading permits	The realisation and compensation of inevitable impacts to biodiversity with the purpose to prevent a net biodiversity loss.	(Santos, Clemente, Antunes, Schröter-Schlaack, & Ring, 2011; TEEB, 2009)

Source: Author

Economic instruments based on economic valuation of nature, have caused controversy. Habel et al. (2019) state that the provisioning of large subsidies needs rethinking to assure the spending of money on projects or project owners with environmentally friendly causes. This is essential to avoid rebound effects or the double negative impact on budget and environment. Payment for Ecosystem Services (PES) is a frequently cited and incorporated approach. However Ingram, Redford, & Watson (2012) motivate it generally incorporates preferred ecosystem services; ignoring other vital eco-systems avoiding having to make trade-offs. The Economic of Ecosystems and Biodiversity (TEEB, 2009) raises awareness for the ethical use of this economic instrument, as it gives the impression for the right or payment to pollute. It also does not affect the rich enough, who are commonly larger polluters. Off-sets is another controversial instrument with a similar or even larger potential for rebound-effects around the unethical right to pollute. According to TEEB (2009), they are to be treated as last resort instrument. Depending on the political structure and situation, fiscal transfers can be considered as motivators for cooperation amongst departments or regions; assisting decision makers in fund raising and promoting their insect conservation ideas or innovative solutions (TEEB, 2009)

Services Instruments (Direct Action)

Utilising governmental services as governance instrument, can also be a form of direct action. Two main types of governance instruments were identified in literature as presented in *Table 3-5*: Service governance instruments. The municipality can factor insects into the periodic provisioning or maintenance services provided to the public. This mainly involves the management of green and blue but also brown or grey spaces. The impact on insect biodiversity from management practices can be considerable. For example, the mowing, weeding or ongoing maintenance of green and blue spaces can cause a loss in habitat or reduces its quality (Aguilera, Öckinger, Ekroos, Persson, & Pettersson, 2018). Excessive tidiness has been the standard as it is perceived as clean, nice and comfortable. Most city dwellers have become used to this and have not seen healthy vegetation in an urban context (Elmqvist et al., 2013). IPBES (2018) identified "*considerable potential for alternative approaches"* and Aguilera, Öckinger, Ekroos, Persson, & Pettersson (2018) suggest, based on testing, that less intensive management practices produces *"high-quality areas for flower visiting insects"*. Whether citizens insist on high intensity urban greenspace management or whether they are willing to accept a less intensive management style is missing in literature.

Closely related to greenspace management as well as urban planning, is restoration or rehabilitation. As greenspaces are threatened by urbanisation or have been planted with many exotic or alien species, the practice of rehabilitation or restoration is increasingly recognised for its mitigating impacts on biodiversity. Despite the fact that rehabilitation is an intricate practice still poorly understood, its benefits are claimed to be not only ecological, but also socially and economically favourable (Elmqvist et al., 2015). Rehabilitation has great potential to be part of a threat management, species or ecosystem specific recovery planning. Urban spaces could be rehabilitated to optimise habitats for specific conservation motivations (Ingram et al., 2012). Additionally, as of now, rehabilitation is not much applied. Public stakeholders need to become aware of the opportunities around rehabilitation (Elmqvist et al., 2015).

Table 3-5: Service governance instruments

Governance Instruments	Description	Source
Green space management	Careful consideration of the tools and methods used for the management of urban green spaces to best suit humans and nature's needs. This includes approaches, routines, styles, machinery etc..	(Aguilera et al., 2018; IPBES, 2018; Shwartz et al., 2014)
Restoration, recovery, rehabilitation	The returning or near returning of an urban area, plot or greenspace to a healthy and rich natural state.	(Elmqvist et al., 2013) (Ingram et al., 2012) (Elmqvist et al., 2015)

Source: Author

Advocacy Instruments

In this instrument subgroup, the local-government acts as a knowledge broker and facilitator. It recognises insect conservation as an issue and is aware that organisation or institutions do not have the capacity, knowledge or awareness. By means of the identified advocacy instruments as presented in *Table 3-6*: Advocacy governance instruments, the local-government can initiate or contribute to developing knowledge and assert their point of view to the public or private sector.

Table 3-6: Advocacy governance instruments

Governance Instruments	Description	Source
Education & psychology	The influencing of urban citizen psychology towards insect conservation through the provisioning of conservation knowledge. This could take many forms, amongst others: educational programmes, information signs, documentaries, platforms, webpages or flyers.	(Dearborn & Kark, 2009; Lyles-chockley, 2008; New, 2018; Simaika & Samways, 2018)
Monitoring & inventory	The documentation and analysing of insect species and populations to obtain insight in their development and identification of threats or threatened species. It involves: the sampling, taxonomy, recording, estimating, and identification of patters to insect species.	(Habel et al., 2019; Jones & Leather, 2012; Nieto et al., 2014)
Species guidelines	An effective output of inventories is turning detailed taxa population, threats and risks, into insect conservation guidelines or Red lists to guide decision makers and biodiversity practitioners.	(Fox et al., 2019; Nieto et al., 2014; Simaika & Samways, 2018)
Supportive models	The digital classification and mapping of urban spaces by means of advanced models/software. It supports urban planning and ecosystem management.	(Colding, Lundberg, & Folke, 2007; Grêt-Regamey et al., 2017; Haase et al., 2014)
Certification or eco-labelling	Creation of awareness and psychology by providing insect risk or impact information through the certification of products and services.	(IPBES, 2018)

Source: Author

Education is a tool capable of effectively informing stakeholders about the severity and impact of the insect decline threat and their role in it. The education of strategic stakeholders, such as urban planners or policy makers, is vital for effective governance (Lyles-chockley, 2008). Furthermore, targeting the public is of equal importance to assists in the creation of insect conservation value psychology. This provides strategic stakeholders reason and the ability to act (Simaika & Samways, 2018). Committing harm to insects often comes down to not knowing that the harm is caused. With education, the public themselves is given the facts and have the freedom to become convinced and act towards the issue. This also makes it a slow and less drastic approach as only a part of them will choose to learn, less will believe, and fewer act. Shwartz et al. (2014) stress the absence in research and missing validation of the influence of education on public opinion and their behaviour.

An instrument central to insect conservation, involves the long-term and detailed monitoring of insect taxa. The extensive insect decline has created the need to track species populations and document their abundance. Accurately doing so, provides facts and thereby reason to act. It also allows for targeted conservation and fitted solutions (Jones & Leather, 2012). The mapping of insects has developed rapidly since it was first performed. Nevertheless, considering the taxonomic challenge, involving the large abundance of insect species of over 1 million defined and another 4 million undefined species (Samways, 2018), more and longer monitoring is required (Habel et al., 2019). Currently, data availability, validity and regional variations, is a pressing issue. Sampling techniques vary a lot and species are rarely targeted specifically (Nieto et al., 2014). This accuracy is important for the usage of the data in governance. The monitoring clearly highlights the performance of species over time, indicating whether they are a healthy population or threatened towards extinction. Guidelines are developed to translate this obtained knowledge and communicate it for educational purposes. A well-known example is Red lists. These are inventories of consolidated most threatened species of a specific area, compiled with the intention to communicate the conservation status of the incorporated species (Nieto et al., 2014). It puts critical species in the spotlight and labels them iconic to raise awareness and increase their value in prioritisation (Fox et al., 2019; Simaika & Samways, 2018).

Another instrument is the application of computerised software or models. Although available for a considerable amount of time, Geographic Information Systems (GIS) offers potential for the allocation and classification of urban landscapes according to terrain type. Such an overview can assist in the planning and demarcation of green spaces and protected areas (Colding et al., 2007). An addition to GIS is Potential Allocation of urban development areas for sustainable Land Management (PALM). This model incorporates geographic zoning of ecosystem services. Such models could support raising awareness and integrating a wide range of stakeholder preferences (Grêt-Regamey et al., 2017). When developed further and combined with weighing factors, it has the potential to assist in discussions concerning difficult trade-offs. Even though the potential is high, such models are not yet able to allocate all kinds of urban landscapes with high certainty and a more detailed resolution could improve its usefulness (Colding et al., 2007).

Lastly, the creation of certification schemes has great potential to influence psychology of producers and consumers nudging the want for insect friendly products and services. It has potential impact on multiple areas like awareness creation or impact reduction (IPBES, 2018). Overall, advocacy instruments contribute facts for the development of effective urban insect conservation governance strategies and tools.

Collaborative instruments

This is a group of instruments which can be supportive and underlying to the other subgroups. It comes forth from social, cultural and personal aspects and is increasingly recognised as an important and principal factor for success (IPBES, 2018). It involves: the recognition and acting towards responsibilities by stakeholders, collaboration between these stakeholders in their execution of responsibilities, involvement of the public, the involvement of (new) knowledge and validation of practices (IPBES, 2018).

Conventionally, public responsibilities involve the designing and implementation of regulating legal instruments. Private stakeholders are the ones addressed and have the responsibility to adhere to such direct regulations (Schröter-schlaack & Blumentrath, 2011). Regulation can influence the relationship between people and nature. However, values towards insect conservation mainly come from social norms, customs or traditions. In modern times, many more factors are involved, as defined by Samways (2018) displayed in *Figure 3-1: Inter-related themes to insect conservation*, leading to the distribution of responsibilities over a broad range of stakeholders with overlapping activities and similar goals. Their responsibilities have vague boundaries that intertwine and are often not clearly defined nor aligned. To develop strategic

responses based on all values; cooperation between stakeholders is key. According to TEEB (2009), stakeholder mapping and involvement is a crucial task to avoid omitting valuable views, knowledge and stakeholder. To assure successful and ethical prioritisation, a wide range of stakeholders needs to be involved. Failing cooperation according to Kerner, (2008), is mainly due to *"a confusion of terminology, the meaning of evidence, or partnerships across research"*. Partnerships are selective and established based on best interest. Verburg et al. (2016) reason there is room for improved cooperation between policy, practice, and research. A common langue for concepts, responsibilities and approaches is needed to realise such a joint approach.

In *sections* ***Error! Reference source not found.*** *and* ***Error! Reference source not found.***, the ce ntral role of the public's awareness was highlighted. Their demand for insect conservation and influence on politics is larger than most individuals believe it to be. Besides demand, the responsibility of the public is also larger than expected. Simaika & Samways (2018) discuss the often poor participation of the private stakeholders or the public and lacking motivation to take action as an individual. They propose involvement by providing tools and responsibility to participate in citizen science projects. Citizen science involves, *'The collection and analysis of data relating to the natural world by members of the general public, typically as part of a collaborative project with professional scientists"* (Lexico, 2019). Successful participation was achieved for involving citizens in large scale insect monitoring attempts. Another initiative, outlined by TEEB (2009) is the awarding of insect champions. This involves the recognition and rewarding of local motivated insect enthusiasts for their efforts. Active rewarding would create a group of stewards, as they have considerable influence in their respective areas. Goddard et al. (2010) focus on the lack of recognition of private residences by local governments. Private residences make up a significant share of the urban surface and are often highly depauperated areas. They state that an innovative approach could be the cluster management of private gardens. This would involve the optimisation of habitats and eco-systems over plots of combined residences, tackling fragmentation, vegetation structure, invasive and tropical species, and intensive management. Such plots could then effectively be embedded in urban green steppingstones. High levels of cooperation and public participation are fundamental to such an initiative.

A last vital area of collaborative focus, is the development and utilisation of knowledge and the validation of existing practices on their effectiveness. Shwartz et al. (2014) confirm that practitioners and policy makers are advancing in the development of conservation instruments, but flag two critical issues. The first, is that instruments are most effective when based on scientific knowledge. They should be developed under close cooperation between research and policy. The second, involves the poor performance of instrument validation, testing their effectiveness. These two issues depending on cooperation, make governance instruments vulnerable to negative rebound effects.

Table 3-7: Collaborative governance instruments

Governance Instruments	Description	Source
Responsibilities	The clear definition of responsibilities towards insect conservation of all public as well as private stakeholders. This also involves the responsibilities amongst different levels of public and private layers.	(IPBES, 2018; Schröter-schlaack & Blumentrath, 2011)
Public participation	The part of stakeholder engagement where the public is recognised for their role in conservation. They are given responsibility in the practice of conservation and given the right to be involved into governance decision making.	(Elmqvist et al., 2013; Goddard et al., 2010; TEEB, 2009)
Research & validation	The developing of new insect conservation knowledge through natural and social research, translating it to applied research and validating its effectiveness to	(Habel et al., 2019; Shwartz et al., 2014)

	improve conservation in practice.	
Cooperation	The collaboration between stakeholders, utilising specialism and avoiding duplication of efforts. Stakeholders are amongst others: NGO's, non-for-profit, public institutions, private sector, and academics.	(Chan et al., 2016; Dearborn & Kark, 2009; R. M. Hunter & Hunter, 2008)

Source: Author

3.3 Chapter Summary

When assessing insect conservation literature, it becomes clear that UICG is an evolving topic. It is generally embedded in overarching biodiversity research and governance. A respectable foundation of natural urban insect threats and conservation science is available. However, applied and social research based on designing UICG instruments is limited.

The reviewed literature approaches the governance instruments differently. Available literature is predominantly of explorative and focused on a broad range of biodiversity or eco-systems. There are various cases of ex ante nature where most propose the application and conversion of general biodiversity conservation instruments to insect specific instruments (R. M. Hunter & Hunter, 2008; Jones & Leather, 2012; New, 2015; Samways, 2018; Samways et al., 2010). Even less cases assess the effectiveness of the instruments by applying an ex post evaluation or impact assessment of UICG in practice.

4 Findings

This chapter contains the research findings as output from the two conducted primary research methods. *Section 4.1* maps the policy landscape around UICG as derived form a detailed document study. The main source of documentation here was grey literature based on policies, programmes and initiatives. *Section 4.2* presents analysed and interpreted expert interview findings.

4.1 Policy Landscape

4.1.1 International

Internationally, biodiversity has been receiving an increasing amount of attention, especially around its important link with the wellbeing of humans and their central role in our economic system. From around the 1990s, biodiversity conservation has made its way into international agreements and regulation, receiving recognition as a global problem best tackled together. Presented on the Rio de Janeiro's Earth Summit in 1992 and entering into force the year after, the Convention of Biological Diversity (CBD) was inaugurated. Three clear main objectives stand at the core of the convention (United Nations, 1992):

- *'the conservation of biological diversity',*
- *'the sustainable use of the components of biological diversity',*
- *'the fair and equitable sharing of the benefits arising out of the utilization of genetic resources'*

Fourteen Convention Of the Parties (COP) and 193 signatory parties later, it is amongst the most extensive cases of international regulation (UNEP, n.d.).

