

Environmental Compensation for Disrupted Ecological Functions in Swedish Road Planning and Design

Kristina Rundcrantz

*Faculty of Landscape Planning, Horticulture and Agricultural Science
Department of Landscape Architecture
Alnarp*

Doctoral thesis
Swedish University of Agricultural Sciences
Alnarp 2007

Acta Universitatis agriculturae Sueciae

2007:118

Cover: The strip is reproduced with kind permission of Bulls Prestjänst AB.

ISSN 1652-6886

ISBN 978-91-85913-17-6

© 2007 Kristina Rundcrantz, Alnarp

Tryck: SLU Service/Repro, Alnarp 2007

Environmental Compensation for Disrupted Ecological Functions in Swedish Road Planning and Design

Abstract

The road network is growing in Europe, resulting in environmental impacts with fragmentation and loss of ecological functions as major problems. This thesis is the first to systematically analyse the use of environmental compensation in the Swedish road planning system. The aim is to provide an increased knowledge and understanding of environmental compensation and specifically to consider how it can be improved in planning and design of roads. The thesis consists of three papers which elucidate different conditions that are important in the application of environmental compensation in Swedish road planning and design.

Paper I reviews the use of environmental compensation in Germany, the USA, the Netherlands, the UK and Sweden. Paper II examines 15 planned Swedish road projects in order to investigate the intended use of environmental compensation. Paper III is a case study consisting of two road projects that have shown that proposed environmental compensation measures have been rather successful, in terms of getting described in the legally binding documents.

The thesis concludes that environmental compensation is a potentially useful tool for a sustainable road planning. It is an instrument that is rather easy to use in the existing road planning system as a part of the EIA process. Municipalities and organisations have a rather positive attitude to compensation. Nevertheless, there are misgivings that environmental compensation can be misused by undermining the environmental consideration in projects. Hence it is of vital importance that the SRA clearly shows that environmental compensation is the third step in environmental consideration after avoidance and mitigation.

The thesis highlights the importance of several factors important for a more successful use of environmental compensation in road planning. The interest and knowledge of professionals, especially project managers, is a crucial success factor. The legal context for environmental compensation also needs to be discussed more. Furthermore check lists that guarantee environmental measures, follow-up studies and better knowledge about environmental compensation are emphasised as important factors. Another conclusion is that environmental compensation can be used as a tool to create new environmental values in the everyday landscape, for example ecological networks.

Keywords: compensation, mitigation, landscape planning, EIA, biodiversity, roads

Author's address: Kristina Rundcrantz, Department of Landscape Architecture, Box 58, 230 53 Alnarp, Sweden. *E-mail:* k.rundcrantz@vv.se

Dedication

To Mum and Dad

Det är skönare lyss till en sträng, som brast, än att aldrig spänna en båge.

Verner von Heidenstam

Contents

List of publications	7
Abbreviations	8
1 INTRODUCTION	9
1.1 Scope and purpose of the thesis	9
1.2 Why the topic environmental compensation in road planning?	10
1.3 The legal framework in Sweden	12
1.3.1 Legislation on environmental compensation	12
1.3.2 The Swedish environmental quality objectives and transport policy	13
1.4 The spatial planning process for roads in Sweden	14
1.5 Issues in landscape planning related to environmental compensation	15
1.5.1 Sustainable development	15
1.5.2 The everyday landscape	18
1.5.3 Road ecology and ecological networks	19
1.5.4 Environmental impact assessment	21
1.5.5 Environmental ethics	22
2 THE STUDIES	25
2.1 Main questions	25
2.2 Summary of papers	26
2.2.1 Paper I	26
2.2.2 Paper II	27
2.2.3 Paper III	27
2.3 Material and methods	28
2.3.1 Case study research	28
2.3.2 Method of the thesis	31
2.3.3 General reflections	34
3 RESULTS AND DISCUSSION	37
3.1 Criticism against environmental compensation	37
3.2 The need of useful instruments for a more sustainable road planning	39
3.3 Practical issues	40
3.3.1 Administrative aspects	40
3.3.2 Professional aspects	43
3.3.3 Legal aspects	44

3.3.4	Sociology of law	46
4	CONCLUSIONS AND IMPLICATIONS FOR PLANNING	49
5	FURTHER PERSPECTIVES	55
	REFERENCES	57
	Acknowledgements	69

List of publications

This thesis is based on the work contained in the following papers, referred to by Roman numerals in the text:

- I. Rundcrantz, K and Skärbäck, E. (2003) Environmental Compensation in Planning. A review of five different countries with major emphasis on the German system. *European Environment*, 13(4), 204-226.
- II. Rundcrantz, K. (2006) Environmental Compensation in Swedish Road planning. *European Environment*, 16(6), 350-367.
- III. Environmental Compensation – a case study of two road projects in Sweden. (Submitted manuscript).

Papers I and II are reproduced with the permission of John Wiley & Sons Limited. Copyright John Wiley & Sons Limited.

Abbreviations

CBD	Convention of Biological Diversity
DP	Design plan
EA	Ecosystem Approach
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
EnvC	The Swedish Environmental Code
FS	Feasibility study
IS or PFS	Initial study / Prefeasibility study
SCA	The Swedish County Administrative board
SDS	The EU Sustainable Development Strategy
SRA	The Swedish Road Administration
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
WCO	World Commission on Environment and Development
WSSD	World Summit on Sustainable Development

1 INTRODUCTION

1.1 Scope and purpose of the thesis

This thesis deals with environmental compensation in the Swedish road planning system. The purpose is to provide an increased knowledge and understanding of environmental compensation and to consider improvements of the applications of compensation in planning and design of roads. The identification of factors that are important to get environmental compensation measures proposed in the legally binding documents in a road project are of special interest in the thesis.

The aim is to produce a material which elucidates different conditions, among others legal, professional and administrative aspects, to apply environmental compensation in the Swedish road planning system. This thesis is focusing on compensation for disrupted ecological functions, especially factors important for biodiversity. Compensation for social, aesthetical or cultural values is equally important for a sustainable development but needs to be subject for a comprehensive work on its own.

There is a problem using the term compensation since it is used in different ways in different countries. The term environmental compensation¹ is in this thesis discussed in the meaning of *practical measures that a developer has to undertake to restore the natural resources and ecological functions disturbed by a (road) project*. It is the third step in environmental consideration, which can be used if an impact can first not be avoided or second mitigated. The main

¹ Compensation (the act of compensating, the state of being compensated). The synonyms for compensate are: counteract, balance, offset, make up for, remedy. The translation to Swedish is: kompensera, ersätta, gottgöra, utjämna.

objective of environmental compensation is to make sure that the existing ecological situation should be equal some years after the project has been built compared with the situation before. Significant disturbances or negative effects on ecological functions (values) will be avoided through repairing, enhancing or creation of the affected functions. Such compensation aims to improve damaged ecological functions in areas or to create new functions. In this thesis the term 'restoration compensation' stand for *environmental compensation for lost values in the right functional context (on-site, in-kind compensation)* and 'replacement compensation' is *environmental compensation for lost values implemented in another functional context (off-site and/or out-of-kind compensation)* (Rundcrantz and Skärbäck, 2003). This definition of environmental compensation is rather all-embracing but is similar, especially, to the German definition of compensation and to other international definitions (Eriksson and Lingestål, 2004; Forman *et al.*, 2003; Iuell *et al.*, 2003; Cuperus *et al.*, 2002; Der Deutsche Bundestag, 2002). Compensation measures used in Swedish road planning and design are for example: building of multifunctional ponds, removing old roads and restoring the land to farmland or natural habitats, restoring certain soil and valuable flora at road slopes, plantation of vegetation (not only for aesthetic values), moving of stone walls and dead wood in order to create new biotopes, restoration of streams or environmental measures at other places than the affected site.

Mitigation and compensation are two different concepts used in the international environmental planning context. The term mitigation does sometimes include both avoidance and compensation in its concept (National Research Council, 1992) but in this thesis mitigation is used as the term to "minimize the ecological impact" (Forman *et al.*, 2003). Mitigation can be achieved by scaling down, relocating or redesigning elements of a project. Commonly used mitigation measures in Swedish road planning and design are for example: adjustment of the road to the landscape, flat slopes, saving of vegetation and to lower conduits in watercourse (Rundcrantz, 2006).

1.2 Why the topic environmental compensation in road planning?

The construction of roads often gives rise to severe environmental impacts by fragmenting the landscape, splitting ecosystems and habitats into smaller ones and creating new structures (European Environment Agency, 2005;

European Environment Agency, 2004; Forman *et al.*, 2003; Iuell *et al.*, 2003; Seiler, 2003; Jongman and Kamphorst, 2002). The road network is still growing in Europe and its impact on biodiversity has become an increasing problem. Habitat fragmentation is one of the biggest threats to the conservation of biodiversity and the construction of roads is a major factor to this (European Environment Agency, 2004; Forman *et al.*, 2003; Iuell *et al.*, 2003).

An essential foundation for the development of society today is the concept of sustainable development and how to achieve it (Council of the European Union, 2006; Hörnberg-Lindgren, 2005; WSSD, 2002). The environmental goals and strategies in Sweden, for example the Swedish Environmental Code (EnvC) are based on the concept of sustainability. The Swedish Road Administration (SRA) has the overall responsibility for the environmental impact of the road transport system and is one authority that has special sectoral responsibility for ecologically sustainable development (The Swedish Environmental Protection Agency, 2007; The Swedish Government, 2006b). There are many international conventions, goals, principles and guidelines on how to reach a sustainable development but in actual fact there seems to be very little material about the practical tools that are needed to fulfil the sustainable development (Bickmore, 2003; Leitão and Ahern, 2002). So, there is a need for useful instruments in order to deal with specific environmental problems in order to reach a more sustainable development.

Through the use of mitigation and compensation measures a more sustainable development in road projects can be achieved. The use of different measures to compensate the environment has been frequently discussed in Europe and the USA as a possible way to recreate ecosystems and minimise the negative consequences of different projects (Wende *et al.*, 2005; Cuperus, 2004; Forman *et al.*, 2003; Butzke *et al.*, 2002; National Research Council, 2001; Cowell, 2000; Skärbäck, 2000; Eden *et al.*, 1999; van Bohemen, 1998; Bengtsson, 1997; Box, 1996). The background can be found in the early efforts of environmental restoration². Already in the 1930's there were attempts to restore forests and prairies in the USA (Jordan, 2000; Cowell, 1993). Since the 1970's, public concern about the environment has encouraged an increased interest in ecological restoration as a way to interest people in nature. The policy moves toward sustainability in Europe during the 1980's and 1990's have also drawn attention to the

² Restoration in the meaning of restoring affected natural resources and functions to the earlier, pre-exploitation (and possibly more stable and productive) state (Morrison, 1987).

possibilities of restoring landscapes and habitats (Adams, 1996; Jarman, 1995). Currently, Germany, with its experience of environmental compensation since the 1970's, seems to have the most developed research and methods for environmental compensation (Rundcrantz and Skärbäck, 2003).

Practitioners have often emphasised the gap between the project plans and the later implementation of these (Arts *et al.*, 2001). Environmental compensation doesn't have any value if it is not put into practice. If environmental measures are not implemented, they are useless, except for being a tool to enable the developer to achieve the desired permission for the project (Boyden, 2002). One important first step is to make sure that the suggested measures are described in the legally binding documents. For that reason it is of vital importance to study and analyse how environmental compensation can be improved in Swedish road planning. Environmental compensation is still a rather new domain in the Swedish planning context. Not much research has been done, hence the need to gain more knowledge about the actual use of compensation (Rundcrantz and Skärbäck, 2003).

1.3 The legal framework in Sweden

1.3.1 Legislation on environmental compensation

Sweden, as a part of the European Union, has to follow the EG directives, which have to be implemented in the member states national legislation. The legal basis for compensation is defined in the directives for Environmental Impact Assessment 85/337/EEG, 97/11/EG, 2001/42/EC, the Habitat Directive 92/43/EEG and the Bird Directive 79/409/EEG (Lerman, 2001). The Swedish Environmental Code (EnvC) (Sveriges Riksdag, 1998) is Sweden's first coordinated body of environmental legislation. It was introduced in 1999 and strengthened the demand for environmental compensation (Emmelin and Lerman, 2004). From a general point of view, conditions for compensation may be attached to permits, approvals and exemptions granted pursuant to the EnvC or to rules issued in pursuance thereof, but it is not imperative for the deciding authority to do so. The EnvC also states that encroachments on protected areas, for example in nature reserves, shall be compensated for to reasonable extent and the measure shall be made in the reserve or in another area. Conditions for compensation can be prescribed in permits according to protected areas, environmentally hazardous activities, hydraulic operations, quarrying,

agriculture and other activities. It is often the Swedish County Administrative board (SCA) that is the deciding authority when the SRA needs permits etc. The Habitat and Birds directives have made the demands for environmental compensation stronger if a plan or project that negatively affects a Natura 2000³ site, must be carried out (Emmelin and Lerman, 2004). Permits for encroachments in Natura 2000 areas in Sweden, may only be accepted after the government's permissibility assessments, if the damage is accepted. The encroachment in natural values, which should be compensated for within the site, start out from the encroachment in the nature types and species which have been the basis for the selection of the area (Naturvårdsverket, 2003). Environmental compensation has also been investigated in an inquiry ordered by the ministry of environment 1997 (Bengtsson, 1997). The inquiry recommended that compensation measures ought to be required in certain protected areas, for example habitats and nature reserves, if exploitation would result in a severe loss of environmental values.

1.3.2 The Swedish environmental quality objectives and transport policy

The Swedish Parliament has established 16 environmental quality objectives to guide Sweden towards a sustainable society. The objectives will function as benchmarks for all environment-related development in Sweden, regardless of where it is implemented and by whom. The overriding aim is to solve all the major environmental problems within one generation. The EnvC shall be regarded as an effective instrument for achieving the Swedish environmental quality objectives. The objectives themselves provide guidance for application of the provisions in the EnvC (The Environmental Objectives Portal, 2007; The Swedish Environmental Protection Agency, 2007). One strategy for achieving the objectives is to ensure effective management of natural resources. For example, the aim of the environmental quality objective for biodiversity is to ensure that ecosystems can continue to deliver these goods and services well into the future (The Swedish Government, 2006a).

The Swedish Government states that transport policy shall be integrated with environmental policy and the environmental quality goals in order to reach a sustainable traffic system. The overall transport policy goal is a socio-

³ Natura 2000 is a European ecological network of special areas of conservation, called to integrate nature protection requirements into other EU policies such as agriculture, regional development and transport. It is aiming to protect certain nature types, species and their environment (European Commission, 2005).

economically efficient and long-term sustainable traffic system for individuals and business community throughout the country. The design and function of the transport system shall promote the environmental quality objectives (Sveriges Regering, 2006).

1.4 The spatial planning process for roads in Sweden

The spatial planning of a road in Sweden follows a sequence of stages with decisions at each stage (see table 1).

Table 1. *The different stages in Swedish road planning (adapted from Rundcrantz, 2006).*

Stage:	Finding out:	Environmental issues:
Initial study / Prefeasibility study (IS) (Förstudie)	IF the road should be built	Decision from the Swedish County Administrative board (SCA) if the project may cause significant environmental effects
Feasibility study (FS) (Vägutredning)	WHERE to locate the road in the landscape	Environmental Impact Report (EIR) must be approved by the SCA
Design plan (DP) (Arbetsplan)	WHAT design shall the road have	EIR must be approved by the SCA. Apply for possible exemptions at the deciding authority (often SCA)
Construction plan (Bygghandling)	HOW to build the road	Implementation of measures, monitoring

First of all an initial study (IS), also called preliminary feasibility study, has to be done. In this step all available information about the area where a project may be realized shall be made known. With the IS as a basis the SCA has to decide whether the project will cause significant environmental effects or not. If there are possible alternative locations, the next step is the feasibility study (FS). The purpose of the FS is to state in which corridor a road will be located. For each road planning project an Environmental Impact Assessment (EIA) procedure is compulsory. An Environmental Impact Report (EIR) that has to be approved by the SCA is linked to the project. The EIR shall be taken into consideration in the decision of which corridor to choose.

The next step is the design plan (DP). The main purpose of this is to investigate where a road can be built within the chosen corridor and how this can be carried out. An approved DP also gives the road administration access to the land that is needed for the new road. A new and more detailed EIR that also has to be approved by the SCA has to be done. The DP has to be approved by the authority for road and traffic legislation and the EIR shall be taken into consideration in this decision. The DP also contains a document, the description to the DP, which describes all the works to be carried out. It is often first at this stage that the SRA applies for exemptions for any impacts in protected areas, for examples in biotope protected areas or shore line buffer zones. In all the previous planning phases described, public participation is compulsory by law. The last step is the construction plan. The purpose of this is to be basis for purchase and construction work (Vägverket, 2005).

1.5 Issues in landscape planning related to environmental compensation

The questions posed in this thesis relate to a range of different issues; the concept sustainable development and biodiversity, the everyday landscape, road ecology and EIA. Finally it can also relate to environmental ethics. These questions are themes in landscape planning which studies the interaction between man and landscape. Landscape and spatial planning is a key element for achieving sustainable development (Jongman *et al.*, 2004; WSSD, 2002; Healy, 1997; Cook and Van Lier, 1994)

1.5.1 Sustainable development

"The public sector is to promote sustainable development designed to ensure a sound environment for current and future generations."

(The Swedish Government, 2006b, p. 6)

The concept of sustainability is an essential foundation for the development of society today and a key phrase in policy making (Council of the European Union, 2006; Hörnberg-Lindgren, 2005; WSSD, 2002 Bramwell, 1994). The history of sustainable development is well-known. Many people point out the book 'Silent Spring' (1962) by Rachel Carson, as an important alarm clock which showed the need for environmental protection. The first international environmental UN conference was held in Stockholm 1972 and was followed by the conference in Rio 1992 and a third in Johannesburg 2002 (WSSD, 2002). The World Commission on

Environmental and development defined in 1987 the concept of sustainable development: *Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs* (WCO, 1987). The first world summit on Environment and Development in Rio de Janeiro 1992, emphasised the importance of biodiversity as a basis for the human existence. Transport networks are a major threat to biodiversity in Europe (Iuell *et al.*, 2003; Catzzone, M *et al.*, 1998). The latest World Summit on Sustainable development held in Johannesburg 2002 stated the importance to integrate sustainable development at all policy arenas - emphasising the importance of land-use and infrastructure planning (WSSD, 2002).

In EU, sustainable development has been a fundamental objective since 1997. EU also has a sustainable development strategy (SDS) which was launched at the Gothenburg Summit 2001 and renewed in June 2006 (Council of European Commission, 2006). This strategy encompassed other programs and commitments, for example, it included the commitments made at the 2002 World Summit of sustainable development in Johannesburg and the Millennium goals⁴ agreed in 2000. Sustainable development is also the overall objective of Swedish Government policy and is a foundation for the 16 Swedish environmental quality objectives and for the Swedish environmental Code (The Swedish Environmental Objectives Council, 2006).

The central core of sustainable development is that economic, social and environmental processes are interlinked and we ought to strive for economical growth as long as it occurs in a social and ecological sustainable way. Public and private agents must in their action take into account the interplay between these three dimensions. The implications for the future of the actions today must be included so that future generations can satisfy their needs - the intergenerational aspect. Another distinguishing feature within a sustainability framework is the importance of the environment to maintain vital functions and to be a source of raw materials (Hörnberg-Lindgren, 2005; Stenmark, 2000; Bramwell, 1994; WCO, 1987). Another important feature in sustainable development is to maintain a rich biodiversity (UNEP, 1992). In this thesis the centre of gravity is linked to the ecological dimension in the concept of sustainable development. In the European SDS one key objective (environmental protection), is emphasising this aspect: *“Safeguard the earth's capacity to support life in all its diversity, respect the limits of the*

⁴ The Millennium Development Goals (MDGs) are eight goals to be achieved by 2015 that respond to the world's main development challenges (United Nations, 2005).

planet's natural resources and ensure a high level of protection and improvement of the quality of the environment. Prevent and reduce environmental pollution and promote sustainable consumption and production to break the link between economic growth and environmental degradation.”(Council of the European Union, 2006, p. 3).

Sustainable growth emphasises that the carrying capacity of the ecosystem is one limitation for the development of the society (Stenmark, 2000). The European SDS identifies 7 key challenges and corresponding targets, operational objectives and actions. One is the Conservation and management of natural resources, where the overall objective is: *”To improve management and avoid overexploitation of natural resources, recognising the value of ecosystem services.”* (Council of the European Union, 2006, p.13). The operational objective includes to avoid overexploitation and improve management of renewable natural resources and to stop the loss of biodiversity and contributing to a significant reduction in the worldwide rate of biodiversity loss. This is also recognized in the Millennium Ecosystem Assessment report (UNEP, 2003) which states the fact that the human species *”is ultimately fully dependent on the flow of ecosystem services.”*(summary p. 1). The report also emphasise that the value of ecosystem services⁵ often is underestimated or ignored in current decision-making processes. One of the policy guiding principles in European SDS is also: Make Polluters Pay, which states: *”Ensure that prices reflect the real costs to society of consumption and production activities and that polluters pay for the damage they cause to human health and the environment.”* (Council of the European Union, 2006, p. 5).

The work with biodiversity⁶ has a base in the Convention on Biological Diversity (CBD) (UNEP, 1992). In Sweden, compensation focuses mainly as a tool for the preservation of biodiversity. It was debated in the preparation to the EnvC and was also discussed in the plans for biodiversity from the Swedish Nature Protection Agency and The National Board of Housing, Building and Planning as a possible way to maintain and enhance biodiversity in Sweden (Sveriges Regering, 1997; Emanuelsson *et al.*, 1996;

⁵ Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other nonmaterial benefits (summary p. 3) (UNEP, 2003).

⁶ Biological diversity (biodiversity) means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (Article. 2 CBD) (UNEP, 1992).