Another convention closely related to biodiversity, yet with a much narrower focus, is the Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES). It tackles the difficult and ethical event of trading, especially threatened wild-life specimen, across borders and aims for reduced impact on their survival. Entering into force in 1975 obtaining 183 signatory parties throughout the years, it successfully recorded and prevented thousands to millions of transactions (CITES, n.d.). Most biodiversity programmes or initiatives anywhere around the world are in line with the CBD and tap into CITES. The principle of subsidiarity is applicable to biodiversity conservation as decision making bodies have delegated biodiversity conservation downwards; gradually breaking-up, adapting, and fitting it to their respective situations (IPBES, 2018). COP meetings on CBD cover a wide range of themes, delivering changes or amendments to the convention. Besides, also strategic deliverables result from these COP meetings. Two subsidiary protocols, the 'Cartagena Protocol' (originated in COP10) and the 'Nagoya Protocol' (originated in COP4) have been supplemented to CBD. Where the Cartagena Protocol on the safe handling, transport and use of living modified organisms (biosafety), focusses on genetically modified food preventing health issues (SCBD, n.d.-a), the Nagoya Protocol on the sharing of arising benefits from resource utilization, influences the psychology and value towards insect conservation (SCBD, n.d.-b).

Initiated as part of COP11, under the theme *"Living in Harmony with Nature"* the United Nations Decade on Biodiversity launched and supports the Strategic Plan for 2011 till 2020. This large and assertive launch intends to get recognition for biodiversity, incorporation into connecting policies and standardise CBD implementation. It revolves around the vision that *"By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people."* The strategy outlines 20 clear 'Aichi Biodiversity Targets' subdivided over 5 strategic goals closely in line with CBD goals (SCDB, 2010) (see *Box 4-1*).

Box 4-1: Goals Aichi Targets

Aichi goal A: Address biodiversity loss caused by mainstreaming biodiversity across government and society	
Target 1:	People are aware of biodiversity values and steps available for conservation
Target 2:	Biodiversity is integrated in national and local development strategies accounting and reporting
Target 3:	Incentives (such as subsidies) harmful to biodiversity are eliminated and positive incentives put in place
Target 4:	Governments, businesses and stakeholders are working towards sustainable production and consumption
Aichi goal B: Environmental impact reduction from direct pressure on biodiversity and promote sustainable use	
Target 5:	Rate of loss of natural habitats is at least halved and degradation and fragmentation significantly reduced
Target 8:	Pollution has been brought to levels that are not detrimental to ecosystem function and biodiversity
Target 9:	Invasive species and pathways are identified and prioritised. Priority species are controlled or eradicated
Aichi goal C: Improve biodiversity status by safeguarding ecosystems, species and genetic diversity	
Target 12:	Extinction of known threatened species has been prevented and improved
Aichi goal D: Biodiversity benefits enhancement to all from biodiversity and ecosystem services	
Target 14:	Ecosystems providing essential services are restored and safeguarded
Target 15:	Ecosystem resilience and biodiversity carbon stock has been enhanced through conservation and the restoration of at least 15% of degraded ecosystems.
Aichi goal E: Enhance implementation through participatory planning, knowledge and capacity building	
Target 17:	By 2015 each party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.
Target 19:	Knowledge, the science base and technologies related to biodiversity are improved, shared and transferred, and applied.

Source: (SCDB, 2010)

Fairly recent in 2015, an even larger global call for action was initiated by the United Nations General Assembly. This call aimed at 2030, exists out of 17 individual Sustainable Development Goals (SDGs) and follows up on the Millennium Development Goals set for 2015. The importance of incorporating biodiversity into these goals for human global development were stressed by the CBD COP. The three CBD goals are now deeply rooted in sustainable development and poverty eradication governance. Biodiversity is to a certain degree interconnected with all SDG's but receives specific dedication in SDG 14 and 15 as shown below.

Box 4-2: SDGs incorporating biodiversity

SDG 14: Conserve and sustainably use oceans, seas, and marine resources (water dependent insects)
SDG 15: Sustainable use of terrestrial ecosystems, manage forests, combat desertification, halt land degradation and biodiversity loss
Other SDGs linking with biodiversity loss: 2.4 sustainable food production, 2.5 sharing of benefits, 6.6 water ecosystems, 8.4 effective resource production, 11.7 green public spaces, 12.8 lifestyles in harmony with nature.

Source: (SCBD, n.d.-c)

Besides regulatory bodies, there are numerous accredited intergovernmental advisory bodies which take a dominant role in international biodiversity conservation. A prominent organisation is the International Union for Conservation of Nature and National Resources (IUCN). IUCN plays a central role in advising the UN and influencing governments to conserve nature and sustainable natural resource use. Their extensive biodiversity mapping and monitoring efforts have as main deliverable their 'Red List of Threatened Species'. This list is an assessment of the global biodiversity conservation status (IUCN, 2019). It has a supporting, yet fundamental role in global conservation. The Economic of Ecosystems and Biodiversity (TEEB) is another such

international organisation, focussed on the mainstreaming of biodiversity conservation and a strong focus on ecosystem service valuation into governance (TEEB, n.d.). Additionally, the intergovernmental body International Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), strives for the conservation and sustainable use of biodiversity by enhancing the incorporation of science into policy making. IPBES main deliverable is the global assessment report on biodiversity and ecosystem services (IPBES, 2019).

4.1.2 European

The European Commission claims to have put in place a *"broad range"* of effective environmental legislation (European Commission, 2019a). This legislation is based on the 7th Environmental Action Plan (EAP), which is a policy guideline aimed at assuring effective environmental policy in place till 2020 yet maintaining a long-term 2050 perspective of *"living well, within the limits of our planet"*. As listed in Box 4-3: Priority objectives EU EAP, the plan outlines 3 key objectives (1-3), 4 enablers (4-7) and 2 horizontal objectives (8-9) (European Commission, 2014). Even though these objectives are on a general level covering biodiversity in its totality, most objectives touch upon similar or related focus areas as identified in the literature study, such as: natural capital and ecosystem conservation, citizen well-being and health, knowledge and policy evidence, and the integration of concerns to assure effective policy.

Box 4-3: Priority objectives EU EAP

Key Objectives

1) Protect, conserve and enhance the Union's natural capital

2) Turn the Union into a resource-efficient, green and competitive low-carbon economy

3) Safeguard the Union's citizens from environmental-related pressures and risks to health and well-being

Enablers

4) Maximise benefits of the Union's environment legislation by improving implementation

5) Increase knowledge and widen policy evidence base

6) Secure investment for environment and climate policy and account for environmental costs from society

Horizontal Objectives

7) Better integrate environmental concerns into policy areas and ensure coherence when creating new policy

8) Make the Union's cities more sustainable

Source: (European Commission, 2014)

Where the 7th EAP is the foundation for engraving environmental friendliness and sustainability in all to be created policies, the '2020 Biodiversity Strategy' is dedicated to halt the loss of biodiversity and degradation of ecosystem services by 2020. The strategy encompasses the CBD objectives to which the EU committed. Published under the name *'our life insurance, our natural capital'* its subdivision into 6 main targets and 20 actions is aimed at increasing focus, cooperation and effectivity (European Commission, 2011). To support the 5th target, a supplemental regulation was introduced in 2015. It clearly outlines the responsibility to prevent, detect and manage invasive species (Directive on the prevention and management of the introduction and spread of invasive alien species, 2014). The targets related to biodiversity to be achieved by 2020 are presented in

Box 4-4: EU Biodiversity Strategy 2020 Main Targets. Section four of the statute is dedicated to cooperation between the member states and goes under the title *"we are all in this together"*. The section is similar in length to the outlining of the targets, stressing the need for a collaborative approach and inability to tackle the issues regarding biodiversity individually.

Box 4-4: EU Biodiversity Strategy 2020 Main Targets

Target 1: Enhance species and habitat protection efforts. 100% more habitat assessments, 50% more species assessments under the Habitat Directive as well as under the Bird Directive.
Target 2: Maintain and restore ecosystems and their services, by restoring 15% of degraded ecosystems.
Target 3 & 4: Anchor biodiversity goals in the most relevant EU policy areas (farming, forest, and fisheries)
Target 5: Combat invasive alien species by focusing on their pathways and species specific control.
Target 6: Step up EU contribution to averting global biodiversity loss.

Source: (European Commission, 2011)

The European Commission has initiated two major bodies of legislation dedicated to the conservation of its biodiversity and ecosystems. The one directly incorporating insect conservation is the Habitat Directive. In place since 1992, it encompasses the conservation of natural habitats and wild fauna and flora, excluding birds. Over a 1000 plants and animal species and 200 habitat types are specified in the directive. Its core purpose is the benefitting of biodiversity or working towards a halt in biodiversity loss (European Commission, 2019e). Closely linked to the Habitat directive, is the Bird Directive. This piece of legislation first enacted in 1979, specifically focusses on the conservation and protection of threatened birds (European Commission, 2019c). As birds are in many ecosystems directly positioned above insects in the food chain, the control of bird populations can indirectly be an effective tool for controlling insects. Emerged from both the Habitat and Bird Directives, the Natura 2000 Network managed to create vast amounts of green infrastructure by establishing a large network of protected areas throughout all European member states. Its purpose is to protect Europe's most valuable and threatened habitats and species, as listed in both directives. It aims for the long-term preservation and incorporates obligations for ecological as well as economical sustainable management (European Commission, 2019b). Even though Natura 2000 areas are sometimes (partly) located in an urban environment, they are more linked with rural conservation and do not face the typical urban treats as defined in *section 3.1.4*.

The urban environment and its urbanisation trends receive dedicated focus in European legislation by the introduction of '*A framework for action'* in 1998 (European Commission, 1998) devoted to foster sustainable urban development. Section 3 of the report recognises the link between biodiversity and quality of urban life as well as that efforts urgently needed to promote biodiversity and green spaces. More modern programmes are focussed on a cooperative approach and the sharing of conservation practices amongst cities, such as the European cooperation programme for urban development (URBACT) (European Regional Development Fund, n.d.) or Urban Development Network (European Commission, n.d.-e). These projects are dedicated to urban conversation. Additional to larger programmes, the European Union developed supporting governance projects to incentivise the attainment of the set goals by the overarching programmes. Structured funds like the LIFE Programme, finances nature conservation (European Commission, n.d.-c) and the European Regional Development Fund, supports urban development (European Commission, n.d.-b). Annual initiatives like the awarding of the titles 'Green Capital' to large cities (European Commission, n.d.-a) or 'Green Leaf' (European Commission, n.d.-d) for small to medium sized cities, are good initiatives to stimulate stewardship. As part of the Horizon 2020 programme for research and innovation, various projects aim at urban development and liveable cities. Although limited direct focus is dedicated to biodiversity conservation, projects like 'Naturvation', contribute to the creation of a habitable urban environment for both human and animal through innovative solutions ('Naturvation 2017 - 2019', n.d.). A European project closely linked to insects is the recently communicated Pollinator Initiative. This project based on learning by doing and sharing of best practices aims to: enhance knowledge, raise awareness and tackle causes of pollinator decline (European Commission, 2019d).

4.1.3 National

As the European Union is signatory to the Convention on Biodiversity and other international agreements (as discussed above), its member states are required to implement the conventions articles and act accordingly (European Commission, 2016). Cascaded down to the national level, conservation situations differ greatly amongst countries (Samways, 2018). European member states have to be present on the biennial meeting of the parties, where progress is discussed, and amendments made. With ratification of the convention comes the obligation to create a country specific 'National Biodiversity Strategy and Action Plan' (NBSAP). This strategy outlines the incorporation of the CBD and its COP decisions into national policy. The development of a nationally adapted strategy, forces nations to engage with biodiversity conservation. Verburg, Selnes, & Verweij (2016) express the importance of a clear division and allocation of responsibilities in national policies, as the affected subsidiary public and private stakeholders should take ownership and responsibility for the implementation.

Additionally, national update reports are to be provided on the implementation, progress and targets of the convention. Where these deliverables allow for administrating compliance and ambitions to fulfil CBD objectives, it also functions as a supportive tool to the (United Nations, 1992).

More reporting is to be completed by the countries towards the European Habitat and Birds Directives. A progress report; including an update on the implementation and progress towards the directive goals and a derogations report; outlining the nationally justified exceptions, are to be delivered on an approximately 4 year basis (Directive on the conservation of natural habitats and of wild flora and fauna, 1992; Directive on the conservation of wild birds, 2010).

Germany

In Germany, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMUB) acts through the Federal Agency for Nature Conservation (BfN) as administrative and supporting body responsible for the conservation of the nation's biodiversity. Where BMUB develops the nations strategy and policies, the BfN administers the CBD and EU directives implementation and delegates responsibilities downwards to the states (Bundesländer). In their tasks, they cooperate with biodiversity conservation agencies like Naturschutzbund Deutschland or Wildtierstiftung in: compiling assessment schemes for species and habitats, monitoring efforts, creation of databases, and assure compliance to the national plan ('The Federal Agency for Nature Conservation (BfN)', n.d.).

Regarding the CBD, the second version of the German BNSAP Nature Conservation Action Programme 2020 delivered in 2016, states that Germany up till then had failed to reduce pressure on biodiversity to allow for targeted regeneration. Instead, individual species conservation received focus and delivered sporadic successes. To achieve the national targets, conservation efforts require upscaling and coordination. There is the realisation that effective cooperation between the different authoritarian levels (federal, state and municipal) and the involvement of non-public stakeholders is fundamental for the realisation of this. On a local level, specifically landowners of 'normal', not protected lands, are mentioned as important stakeholders. In general terms the strategy subdivides biodiversity conservation in: fields and meadows, coasts and marine waters, floodplains, forests, wilderness, protected areas (Natura 2000), cities, international responsibility, knowledge, and financing. This subdivision deviates considerably from the Aichi targets as it structures according to landscape instead of environmental issue. The dedicated section 'VII – cities' to greening urban environments goes under the title *"engaging with nature at home"* and stresses funding, support, cultural and religious diversity as focus areas (Hendricks, 2016). Germany's development towards the Aichi Targets is as required published in their National Progress Reports.

Progress for Germany[4] towards the Aichi Targets -relevant to UICG- is listed in *Box 4-5*:

Germany's progress towards Aichi Targets related to UICG as of 5th progress report

Box 4-5: Germany's progress towards Aichi Targets related to UICG as of 5th progress report

Aichi goal A: Address biodiversity loss	
Target 1:	The term biological diversity is relatively well known. ¾ heard of it while ½ knows what it means. Initiatives are in place and target group specific measures taken
Target 2:	Increase in international and national conservation projects with a main focus on illegally felled timber
Target 3:	Taxation and reduction in ecologically transfer payments receive focus. Rewards for emission savings and forest conservation in place
Target 4:	In-depth guides developed for private sector, certification schemes in place. Focus is on knowledge sharing and cooperation programmes
Aichi goal B: Environmental impact	
Target 5:	Various habitat programmes in place. 10% of German territory is interlinked biotopes. Natural parks approx. 3.5%. Natura 2000 is far advanced with well-functioning management system.
Target 8:	Marked decline in pollutant emissions, particularly sulphur and dioxide. Reduction measures not sufficient to prevent eutrophication and ozone pollution of terrestrial ecosystems
Target 9:	Nationwide native plant species plan and regulation. Continued problem but first results achieved
Aichi goal C: Improve biodiversity	
Target 12:	Biodiversity programme with 15mil annual budget with focus on special responsibility species. Numerous positive trends, yet larger extent of species trends is still negative requiring large efforts.
Aichi goal D: Biodiversity benefits	
Target 14:	Continued access to ecoservices is promoted with a focus on fair sharing of genetic resources
Target 15:	Plans for forest adaptation to resist climate change and safeguarding of peat and moorland have focus
Aichi goal E: Enhance implementation	
Target 17:	National strategy and corresponding measures in place, focus on frequent updates and evaluation
Target 19:	Central role in biodiversity conservation. Taxonomic research and applied research developing efficient methods for conservation have focus. Research sustainable partnerships with other countries in place.

Source: (BMUB, 2014)

Germany's actions towards the implementation of the European Habitat and Bird Directives have predominantly been the establishing of two pieces of legislation. The first, is the Federal Nature Conservation Act (BNatSchG), put in place in 1977 and latest revised in 2010. It covers a wide range of nature conservation elements such as landscape planning, ecosystem fragmentation and connectivity, recreation, compensation for impacts, and stakeholder involvement (Bundesnaturschutzgesetz, 2009). The second, is the Federal Regulation on the Protection of Species (BArtSchV), put in place in 1986 and latest revised in 2013. It specifically focusses on the impact on reproductive and resting places of animals, the killing or destruction of animals and plants, and the lasting disturbance of animals. This regulation covers the gap of BNatSchG regarding species protection as outlined in Article 16 and Annex IV of the Habitat Directive (Bundesartenschutzverordnung, 2005). In these bodies of legislation, nature conservation is assisted in its prioritisation by means of the incorporation of some stringent environmental principles. For example, the precautionary principle; preventing degradation without scientific certainty for the better of nature and polluter pays principle; the internalisation

[4] Even though the deadline for the submission of the 6th National Progress Report on CBD was due 31 December 2018, they are not available at the time of writing. The latest progress towards the Aichi Targets relevant to UICG from both Germany and Sweden are therefore from the 5th National Progress Reports.

of damage to nature as an externality by making the benefiter pay for it. Sometimes even requiring the polluter to restore nature to its form before the damage (BMUB, 2014).

Besides regulating, the BfN in cooperation with scientific expert stakeholders, creates and widely publishes multiple Red Lists to promote threatened species in Germany. The lists are go-to sources for abundant of disciplines having to work with biodiversity. They are strongly valued for their clear conversion of complicated natural science data into biodiversity guidelines (Federal Agency for Nature Conservation, n.d.).

Chapter 2 of the BNatSchG presents landscape planning legislation, regulating the spatial and landscape conservation for both rural and urban areas (Bundesnaturschutzgesetz – BNatSchG, 2009). Recently in 2015, a large urban focused report dedicated to the enhancement of urban green infrastructure and the design of a liveable environment, called *'Green in Cities – for a liveable future'* was published (BMUB, 2015). Main urban challenges, perspectives and recommendations are presented in the report with a focus on educating and supporting cities. This was followed by an '*Urban Greening White Book'* or governmental strategy for supporting urban greening (BMUB, 2017). A strategy or national legislation focussed on urban biodiversity is absent.

Sweden

The Swedish Environmental Protection Agency (EPA) (Naturvårdsverket), is the public body positioned with the task of the nation's biodiversity conservation. It is responsible for assisting in the development and establishment of a stable environmental policy basis. At the core of the national legislative landscape stands the Nature Protection Act of 1909, embedding nature preservation in legislation with a main focus on creating national parks (Naturvärdsverket, 2017). Towards the end of the 20th century (1999), as a reaction to intensifying environmental issues, the Swedish Parliament adopted a broad and stringent Environmental Code. It incorporated the 'generational goal' of passing on a society in which major environmental problems have been solved, forming the standard for embedding environmental concerns into: policy making, regulating environmental impact, and a framework for compensation. At its core stand 16 Environmental Quality Objectives (EQO) characterised by the three themes of focus: protection and management of nature, species protection, and sustainable use (Environmental Code, 1999). *Box 4-6*: Sweden EQO objectives related to UICG states the EQO's most applicable to UICG.

Box 4-6: Sweden EQO objectives related to UICG

EQO 4: A non-toxic environment
EQO 15: A good build environment
EQO 16: A rich diversity of plant and animal life

Source: (Naturvärdsverket, 2016)

From 2014 on a dedicated conservation strategy *"a Swedish strategy for biodiversity and ecosystem services"* was implemented by the Swedish government (Riksdag) to assist the country in achieving its environmental goals as well as assuring compliance to the EU 2020 strategy and CBD. Sweden submitted a 3rd NBSAP version, including a holistic overview of all their major environmental and biodiversity governance constructs such as: strategy, objectives, international role, CBD contribution, and action areas (A Strategy for Biodiversity and Ecosystem Services, 2013). Incorporated action areas are amongst others the need for accurate and reliable ecosystem knowledge and tailored support to research. This should lead to suitable biodiversity indicators compatible with policy making to allow links between ecological, economic and social sustainability. Another is the improvement of guidance to: governmental bodies, administrative boards, and municipalities as well as the fostering of knowledge sharing and communication between them. This knowledge should be translated into biodiversity friendly decision-making

knowledge and forwarded to consumers and investors. The report goes on by expressing the need for economic conservation incentives. The polluter pays principle is seen as an effective solution in need of wider implementation. Other focus points are: the leading as example through green public procurement, intensified species specific conservation, precise alien species management, and the finishing of Natura 2000 green infrastructure in Sweden (A Strategy for Biodiversity and Ecosystem Services, 2013).

Progress for Sweden[5] towards the Aichi Targets -relevant to UICG- is listed in *Box 4-7*:

Sweden's progress towards Aichi Targets related to UICG as of 5th progress report

Box 4-7: Sweden's progress towards Aichi Targets related to UICG as of 5th progress report

Aichi goal A: Address biodiversity loss	
Target 1:	Communication strategy for ecosystem services, public participation promotion, and school programmes
Target 2:	National strategy for green infrastructure is planned as well as an ecosystem service identification tool
Target 3:	Around 100 different policy instruments in place of which predominantly for rural
Target 4:	One-sided ecosystem service focus, intensive land and water use and high consumption pose threats to ecosystem stability
Aichi goal B: Environmental impact	
Target 5:	Remaining issue of fragmentation, habitat loss due to insufficient governance
Target 8:	Much progress made and interim targets met, situation in natural habitats still far from satisfying
Target 9:	Number and threat of alien species increases. Control is strict but focused on utilitarian value.
Aichi goal C: Improve biodiversity	
Target 12:	Wide assessments performed and red-list available, yet no overall improvement on threatened species
Aichi goal D: Biodiversity benefits	
Target 14:	Focus on green infrastructure and maintenance of ecosystem services
Target 15:	Restoration is performed but is a slow process. Stronger legislation would benefit this process.
Aichi goal E: Enhance implementation	
Target 17:	Strategy in place, adaptations likely to occur in future
Target 19:	Natural science is strong, knowledge on the management of biodiversity is missing.

Source: (Miliö- och Energidepartementet, 2014)

National legislation was put in place in 2007, covering the EU Habitat and Bird Directive. This piece of legislation called the '*Species Protection Ordinance'* (2007), embeds the conservation of threatened plant and animal species. It defines the governance of wild species killing, capturing, taking, trading, and other actions involving the treatment or possession of species. Additional regulation to control Sweden's ecosystems around insects, is the control of its strong hunting culture, on mainly birds and mammals by means of the '*Hunting Ordinance'* (1987) or the '*Fishing, Aquaculture and Fisheries Ordinance'* (1994) for aquatic ecosystems. The country published national Red lists of the protected species; indicating their threat levels and restrictions to the public. 27 insects, out of the 25.000 present in Sweden received the status as 'protected'. The rate of biodiversity loss remained over the past 15 years and proves difficult to turn around. Logging is classified as main cause for the loss (Naturvärdsverket, 2012).

Where the previous regulations cover all type of areas, a specific focus on regulating the build environment is the *Building Act*. Its need was already present when it was enacted in 1874 and it was latest amendment to match the modern build environment in 2010. The incorporation of

[5] The deadline for the submission of the 6th National Progress Report on CBD was due 31 December 2018. However, they are not available at the time of writing. The latest progress from both Germany and Sweden are therefore from the 5th National Progress Reports.

biodiversity in such regulation has been challenging due to the intensive demand for land and water in these areas. The act requires municipalities to draw up a detailed urban plan and to consider the values of individuals in urban planning (Plan and Building Act, 2010).

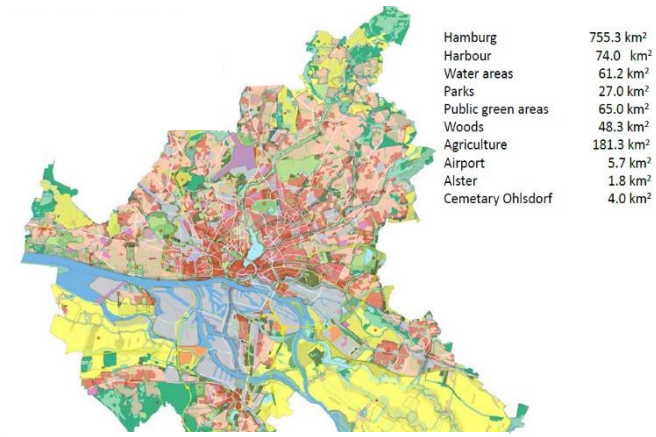
4.1.4 Local (Cities)

This is the level where policy becomes applicable to society, such as the private sector and the public. Policy is to be shaped according to the local situation and abstract and general statutes are converted to actionable measures and concrete variables (Dearborn & Kark, 2009). The results of explorative studies often reflect shared beliefs and values of the local society. These beliefs and values are to be fitted into suitable management plans and governance to assure future development (Verburg et al., 2016). Two case cities were reviewed and are presented below, delivering an insight on the local/urban situation regarding UICG.

Hamburg

The city of Hamburg and its direct surroundings are its own city-state. It goes under the name Free and Hanseatic City of Hamburg (Freie und Hansestadt Hamburg), which remains from its golden times between the 13th and 15th century. The city of about 1.8 million inhabitants in 2019, has a total surface area of 755 km^2 having an approximate population density of 2,460 per km^2. According to Eurostat (2019), this classifies as a highly urbanised area. Nevertheless, the bountiful lakes surrounding and in the middle of the city, together with the vast green spaces and recreational areas, make up about half of the total urban area. The city is located in the north of Germany and is established on the riverbanks where the Alster flows into the Elbe. Where the Elbe passes Hamburg, it is almost on its way out into the North Sea. This connection to sea has been vital to Hamburg for its economic, cultural and social prosperity, but equally so for the diverse sea and terrestrial landscape offering abundant and diverse habitats. (Behörde für Umwelt und Energie, 2012).

Figure 4-1: Map Hamburg Urban Landscape Programme



Source: (Berghausen, 2010)

According to the German basic law, it is the responsibility of the provinces to implement the national commitments towards nature conservation legislation and follow the national strategy. The provinces are perceived to be in the best position for the assessment and development of locally fitting, ethical and effective governance. Because the city of Hamburg operates simultaneously as a municipality and as a province, it can effectively assess their local situation and has the knowledge and flexibility to integrate the biodiversity conservation horizontally in their governance. It also eases delegation of responsibilities for the enforcement of biodiversity conservation (Freie und Hansestadt Hamburg, 2015). The governing responsibility for biodiversity or insect conservation in Hamburg, lies with the Ministry of Environment & Energy (Behörde für Umwelt und Energie). The ministry is divided in 5 main departments: Central Tasks and Legislation; Water, Sewage and Geology; Nature Conservation, Green Planning and Soil Protection; Emission Protection and Waste Management; and Energy and Climate (Behörde für Umwelt und Energie, 2019). The ministry cooperates with a wide network of public and non-public conservation organisations active in the municipality (Behörde für Umwelt und Energie, 2016).

Recognising the vast amount of national and international legislation, as an overall strategy, the Ministry of Environment & Energy drafted a 'Climate Master Plan'. The report predominantly focusses on climate change, greenhouse gasses, and climate adaptation. Main future focus areas are how to deal with urban heat in dense parts of the city and the handling of intense rain bursts. Conservation is incorporated under section 2.9 'Nature and Soil Conservation' (Freie und Hansestadt Hamburg, 2015). Where clear targets for emission reduction are defined, strategy and aims for conservation, as defined in *Box 4-8*: Hamburg Climate Plan Aims on Biodiversity, remain abstract terms, as they lack quantification and deadlines or milestones. The core strategy is to maintain environmental conditions, diversity, and city structures and patchwork. Other sections of the plan: human health, education, research, and monitoring; closely link with defined focus areas for insect conservation, but miss any connection to biodiversity whatsoever (Freie und Hansestadt Hamburg, 2015). In another publication based on Hamburg's green spaces, the bold claim *"German Capital of Nature Conservation"* is made. The publication highlights: the city's green hearth, promenade, squares, authentic and modern parks, clever green quarter city design, river (Elbe), lake (Alster), swamp landscapes, and nature reserves (Behörde für Umwelt und Energie, 2009).

Box 4-8: Hamburg Climate Plan Aims on Biodiversity

- Maintain biodiversity
- Ensure productive and functional capacity of the environment
- Maintain biodiversity, uniqueness and beauty of nature and the landscape
- Buffer and contain climate changes and extremes
- Guarantee human relaxation and recreation in the long-term

Source: (Freie und Hansestadt Hamburg, 2015)

A flagship project, manifested in legislation, is the '*Biotope Network'* or '*Green Network'* existing of an inner and outer ring of connected green spaces (steppingstones). This multipurpose green infrastructure project aims to benefit the urban climate by tackling the urban heat island, creating recreation and engagement with nature for urban dwellers, and tackling fragmentation. It has a strong underlaying motivation to enhance the quality of existing green spaces and protect what is there (Behörde für Umwelt und Energie, 2012).