Naturvårdsverket, 1995). The World Commission of Environment and development has been criticised for emphasising too much on development in general and too little on the actual ecological conditions for such development. The economical dimension of sustainable development is often more stressed in underdeveloped countries than in developed countries (Hörnberg-Lindgren, 2005). Sweden is a country which, in an international context, has a good social and economic situation (UNDP, 2006; Vogel and Wolf, 2004). Therefore we ought to be capable to a greater extent of dealing with the ecological dimension of sustainable development. Bramwell (1994) emphasises this at the very end of her book: *The Fading of the Greens* "...only the maligned Western world has the money and the will to conserve its environment. It is the 'Northern White Empire's last burden, and may be its last crusade."(p. 208).

1.5.2 The everyday landscape

"The great majority of our biological diversity is to be found, not in protected areas, but in areas used by people for fishing, farming, forestry and settlement... a landscape approach must be applied."

(The Swedish Environmental Objectives Council, 2006, p. 80).

To see the landscape as a whole and as the result of interaction between human and natural activities is emphasised in the European Landscape Convention (Council of Europe, 2000). This thought is also similar to the Ecosystem Approach (EA), which is a strategy promoted by the CBD (UNEP, 2000). It points toward taking a comprehensive approach in managing ecosystems. The focus in the EA is on structures, processes and on functions in ecosystems and the EA emphasises that maintaining and restoration of ecosystem functions in the long-term is better than to only save species (Slootweg *et al.*, 2006; Korn *et al.*, 2003; UNEP, 2000). The European Environment Agency states in their annual environmental report that the biodiversity is still declining even though the countries in EU have succeeded well in the work to protect valuable environments. The environment that is in the greatest need of protection is in the everyday landscape and it is the operators that in their daily activities need to create the essential environments. In order to reach an ecological well-functioning landscape in a more and more exploited Europe, we need to plan not only for protected areas such as nature reserves, but for the total landscape (Lerman, 2000; Philips, 2000; Selman, 2000).

The Swedish government bill concerning the political alignment for future transports, states that the environmental politics for nature, to a great extent, have been characterised by a focus to preserve objects, spatial places and species. Instead the infrastructure ought to be planned from an overall perspective which includes an ambition to maintain and develop ecological functions, cultural values and out-door life at the same time as impacts are minimised (Sveriges Regering, 2006). This is also emphasised in the SRA's strategy for Landscape which is one basis for the national strategic plan for the years 2008–2017. This strategy states that the SRA has great opportunities to create new environmental values at a very low cost by adapting the maintenance of roads but also when planning, designing and building a road. Examples are habitats for rare plants and species and nature values that diminish barriers in the landscape. This kind of adaptation of the ordinary road activity may create habitats for some rare species and so the government can coordinate and make the work more efficient which will lead to lower costs for society as a whole (Vägverket, 2007a). The Swedish Environmental Objectives Council (2006) also stress that a wider landscape approach must be applied to attain sustainable use and that the great majority of our biological diversity is not to be found in protected areas. Protected areas already have a lot of legal support and measures to protect and increase their values. So, the use of compensation should also have a good impact in the rest of the non-protected areas (Lerman, 2000; CBM, 1997).

1.5.3 Road ecology and ecological networks

“... to a large degree the ecological landscape is the mirror image of the road network. The more connected and impermeable the road system, the less connected is the landscape matrix in which it is embedded.”

(Forman et al., 2003, p. 173)

The concept of ecological network has been discussed for several years, especially in the work with a Pan-European Ecological Network but also as a part in road ecology (Jongman *et al.*, 2004; Forman *et al.*, 2003, Jongman and Kamphorst, 2002). Road ecology explores and deals with the relationship between the natural environment and the road system. It covers for example ecological research, planning and mitigation of road systems. Road ecology is an integrated component of sustainable development and sustainable transportation. It is one factor of a sustainability strategy because it is intimately related to a number of problems, for example habitat fragmentation and impacts on biodiversity (Forman *et al.*, 2003). Roads provide many benefits (allowing economies to function efficiently etc) but

also threaten the biodiversity. The challenge is to keep hold of the benefits while eliminating or mitigating the threats. A policy in road ecology is to perforate the road corridors with underpasses and overpasses for wildlife and water crossings to reduce the habitat fragmentation and to lessen the barrier effect (Forman *et al.*, 2003; Forman, 1999).

To reverse the degradation of biological diversity is extremely important in the highly exploited Europe. An ecological network consists of core areas (important ecosystems, habitats and species population), ecological corridors to interconnect the core areas and buffer zones to protect the network from damaging activities outside the network (Jongman *et al.*, 2004). An ecological corridor is an element that is maintaining or re-establishing natural connectivity and is an important instrument in landscape planning (Cook and Van Lier, 1994). In Europe they are mostly results of human activities in nature as stone walls, regulated rivers and hedgerows but also 'spot disturbance' as railroad and power line strips (Jongman and Kamphorst, 2002). There seems to be a need to develop instruments for implementation especially at the local level (Jongman *et al.*, 2004). In the work with the Pan-European Ecological Network, Council of Europe (1998) states that the goal of conserving biodiversity cannot be achieved only through actions that preserve nature in its existing condition; it will also be necessary in certain cases to restore damaged habitats. Today there is a need to find ways in which ecosystems can continue to function in landscapes that are also used for human activities. The concept of ecological networks provides a model for maintaining biodiversity yet it allows a degree of human exploitation of the landscape (Council of Europe, 1998). Such a network also needs to consider the connections to social and cultural values in order to function properly in the landscape. What is a bit striking is that Sweden has no special designated ecological network except Natura 2000 (UNEP, 2006).

Spatial planning is a most important framework for the establishment of ecological corridors and land use instruments is one of the key tools used for their implementation (Jongman *et al.*, 2004; Cook and Van Lier, 1994). If environmental compensation could be used more in road planning it ought to be able to function as one instrument to implement ecological networks. In Germany, the compensation system also gives possibilities for future compensation measures in regional landscape planning (Müller-Pfannenstiel and Rössling, 2000). Developing opportunities for the enhancement of landscapes and habitats and to use ecological compensation is pointed out in

‘Code of practice for the introduction of biological and landscape diversity considerations into the transport sector’ – by the Committee for the Activities of the Council of Europe in the Field of Biological and Landscape Diversity (Bickmore, 2003).

1.5.4 Environmental impact assessment

“Environmental Impact Assessment is a process for taking account of the potential environmental consequences of a proposed action during the planning, design, decision-making and implementation stages of that action.”

(Morrison-Saunders and Arts, 2004, p. 1)

Environmental Impact Assessment (EIA) is an instrument to safeguard consideration of environmental impacts within development planning. The EIA process tries to influence the relationship between development and the environment in order to reach a more sustainable management of development projects (Glasson *et al.*, 2004). EIA has been an significant tool implementing environmental issues in the planning of projects and society (Fischer, 2003; Larsson, 1999). The Swedish EIA Centre states that the purpose with EIA, according to the directives, government bills and laws, is to protect the environment and contribute to a sustainable development through preventing, counteracting or compensating negative environmental impact (Hedlund, 2007). Within EIA, compensation measures can be proposed to ensure that the overall environmental value of an area is not reduced excessively by the development (Morris and Therivel, 2001). The road sector is governed by both the EnvC and the Roads Act which makes the environmental demands rather strong (Sveriges Riksdag, 1998; Sveriges Riksdag, 1971). An environmental impact report (EIR) shall contain a description of the measures being planned with a view to avoid, mitigate or remedy adverse effects. The regulation for the road administration concerning public participation and EIA etc in initial studies, feasibility studies and design plans also state that an EIR for a design plan shall clearly show how the EIR has affected the design of the road and the environmental impacts of the chosen design of the road project and compensation measures if needed (Vägverket, 2007b). The new handbook for EIA for roads discusses the use of compensation measures if an impact cannot be avoided or mitigated. The purpose is that the total quality of the environment measures within an area shall not be reduced because of road measures (Eriksson and Lingestål, 2004).

EIA has been and still is one of the strongest tools for bringing environmental consideration in different projects (de Jong *et al.*, 2004; Morrison-Saunders and Arts, 2004). Environmental compensation is linked to EIA both in the planning process and in the document (Peters, 1993; Bengtsson, 1997). The operating principles of EIA best practice, made by the international association for impact assessment, state that the EIA process should provide measures that are necessary to avoid, minimise or offset predicted adverse impacts (IAIA, 1999). In 2006 the Conference of the parties to the CBD endorsed guidelines for Biodiversity in EIA & SEA (Strategic Environmental Assessment). One of the principles: No net loss, emphasise the use of compensation in the statement: “...that loss of irreplaceable biodiversity must be avoided, and loss of other biodiversity has to be compensated (in term of quality and quantity).” (Slootweg *et al.*, 2006, p. 23). At present, EIA still seems to be the best tool in order to discuss and practically use environmental compensation. Hörnberg-Lindgren (2005) argues that EIA should, in order to be an instrument for sustainable development, present feasible compensation plans and, where appropriate, compensation for loss of habitats should be a requirement for approval.

1.5.5 Environmental ethics

“Spatial and land use planning systems, which focus on what development happens where and on what terms, are unavoidably involved in the contemporary re-thinking of our relationships with the natural world.”

(Healy, 1997, p. 186).

Environmental philosophy and ethics⁷ play a role in making explicit the hidden value assumptions of different environmental policies. Environmental issues raise fundamental questions about what the kind of beings we as humans are, our place in nature and what we actually value (Des Jardins, 2001; Light, 2000). Both science and ethics are essential if we hope to make meaningful progress in meeting the environmental problems (Des Jardins, 2001). Three current main environmental ethic perspectives are: *Intergenerational anthropocentrism*, which means to take into consideration today living humans and future generations; *Biocentrism*, which means to take into consideration all living creatures needs and only these; and *Ecocentrism*, which means to take into consideration all living creatures needs and only these, and the integrity of species and ecosystem (Stenmark, 2000). Environmental compensation is criticised from in a variety of ways. In some

⁷ Environmental ethic is a systematic account of the moral relations between human beings and their natural environment (Des Jardins, 2001).

ways it seems to challenge our common way to look at nature. Today empirical science shows that more and more people, mainly young people, do not have an anthropocentric approach but more a biocentric or ecocentric approach (Stenmark, 2000). Valuations seem to have changed which is one reason to discuss valuations and ethical standpoints more.

The intergenerational anthropocentrism is an ethical perspective which focus on human needs – only humans are seen to have intrinsic value (Palmer, 2003; Sundqvist, 2003; Stenmark, 2000). An object has an intrinsic value (non-instrumental) when it is valuable in itself and is not valued simply for its uses (Palmer, 2003; Des Jardins, 2001; Brennan and Lo, 2000; Stenmark, 2000). The intergenerational anthropocentrism reflects the politics of sustainable development (Palmer, 2003; Stenmark, 2000) and has shaped the environmental goals and policies in Sweden and internationally. Council of Europe (2003) states that: *“Ethics must serve as a foundation for sustainability”(p. 8).”There must be a real change in the present measurements of country performance based primarily on economic indicators to include more holistic measures such as health, poverty levels, biological diversity, and social justice”(p. 8).*

Biocentrism is an ethical perspective which extends concern for individual well-being, arguing for the intrinsic value of organisms achieving their own good (Brennan and Lo, 2000). Paul Taylor (1981) argues that each individual living thing in nature has equal intrinsic value which entitles them to moral respect. This generates a moral duty on humans to preserve or promote their goods as ends in themselves, and that any practices which treat those beings as mere means are intrinsically wrong. Taylor also states that we as humans have a duty to compensate other living creatures if we do them morally wrong (Taylor, 1981). The thought of compensation has also a support in a biocentric view, but the discussion will be concerned with if the exploitation is defensible from a moral standpoint concerning all living individual creatures and not only humans.