The citizens of Hamburg have expressed their worry for the disappearance of green areas and the municipality takes this very seriously. Taking the citizens mental and physical health as a base, there are clear goals to become a green, liveable and climate smart city (Behörde für Umwelt und Energie, 2012; Freie und Hansestadt Hamburg, 2015). Hamburg has established a legislation for the implementation of the national nature conservation BNatSchG. A similar legislative body for the species conservation regulation BArtSchV is non-existent, however two sections (§ 13-16) of the implementation law for BNatSchG are dedicated to species conservation (HmbBNatSchAG, 2010). As nature and species conservation goes hand in hand with the strategic management and planning of urban land, a Landscape programme was incorporated in 1997 (Landschaftprogramm (LaPro)). This programme ensured the mapping of important landscape features, animal and plant habitats, species abundance, and aimed to identify public values to ease the incorporation in governance practices. Additionally, a subprogramme of to LaPro, called '*AuBS*', is designed to incorporate species and biotope conservation in urban planning (Berghausen, 2010).

A more recent effort towards the greening of Hamburg was the introduction of the 'Naturcent' off-setting programme, supported by the EU Horizon 2020 Naturvation Project. It involves the raising of property tax per m^3 to reinvest in the development of green spaces. This innovation matches the 'greening but growing' and 'quality over quantity' mentality towards green spaces (Toxopeus, 2019). A critique against this approach is however that the enhancement of green

spaces will benefit the privileged residence who live close to them or can easily afford it. It leaves out various existing issues around the natural situation for many individuals (Dube, 2016). Another project is '*Clever Cities'*, dedicated to green innovation with a focus on nature-based solutions. Green corridors, green roofs and school playgrounds are especially targeted ('Clever Cities Hamburg', n.d.). For the future, Hamburg is about to start one of the largest German urban greenspace agglomerations as part of the '*Naturlich Hamburg*' project. The project's planning and design phase is scheduled for 2017 – 2021, where the implementation is planned for 2021 – 2030. The project's aim is to drastically improve the function of green space for both nature and human. Focus are habitat and biodiversity as well as experience and recreation (Behörde für Umwelt und Energie, 2017)

The following table is an overview of additional identified governance initiatives not discussed above, initiated or supported by the municipality of Hamburg:

Table 4-1: Further Hamburg initiatives related to UICG

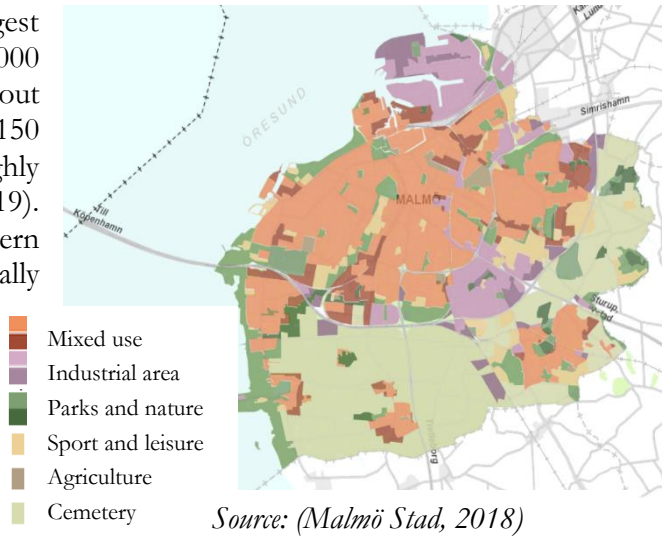
Initiative	Description	Partners	Source
Subsidising green roofs	Large scale application of nature-based solutions on roofs of public as well as private residences. A subsidy scale is in place to support private application of green roofs.	Private households	('Green Roofs', n.d.; Quanz, 2019)
My Tree – My City	Tree planting initiative based on donations. Donators can influence the trees location. It has a dual purpose: greening the urban environment and creating value for green spaces.	Loki Schmidt Stiftung	(Behörde für Stadtentwicklung und Umwelt, 2011)
Insect education	The education of insect benefits and ecoservices on schools for awareness raising	Academic institutions	(Quanz, 2019)
Green Procurement	The strategic purchase to support environmental goals. Supported by the establishment of indicators in line with the goals and the incorporation of these indicators in supplier contracts. Embedded in a Hamburg Public Procurement Act (HmbVgG).	Suppliers – private sector	(Behörde für Umwelt und Energie, n.d.-b)
Monitoring and the development of Red lists	The municipality has initiated and is involved with multiple monitoring activities related to insects and the development of respective Red-lists and monitoring reports are available for: butterflies, locusts, and dragonflies. 4 district reports and one overall report are available. A wild bee Red-List is under development for Hamburg, coordinated by Wildtierstiftung.	Wildtierstiftung	(Behörde für Umwelt und Energie, n.d.-d)
Optimisation of urban (green) space	An animal added design strategy is increasingly incorporated into urban planning, where ecologists or design experts are consulted for running projects. Another strategy is the 'more city in city' project dedicated to the optimisation of green space quality and effective densification		(Behörde für Umwelt und Energie, 2013; Quanz, 2019)
Transparency and knowledge sharing	The publishing of reports and biodiversity data and assuring the availability of information to the public. This includes information campaigns, project results, spatial planning, public participation, and citizen science		(Behörde für Umwelt und Energie, n.d.-e, n.d.-a; Quanz, 2019)
Winner Green Capital Award 2011	Hamburg was recognised by the European initiative for its greenness in 2011. It entered a year of appraisal but also green stewardship and awareness raising by means of its green efforts.		(Behörde für Umwelt und Energie, n.d.-c)

Source: Author

Malmö

The city of Malmö is the capital of Sweden's third most populous province called Scania (Skåne). Equally so, Malmö is the third largest city in terms of population, with 340.000 inhabitants in 2019. With a surface of about 157km^2 its density is approximately 2.150 inhabitants per km^2, also qualifying as a highly dense urban area according to (Eurostat, 2019). Located on the west coast of the most southern part of the country, Malmö is strategically located as hub between Europe's mainland and Scandinavia. Build on the shore, the city is surrounded by the Baltic Sea on the West-side and predominantly agrarian and semi-urban areas on the other boundaries (Delshammar & Melin, 2015). Where it achieved great prosperity as an industrial city mid-20th century, it struggled adapting to a more post-industrial period. Large sections of the city were allocated to industry. This changed by turning these areas into residential or recreational green areas. A strategic switch in identity and large migration caused the city to grow to a cultural and sustainable pioneer over the past decades ("International cities: Malmö case study," 2017). Moreover, 50% of the city is now dedicated to green spaces, including parks and residential areas (Delshammar & Melin, 2015).

Figure 4-2: Map Malmö Land-use Plan



Source: (Malmö Stad, 2018)

The biodiversity governance situation of Malmö municipality is dependent and shaped by the national and local strategies. Nevertheless, due to Malmö's ruderal and agrarian dominated landscape, Malmö faced a unique situation compared to the rest of the country and introduced a number of own policies adapted or differing from the Swedish and Skåne policies. Within the municipality, the city council (Kommunfullmäktige) is the highest political decision-making body, supported in directing and coordination of the municipality by the municipal executive board (Kommunstyrelsen), and city administrative office (Stadskontoret). These bodies are supported by 16 committees of respective disciplines, each responsible for the execution and supervisory of the board regarding their areas. Each committee again has an executing department. One of these departments is the Environmental Department (Miljöförvaltningen) responsible for control of the cities environment and health and ensure sustainable development. Urban development is dealt with by two departments, the City Planning Office (Stadsbyggnads Kontoret), performing comprehensive urban planning and the Streets and Parks Department (Fastighets- och Gatukontoret), focussing on land-use, infrastructure, green spaces and nature reserves. Additionally, the service committee (Serviceförvaltningen) takes care of the practical management of green, blue and brown spaces (Malmö Stad, 2019).

> The Regional Board (Region Skåne) created an environmental programme with concrete goals towards 2020. It is not stated in the report that this is based on the European strategy, probably because most targets go beyond compliance. The goals related to UICG are presented

Box 4-9: Region Skåne environmental goals in line with UICG.

Box 4-9: Region Skåne environmental goals in line with UICG

Objective 2 – a healthy environment
2.3: increase the proportion of organic and local productions
Objective 4 – Strong environmental profile
4.2 – Incorporation of environment and health in decision making, procurement and funding
4.3 – Transparency and dissemination of knowledge

Source: (Department of Public Health and Environment, 2016)

The strategy for Malmö is framed by a comprehensive plan (Översiktsplan) as required through the *Planning and Building Act*. The plan focusses on a 30-year timeframe and outlines how the municipality intends to make use and develop land and water areas. It has set three main special priorities with respect to urban planning: *"close, dense, green mixed-function city", "a regional driver of green growth and employment",* and *"the city as a venue for culture and democracy*" (Malmö City Council, 2018). It dedicates a specific section to biodiversity and greening of a densifying city. Natural area and biodiversity protection are based on the 'mitigation hierarchy' where the last step is 'the balancing principle'. This includes the compensation of lost green space by off-setting. It includes the possibility to compensate the removal of green areas, with green areas somewhere else. Defined priorities towards biodiversity conservation in the plan are: typical native areas, endangered and rare species, the increase of biological quality, and knowledge generation (Malmö City Council, 2018). Another bold goal, is published in Malmö's Environmental Programme (Miljöprogram) 2009 – 2020 claiming that *"Malmö will be the best city in the world for sustainable urban development by 2020*" (Malmö City Environment Department, 2009). This programme is the core construct on which all environmental activities are based. Comfort, pleasure, safety and quality are the core concepts used to describe Malmö's view on their environment where citizens are connected to a nature rich in biodiversity (Malmo Stad Miljöförvaltningen, 2009). An annual report (Miljöredovisning) is published to track and assess the development towards the goals (Malmö Stad Miljöförvaltningen, 2009). The objectives related to UICG are shown in *Box 4-10*: Malmö's Environmental Programme Targets Related to UICG.

Box 4-10: Malmö's Environmental Programme Targets Related to UICG

- **Responsibility** is held by every board and steering committee, enabling a simple environmental leadership
- **Green and blue amenities will be** expanded, safeguarded and have strong recreational and biological value
- **Resources will be used more wisely** through densification onto brown areas, saving fertile lands
- **A pleasant environment** for everyone. Children are able to play in a healthy and inspiring environment
- **Nature is protected** with a focus on endangered species, enhancing citizen knowledge and increasing interest
- Malmö will continue to develop as a **knowledge and innovation city**

Source: (Malmö City Environment Department, 2009)

Corresponding with the target on expanding and safeguarding green and blue spaces, a detailed '*Environmental Protection Plan'* (Naturvårdsplan) incorporates an overarching as well as detailed description and plan per greenspace. It uses a GIS digital tool for zoning, creating a database of area characteristics. Recognising that every area is different, even in the same city, this report incorporates detailed conservation and management of the sites as well as its biodiversity and also specifies insects (Malmö stadsbyggnadskontor, 2012). Also, Malmö is focussing on the creation of a green and blue network throughout its inner city and connecting it to the countryside. Green main routes connected to a denser network of corridors is planned for (Malmö City Council, 2018). Specification on whether this network is to benefit biodiversity is however not provided. To help reaching its targets and allow measurement of greenness, Malmö

has put in place the '*Green Area Factor*'. This indicator is based on the awarding of a score to the degree of greenness, habitat and natural services for respective areas (Kruuse, 2011).

Besides green strategy making, Malmö is active in various programmes, often coordinated and funded from European level. A project most engaged with insect conservation was the '*BiodiverCity*' project (2012 – 2017). The project was aimed at the enhancement of biodiversity in the city and had a focus on the effective application of nature based solutions to various urban surfaces (*BiodiverCity - Biodiversity in the Dense City*, n.d.). According to Poppius (Email interview, 2 July, 2019), regardless of the general biodiversity aim of the project, insects and plants received most focus due to their abundance and role in the urban environment. The programme initiated sub-projects of which a few were specifically dedicated to the creation of a plan for butterfly conservation (Poppius & Kruuse, 2016) and a study on butterflies and bees in green structures (Haaland, 2017a). The project was financed by a national council for innovation called *'Vinnova'*. Another project was '*Green Surge'* (2013 – 2017), aimed at innovative governance practice, enhancing green infrastructure and identifying the link between biodiversity and cultural diversity (Delshammar & Melin, 2015). The project was part of EU's '*7th Framework Programme'*.

The following table is an overview of additional discovered governance initiatives initiated or supported by the City of Malmö:

Table 4-2: Further Malmö initiatives related to UICG

Initiative	Description	Partners	Source
Insects on green roofs and facades	The project ran from Jun/Aug '17 and was part of the BiodiverCity project. It involved the monitoring and comparison of insect activity on green roofs by means of time lapse cameras. Visitors per roof type were clearly measured, yet identification of specific proved difficult.	- Scandinavian green roof institute. - Swedish Agricultural University (SLU	(Haaland, 2017b)
Pollinator Project	A guideline on the creation of favourable habitats for pollinators. It includes both a governance and practical views. Financed by the County Administrative Board (Länsstyrelsen).	Lund University	(A. S. Persson, 2012)
Intensive Management	The city has adopted the 'dare to refuse cutting' (Våga vägra klippa) project, in which an alternative, less intensive, management style is maintained for green spaces and motivated for the public. It has the aim to enhance habitats and greens space quality by a low operating costs yet high biodiversity strategy.	Lund University	(Miljöförvaltningen, 2016)
Education Programmes	(1;2) The city has been publishing and physically placing natural information in nature on insects, targeted at the public. Main topics are insect statistics and facts and ecosystem services. A large online publication is Man's best friends (Kolla in nature). (3) Also, an educational programme for schools was tested, but recently came to an end.	Swedish University of Agriculture (SLU)	(1;2) (Malmö Stad, 2018; Nilsdotter, 2019) (3) (Wiren, 2019)
Transparency and Publications	The public has access to most reports, projects, developments and are motivated to get involved. This is performed with the intention to create awareness and develop an environment by the public for the public.	Lund University	(Nordqvist, 2014)
Tree Strategy	Local strategy on increasing biodiversity while improving the social urban situation by the planting of a wide variety of trees.		(Bernadett, 2017)

4.2 Interview Findings

In the following research section, the expert responses of the interviews are presented. Their knowledge, visions and statements regarding UICG for both Hamburg and Malmö are evaluated based on the four themes central to the interviews: insect conservation & urbanisation; strategy & policy landscape; urban planning & trade-offs; and focus areas & next steps. The interviewed experts included: project leader, landscape architect, ecologist, researcher or local politician.

4.2.1 Hamburg

Urbanisation & Insect Conservation

Faced with the challenge of being a small county, the growth which Hamburg is expecting, must take place within its narrow borders. The strong urbanisation trend led to an innovative densification growth strategy. With the motto *"More city in city",* especially the city centre is experiencing densification (Quanz, Personal Interview, 11 July 2019)[6]. If this urbanisation trend is not strategically approached and its effects on insect conservation are ignored, failing the incorporation of conservation elements into policy, this will have major impacts on insect population and diversity. Conserving insects will get really difficult if not incorporated into policy (Demuth, Personal Interview & Field Trip, 11 August 2019).

Quanz (2019) mentioned that urbanisation and more people moving to Hamburg are the main barriers for insect conservation. A main driver and good policy instrument is regulation. Compliance is high on the municipality's priority lists and therefore an effective way to assure insect conservation. Besides regulations such as prohibiting the use or discharging of chemicals to nature or command and control of habitat protection, the availability of detailed Red lists is an instrument which can create value for the conservation of insects in Hamburg. An increasing valuation of insect conservation amongst the public, raises interest amongst various municipal function such as urban planners, but also policy makers and politics. As insect conservation ambassadors, municipal environmental departments and ecologists are backed up by the voice of the public, increasing their leverage position (Quanz, 2019). Even tough experiencing an uptake, awareness for insect decline and even biodiversity loss amongst both the public and policy makers is lacking to the extent required for becoming a recognised and mainstreamed issue. It stands in the shadow of climate change. People seem to have difficulties coping with large scale and complex problems. For most, climate change is enough to cope with at this moment (Demuth, 2019).

Currently, insect conservation is primarily embedded as a part of biodiversity conservation. In a few cases, threatened local or special species receive dedicated focus as a result of Red-lists or monitoring results. Managing on species level can be beneficial as it prevents extinction or allows the support of an entire ecosystem. However, it can also lead to unfavourable habitats for other species if not well understood. Managing on a species level also requires vital insect conservation knowledge (Quanz, 2019). Demuth (2019) highlighted that both species specific and general knowledge are essential. Nevertheless, total biomass, and therefore general conservation, has priority over single species, as it is more vital in keeping ecosystems healthy.

Strategy & Policy Landscape

In local politics, insects do not make it into the already limitedly covered nature conservation topics. Local politics is a good place to discuss about insect conservation, yet it is not what

[6] First citations of interviews include date: day and month. For more information regarding interviews see Appendix 1

people are interested in. Topics covered in politics are topics the people are concerned about or interested in. (Salinger, Personal Interview & Field Trip, 9 September 2019)
Momentarily, goals established around biodiversity conservation are vague. They are not specified or quantified. The mass is targeted with the aim to increase biodiversity as a whole. A focus on native species or local habitats is absent (Demuth, 2019). Such vague goals ease meeting the targets. It is likely that municipalities are afraid of detailed targets for the likelihood not meeting them.

There exists no insect programme on the administrative level. There are however various smaller projects and numerous initiatives dedicated to or encompassing insects. These are primarily short-term projects which have a focus on honeybees (Quanz, 2019). Demuth (2019) reasons that short-term projects can be synced with political cycles and flexibility, but they do not match natural processes and needs. Thus, longer-term projects are needed for effective insect conservation, as they allow for continued protection, long term knowledge development, evaluation and improvement.

Responsibilities for putting conservation into practice lie at the Nature Conservation Department. The development and administration of governance is the responsibility of the Ministry of Environment and Energy together with the Ministry for Agriculture. Furthermore, private stakeholders are also important stakeholders and good cooperation amongst the public and private stakeholders is in place. They are aware of, and involved in, each other's activities (Berghausen, Email interview, 12 July 2019). However, the allocation of responsibilities has not been clarified in detail. This leads to passive behaviour hindering conservation action (Quanz, 2019). Demuth (2019) highlighted the differing interests of nature conservation stakeholders as a core reason for a complex and stagnating conservation situation. Each stakeholder has their own ideas around what is needed for conservation, however a misalignment in values and priority causes inaction. *"For example, in grassland, ornithologists, botanists, and entomologists would demand three different management concepts. … Only by considering the different requirements of as many organisms as possible, can we succeed in preserving biodiversity. This requires the willingness of all to compromise"* (Demuth, 2019). Demuth (2019) expanded that insect conservation can be restricted by market lobby. This happens in the city but is especially evident in the agrarian sector, where it must cope not only with a lacking value but also the intention to keep this to a minimum. Additionally, the public and especially homeowners are responsible for their own properties. Unfortunately, not every individual is aware he/she is a stakeholder. Conservation knowledge is not available or obvious to the individual. "*The government in the end, is responsible to influence the public"* and should assure the public has access to this knowledge. *"They don't have the same knowledge and awareness as the ministry of nature conservation."* (Quanz, 2019).

Urban planning & trade-offs

Currently, insects are not structurally incorporated into urban planning. Insect conservation has a low priority in urban planning and has difficulties competing with a wide range of other interests, requiring a trade-off to be made. Involvement of the right stakeholders and disciplines and discussions amongst them are the way such trade-offs are approached. The valuation and analysis of trade-offs is a difficult process, especially in a city with so many differing socioeconomic interests and factors (Quanz, 2019). Demuth (2019) shined light on the role of protected areas. He reasoned that they are great means of ensuring nature in the urban environment on the longer term, however it occurs that the institutions administrating such areas strictly work their own agenda's. These might differ with requirements of native species or habitats. This can also jeopardise effective cooperation or the joint development of conservation knowledge. "*There often is a one-sided communication between experts and municipalities and*

also with the decision makers of large nature conservation associations … The involved stakeholders (farmers, municipalities, botanists, entomologists, ornithologists… are often too little willing to compromise. This makes them less flexible towards cooperation while alignment is what is required to establish a suitable and effective conservation for Hamburg. *"Decisions or initiatives are based on ten-year-old studies compared with bureaucracy and austerity leads to less efficient measures, lacking adaptation to today's conditions in the city* (Demuth, 2019)*."*

Focus areas & next steps

Focus areas for UICG in Hamburg are according to Quanz (2019) awareness raising, by means of information campaigns on for example ecosystem services or the development of insect guidelines, including information on insect threats and practical conservation initiatives for the public. Awareness creates recognition for individual impacts; which regulation fails to micromanage. The prevention of habitat loss as well as habitat creation, and improvement of habitat quality, receive main insect conservation focus included in urban planning. In doing so, special focus is paid to the protection of native species and the development of an optimal shared habitat between human and insect (Berghausen, 2019). The methods of interest to Hamburg are the effective optimisation of green spaces, promotion of nature-based solutions and the creation of new innovative niches by utilising low purpose spaces like roof tops and or isolated strips and patches (Quanz, 2019). A longer term step is allowing densification in a smart way, where isolation and fragmentation are prevented. Demuth (2019), expresses not just the need for awareness, but for tackling the damage done due to unawareness. A large share of stress to insects is unintentionally or indirectly resulting from not being aware of these impacts. According to him, next steps for Hamburg, would be to dedicate time and resources to the designing, evaluation and adapting of conservation instruments to the local situation. A change in strategy from short- to a longer-term is needed to achieve this and match the conservation strategy with natural processes.

Demuth (2019) reasons that a better cooperation between academics and practice is needed including an improved understanding of how to put conservation knowledge into action. Additionally, cooperation amongst conservation stakeholders is needed and a 'shared' approach of land management, where concepts and approaches from experts are applied in a best suitable mix. *"Only by considering the requirements of as many organisms as possible can we succeed in preserving biodiversity"* (Demuth, 2019). Also Quanz (2019) motivated *"the knowledge is there"* it is awareness which is lacking. Demuth (2019) also stresses the fact that experts active in the practical insect conservation are less frequently asked for their consultation by government officials. The incorporation of conservation knowledge seems to be a bottleneck in the development of conservation governance. Besides stakeholders in the municipal environment, the public needs targeting as insect decline is everybody's problem. Also, the public's awareness shapes policy. It starts with their votes and government officials represent the public in their daily activities (Demuth, 2019). *"We need to act and we need to take with us the public … we cannot do it against them."* (Quanz, 2019). Special awareness raising initiatives are needed to target the people who are unaware. Currently, most activities reach people who are (to some degree) interested and aware of insect conservation (Demuth, 2019). To the question whether the public can play a bigger role in insect conservation and potentially relieve some resource issues, Salinger (2019) explained that regardless of the potential, this proved extremely difficult to achieve in politics. There is a small group of fanatics who organise: tours, talks and presentations. However, the audience is small and it attracts mainly other fanatics. The common public is generally uninterested for insect or nature conservation. Quanz (2019) communicated Hamburg's intentions to focus more on children as part of education and the intention to create insect conservation stewards. Salinger (2019) stresses the vital role of education and explained how nature is hardly present in current educational programmes. Assuring the utilisation of knowledge by passing it on to next generations should be a basic practice. Besides, achieving an

increased valuation of insects amongst children is an effective way to raise awareness, as they pass it on to their parents. "*education goes both ways, from old to young, but definitely also from young to old"*.

Differing interests is a major issue according to Demuth (2019), leading to lengthy processes and the inadequacy of establishing conservation governance. Alignment of interests and conservation intentions is needed amongst conservation stakeholders. *"Each expert: ornithologists, botanists and entomologists, would demand different management concepts. … This requires the willingness of all actors to compromise."* He goes on by stating that in the case that this willingness is not there, then *"surfaces must be 'shared' and maintained according to different concepts."*
As mentioned by Demuth (2019), insects need general as well as down to species management. The general management is in need of effectiveness evaluation and improvement, where species specific conservation needs an enhanced knowledge base and expansion. Berghausen (2019) expresses that the *"main focus area is the support of native species and their habitats in natural and urban surroundings"*.

4.2.2 Malmö

Urbanisation & Insect Conservation

Over the past decades, Malmö experienced a drastic change from a city characterised by industry to a green city with high quality of life. Compared to the size of the city, Malmö is experiencing a large population increase. It is rapidly building houses and experiences intensive urbanisation effects. Wiren (Phone interview, 3 July 2019)[7] elaborates how this is causing a densification trend, which puts pressure on the existence and quality of green spaces. *"Green spaces rather make place for buildings than the other way around."*

An insect specific focus is not so much on the political agenda. It is embedded in biodiversity conservation. "*For Malmö it is impossible to focus on a species level as such. We have to make sure that biodiversity is on the planning radar"*. It is likely more effective to keep it on a high level, as for now the main challenge is to try to preserve green and blue spaces at all. *"… the aim is to ensure an as high as possible biodiversity overall"* (Nilsdotter, Skype interview, 9 July 2019). Nonetheless, (Wiren, 2019) states that the public and politics have engaged more with insect conservation and increasingly value their services. He reasoned that very recently this gained attention as a result of increasing awareness for the SDG's and international biodiversity reports. Most notably, awareness of pollinators followed the publishing of a report on their value for Malmö. Especially bees are leading the way as stewards for insects (Persson, Skype interview, 26 June 2019). Unfortunately, this increasing level of detail towards pollinators is *"misdirected attention"* as focus is often predominantly on honeybees. Out of all pollinators, this is the species which is not threatened. According to Wiren (2019) *"the species or specific conservation is definitely something we could do better"*.

Strategy & Policy Landscape

Malmö has established a set of environmental indicators, managed by the Environmental Department. These indicators are monitored to track performance over time. They mainly indirectly cover biodiversity. Besides indicators, the law is the main guideline for biodiversity conservation. *"My main task is to check whether the projects and activities actually follow environmental law, all the time"* (Nilsdotter, 2019).

[7] First citations of interviews include date: day and month. For more information regarding interviews see Appendix 1

Insects are incorporated in biodiversity governance, vaguely in strategies and even more seldom in actions. The projects that do encompass insect conservation are very much based in EU funded projects' basis, involve practical initiatives and are short-term focussed. They have given Malmö a green image locally and internationally and made people realise that biodiversity matters. Such projects are however not seen as internal to Malmö's governance and have difficulty translating into every day work practices. They are *"flagships, which have trouble getting in the municipal plans or fail to transfer to other departments"*. Current actions are thus not sufficient to stop insect biodiversity decline in the municipality and the distribution of responsibility is likely too unclear to make an impact and result in mainstreaming the subject (Persson, 2019).

"The municipality has grown a lot and turned into a huge organisation" (Nilsdotter, 2019). This changed the way communication is arranged and led to a division of the organisation. The structure is increasingly vertically organised, and therefore ecologists no longer talk to policy makers directly. Ecologists have a consulting role, which has complicated getting biodiversity into policy (Wiren, 2019). Persson (Email interview, 23 August 2019a)[3] states: *"municipal staff makes suggestions, but politicians take the decisions"*. Ecologists are confined to their departments and restricted to what they can do, as becomes clear from the following statement: *"An ecologist knew exactly where the hotspots were but couldn't do anything"* (Persson, 2019). *"Knowledge on central role of insects is there and the will to do good is definitely there"* but regardless of this, it does not make it into policy (Wiren, 2019).

Insect dedicated projects have predominantly been initiated by individual particularly interested municipal officials (e.g. an ecologist), as a dedicated working group for insect conservation is not existent (Persson, 2019a). Ecologists do collaborate and communicate well with each other. They meet every week, align on their activities and advice one another (Wiren, 2019; Nilsdotter, 2019). They write comments together to give it more authority (Persson, 2019). Besides interdepartmental cooperation, Malmö cooperates with other municipalities in Skåne. Also, the sharing of knowledge, cooperation and consultation with private stakeholders is repeatedly performed. "*For each case, the departments work with respective specialists and organizations such as NGO's, like the botanical organization or the entomological organization. Depending on the required specialism, like, birds, insects or fungi, etc. such organisations are consulted individually* (Nilsdotter, 2019).

Urban Planning & Trade-offs

Dalshammar, (Email interview 25 June 2019) communicates that insects are not structurally incorporated into urban planning policy. Complexity seems to be a main reason for this decision. Each green space varies in size, type and has different vegetation. Conservation efforts and required management practices depend on such local conditions. *"We do a lot … to benefit native fauna as best as possible"* (Wiren, 2019). Besides natural elements, economic elements are a main decision factor for urban planning as it fully depends on available budget (Nilsdotter, 2019). Wiren (2019) also reasons about the importance of social elements, as urban spaces are designed for the public. While the majority is usually satisfied, a small number of citizens actively complain when conservation efforts do not match their interest.

Persson (2019) found that Malmö's ruderal areas contain highly favourable insect habitats. They are however *"not really acknowledged for the biodiversity they contain"*. Biodiversity, let alone insects, have difficulty competing for priority with social issues like housing shortage or unemployment (Wiren, 2019). In the cases of housing, such habitats are lost, but also in the case of planned greenspaces, they are generally lost as these are designed from scratch. Efforts were made to preserve such areas and integrate them in new urban plans. "*Ecologists were happy about this, but I am not sure whether the planners liked it"… "The value of derelict areas is known amongst ecologists… but*

considered as useless weeds or shitty vegetation when developing ex-industrial sites" (Persson, 2019). Cooperation with property owners is crucial in such cases. Often landowners are unaware of suitable insect habitats and do not value their conservation. A focus on private property, greatly assists urban green space conservation area creation (Poppius, Email interview, 2 Juli 2019). *"In a perfect world every individual does its share",* in practice this is unrealistic and final responsibility comes down to the public sector. The private sector has ethical responsibility while the public sector has obligatory responsibility towards society (Nilsdotter, 2019). In terms of trade-offs, Nilsdotter (2019) elaborated on the vital role of legislation. Legislation converts biodiversity conservation into compliance or non-compliance. Conserving insects then means adhering to the law.