Ecocentrism is an ethical perspective which advocates a more holistic view. It is not the individual that is most important but species, ecosystems and the biosphere which as a whole is morally significant and thus has an intrinsic value (Des Jardins, 2001; Brennan and Lo, 2000; Stenmark, 2000; Rolston, 1994). Holmes Rolston (1989, 1994) argues that species are often more valuable than individual specimens, since the loss of a species is a loss of genetic possibilities. The deliberate destruction of a species shows disrespect for biological processes which make possible the emergence of individual living things (Brennan and Lo, 2000). In this sense compensation is not mainly important for the individual and thus compensation shall be seen on

a grander scale. In a very 'strong' kind of ecocentrism which some deep ecologists might argue for, any form of environmental harm (and thus also environmental compensation) would hardly be accepted at all – but in a weaker, more pragmatic ecocentrism, humans have a greater value than ecosystems etc (Des Jardins, 2001; Stenmark, 2000).

These different perspectives can be linked to environmental compensation as compensation often brings matters to its head concerning our valuations of nature. It involves environmental ethics in the sense that it may put our own view to change from seeing nature as a free resource to be used as man likes, to something very valuable that shall be sustainable for generations to come. It can even be seen to give nature an own intrinsic value despite its use for humans. It also forces us, in a rather realistic and down-to-earth way, to deal with the concept of sustainable development in exploitations (Rundcrantz, 2004). Environmental compensation is discussed in all these different views. The difference for compensation in these ethical perspectives is the discussion of whom/what has the right, the intrinsic value to be compensated for? Is it only humans that are living today? Is it also future generations? Is it only the living creature or is it the species, total biotope and ecosystem?

Lo (1999) argues that restoration of nature need not be anthropocentric and may be aimed at benefiting the nonhuman world. Stone (1974) for example, proposed that trees and other natural objects should have at least the same standing in law as corporations. He claimed that the list of legal right-holders has continually expanded where, not long ago, only landowning white adult males had full legal rights but now it includes women, people who do not own land, corporations, trusts, cities and nations (Stone, 1974). The philosopher Fox (1984, 1990) states that if humans give an intrinsic value to the 'non-human' world, this implies that the developer has to justify his actions in a moral way – the burden of proof should shift. This would be a fundamental change in contemporary environmental debate and decision-making.

Environmental compensation is in this thesis discussed from an ethical perspective which has its basis in intergenerational anthropocentrism. This is due to the importance of the political dimension, which is crucial in any environmental issue needed to be solved.

2 THE STUDIES

This thesis is based on case study research as well as review and synthesis of previous work in a context of planning and management of roads in landscapes.

2.1 Main questions

The main question posed in this thesis is: Why, how and in what way can environmental compensation better be used in Swedish road planning and design?

This question is broken down in several more detailed, sometimes pragmatic, questions in order to elucidate different conditions, among others professional, legal and administrative aspects to apply environmental compensation in the Swedish road planning system.

The questions at issue have been the following (the papers and sections in the thesis where the questions have been subject to most thorough analysis are printed in *italics*). The questions with a short summary of answer recur in the chapter Conclusions and implications for planning, p. 49-54:

- What is the present situation for environmental compensation in the international context? (What developments, controversies, breakthroughs are currently engaging the leading practitioners in this field). *Paper I and under the headlines: Why the topic environmental compensation in road planning?, p. 10-12 and Result and discussion, p. 37-45.*
- What is the current state for environmental compensation in Swedish road planning and design? *Paper I and II and under the headline: Result and discussion, p. 40-46.*

- What are the motives for using environmental compensation? *Paper I, II and III, and under the headlines: Why the topic environmental compensation in road planning, p. 10-12; Issues in landscape planning related to environmental compensation, p. 15-24 and The need for useful instruments for a sustainable road planning, p. 39-40.*
- What is the legal framework and limits for environmental compensation in Sweden? *Paper I and II and under the headlines: The legal framework in Sweden, p. 12-14 and Result and discussion, p. 44-47.*
- What is the knowledge and opinions about environmental compensation among professionals? *Paper III and under the headline: Result and Discussion, p. 38, 40-46.*
- How does and can environmental compensation fit into the road planning process and EIA process? *Paper I, II and III and under the headlines: Issues in landscape planning related to environmental compensation, p. 21-22 and Result and discussion, p. 41-44.*
- Which factors are of vital importance in order to reach a successful use of environmental compensation in Swedish road planning? *Paper III and under the headline: Result and Discussion, p. 39-47.*

2.2 Summary of papers

2.2.1 Paper I⁸

Paper I is the actual basis for the following papers. It reviews the use of environmental compensation in Germany, the USA, the Netherlands, the UK and Sweden. This review did strengthen the belief that environmental compensation is highly topical and much discussed in Europe and USA. It also showed the close connection between the phenomena and the EIA process and the philosophical discussion in the context. It gave much input in the research - what developments, controversies, breakthroughs are currently engaging the leading practitioners in this field. Germany, with its experience of environmental compensation since the 1970s seems to have the most developed research and methods for environmental compensation. In the USA there are requirements for mitigation and compensation measures for wetland losses. In the Netherlands, the compensation measures are focused on certain protected areas. In the UK there are few legal instruments that formally require environmental compensation. In Sweden the new environmental legislation has made it possible to legally demand

⁸ The co-author, Erik Skärbäck, has contributed to the paper mainly by translating the German articles used as sources in the paper.

environmental compensation measures to gain permits for exploitations. However these new Swedish requirements have only been available since 1999 and the use of compensation measures needs to be developed. It would be worth studying the German environmental compensation practice in order to learn more from it and to develop the use of environmental compensation methods in the Swedish planning system.

2.2.2 Paper II

The second paper mainly described and analysed a survey in order to find out the current status for environmental compensation. It was also an important base for the selection of two road projects which would be the main core for the case study. The purpose of the survey was to find out the intended use of environmental compensation today in the Swedish state road planning sector. The paper examines 15 planned Swedish state road projects in order to investigate the intended use of environmental compensation. The analysis serves to point out problems and opportunities for improvement to facilitate the use of compensation. It discussed the findings in an international context and focused on the connection to sustainable development. The results show that while environmental compensation is proposed in several projects, measures are seldom explicitly documented or interpreted as compensation measures. The planning process needs also to be better coordinated. The most explicitly described environmental compensation in the Swedish projects is connected to water issues while compensation for impacts on small biotopes is rare. When the descriptions of the environmental impacts of a project are compared to the suggested measures in the EIR and DP the proposed environmental measures are almost never in sufficient proportion to the damage that will be caused.

2.2.3 Paper III

The last paper is the actual case study for two road projects - which were selected from the survey described and analysed in the second paper. It is the final result of the two other papers and answers most of the questions and issues posed in these. The purpose of the third paper was to find out why environmental compensation was more prominent in two projects and to give better answers to the conditions, among others, professional and administrative, that are important in order to apply environmental compensation to a greater extent in the Swedish road planning context. The third paper is more detailed; all documents and several interviews with professionals have been done in order to gain a deeper knowledge about environmental compensation in these projects. This paper analyses two

Swedish road projects that have shown that proposed environmental compensation measures have been rather successful, in terms of getting described in the legally binding documents. The paper also discusses environmental compensation as an environmental instrument used in contemporary road planning. It can be one possible tool for reaching a more sustainable development when building a road, but it is crucial that the proposed measures are carried out. The result is enhanced by the information gathered from interviews where the interest and knowledge of the professionals, especially the project managers, is deemed as a crucial success factor. The paper also refers to a questionnaire which supports the findings from the interviews, which further strengthen the material (Rundcrantz, 2005). Furthermore check lists that guarantee the environmental measures, follow-up studies and better knowledge about environmental compensation are emphasised as important factors. The paper gives recommendations on how to implement and strengthen the use of compensation in road planning and design.

2.3 Material and methods

2.3.1 Case study research

The studies included in this thesis are all a part of the case study investigating environmental compensation. There are different ideas about what a case study is, but this thesis is influenced by several researchers using case study as a methodology, mainly Johansson (2004, 2005), Gillham (2001), Merriam (1994) and Yin (1994). Johansson (2005) states that case study methodology has developed in the direction of eclecticism and pragmatism but declares that: *“A case study is expected to capture the complexity of a single case, which should be a functioning unit, to be investigated in its natural context with a multitude of methods, and be contemporary.”* (Johansson, 2005, p. 30).

Case studies first appeared within the discipline of anthropology around 1900 but were also developed within medicine (description of individuals). It developed furthermore and is now an important methodology within the social sciences (Johansson, 2005). The advantage of the case study method is its strength to deal with many different sources, documents, interviews, observations etc (Gillham, 2001; Merriam, 1994). It's a qualitative and interpretive research which has a holistic approach to the research subject (Johansson, 2005). Gillham (2001) states that case study is a main method – with a multi-method approach. Within it different sub-methods are used:

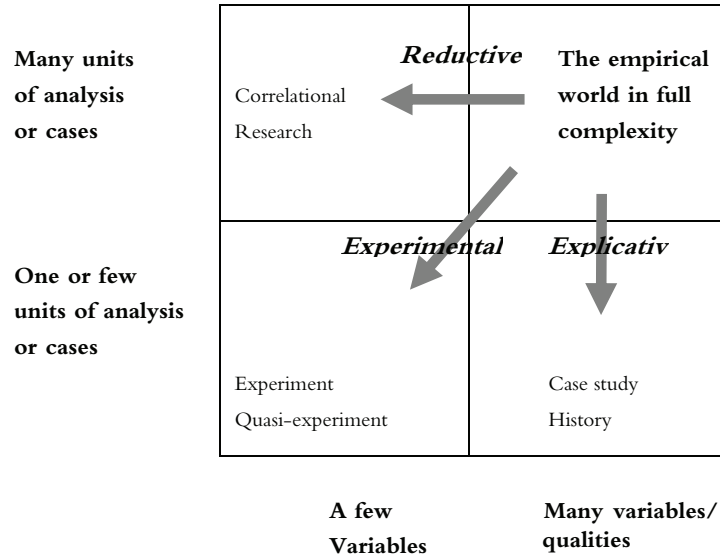
interviews, observations, document and record analysis, work samples and so on. A qualitative case study is appropriate when dealing with contemporary course of events where the questions 'why' and 'in what way' are best suited. It is a method to be used when examining a specific occurrence, for example, a program, a person, an institution or an event. Merriam (1994) defines qualitative case studies as an intense, comprehensive description and analysis of one unit or phenomenon. The main purpose is to understand the meaning of certain phenomena or experience. The method is useful, adaptable and more possible to develop than other methods in a given situation (Merriam, 1994). Flyvbjerg emphasises the importance of case studies as crucial to reflexive analysis and the discussion of values and interests which is important for the development of society (Flyvbjerg, 2001). A characteristic feature in the methodology is to triangulate i.e. different methods are combined in order to study the case from different angles (Johansson, 2005; Gillham, 2001; Stake, 1995; Yin, 1994). The method is also characterised by changing focus and boundaries of the case which often change through the research process (Johansson, 2005). The qualitative case study is inductive in its nature so new theoretical concepts can be explored but it can also be used to try existing theories or to slightly alter or explore them (Merriam, 1994).

The logic of case studies can be based on the same viewpoint as the qualitative methods in the sense that the purpose of a qualitative method is to understand the true meaning of a phenomenon or experience in its context (Merriam, 1994). The research in this thesis is applied science in the sense that it is concerned with presenting knowledge that can relatively swiftly lead to explicit measures (Patel and Davidson, 1994). The study has the characteristic of a qualitative research but has also used quantitative methods. The research is also normative in the sense that it gives proposals for improvements and what action to take (Wallén, 1996).

A pragmatic legitimisation emphasises the suitability aspect of case study research as an appropriate scientific method. As such the method can be defended on the basis of that it is functional, adaptable and more easily developed than other methods in a given situation. The knowledge gained through case studies can thus be judged by how understandable and suitable it is – a pragmatic view of the truth is therefore the basis for this approach (Merriam, 1994). Flyvbjerg argues for the Kuhnian insight: *"...that a scientific discipline without a large number of thoroughly executed case studies is a discipline without systematic production of exemplars, and a discipline without exemplars is an ineffective one."* (Kuhn, 1987, cited in Flyvbjerg, 2006, p. 219).

Johansson (2005) also states that a case study has special importance in practice oriented fields of research, for example planning. This is due to the fact that the ability to act within professional practice is based on knowledge of a repertoire of cases.

Table 2. *Three strategies to focus empirical research. From Johansson (2005).*



Quantitative and qualitative data are often mixed in case study research. There is a well-known discussion about the use of quantitative and/or qualitative methods in research. However, some scientists argue that it is possible to use both of them in research projects as long as one leaves the philosophical questions to others (Merriam, 1994). Johansson (2005) also states that this methodology does bridge the gap between quantitative and qualitative methods in the social sciences.

A case study can be studied with an intrinsic interest in the case as such or with an interest in generalising (Johansson, 2004; Stake, 1995). A case might be selected in virtue of being rich in information, critical revelatory, unique or extreme. If a case is purposefully selected, then there is an interest in generalising the findings. Generalisations made from case studies are based on reasoning – they are analytical and not statistical. There are three main principles; induction, deduction and abduction (Johansson, 2004, 2005; Wallén, 1996). Induction means that generalisations are made through conceptualisation, i.e. an explanation (theory) is made from facts in a case. A

generalisation where a hypothesis is tested in a case is based on deduction, and finally abduction where an actual problem situation is compared to known cases i.e. from facts and theory to a case – a generalisation made through comparison with a repertoire of cases (Johansson, 2005).

Gillham (2001) claims that theory (explanation) is something case study researchers create, working inductively from what is there in the research settings. *“Another fundamental characteristic in case study research is that you do not start out with a priori theoretical notions (whether derived from the literature or not) – because until you get in there and get hold of your data, get to understand the context, you won’t know what theories (explanations) work best or make the most sense.”*(p. 2). On the other hand, other scientists claim that theories do not contain anything except what is already in the empirical material i.e. there’s a theoretical thought already in the beginning of the selection of what one chooses to observe (Wallén, 1996). Merriam (1994) states that research that uses surveys is deductive in its nature because variables are chosen from assumptions made before the investigation starts. This can be the base for the later case study. Flyvbjerg (2006) declare that case studies both generate and test hypothesis. Johansson (2004, 2005) however, argues that the different types of analytic generalisation do not exclude each other and can be combined in a case study.

2.3.2 Method of the thesis

This thesis is based on three different parts consisting of a review, a survey and a study of two road projects which, together with a questionnaire, form the case study. The work has mainly followed this sequence:

- Reading the probably relevant literature (for the review).
- Getting to know the case in the setting.
- Deciding what the broad aims are.
- Making a start getting the research in shape.
 - Review
 - Survey
 - Questionnaire
 - Core case
 - Theorizing (explanation)

The research has been done in at least three steps. The review (paper I) can be seen as a first step in order to gain as much information about environmental compensation as possible. The second step is a survey (paper II) that aimed to find interesting cases. The third step is the actual core case

study (paper III). In this thesis my basis is the qualitative case study. I use some quantitative method – especially in the survey and the questionnaire but the discussion starts out from a qualitative standpoint in the framing of the research question and also in the analysing of the material. This case study is both descriptive and interpretive in its nature. The information gained is analysed, interpreted and used to theorize about environmental compensation.

Paper I

The main literature in the field of environmental compensation and related subjects was examined. The literature databases Transport 1988-2001/02, CAB Abstracts 1992-2001/01, AGRIS 1995-2000/11, ICONDA 1976-2001/01, AGRICOLA 1979 -2001/03, TREECD 2000/02-2001/01, Biological Abstracts 2000/01-2000/06, EconLit 1969-2001/03 was scanned for a wide range of recent studies of compensation methods. From this material other relevant articles were traced. A journey to Germany in order to gain information about the German compensation system was also made during March 2002. The following institutions were visited: the Federal Environmental Agency in Berlin, the Road Administration of North-Rhine-Westfalia, the Institute for Landscape Planning and Environmental Planning at the Technical University in Berlin and the Federal Agency for Nature Protection in Leipzig.

Paper II

All design plans (DP) found in the official records with an approved EIR during 2001 and 2002 in three different regional road administrations were examined. This means that the selected projects are a representative selection of Swedish road projects with attached EIRs carried out during the past years. 125 projects were found in the screening of the archives. Only 15 of these projects had an approved EIR and a previous decision that the project may cause significant environmental impact. The regions were selected after discussions with the EIA expert and the Planning expert from the Head office for the SRA. Each region can be seen as representing a “average” SRA region. The regions contain arable land and forests and two of the largest cities in Sweden (Malmö and Göteborg) are situated there. They also have a certain land pressure, especially Skåne, with the fast developing fragmentation of land. The National Board of Housing, Building and Planning has also especially pointed out Skåne as a region in which environmental compensation ought to be used in order to maintain and enhance biological diversity (Emanuelsson *et al.*, 1996).

The survey was a crucial help in finding projects where environmental compensation measures can be considered as rather well described, discussed or analysed in the DP. The DP is the most important step, because it is this document that is legally binding. The cases in the survey are average, typical road projects that are done during a certain period. This means that it is not a strategic choice from the beginning. But the cases selected for the case study are on the other hand chosen from a strategic reason – their connection to environmental compensation.

Paper III

The two projects were selected so that they predict similar results i.e. literal replication (Yin, 1994). The intention was to compare these projects in order to describe the similarities (or differences) that will be revealed. In each project several documents were studied: the initial study, the feasibility study, the EIRs, the design plan and any road architecture program or design principles belonging to the project, the construction plan, the exemption permits and other documents connected to this. Interviews were also made with several people connected to the projects; the two senior project managers responsible for the projects, consultants and the landscape architects, handling officer at the authority for road and traffic legislation, environmental experts at the SRA and at the SCA.

The purpose of the interview was to obtain descriptions of the interviewed person's lifeworld⁹ with intention to interpret the described phenomena's meaning (Kvale, 1997). The validity of such interviews can be measured to what degree the result reflects on the source and also in a more general way increases the understanding of the case (Lantz, 1993). The interviews were taped and notes were taken. Each interview lasted approximately between 30 and 60 minutes. The discussion focused mainly on the following subjects:

- The knowledge, understanding and opinion about environmental compensation
- The different projects – especially the environmental issues, the planning processes, how and why environmental compensation is used in the project, legal matters and responsibilities.
- Interesting questions connected to environmental compensation, especially those issues considered being a problem internationally;

⁹ Lifeworld is the "background" environment of competences, practices, and attitudes representable in terms of one's cognitive horizon. It's the lived realm of informal, culturally-grounded understandings and mutual accommodations (Habermas, 1987).

the difficulties in coordinating the planning processes, the need for guidelines for monitoring and follow-up studies, the problems of implementing suggested environmental measures and problems finding appropriate land for compensation measures.

In my professional work at the SRA in Region Skåne, a study using a questionnaire was also made, where all 33 municipalities in the region, 8 larger environmental organisations and 5 national environmental institutions were given the opportunity to air their opinion about environmental compensation (Rundcrantz, 2005). These organisations are those that the SRA in Region Skåne often cooperate with or are bodies to which a proposed measure is referred for consideration. The purpose was to gain knowledge about the opinion and attitude towards environmental compensation and to identify important conflicts in order to develop the use of compensation in road planning. The questionnaire consisted of both set questions/answers and open questions. 61 of 77 answered the questionnaire which made the answering frequency over 79%. The result was an input to the research.

2.3.3 General reflections

The case undertaken in this thesis is mainly based on these three papers. This means that full general conclusion can not be drawn from it. However, a case study can by generalisation transfer knowledge to other cases and thus has the potential to bridge the gap between research and practice (Johansson, 2004). The case, which has few units of analysis and many variables/qualities, fits into the explicative strategy described in table 2.

This case study is not purely inductive nor deductive or abductive. The research started with a rather vague thought about environmental compensation, but transformed, mainly after the review, to more systematic thoughts about how to explore the concept. The questionnaire and survey also pointed to important issues to explore and explain. Finally I also generalised from known cases in my work. The analytic strategy is to use an explanatory theory building where a coherent and reliable picture of the phenomena (the conditions needed to make environmental compensation successful in the road project) is made.

Could other methods have been useful? I think that case study research has a lot of strength in its use of several methods in order to capture the

complexity of a functioning unit in its natural context (environmental compensation in two road projects).

3 RESULTS AND DISCUSSION

The common theme of the papers presented in this thesis is environmental compensation and how to improve the use of it in the Swedish road planning system. First I discuss the criticism against environmental compensation and also the motives for using it. Second I discuss different conditions that are important in the application of environmental compensation in road planning and design.