Focus Areas and Next Steps

Main areas of focus towards UICG for Malmö according to Wiren (2019), are human, economic and time resources. Desires regarding conservation cannot be put into practice because of limiting resources. Especially when considering the intensive planning for nature conservation and plentiful and fast-moving urban projects. Additionally, public as well as politicians awareness for insect related issues and effective instruments proves a big effort. Nilsdotter (2019) adds to this that regarding awareness raising, most efforts were regarding information campaigns and raising awareness amongst municipal departments and policy makers. She also expressed the strong focus for the prevention of habitat loss wherever possible. This mostly occurs reactively as consultations in urban projects. The optimisation of habitat quality is priority after habitat loss prevention, with the intention to achieve an as high as possible biodiversity. Additionally, she expressed the future need for better legislation, especially in planning and building. At the moment, the comprehensive plan incorporates little to nothing about biodiversity. *"We have no guideline to work with or stand on to convince stakeholders"* (Nilsdotter, 2019).

Insect conservation requires a lot of planning and work. Considering the limited resources and few positions outside the Environmental Department dedicated to nature conservation, this affects what can be focussed on and the degree to which biodiversity is embedded into activities (Wiren, 2019). The resources that are available tend to work on their own projects. According to Persson (2019) a stronger collaboration should be an area of focus, so that knowledge can be transferred between ecologists, the Environmental Department, landscape planners and green space management. Ineffective silo operations should be prevented and lengthy communication paths avoided. Persson (2019) also states that the insect decline issue needs acknowledgement amongst those who sit on the money. *"Recognition is first needed to be able to change things in how the municipality works"*. Besides the government officials it is essential to change the perception of the public. Creating awareness amongst the public on conservation needs and insect benefits is a difficult task. "*This takes time, just like with anything new"* (Wiren, 2019). He elaborates on the potential for information raising campaigns focussed on departments, policy makers but moreover the public. The targeting of schools and children, private gardens and placing information around the city are areas of focus for Malmö. Persson (2019) urges the exploitation of the pollinator momentum to support expansion to other insect species. It is essential that insect stereotypes as either creepy and scary, or something that only concerns nature lovers and entomologists are removed.

Another area of focus is the tackling of the issues around unclear responsibilities and cooperation. Persson (2019) expresses the need for clearer coordination of conservation governance. She presents two governance methods. One is a scattered distribution of responsibility, like a spider web. This is currently partly in place. The other involves bringing the governance to a central body, closer to the money. This involves a more joint operation and tighter network. Persson (2019b) shares her belief, that only if coming from a higher governance

level, will departments have to act accordingly, and conservation can be prioritised. When an issue is closer to the money, insect conservation is more likely to be factored into core decisions and the budget as they are positioned at decision making level. Factoring in insects becomes strategic and easier when positioned with the money, as economic issues come first, social issues 3rd of 4th and ecological issues even lower in the ranking.

4.3 Chapter summary

When viewing the governance side, Germany and Sweden are complying to the CBD requirements and have established long-term monitoring projects and Red lists. In addition, Hamburg and Malmö have taken their subsidiarity responsibilities by implementing and going beyond compliance on these pieces of legislation.

For the Hamburg and Malmö, UICG is mainly approached through the application of practical green space management initiatives, or short-term monitoring or awareness raising project basis. Various conservation initiatives are therefore in place, yet the structural incorporation and utilisation of tools and knowledge in strategic management by the municipalities is limited.

Areas of focus for an improved UICG, as expressed by the experts are:

- The vital prevention of habitat loss and where possible creation or improvement of habitats.
- Enhancement of awareness raising campaigns amongst the public, political, and other conservation stakeholders.
- Responsibilities of conservation experts and reaching consensus on the to be applied conservation methods. Unspecified responsibilities and differing agendas can jeopardise effective cooperation and cause a mismatch of conservation efforts to requirements.
- Conservation experts as well as policy makers and urban planners, need conservation tools to work with. Momentarily insects are absent or vaguely included in programmes or targets.
- Available monetary, time and human resources was expressed to be a limiting factor in the conservation efforts for the municipalities.

5 Discussion

This section further analyses and interprets the research findings obtained from the research questions. The relevance of the case study findings is put in perspective by comparing them to the findings from the reviewed literature, addressed here per main identified themes: reflection on governance instruments; governing urban insect conservation; defining conservation scope; insect valuation; and conservation responsibilities. Experienced limitations while executing the research are commented on at the end of the discussion.

5.1 Reflection on Governance Instruments

From the UICG inventory in *section 3.2.5,* the identified instruments applied for Hamburg and Malmö predominantly cover a policy mix pattern around advocacy, service and collaborative instruments. The literature, on the other hand, has a more strategic focus of regulatory, economic and advocacy instruments. It is the translation and tailoring of the case specific situation into these governance instruments which proves to be a complex process of present UICG (Botzat et al., 2016; Verburg et al., 2016). This also proved relevant for the investigated cases. The incorporation of insects into strategic management proved limited, as only a couple of strategic level insect specific initiatives were defined: Red lists, monitoring and information campaigns. Insect specific conservation was materialised by predominantly smaller and practical initiatives: information campaigns, guidelines, monitoring, Red lists, management practices. When comparing the insect governance situation of the case studies to the reviewed literature, the following inferences were identified for each group of policy instruments:

Direct regulation instruments rarely make it down to insect specific coverage. The identified regulatory instruments around technology (for example: green and blue space management practices and regulations around buildings) or performance (for example: threatened or rare species as well as exotic plant and alien animal species management) are in place and adhered to accordingly in the cases. These regulations for the most part come forth from the international conventions and national legislation. Due to complexity in monitoring and enforcement, regulatory instruments are often less suitable tools for administration on a city (micro) level. Where technological and performance regulation in the cases incorporates various terrains other than urban and contribute to conservation efforts beyond the local scope, urban planning is the regulative instrument fully dedicated to the city level. The cases show that in practice, insect conservation does not structurally make it into urban planning. Generally, conservation is newly approached for each urban planning project. The reasons for conservation in urban planning, expressed by the interviewees, match with the predominantly utilitarian motivations of costs, human well-being and eco-system services, as described in *section 3.1.3*.

Economic instruments on a biodiversity level are a rarity in the cases. Likely owing to the reason described by Costanza (2015) that, economic instruments are hard to monitor and come with high administrating costs. This is especially the case in the urban context, with many abundant unknown impacts unable to trace back to a single polluter and for the complex management of insect abundance and miniscule size. On the larger biodiversity scale, economic instruments were in place for the cases, namely: subsidies for green roofs and off-setting programmes.

Service instruments is a governance instrument group little touched upon in literature but proved more prominent in the case cities. Practical conservation initiatives were incorporated into services provided by the municipality, with relatively little strategic change. These practices prove effective, with potential to achieve quick natural habitat improvements and influencing the public's opinion, as these practices are visible to the public. There is a strong awareness for greenspace quality, including a priority for the preservation of native animal and plant species.

Advocacy instruments proved a dominant instrument group for both literature and practice. Positioned amidst most stakeholders, the municipalities in the cases seek to maintain a knowledge broker role. Awareness raising and educational campaigns aimed to influence citizen psychology are implemented and under development. The monitoring and creation of inventories from which guidelines and Red lists are developed, deliver insight in the quality of green areas and health of insect species. Advocacy instruments assist insect experts in their consultations and provide and evidence base to decision makers.

Collaborative instruments were approached as an underlaying element in literature. However, the cases showed that in practice, topics like responsibility and cooperation proved a returning element. The interviews revealed that conservation efforts are regularly limited due to a restricted influence and consultation of conservation experts and academics. Additionally, stakeholders in conservation were said to have own goals and agendas, restraining conservation efforts from an effective cooperation and delineation of responsibilities amongst conservation stakeholders on a city level. An innovative approach to cooperation is the empowering and involvement of the public. This is presented as promising in literature but proved difficult in practice due to limited interest.

5.2 Governing Urban Insect Conservation

Overall, the assessed literature indicates that UICG is an acknowledged concept, increasingly considered important and progressively enshrined into policy. As derived from the document study, the policy landscape around UICG is almost in its totality based on the CBD and EU Habitat Directive. Europe puts a large dependency on these pieces of legislation; forming the backbone of nature conservation. As these pieces of legislation are initiated on a macro level with the intention to control the micro level, they fully depend on actions and policies adopted at lower authoritarian levels. There is a clear regulatory path from international and European level down to the case cities, but this is a path of broad unspecified targets. Where the CBD and Habitat Directive provide a great framework, it does not guarantee any insect conservation per se. Unlike for birds, there are neither dedicated regulation nor specific targets for insects. As for the local situation in Hamburg and Malmö, this recurs as equally vague targets. Urban insect conservation thus, regardless of the regulatory framework, largely comes down to: the incorporation of insects as part of biodiversity, as well as value put on insect conservation locally, and the municipality's best interest to go beyond compliance. Both cities have strong ambitions to become green urban pioneers, to which an insect friendly image could contribute.

Reflecting the identified situation of the case studies upon the conceptual model identified from literature, presented in *figure 3-5*, recurring themes revolved predominantly around human factors. When analysing the role of urbanisation towards UICG, the cases confirm similar threats as prominent compared to literature in *section 3.1.4*. Namely: densification, fragmentation, isolation, alien species, and habitat loss. Habitat availability and particularly its sub-category habitat loss prevention, were perceived main strategic activities in the conservation efforts of the cases. As second but equally so focal priority, the strategic optimisation of habitat quality is predominantly realised by smaller practical initiatives. The cases put focus on management practices and the conservation of native species and management of alien species. The interviewed experts expressed that habitat loss is for a large extent subject to reactive management. Insect conservation experts have as priority the ongoing consultation and lobbying in often already initiated urban planning and building projects; threatening the loss of valuable habitats. Experts regularly do not have a fixed role in such projects but are often consulted when the need arises. This raises the issue of not structurally incorporating insect conservation into urban planning procedures.

Additional recurring themes around UICG raised throughout the case studies, concerned socioeconomic factors. The human influence and societal factors recurred repeatedly and were raised in connection to natural and urbanisation themes. The essence for understanding these elements was expressed in literature. In the cases socioeconomic factors were recognised and efforts are performed with the aim to influence: the value of insect conservation, awareness raising, knowledge sharing, cooperation and coordination, and available resources. These aims link with the reviewed literature presented in *sections 3.1.2 and 3.1.3*. A distinction in socioeconomic groups was not made in the cases, other than a small focus on educating children for both cases.

5.3 Defining Conservation Scope

Reviewed UICG literature and the case studies provide evidence for the overshadowing of insect species factors by a general governance scale and unavailability of adapted species specific governance tools. Botzat et al. (2016) outlines this scoping phenomenon, and reasons how impacts resulting from such large scopes, both positive and negative, are difficult to isolate for specifically insects; often remaining unknown (Botzat et al., 2016). For the cases, most conservation efforts in place, focus on biodiversity maximisation. However, an increasing focus on insects or projects with a focus on specific ecosystem services -provided by a group of animals (for example pollinators)- have sporadically started being initiated. Such focussed initiatives are on short-term project basis and mostly do not come from strategic management but are initiated by a motivated individual. This development offers prospect towards a more detailed insect conservation.

Considering the phenomenon of preferred animal (mammals & birds) conservation, as highlighted by Sánchez-bayo & Wyckhuys (2019), cause insects to go unnoticed in the above described large scopes. It makes them dependent on conservation efforts fitted to other fauna or flora. Maestre Andrés et al. (2012) substantiates how depending on the conservation of insects from overarching scopes, makes governance susceptible for uncertain rebound effects. For Hamburg and Malmö, interviewees expressed how the initiation of short-term and small-scale projects have delivered valuable UICG knowledge and experience but miss structural incorporation of insects into strategic conservation governance.

Demuth (2019) views it the other way around. He expresses the need for biodiversity maximisation in current governance because otherwise undervalued and less evident species like insects would fall out of scope and be negatively impacted. He also states that conservation stakeholders and experts all have own conservation ideas leading to a conflict of interest. These insights into practice combined with the shared limited available resources towards conservation within the municipalities, require a careful consideration and consensus on conservation detailed scopes and timeframes. A suitable conservation strategy aimed at factoring in all animals and plants (biodiversity), but where possible with sub-conservation efforts targeting insects, ecosystem services or other animal groups would greatly benefit city wide conservation effectiveness.

The scoping phenomenon, maintaining the aim of biodiversity maximisation, is likely to avoid the incorporation of insect specific knowledge. This connects with the gap between available natural knowledge and applied governance. Where Shwartz et al. (2014) communicate the essence of basing policy on available scientific knowledge, neglecting UICG knowledge presumably results in ineffective conservation efforts. The lack of an existing knowledge foundation matches with the concern raised by the interviewees, regarding the unawareness of policy makers. Regardless of the municipality's conservation intentions, limiting resources was motivated to be a restricting factor towards the ambition for conservation, but also for the

incorporation of detail into the conservation scope. This indicates that elements of time, money and human resources, should be considered when investigating a specific local UICG situation.

5.4 Insect Valuation

Acknowledged in *section 3.1.2*, the value people have towards insects, stand at the core of their behaviour and result in the by Kowarik (2011) defined: direct, indirect or socioeconomic impacts to urban biodiversity. Almost in all reviewed literature, and in the cases, insect conservation value is of utilitarian form, taking the ecosystem services concept as a baseline. According to the motivations framework by Dearborn & Kark (2009), the application of the ecosystem services framework, aims for a human and ecological win-win situation. The strong utilitarian view of insects in an anthropocentric urbanised environment as emphasised in the case studies, raise doubt to what extent this dual benefit is applied in policy and or realised in practice.

Awareness for insect benefits and their incorporation into policy, proves not just dependent on their existing intrinsic and utilitarian value, but often on the recognition for the disappearance of this value. Mostly in the form of ecosystem services which they provide to humans. Regarding the valuation of insect conservation, the cases show considerable activity. Awareness raising campaigns, red-lists and guidelines, monitoring, knowledge sharing and education; attempt to influence the perceived values for insects. However, when placing these efforts into perspective by comparing it to its large and diverse target audience of urban planners and policy makers, the private sector, and the public; these efforts look relatively minimal. From the interviews could be deduced that, unlike climate change, nature and insect conservation are not seen as a problem for all. This matches Persson's (2019b) confirmation on the fact that UICG is still in a stage of awareness raising, highlighting the importance for information campaigns and knowledge sharing. Quanz (2019) supports the need for awareness raising by stating that the stage of acting is here, but that acting is only possible if the public is on board. This highlights the importance of matching governance instruments with the expected conservation willingness and awareness.