3.1 Criticism against environmental compensation

There is a vital discussion about environmental compensation and the different philosophies behind it. The use of compensation measures does not occur without controversy. One objection connected to compensation is its aim to restore nature. Creation of habitats is an important issue in environmental compensation (Cowell, 1997). The difference between environmental compensation and ecological restoration or habitat creation is that environmental compensation is associated with disadvantageous impacts on nature due to development (Cuperus *et al.*, 1999). Some environmental philosophers argue that any form of ecological restoration is an artefact (Katz, 1992, 2000). The restored environment is produced through human dominance and technological control and the result can for that reason not be authentic – it is a product of human intentions and design (Katz, 2000). This does however seem incompatible with any concept of an environmental ethic in which humans are seen as part of nature. Many species will also accept changes in their environment if certain features essential to their survival are maintained (Gunn, 1991). The objection about the authenticity in restoration seems therefore unhelpful because it is rarely the goal of restoration projects in Europe. A ‘natural’ state is also probably

not possible to find, at least in Europe, because of long time land occupation and use of the environment (Eden *et al.*, 1999). Furthermore, restoration cannot be based on static attributes because most ecosystems are dynamic, so there should be a focus on the desired characteristic for the ecosystem (Hobbs and Harris, 2001). Even Katz admits that restoration is a way to clean up our mess if we have exploited the environment – it's a policy that makes the best of a bad situation. However, as a matter of policy it is always better to prevent the damage (Katz, 1992).

Another difficult objection is that environmental compensation can be used to obscure or justify environmentally damaging projects (Cowell, 2000; Eden *et al.*, 1999; Elliot, 1982). This problem is connected to the use of 'natural capital' as a way to define and protect environmental valuable areas, species or functions in the interest of sustainable development. There seem to be a growing economic view in landscape and ecological engineering that environmental loss may be traded off against restored gains thus maintaining the overall environmental capital for the next generation (Cowell, 1997). There is a fear that the idea of maintaining the environmental stock does reinforce a technocratic view of sustainable development and does separate the public debate from important issues about the economic, social and environmental desirability of different development patterns from public debate (Cowell, 2000). From another point of view, others argue that restoration is a way to heal relationships between nature and humans, reconnecting us with the surrounding landscape (Light, 2000; Stevenson, 2000).

This criticism can be compared to the results from the interviews in the case study (paper III) and the questionnaire (Rundcrantz, 2005). The results are very concordant. Most misgivings were that environmental compensation could be misused by undermining the environmental consideration in projects or justify environmentally damaging projects. Another criticism was that compensation measures can be expensive. But the answers in the questionnaire also showed that there is a great interest and a rather positive attitude to environmental compensation¹⁰. One advantage was the possibility

¹⁰ 87 % (48 of 55 answering) agrees or partly agrees that environmental compensation is something positive for the development of society (2 are doubtful and 1 totally rejects the idea). 78% (43 of 55 answering) agreed or partly agreed that environmental compensation is a good instrument to achieve sustainable development (8 are doubtful and 1 totally rejects the idea).

to maintain or enhance the biodiversity and the possibility to increase requirements for environmental consideration in projects. The statements in the interviews also showed the opinion that the use of environmental compensation had made the projects better. No one believed that compensation had been misused in the projects.

The use of environmental compensation can show the developers concern about environmental issues and that the ecological functions are entitled to cost money. This can also become an obvious reason for a developer trying to avoid certain impacts and to find other solutions. Ecological functions will not be so tempting to exploit if it costs money to do so. In order to diminish the fear that environmental compensation could be misused to undermine the environmental consideration in projects, it is of vital importance that the SRA clearly shows that environmental compensation is the third step in environmental consideration after avoidance and mitigation. The Swedish authorities could be influenced by the German way in dealing with compensation. In Germany the deciding authority has to weigh and balance the project interests for the society against the relevant nature conservation concerns after all measures to avoid, mitigate and compensate the impacts are done. If the nature conservation concerns seem to be more important than interest of the society for the project, the authorisation has to be denied. In the other case, it cannot refuse the authorisation just on the grounds of nature conservation requirements (Der Rat von Sachverständigen für Umweltfragen, 2002).

3.2 The need of useful instruments for a more sustainable road planning

There is a need for useful instruments in order to deal with specific environmental problems. The practice of spatial and land use planning is very difficult to separate from environmental issues (Healey, 1997). The road network is still growing in Europe and its impact on fragmentation has become an increasing problem (European Environment Agency, 2004; Iuell *et al.*, 2003; Catzzone, M *et al.*, 1998). There are numerous conventions, goals, principles etc on how to reach a sustainable development but still there seems to be very little material about the practical instruments that are required (Bickmore, 2003; Leitão and Ahern, 2002). Moving from words to action concerning sustainable development is experienced to go so slow (Isaksson, 2006; Asplund and Skantze, 2005). Environmental compensation is a tool that not only discusses the concept of sustainability in theory but is

also rather easy to use in the individual project and in the existing road planning process. It can be a useful tool for landscape development management (Bruns *et al.*, 2001). Environmental compensation is a way to ensure the natural capital for future generations in a more and more exploited Europe.

Environmental compensation is an approach in order to better maintain ecological functions despite exploitations. It aims to improve damaged ecological functions in areas or to create new well functioning values. This implies that environmental compensation can be used as one practical tool to achieve some of the Swedish environmental quality objectives (Johnmark, 2006). For example, the interim targets for the objectives 'Flourishing lakes and streams' and 'Thriving wetlands', suggests restoration of streams and establishment of wetlands and ponds. But where environmental compensation probably will do best use as a functional tool is for the objective: 'A Rich Diversity of Plant and Animal Life'. One way to achieve this objective is, among others, that: *"where important habitat types have been damaged, these must be restored, significantly improving conditions for biological diversity."* (The Swedish Government, 2006a, p. 51).

3.3 Practical issues

The findings from this thesis highlight important issues to deal with; the financial and legal aspects, the strong connection to EIA, the lack of compensation for small biotopes, the need for better environmental expertise and the importance of the involved professionals (paper I, II and III). It further supports internationally known problems connected to environmental compensation; the difficulties in coordinating the planning processes (Müller-Pfannenstiel and Rössling, 2000), the need for guidelines for monitoring and follow-up studies (von Jessel, 2002; National Research Council, 2001; Treweek and Thompson, 1997; Kiemstedt *et al.*, 1996), the problems of implementing suggested environmental measures (Boyden, 2002; Schwoon, 1997) and problems finding appropriate land for compensation measures (Wende *et al.*, 2005; Cuperus, 2004; Bruns *et al.*, 2001; Kuiper, 1997).

3.3.1 Administrative aspects

(Coordinating the planning processes, the problem of implementing the suggested measures, the need for monitoring and follow-up studies and the need for guidelines).

The projects in the case study (paper II and III) do show the initiators intention to act within the current policies and laws for nature conservation by avoiding or mitigate damage as far as possible. Environmental compensation is also described and proposed although the measures are seldom interpreted as compensation measures in the documents. A possible explanation could be that the terminology has not been clear in the SRA's old handbook for EIA compared to the new handbook, which is from 2002 (Eriksson and Lingestål, 2004). There are more environmental measures proposed in the EIR than in the description to the DP. The accounts of the proposed measures are also more detailed and explicit in the EIR. The study also shows that the descriptions in several of the projects lack the link between the impacts and the affected ecological function. What is often absent in the documents is the discussion of why environmental compensation should be used and that it is the next step to take if avoidance and mitigation measures are not enough. In a paper about the implementation of mitigation measures in EIA in UK, Boyden (2002) states that *“When determining planning applications subject to EIA, decision-makers need to be confident that mitigation measures can and will be implemented as envisaged, so that development proposals and environmental impacts will be acceptable (to decision makers and the community)”*(p.11). This ought to be the same for compensation measures and of course also important for the public when giving their opinion about a project. The interviews also showed the need for better guidelines that are easy to apply (paper III).

Sadler (1999) stresses the need for EIA to move from processes to minimise impacts toward processes to maintain the functions of natural systems – a transition which calls for no net loss of natural capital. Higgs argues that a good ecological restoration is as much process oriented as product oriented. It involves the perspectives of interested stakeholders and ecological knowledge (Higgs, 1997). So, rather than creating a 'new' planning process for environmental compensation it will probably benefit if better emphasised in the EIA which already is well known process which functions together with the road planning processes. This implies that the planning process (the EIA process and the road planning process) would benefit if better coordinated in order to facilitate the use of environmental compensation, preferably as early as possible in the planning process. This is also something that is pointed out as an important factor in the projects in the case study (paper III). For example, today different persons are often producing the EIR and the DP for a road project. It is seldom that the same project manager leads a project from the early planning phase to the actual building

of the project. This indicates that there can be a problem in making sure that all of the proposed and discussed environmental measures will be realised.

Morrison-Saunders and Arts (2004) state that the important role of follow-up in EIA has not been systematically required or fully applied. The interviews in the case study also show that follow-up studies of environmental measures after the project is finished are poor (paper III). Follow-up studies of environmental measures described in EIR are a neglected area (Antonsson and Folkeson, 2001; Folkeson, 1999), and follow-up studies of compensation measures are almost non-existing. In order to have real impact on a project, the proposed measures have to be followed up in assignments and commitments in the permission or suchlike and with provisions in the assessment of a decision (Lerman, 2001). The developers own responsibility for control and follow-up studies is most likely an important issue, because the responsible supervisory authority does not always have time to call attention to this. It would most likely be very informative if the deciding authority, mainly SCA, made follow-up of, for example, the exemption permits – to see if and how the SRA has executed the environmental measures demanded in the permits. The SRA has in its own regulations demands for follow-up studies of the predicted measures in the EIR but there are needs for improvements (Lerman, 2001).

The Swedish National Audit Office and The Swedish National Road and Transport Research Institute has criticised how SRA deals with environmental aspects in the planning and building of roads (Antonsson and Folkeson, 2001; Folkeson, 1999; Riksdagens revisorer, 1999). The Audit Office states that environmental measures that are suggested in the EIR need to be followed-up and be taken into consideration during the whole planning and building process. The SRA does not on a regular basis follow-up the environmental effects of the projects which limits the knowledge of the environmental influence. There is risk that environmental issues will be forgotten during the process and in the end are left out from formal examination. The suggestion is that the SRA in a more clear way demonstrates how the environmental aspects shall be taken into consideration. The critique is also supported by a follow-up study of environmental considerations in road projects (Sundin, 2006). This report suggests the use of routines and check lists in order to assure that the environmental measures suggested in the EIR also will be considered in the DP and in the construction plan. The EIR needs to be more legible especially when describing possible consequences and mitigation measures. It

also recommends that the environmental specialist be more involved in the process. All these ideas were also mentioned in the interviews in the case study (paper III). The interviews also pointed out that the project managers for the projects in the case study are known to be careful and skilful in checking all undertakings in the project. This probably contributed to the rather successful implementation of the environmental measures in the projects (paper III).

3.3.2 Professional aspects

(The lack of small biotopes i.e. the need for better knowledge).

All the interviewed people in the case study emphasise the importance of the attitude of the involved professionals. If they, especially the project manager, are in favour of environmental compensation the measures will be documented and finally carried out (paper III). Nonetheless, all of the proposed measures in the projects were not executed and there are needs for improvements. It would be better if the consequences were described both with and without environmental measures in order to facilitate the priority of the measures (paper III, Sundin, 2006). In that way it is clearer for the reader and the professionals and the decision makers what is needed in order to mitigate and compensate negative impacts. The exemption permits are more detailed regarding the demanded compensation measures but even here they are not always connected to the actual ecological function (paper III). For example – when getting a permit to cut down a row of trees, only a new row of trees is demanded and not, which probably would be needed in order to gain the same ecological function, several trees in order to replace one old tree. Maybe even further ecological measures need to be carried out. In the new regulations for the SRA concerning public participation and EIA etc there is a demand that the EIR shall compare the project with the Swedish environmental quality objectives (Vägverket, 2007b). Hopefully this will make it easier to assess if the developer is successful in compensating for the impacts made in a project.

The question about impacts in small biotopes is seldom noticed in the EIR and will often first be noticed when a permit for an exemption is needed (paper II and III). The interviews in the case study point to that the consultants and project managers do not always see this and therefore it is most likely very important to educate those involved more (paper III). In order to raise the quality in the general EIA today, there is a need for a better professional knowledge in understanding the relations in the

environment and to predict the effects of an impact (Wallentinus, 2007). The project managers also expressed a wish to have greater involvement from environmental specialist in the projects. Small biotopes do not seem to be important enough to compensate for (paper II and paper III). This is a common but most unfortunate position in infrastructure planning. All these impacts in small biotopes etc will gradually reduce the biodiversity in the landscape until there is so little left. Researchers have lately pointed out that the small remnant islands, and the creation and maintenance of these, are essential in order to enhance biodiversity in the agricultural landscape (Jongman *et al.*, 2004; Duelli and Obrist, 2003). Box (1996) claims that the creation of habitats is fundamental in order to maintain the biodiversity and to reach sustainability.

3.3.3 Legal aspects

(Problems finding appropriate land for compensation measures and the financial aspect).

Even if the possibility to demand compensation does exist in the EnvC, the case study (paper II and III) indicates that the SCA does not yet make extensive use of this legal tool. No one points out that the law is to tame – but suggest that the deciding authority should be more careful (paper III). It seems to be of vital importance to improve the application of the Swedish law, concerning environmental compensation, in a stricter sense. This is not only a Swedish problem, Treweek and Thomson (1997) state that in UK, there also seems to be confusion about the extent to which ecological mitigation and compensation is required.

One severe problem is that it still is unclear to what extent the Swedish legislation does support the requirement of land needed for compensation measures. The case study (paper III) shows that this is an important aspect that can make compensation attempt to fail. Today, it is not clear if the SRA can use the possibility for expropriation from the Road Act and meanwhile it is functioning by voluntary efforts (paper II and III). In the future it will probably be tested in the environmental court in order to create a precedent. The problems connected to finding appropriate sites and buying land is also emphasised in both Germany and the Netherlands (Wende *et al.*, 2005; Cuperus, 2004; Bruns *et al.*, 2001; Kuiper, 1997).

Even if compensation measures are described in the DP it can still be very difficult to gain land on a voluntary basis if the price is high. This will probably be the case in areas which would benefit most from these measures (i.e. densely populated areas and arable land) to enhance biodiversity. In the

interviews the project managers also pointed out that compensation measures should be easier to perform if they were discussed in an early stage and if it was possible to require land earlier in the process (paper III). Yet, compensation should not be something carried out merely because of its simplicity – it should be used as a proper tool to increase biodiversity and as a practical instrument for polluter pays principle. If it is considered to be so important for society to build a road in these areas then the exploiter ought to afford to pay for the environmental measures. One alternative solution to the problem is development of ‘compensation pools’, where several environmental measures to compensate for impacts from different projects can be concentrated in large sites. This can be more practical and financial efficient and also give a more stable ecological function compared to small isolated compensation measures (Wende *et al.*, 2005; Stein and Tabatabai, 2000).

One disadvantage mentioned in the interviews and the questionnaire is that environmental measures are expensive (paper III). Nevertheless, the project managers estimated the cost for environmental compensation in the two studied road projects, as rather low, approximately 2-5% of the budget. It is difficult to evaluate the ecological functions in economical terms. Functional ecosystem represents natural capital upon which the economy depends and humanity benefit from ecosystem functions at little or no costs (Clewel, 2000). The SRA’s adopted management philosophy is steering by setting objectives, targets and goals and following up the achieved results. This means that the desired quality is reached at the lowest possible cost through proper management. So, in modern Swedish planning, in its true sense, there are no extra costs for taking ecological values into consideration. A project will only be seen as too costly when a solution is chosen which is more expensive than needed for fulfilling the desired quality (Vägverket och Banverket, 2005). If a project shall fulfil the international and national environmental objectives the environmental measures have to be considered necessary in the project. The Government declares that there is a direct connection between biodiversity and the ability of economic systems to function. The Government also states, when deciding about the environmental quality objective for rich biodiversity, that the objective most likely will lead to economic gains in the long term even if efforts to achieve this objective will involve costs in the short term (The Swedish Government, 2006a). One can also compare this to that the estimated value of ecosystem services and natural resources was 33 trillion US\$ per annum

1997 (Costanza *et al.*, 1997). This gives a pragmatic reason to restore ecosystems (Clewel, 2000).

3.3.4 Sociology of law

Sociology of Law is studying the relation between law and society. This perspective on law does not focus on some single enactment but on law in a social context (Faculty of social sciences Lunds University, 2007). Fog and Åström have studied how a change in law or a change in a planning process can cause a change in different actors influence, thus causing a change of power in society. Different resources, political, professional, financial and legal, that support the different participants can also change (Fog and Åström, 1994; Fog *et al.*, 1992).

The use of environmental compensation has been studied in a case study of a planning area (Ideon) in the city Lund in Sweden. The result from that study shows that it is the same participants in a planning process involving environmental compensation, as in an ordinary planning process. An exception is if replacement compensation outside the planning area is of interest. In that case another landowner might be involved (Grip *et al.*, 1999). A more strictly appliance of environmental compensation measures might lead to a more natural resource-orientated planning process whereas implementation of EIA has made it rather focused on politics. The process may change from a more stakeholder focus to a larger extent of focusing on resources, functions and values (Skärbäck, 2000; Grip *et al.*, 1999). Starik (2004) claims that the stakeholder concept is more than a human economic and political one, and that nature today is not sufficiently represented by other stakeholder groups. Maybe compensation can be a tool to strengthen the status for nature in a legal context? The project managers' strong influence on environmental compensation issues might also diminish benefiting other participants interested of compensation measures. The professional resource will probably be needed more in order to do evaluations and analysis.

In order to fulfil a planning decision there is need for political, legal, material and professional legitimacy (Grip *et al.*, 1999). Environmental compensation has a basis in the concept of sustainable development and the 'polluter pays principle' (Skärbäck, 2000; Peters, 1993) which gives an ethical and political legitimacy. This was also something evident in the interviews (paper III). No one seemed to object the political legitimacy, but more that the law is not applied in a strict sense. The involved professionals also seem to mainly

have good skills in order to secure the professional legitimacy, but what is missing is check lists and knowledge about how to describe, motivate and sometimes quantify environmental compensation measures in a more explicit and legible way. Water seems to be the most compensated resource and this is probably due to the economical aspect, its historical importance for people and fishing (paper II). Environmental compensation is one practical solution to maintain the environmental stock for future generations i.e. environmental compensation also has a pragmatic and financial legitimacy from an economic perspective (as discussed earlier) (Clewell, 2000).

4 CONCLUSIONS AND IMPLICATIONS FOR PLANNING

This thesis is the first to systematically analyse the use of environmental compensation in the Swedish road planning system. The main question posed in this thesis is: Why, how and in what way can environmental compensation better be used in Swedish road planning and design?

This question is broken down in several more detailed, sometimes pragmatic, questions in order to elucidate different conditions, among others professional, legal and administrative aspects to apply environmental compensation in Swedish road planning and design.

The questions at issue have been the following (the papers and sections in the thesis where the questions have been subject to most thorough analysis are printed in *italics*):

- What is the present situation for environmental compensation in the international context? (What developments, controversies, breakthroughs are currently engaging the leading practitioners in this field?). *Paper I and under the headlines: Why the topic environmental compensation in road planning?, p. 10-12 and Result and discussion, p.37-45.*
 - The use of different measures to compensate the environment has been frequently discussed in Europe and the USA as a possible way to recreate ecosystems and remedy the negative consequences of different projects. Currently, Germany, with its experience of environmental compensation since the 1970s seems to have the most developed research and methods for environmental compensation.

- There is a discussion about environmental compensation and the different philosophies behind it. The use of compensation measures does not occur without controversy. Some environmental philosophers argue that any form of ecological restoration is an artefact - the restored environment is produced through human dominance and the result can for that reason not be authentic. Another objection is that environmental compensation can be used to obscure or justify environmentally damaging projects.
- Other internationally discussed issues are; the need for guidelines and the need for monitoring and follow-up studies, the problems finding appropriate sites and buying land, and the need for a better coordination of the planning processes.
- What is the current state for environmental compensation in Swedish road planning and design? *Paper I and II and under the headline: Result and discussion, p. 40-46.*
 - Environmental compensation is used to some extent in Swedish road planning and design but it is not always it is called compensation. The results show that while environmental compensation is proposed in several projects, measures are seldom explicitly documented or interpreted as compensation measures. The most explicitly described environmental compensation in Swedish road projects is connected to water issues while compensation for impacts in small biotopes is uncommon. When the descriptions of the impacts of a project are compared to the suggested measures in the EIR and DP the proposed environmental measures seems almost never be in sufficient proportion to the damage that will be caused. What is often missing in the documents is the discussion of why environmental compensation should be used and that it is the next step to take if avoidance and mitigation measures are not enough. Follow-up studies of environmental compensation are poor.
- What are the motives for using environmental compensation? *Paper I, II and III, and under the headlines: Why the topic environmental compensation in road planning, p. 10-12; Issues in landscape planning*

related to environmental compensation, p. 15-24 and The need for useful instruments for a sustainable road planning, p. 39-40.

- Environmental compensation is a tool which can contribute to a more sustainable development despite exploitations. It fits in to a lot of international conventions, goals and principles on how to reach a sustainable development. It is an instrument that not only discusses the concept of sustainability in the theory but is also rather easy to use in the individual project and can be used in the existing road planning process. It is a way to ensure the natural capital for future generations in a more and more exploited Europe. In Sweden compensation is especially seen as an instrument for enhancement of biodiversity. It can also contribute to achieve the Swedish environmental quality goals. The ecosystem services and natural resources stands for a huge value which gives a financial and pragmatic reason to restore ecosystems. In addition, the use of environmental compensation can show the developers concern about environmental issues and that the ecological functions are entitled to cost money. This can become an obvious reason for a developer trying to avoid certain impacts and to find other solutions.
- What are the legal framework and borders for environmental compensation in Sweden? *Paper I and II and under the headlines: The legal framework in Sweden, p. 12-14 and Result and discussion, p. 44-47.*
 - Demands for compensation can be found in the EG directives and in the Swedish EnvC. The legal context for environmental compensations in Sweden is not clear. The result in the thesis indicates that the deciding authorities do not yet make extensive use of this legal tool. It seems to be of vital importance to improve the application of the Swedish law, concerning environmental compensation, in a stricter sense. It is also indistinct to what extent the legislation does support the requirement of land needed for compensation measures. A need for further discussions and testing is important.