The interviewees unanimously motivated how a lacking valuation and awareness amongst the public, private sector and policy makers, affects the UICG situation. This links with the in *sections 3.1.2* and *3.2.2* motivated interdependency between UICG governance effectiveness and the perceived UICG value. Governance instruments can therefore take an influential approach aimed at the persuading its addressees value perception, often taking the form of advisory, services and in some cases economic instruments. Or establish a certain value as the norm by enforcing what is and what is not allowed by means of directly regulating or economic instruments. Where a local situation experiences difficulty with both the valuation and governance side, the likelihood for a stagnating UICG situation arises.

The different valuation of UICG by the public and conservation stakeholders commonly leads to conflicts of interest (Assessment Millenium Ecosystem, 2005). This raises the in *section 3.2.3* required trade-offs where intrinsic and utilitarian insect values compete against the opportunity costs for conservation. The absence of insects in Hamburg's and Malmö's strategic governance and urban planning, raises the likelihood that, besides a difficulty of realising a win-win situation between human and ecology, insects are not even factored into the prioritisation. Where other preferred animals are valued enough for their individual: valuation, prioritisation, and trade-offs; insects are mostly dependent on overarching animal groups or highly valued predators that depend on them. In Malmö, a development towards this exact case provides prospect for value raising governance initiatives. An increased awareness for ecosystem services amongst decision makers, resulted in the establishment of a pollinator focussed project. Interviewees from Malmö recognise the opportunity to latch on to this momentum, with the aim to expand value and thereby conservation efforts.

5.5 Conservation Responsibilities

In both cases the municipalities have shown a growth in their organisational capacity, becoming increasingly hierarchically organised. The interviewees from Malmö expressed that this has led to a more isolated operation of departments. Also, decision making is increasingly separated from where the insect conservation knowledge is located. Having caused expert consultations to policy makers and other departments to diminish and run indirectly via their management to external stakeholders. This separation between strategic level and the experts in practice, equally so results in an isolation of insect conservation knowledge, which on its turn restricts knowledge transfer and eventually affects UICG effectiveness. The interviews highlighted a discussion around responsibilities and the position of UICG within the municipal organisational structure. Conflicting expert views were obtained towards the positioning of UICG down in practice (decentralised) or higher up in strategic management (centralised), closer to where the budget is allocated. Positioning UICG differently in the organisation, might influence its structural and strategic incorporation. Research, analysing the position of UICG responsibility and whether a flat or hierarchical allocation influences UICG effectiveness is yet to be performed.

Where this isolation influences the degree of insect conservation on a strategic level, it could also explain the focus on short-term programmes and predominantly practical UICG instruments as implemented by the cases. These practical initiatives are mostly initiated and administrated by a motivated conservation expert. Many locally administrated insect specific initiatives are therefore not initiated by strategic management but down in practice. This might indicate that conservation experts regardless of the absent strategic support, realise conservation initiatives on a project basis out of best interest. This would explain the short-term focus as identified for the cases.

Considering the expressed cooperation and crosstalk by the interviewees, the alignment of intentions, projects and deliverables amongst private and public conservation stakeholders, is generally performed in a suitable manner. Regardless, public and private stakeholders within insect conservation were claimed to have a clear individual focus, with own defined aims and agendas. The misalignment between conservation stakeholders was claimed to restrict some cooperative intentions. This might result in the overlapping of preferred activities and missing of some uninteresting conservation needs. City wide, conservation effectiveness could be benefitted by a clearer delineation of responsibilities.

Literature motivates a closer involvement of the public in conservation efforts. It involves the creation of insect stewards through the engagement and empowering of individuals or focus groups. This could leverage detailed knowledge on local values and tackle the issue around limited resources. It might also enhance cooperation by bridging the gap between municipality and the public. Public participation was expressed as a concept explored in Hamburg. However, lacking interest amongst the public made this a difficult initiative to realise and remains unexploited. Expectations from the public towards the municipality for being responsible to put in place conservation efforts, is a likely limiting factor to involving the public.

5.6 Limitations & Legitimacy

The research methods applied were considered to best match the exploratory and social as well as applied type of research. Nevertheless, limitations and unforeseen impediments to the methods must be acknowledged. They relate to data saturation, misinterpretation, and biased stakeholder views.

Overall, the research questions fitted the exploratory research intention to investigate what pivotal elements are towards effective UICG. While efforts were made to get a holistic overview of the UICG situation by performing case studies and a triangulation of data sources, this was

not realised as intended. For the document study, there was uncertainty regarding the saturation of required data. The researcher was unaware whether the grey literature that was publicly available, was representative for a holistic insight in governance instruments in place for the case studies. Even when requesting for verification to the interviewed experts, it became evident that different disciplines had different awareness of existing grey literature. The researcher therefore approached this by consolidating saturation insights from a detailed web search and the expert judgements.

The expert interviews allowed for the capturing of expert judgements, opinions, beliefs and values as expected. However, where a balanced insight and incorporation of varying UICG stakeholders was intended, this proved difficult to realise. Instead, mainly specific municipal, ecologist and academic stakeholder views were obtained. Other angles such as NGO or foundation are excluded. Throughout the research a slight change in interview approach was adopted from personal semi-structured interviews to also focussed open-ended email interviews. This was applied to better match experts who were unable to conduct a lengthy interview in person. As the insights obtained are qualitative and subjective per person, they also have the risk for misinterpretation. Questions posed can be understood differently by interviewees, but moreover the answers obtained can be misinterpreted by the researcher. To minimise misinterpretation, the researcher followed up with a couple of interviewees, indicating possible misinterpretation, strong inferences or usage of many quotes. Validity could have been further enhanced by following up with the rest of the interviews.

This research contributes to the developing of an understanding on how UICG can best be applied in practice. It can serve the purpose as go-to guidance document for stakeholders first interested or seeking to enhance their knowledge on UICG. It can function as point of departure for further applied or social UICG research or comparative study to other UICG case studies. Considering that this research is amongst the first exploratory studies regarding UICG, further exploratory research is should validate whether the identified elements around UICG are valid and present in other cases. If to be generalised to urban areas other than the cities of Hamburg and Malmö, caution is to be used as due to a wide variety of factors (cultural, natural, geographical, organisational, ….), the findings and conclusions UICG are different for every case.

5.7 Chapter Summary

The identified instruments applied in practice for Hamburg and Malmö predominantly cover a policy mix pattern around advocacy, service and collaborative instruments. The literature, on the other hand, has a more strategic focus of regulatory, economic and advocacy instruments.

This chapter analysed and compared: the concepts and existing knowledge as derived from the literature findings, with the policy landscape and governance instruments from the document study, and lastly triangulates this with the obtained expert views and judgements form the interviews. It delivered insights around the four main themes; governing urban insect conservation; defining conservation scope; insect valuation; and conservation responsibilities.

6 Conclusions

This research positions itself around two research gaps in the field of urban insect conservation. The first, is centred around the lacking social and applied insect conservation research. The second gap acknowledges the limited translation of knowledge in urban specific governance conservation tools. By investigating and analysing the cases of Hamburg and Malmö, this research draws four main conclusions from its research findings:

- Urban insect conservation deals with abundant and complex human and ecological factors. These factors lack applied understanding, tailored governance and strategic incorporation.
- There exists controversy around the scope and timeframes of UICG efforts. Detail enhances knowledge and species-specific conservation, where biodiversity maximisation in the current system is needed to avoid leaving species out of scope.
- UICG is interdependent with the perceived value of insects by society. Efforts made to influence value or establish governance, influence the currently weak position of insects in their prioritisation, consideration in policy making and urban planning. Especially when trade-offs are to be made.
- Organisational structure, communication channels, conservation agenda's affect UICG effectiveness and knowledge utilisation. There are opportunities for enhanced delineation of responsibilities and alignment of conservation efforts.

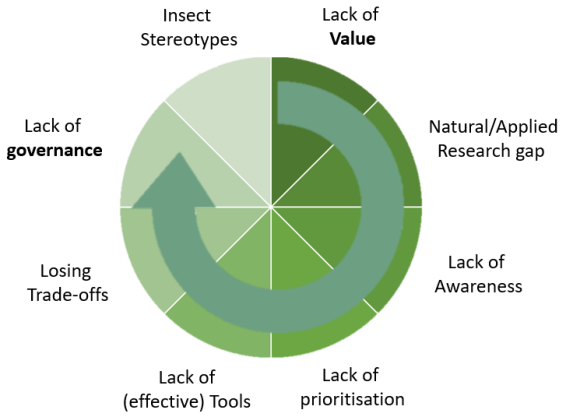
The first conclusion, is around the complex and lacking strategic UICG situation. The research concludes that urbanisation causes urban environments to change rapidly; resulting in a high degree of uncertainty towards UICG. It becomes clear that the urban insect conservation situation is very different from rural terrains. Main urban impacts relate to: habitat loss, habitat quality, fragmentation, isolation, densification, alien species, and intensive green space management. These impacts concern strategic and long-term consideration within urban planning and policy. In practice, an insect specific focus proved nearly absent in strategic management. Conservation policy dedicated to specifically urban environments is not so present in the current policy landscape. Conservation programmes include general conservation goals and targets, aimed at biodiversity maximisation. Such overarching regulations and practical initiatives do support UICG but are limited in tackling the insect decline issues for the urban context. This lack of detail leaves policy makers and urban planners with vague conservation aims and does not provide conservation experts conservation tools nor guidelines as a base for conservation argumentation, discussion, policy process, or agenda setting. Where this research identified an extensive inventory of governance instruments, the knowledge and tools to create effective UICG instruments are unavailable. Matching and tailoring these available governance instruments, with existing UICG knowledge, the local ecological and socioeconomic situation, while depending on limited resources, is a complex process. Because of absent tools and lacking strategical incorporation, each UICG case is to be approached from the start. With regards to insect conservation, this results in a set of loose, predominantly small scale and short-term practical conservation initiatives and a lack in strategic development. These generally take the form of service or advocacy instruments like: information campaigns, monitoring, or green space management practices.

The second conclusion, relates to the identified pattern around the scope of incorporated flora and fauna to be conserved and the duration of the conservation programmes. The case studies reveal that insect specific programmes are often experimental and of short-term focus. These timescales refrain its strategic and longer-term conservation. Besides timescales, insects are

generally embedded into conservation efforts maintaining scopes set on wider biodiversity. This causes insects to go unnoticed or make them dependent on conservation efforts fitted to other animals or plants. Such larger scopes are likely to reduce governance instrument effectiveness and makes them vulnerable for negative rebound effects, as the conservation of many animals at once might lead to the benefitting of dominant species, where threatened or less obvious species are ignored. Uncertainty exists regarding the effectiveness of current conservation efforts, especially those maintaining large biodiversity scopes, because of the existing gap around applied and evaluation UICG research. Due to this unawareness, large scopes speculate to positively impact insects, but it could equally so be that there is little or even negative impact.

A third conclusion, relates to the investigated interconnection between the effectiveness of UICG and the perceived value towards insect conservation by the private sector, public sector as well as the public. Where value can be seen as the input, conservation is the related output and visa-versa. The perceived value indirectly determines how insects are prioritised and its position in trade-offs within urban planning and land-use within an urban context. *Figure 6-1*: Independency of insect valuation and UICG effectiveness visualised as vicious circle illustrates the identified pattern regarding the interdependency of UICG and its perceived value. It is portrayed as a vicious circle, which is likely to remain unchanged if efforts towards influencing either the value or governance side are not undertaken.

Figure 6-1: Independency of insect valuation and UICG effectiveness visualised as vicious circle



Source: Author

A fourth conclusion, regarding responsibilities and alignment of conservation efforts amongst the stakeholders, can be drawn from the case studies. Management style and a change of organisational structure can have an isolating effect between strategic management and the conservation experts. In the cases, silo operation amongst the departments resulted in a separation of activities and detachment project management. These trends complicated cooperation and knowledge transfer within the municipality, likely leading to ineffective utilisation of insect conservation knowledge. A change in structure also led to, experts not being consulted less on a structural basis and more reactively in already initiated projects. Also, insect conservation knowledge is not directly sourced from the experts, but increasingly indirect via for example department heads.

While cooperation amongst public and private conservation stakeholders on a city level proved in place, differing interests and agendas were claimed to be limiting factors towards effective conservation efforts on a city level. There is the opportunity for a more effective allocation of

responsibilities and alignment of conservation efforts to benefit the larger, instead of individual conservation aims. Also, research and practice do collaborate on a project basis, but leave much opportunity for a more structural and longer-term joint conservation approach. Such cooperation and clearly defined responsibilities benefit the development of balanced and fitted conservation instruments factoring in existing knowledge and reaching consensus on what is effective UICG. This moves towards conservation out of best interest to insects and its ecosystems on a city level.

These four conclusions derived from answering the three sub questions of this research, collectively answer the research question: '*What are main elements to the development of an effective urban insect conservation governance?'* Main identified elements for a(n) (enhanced) urban insect conservation governance effectiveness are: applied and social research; tools or guidelines for policy makers and urban planners; awareness for perceived insect values and motivations for conservation; utilisation of available knowledge; close and structural cooperation amongst conservation stakeholders; definition and allocation of clear responsibilities; and matching conservation efforts to available resources.

6.1 Recommendations

The presented set of recommendations focusses on the interdependency of UICG and its perceived value by the public and private sectors. The recommendations are based on inferences made by the researcher in line with the defined main UICG elements as outcomes from the research question.

Reducing ambiguity

The first recommendation revolves around the lacking incorporation of insects into strategy and ineffective, vague, or general UICG. This is to be avoided by commitment towards the reduction of ambiguity in conservation programmes. The incorporation of detail by means of an enhanced insect specific focus in conservation: programmes, goals, targets, aims and key performance indicators, is a clear method for embedding UICG into strategy. A smaller scope of conservation programmes by breaking biodiversity maximisation into more specific conservation aims, benefit the development of locally fitting insect conservation activities and the generating as well as evaluating valuable applied conservation knowledge. Important is to balance conservation efforts with varying scopes to avoid negatively impacting species left out of scope.

Responsibilities and knowledge

Linked to more specific targets, is the assigning of responsibility to these targets. The definition and allocation of such responsibilities supports conservation stakeholders in their activities and provides policy makers and urban planners with policy specifications and guidelines. Conservation experts can be further supported by the development of best practices and knowledge sharing. Avoiding each urban case to approach conservation from the start as well as aiming to avoid repeating the same mistakes to occur in each of them, is of great importance considering the often limited insect conservation efforts and available resources. Urban insect threats are applicable in many cities and conservation is more widely implemented in varying degrees. The establishment of inter- or intracity knowledge sharing platforms or programmes could greatly benefit UICG at this stage, where it is more widely recognised. To assure the utilisation of conservation knowledge, strategies and policies are to be based on scientific and applied knowledge. Future projects should take advantage from existing or completed projects by positioning them so that they incorporate, connect with and build on the latest knowledge and accomplishments. A closer and more structural cooperation between academics and authorities, can greatly enhance knowledge transfer and the interchanging of state of the art

scientific and applied knowledge. This is likely to counter the increasing gap between natural and applied UICG research. Additionally, efforts are to be made to reverse the increasing isolation between: 1) urban planners, policy- and strategic decision makers, and 2) conservation experts, like: municipal ecologists, nature conservation organisations, researchers or interest groups. Efforts are to be made to reduce indirect communication channels; establishing a continuous crosstalk and fruitful knowledge exchange between conservation experts and policy makers. Focus is to be paid at reaching consensus on tailored conservation with a best interest for an effective conservation strategy on a city level. If available resources restrict this, other efforts towards the establishment of a more effective knowledge transfer from expert to policy maker are to be made. Strategic and proactive utilisation of knowledge should be prioritised and more structurally incorporated into urban projects and policy making. Realisation is needed that a proactive consideration of knowledge is required if a win-win situation for human and insect is the goal.

Understanding and influencing the local situation

A comprehensive understanding of the local socioeconomic and ecological situation was found to greatly support the development of effective conservation. Elements contributing to an understanding of the local situation derived from this study could be: an assessment of the specific urban environment and its types of terrain; mapping of habitats and insect species abundance; insect threat levels; understanding the perceived value and motivations towards insect conservation -where possible from various societal groups and cultures-; and incorporating available knowledge and stakeholders. It is recommended to adapt the conservation strategy as well as develop initiatives to influence the local psychology towards insects into the developed local understanding. For example, if there is the intrinsic motivation to protect urban insect life and not to benefit humans, then more drastic conservation factoring in justice are to cause a decoupling or shift away from the urban development pathway, threatening urban insects. If the motivation for conservation is utilitarian, then the establishment of intrinsic conservation which restricts human activities (for example: recreation), might result in resistance and unacceptability from the public.

Considering the current situation in the cases, where according to (Persson, 2019b) we are 'still' very much in need of awareness raising, it is recommended to expand on large scale awareness raising campaigns for the public as well as training for policy makers and urban planners. A suitable starting point for the public could be the eradication of the negative stereotypes from which insects suffer. A focus on defining what habitat loss and habitat quality means with respect to insects, could be effective for policy makers and urban planners. Education and awareness raising to the public has the option to be tailored to the audience. For audience with utilitarian values, campaigns on ecosystem services suit. Were for more intrinsic valued audience, beauty of insects and the right of our children to enjoy insects would suit. If rebound effects towards benefitting human needs over insect conservation are to be avoided, awareness raising campaigns should increasingly focus on intrinsic values.

Available Resources

Municipal capacity to implement UICG highly depends on the available time, monetary and human resources. Also, the research findings, recommendations and suggestions for further research in this research, are depended on and to be approached with the consideration of available resources. In case of few resources, strategic and long-term incorporation or developing a detailed understanding of the local socioeconomic factors might not be realistic. In that case, the initiation of practical initiatives, as shown in the cases, might be a way forward. For example: less intensive and innovative green space management or educational campaigns could be considered as low hanging fruit. It is recommended to plan conservation efforts and

establish conservation aims that match the available resources. An area of focus could be the development of a management style that supports: the effective utilisation of resources, allocation of responsibilities, and initiative taking of motivated individuals. Also, a creative mentality towards the enabling and empowering of the public offers great opportunities to lessen the pressurisation of resources and expand conservation efforts.

6.2 Further Research

The analysis of research findings highlighted the following areas for further research: need for social and applied research, evaluation or ex-post research of existing conservation programmes, and investigating the municipal organisation structure.

Natural science knowledge is sufficiently available, yet underutilised. What would progress UICG from the investigation to the development phase, is the development of more applied research. To close the gap between natural and applied research: knowledge, experience and tools are needed for the adaptation of natural knowledge into: effective managerial and governance tools, urban planning strategies, policy and programme guidelines, and practical initiatives.

As governance is applicable to the society, an enhanced understanding of socioeconomic and cultural factors, allows for the fitting of the instruments to the society. Fitting and tailored instruments affects the prioritisation of insect conservation and leverages their position in trade-offs to be made in urban projects. Enhanced social research could help develop an understanding of local insect valuation and motivations for conserving insects amongst the public as well as policy makers and urban planners in the municipality. This tailoring of governance returns acceptance from the community towards the instruments.

Where literature expresses the need for applied tools and knowledge to develop suitable UICG instruments; evaluation research, focussing on the effectiveness and improvement of existing conservation efforts is also scarce Such ex-post research aimed at policy and governance evaluation, is essential to confirm governance effectiveness and highlight focus areas for improvements towards assuring a balanced human-ecology win-win situation. Evaluation could especially deliver valuable knowledge, if evaluation research could allow for the teasing out of insect specific impacts from the biodiversity maximisation governance.

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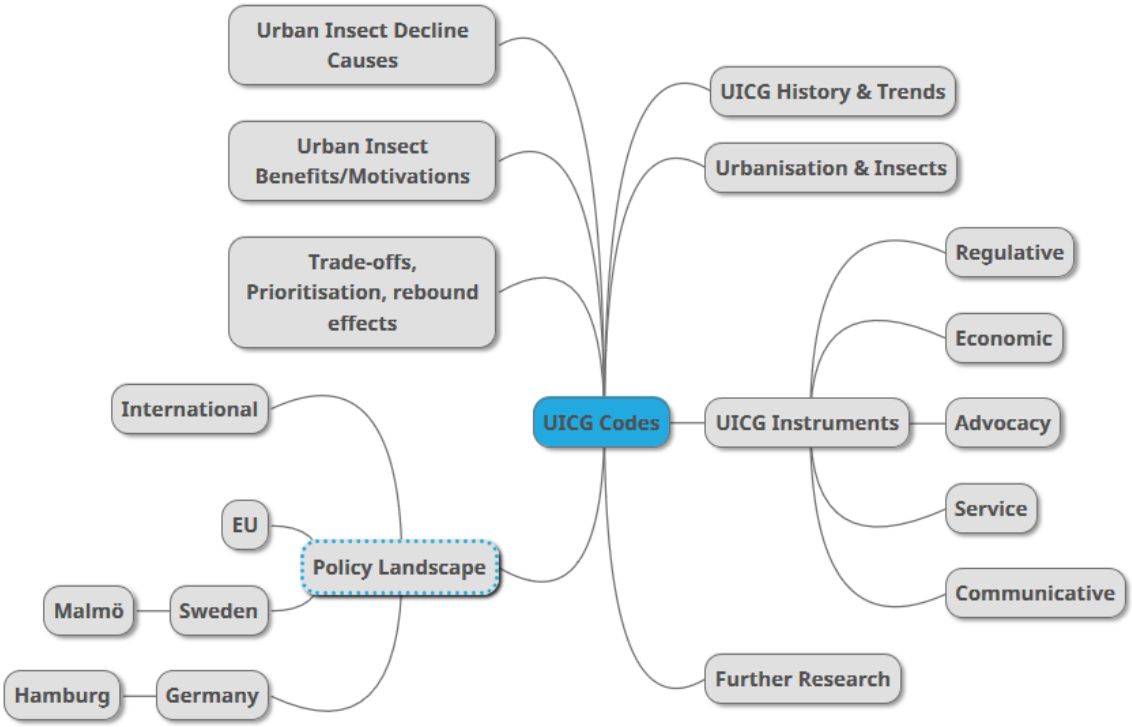
Appendix I – List of Interviewees

Name	Organisation	Role	City	Date	Time	Method	Medium
Dr. Martin Husemann	Centrum für Naturkunde (CeNak) - Center of Natural History Universität Hamburg - Zoological Museum	Head of Entomology	Hamburg	04-06-2019	-	Answered Queries	E-mail
Bettina Wilk	ICLEI - Local Governments for Sustainability - European Secretariat	Officer - Sustainable Resources, Climate and Resilience	Hamburg	07-06-2019	-	Answered Queries	E-mail
Ulrika Poppius	Malmö Stad – Environment Department	Project leader (BiodiverCity)	Malmö	24-06-2019	-	Answered Queries	E-mail
Anna Persson	Lund University – Center for Environment and Climate (CEC)	Researcher	Malmö	25-06-2019	16:30 – 17:25	Interview	Video conference
Tim Delshammar	Fastighets- och gatukontoret Inriktningsavdelningen	Landscape Architect	Malmö	25-06-2019	-	Answered Queries	E-mail
Mats Wirén	Malmö Stad - Fastighets- & Gatukontoret	Ecologist	Malmö	03-07-2019	11:00 – 11:50	Interview	Phone call
Jonna Nilsdotter	Malmö Stad - Stadsbyggnadskontoret Strategiavdelningen	Ecologist	Malmö	09-07-2019	10:10 – 10:50	Interview	Video conference
Justus Quanz	Free and Hanseatic City of Hamburg - Ministry of Environment & Energy - Department of	Project assistant Horizon 2020 – CLEVER Cities	Hamburg	11-07-2019	11:05 – 12:10	Interview	In person

	landscape planning and greenery						
Dr. Maja Berghausen	Ministry of Environment & Energy – Department of landscape planning and greenery	Research Associate Climate in Urban Development	Hamburg	12-07-2019	-	Answered queries	E-mail
Torsten Demuth	Neuntöter e.V (Association for research and diversity)	Entomologist and Terrestrial Insect Monitoring	Hamburg	11-08-19	11:00 – 13:30	Interview	Personal Interview & Guided Tour
Hellmut Salinger	- Green Party Halstenbek - Founder of Federation for Environment and Nature Conservation Germany (BUND)	Member of local political party and Founder	Hamburg	09-09-2019	17:15 – 18:25	Interview	Personal Interview & Guided Tour

Appendix II – Codes



Appendix III - Interview Guide,

Below is stated the overall interview guide used as inventory for compiling the expert interviews. Please note that:

- Questions were selected from this guide based on the role of the interviewee and intention of the interview
- This guideline solely functioned as support document for the structuring of the expert interviews. Therefore, questions were adapted from how they are included here. Also, the expert interviews were semi-structured and therefore the actual interviews include follow-up questions and topics not covered in this guideline.

Interviewee:			
Date:			
Starting Time:		Ending Time:	

Background

- I am a Master student from IIIEE, studying Environmental Management and Policy.
- Research Thesis on mapping and evaluating the situation around insect conservation governance
- My research focusses on mapping and evaluating governance of insect conservation. This interview is divided in two main parts, of which the first aims to identify or map the current situation of insect conservation governance in Hamburg/Malmö. And the second part, aims to tease out your personal judgement and evaluation on this identified state of affairs. It has the aim to highlight areas for improvement and policy recommendations.
- Findings will be presented in Lund – Sweden end of September / begin October

Practicalities

0.1 Is it good with you that I record the interview to allow listening back to your answers on a later time and to aid me in validating research claims?

0.2 Do you favour anonymity or would it be okay to refer to your name and position in my research?

0.3 Would it be okay for you if I followed up via email in case of clarifications or remaining questions?

Context questions - Interviewee & Role:

0.4 Could you briefly introduce your role(s), departments and roughly where you are positioned in the organizational structure?

0.5 How are your roles closest engaged with the conservation of insects?
(consider mentioning identified areas to set baseline)

Part 1: State of Affairs

1.1 Strategy

1.1.1 What are typical 'Urbanization' and 'Biodiversity' trends for the city of Hamburg/Malmö?
1.1.2 What are plans/strategies around these two topics? *(focus on insects where possible)*
1.1.2.1 Does Hamburg/Malmö aim to enhance liveability or become a green city?

1.2 Insect Conservation
1.2.1 What is your general view towards the conservation of insects for the City of Hamburg/Malmö?
1.2.2 How has insect conservation developed over the past period?
1.2.3 Where on the political agenda is insect conservation for Hamburg/Malmö?
1.2.4 How do you view the link between scientific and applied research regarding insect conservation?
1.2.5 What are main drivers and barriers for insect conservation in Hamburg/Malmö?

1.3 Policy Landscape
1.3.1 Are you familiar with the policy landscape around biodiversity or insect conservation?
1.3.2 If existent, would you be able to sketch the vertical policy landscape, with regards to insect conservation, from EU down to Hamburg/Malmö?
1.3.3 And where is insect conservation embedded or positioned horizontally, on a city level?
1.3.4 Would you be able to provide an overview of plans, programmes or initiatives around the conservation of insects for Hamburg/Malmö?
1.3.1.1 Are there any form of policies or procedures regarding biodiversity or insect conservation?
1.3.1.2 How is the coordination of such activities arranged?
1.3.4 To what scale/detail are insects incorporated in governance practices? (*species, animal group, biodiversity)*
1.3.5 What indicators and corresponding assessment methods are used to incorporate biodiversity/insects into governance?
1.3.7 Which stakeholders or interest groups are mostly involved with insect conservation?
1.3.7.1 And which have main decision making responsibility?
1.3.8 *Consider: Discuss policy/programme documents obtained so far?...*

1.4 Urban Planning
1.4.1 How is the conservation of biodiversity/insects prioritised in urban planning?
1.4.1.1 What are main areas of focus in urban planning?
1.4.1.2 Are there indicators or is there a procedure for the prioritisation of insects (or biodiversity) in Hamburg/Malmö?
1.4.1.3 What, do you think, are common trade-offs for conserving insects?
1.4.1.4 What does Hamburg/Malmö do in terms of nature based solutions?
1.4.2 Is there anything we have not yet discussed regarding the current situation of insect governance, that is worth highlighting?

Part 2: Acceptability

2.1: Judgement

2.1.1 If you were to judge the current state of insect conservation governance, where is Hamburg/Malmö momentarily*?*

- 2.1.1.1 What is performed well?
- 2.1.1.2 What are main challenges?

2.1.2 Who, would you say, play largest roles in insect conservation?

- 2.1.2.1 Is this different from the players with largest responsibility?
- 2.1.2.2 What is your judgement on the role of the municipality?

2.1.3 What is your judgement on the sufficiency of current governance practices?

2.1.4 Is there a discrepancy between theory and practice?

2.1.4 What is your judgement regarding current distribution of responsibilities?

2.1.5 And what is your judgement regarding current cooperation towards insect conservation? (Policy makers, private institutions, urban planners, etc..)

2.2: Improvements and improvement areas (Ideal situation)

2.2.1 According to you, what are focus areas for an improved insect conservation governance?

- 2.2.1.1 What would be essential next steps?
- 2.2.1.2 And what would be suitable governance/policy instruments?

2.2.2 Is there something specific that needs change?

2.2.3 Do you think coordination of loose initiatives in an overarching programmes could be a method for improvement?