- What is the knowledge and opinions about environmental compensation among professionals? *Paper III and under the headline: Result and Discussion, p. 38, 40-46.*
 - The professionals seem to have rather good general knowledge about environmental compensation. What seems to be missing is knowledge about why and how it can be used more explicitly. The statements in the interviews showed the belief that use of environmental compensation had made the projects better. No one believed that compensation had been misused in the projects. Municipalities and organisations have a rather positive attitude to compensation and see it as an instrument to maintain or enhance biodiversity and to increase requirements for environmental consideration in projects. Nevertheless, there are still misgivings that environmental compensation can be misused by undermining the environmental consideration in projects. Another criticism is that compensation measures can be expensive.

- How does and can environmental compensation fit into the road planning process and EIA process? *Paper I, II and III and under the headlines: Issues in landscape planning related to environmental compensation, p. 21-22 and Result and discussion, p. 41-44.*
 - Environmental compensation is linked to EIA both in the planning process and in the document. At present, EIA still seems to be the best tool in order to discuss and practically use environmental compensation. The studies in this thesis stress that it is very important to discuss environmental compensation in the EIR and to make sure that the proposed measures are documented in the description to the design plan. If compensation measures are proposed, described and analysed in a good way in the EIR this will probably make it easier for the measures to be implemented in the project. Environmental compensation would do good if better emphasised in the EIA, which already is a well known process, functioning together with the road planning processes. This means that the planning process (the EIA process and the road planning process) would benefit if better coordinated thereby facilitating the implementation of compensation measures.

- Which factors are of vital importance in order to reach a successful use of environmental compensation in Swedish road planning? *Paper III and under the headline: Result and Discussion, p. 39-47.*
 - Environmental measures have no value if they are not implemented. A vital conclusion in this thesis is that the interest of the professionals, especially the project managers, is a crucial success factor for getting environmental compensation measures into the legally binding documents. All professionals need to have a close cooperation when planning a road and the planning process needs to be well coordinated.
 - In addition, for further development and more successful use of environmental compensation in road planning the research in this thesis emphasise the following aspects important to deal with:
 - To increase the knowledge about environmental compensation and its proper place in road planning/building and EIA.
 - To incorporate environmental compensation as early as possible in the road planning process.
 - To discuss the legal circumstances; the possibilities and limitations.
 - To promote the use of instruments, for example check lists, which guarantees that the environmental issues are managed in the whole planning process.
 - To increase the cooperation between the environmental specialists and the project team.
 - Furthermore, follow-up studies of environmental compensation measures need to be described in the planning documents and the authorities have to put effort into carrying out these studies (both the exploiter and the supervising authority).
 - In order to diminish the fear that environmental compensation could be misused to undermine the environmental consideration in project, it is of vital importance that the SRA clearly shows that environmental compensation is the third step in

environmental consideration after avoidance and mitigation.

- It would be worth studying the German environmental compensation practice in order to learn more from it and to develop the use of environmental compensation methods in the Swedish planning system.
- It would also be worth discussing a possible use of 'compensation pools'.
- To see that compensation can be used as a tool to create new environmental values in the everyday landscape, for example ecological networks.
- This thesis deals with ecological functions, not visual, cultural and social aspects. Similar studies are required from those perspectives.

5 FURTHER PERSPECTIVES

I think it is of vital importance to understand that environmental concern in road projects can be used to promote certain environmental interest and not only destroy or avoid the existing values. Roads are long elements which wriggle across the landscape, creating new structures and at the same time destroying others. Can creation of green corridors be one proper and ethical fair way to compensate for the impacts? Cook *et al.*, (1994) argues that ecological networks can be viewed as one of a spectrum of spatial concepts to correct the negative aspects of intensifying the uses of land and of our natural resources. It would not be difficult to develop a map of the primary ecological network (large vegetation areas plus connecting major water and wildlife corridors) and then overlay the road network onto this. This would identify conflicts areas between ecology and infrastructure and can be used as areas suitable for compensation measures (Forman *et al.*, 2003). The idea of ecological networks will however require a holistic approach that includes an integration of ecological, social and cultural values. The SRA is already restoring a network, a dispersal corridor, for the otter, by facilitating passages under roads (Vägverket Region Skåne, 2007). The administration also tries to facilitate passages for rare frogs at certain sensitive conflict points and to place nesting boxes for birds and bats under bridges (Loman, 2004). So, the SRA has possibilities in its planning context to promote measures to enhance and create environmental values, for example, dispersal corridors for wildlife by restoring areas as a compensation measure for road exploitations. Environmental compensation might even be used to remedy for impacts that the existing, old road system is responsible for.

Two other tricky questions, which need further analysing and research, are how to require land for compensation measures and how to deal with the management of the areas. Few public operators (municipalities) are

interested in managing a compensation area and this probably has to be solved individually in each project (Rundcrantz, 2005). Presumably should the areas be managed and administrated by a governmental administration for example the SCA. An interesting issue to investigate is starting up cooperation with the municipalities to find areas and measures suitable for environmental compensation. This kind of cooperation can hopefully lead to a wider and more regional perspective on the issue. The idea of developing a green structure over the landscape might be realised. Can it even become possible to discuss a future development of 'compensation pools', where several environmental measures to compensate for impacts from different projects can be concentrated in one large site?

Environmental compensation in road planning can also be discussed in a more theoretical and philosophical perspective. Furthermore it would be interesting to investigate how different actors perceive environmental compensation both as a phenomenon and how they view it as a method.

REFERENCES

- Adams, WM. (1996) Creative Conservation, Landscapes and Loss. *Landscape Research*, 21(3), 265-276.
- Antonsson, H and Folkesson, L. (2001) *Uppföljning av miljöeffekter av vägprojekt: behov av utveckling och erfarenhetsåterföring*. VTI meddelande 917. Linköping, VTI.
- Arts, J *et al.* (2001) Environmental impact assessment follow-up: good practice and future directions – findings from workshop at the IAIA 2000 conference. *Impact Assessment and Project Appraisal*, 19(3), 175-185.
- Asplund, E and Skantze, A. (2005) *Hållbar utveckling i praktiken: möten, gränser, perspektiv*. Forskningsrapport KTH. Stockholm, Elanders Gotab.
- Bengtsson, B. (1997) *Kompensation för förlust av miljövärden, Ds 1997:52*. Stockholm, Regeringskansliet offsetcentral.
- Bickmore, C. (2003) *Code of practice for the introduction of biological and landscape diversity considerations into the transport sector – by the Committee for the Activities of the Council of Europe in the Field of Biological and Landscape Diversity. Nature and environment, No. 131*. [online] Strasbourg, Council of Europe Publishing. Available from: http://www.coe.int/t/e/cultural_co-operation/environment/nature_and_biological_diversity/publications/SN131-E.pdf?L=E [Accessed 19 October 2007].
- Box, J. (1996) Setting Objectives and Defining Outputs for Ecological Restoration and Habitat Creation. *Restoration Ecology*, 4(4), 427-432.
- Boyden, A. (2002) *Keeping a promise: The implementation of mitigation measures in environmental impact assessment. Paper of presentation given at IA follow-up workshop: The mitigation measure aspect of follow-up. The annual IAIA conference, Netherlands*.
- Bramwell, A. (1994) *The Fading of the Greens. The Decline of Environmental Politics in the West*. London, Yale University Press.
- Brennan, A and Lo, YS. (2002) *Environmental Ethics. The Stanford Encyclopaedia of Philosophy*. [online]. Summer 2002 Edition. Edward N Z (eds). Available from: <http://plato.stanford.edu/archives/sum2002/entries/ethics-environmental> [Accessed 11 April 2007].
- Bruns, E *et al.* (2001) *Typisierung und kritische Würdigung von Flächenpools und Ökokonten*. UVP-Report, H. 1.

- Butzke, VA *et al.* (2002) Wetland Mitigation and Mitigation Banks in the US - The American Impact Regulation for Wetlands (Wetland Mitigation und Mitigation Banks in den USA). *Naturschutz und Landschaftsplanung*, 34(5), 139-144.
- Carson, R. (1962) *Silent Spring*. Boston, Houghton Mifflin.
- Catzone, M *et al.* (1998) *Understanding Biodiversity. An agenda for research into biodiversity prepared by the European Working Group on Research and Biodiversity (EWGRB)*. European Commission, Directorate General XII, Science, Research and Development – 1998. EUR 18444. Ecosystems Research Report No 25.
- CBM (Centrum för Biologisk Mångfald). (1997) Betänkandet "Kompensation för förlust av miljövården", Ds 1997:52. Yttrande 971029.
- Clewell, A. (2000) Restoration of natural capital. *Restoration Ecology* 8(1), 1.
- Cook, A and Van Lier, H. (1994) *Landscape Planning and ecological networks*. Amsterdam, Elsevier.
- Costanza, R *et al.* (1997) The Value of the World's Ecosystem Services and Natural Capital. *Nature*, 387, 253-260; doi:10.1038/387253a0.
- Cowell, MC. (1993) Ecological Restoration and Environmental Ethics. *Environmental Ethics*, 15, 19-33.
- Cowell, R. (1997) Stretching the limits: environmental compensation, habitat creation and sustainable development. *Transaction of the Institute of British Geographers*, 22(3), 297-306.
- Cowell, R. (2000) Environmental Compensation and the Mediation of Environmental Change: Making Capital out of Cardiff Bay. *Journal of Environmental Planning and Management*, 43(5), 689-710.
- Council of Europe. (1998) *The PAN-European ecological network. Questions and answers. Series no 4 – 1998*. [online]. Council of Europe. Available from: http://www.coe.int/t/e/cultural_co-operation/environment/nature_and_biological_diversity/ecological_networks/peen/QA_4.asp#TopOfPage [Accessed 11 April 2007].
- Council of Europe. (2000) *The European Landscape Convention. European Treaty Series - Nr. 176*. [online]. Florens, Council of Europe. Available from: http://www.coe.int/t/e/cultural_co-operation/environment/landscape/Presentation/index.asp#TopOfPage [Accessed 16 April 2007].
- Council of Europe. (2003) *Conference on Environment, Sustainable development and Ethics. Proceedings / Acts*. [online]. Strasbourg, Council of Europe. Available from: http://www.coe.int/t/e/cultural_co-operation/environment/news/a.Proceedings.asp [Accessed 11 April 2007].
- Council of the European Union. (2006) *Renewed Sustainable Development Strategy: European Council DOC 10117/06*. [online]. Brussels, Council of the European Union. Available from: <http://ec.europa.eu/environment/eussd/> [Accessed 11 April 2007].
- Cuperus, R *et al.* (1999) Guidelines for ecological compensation associated with highways. *Biological Conservation*, 90, 41-51.

- Cuperus, R. *et al.* (2002) Preparation and Implementation of Seven Ecological Compensation Plans for Dutch Highways. *Environmental Management*, 29(6), 736-749.
- Cuperus, R. (2004) *Ecological compensation of highway impacts. Negotiated trade-off or no- net-loss?* Delft, Strapatz.
- de Jong, J *et al.* (2004) *Hur behandlas biologisk mångfald i MKB? [How are impacts on biodiversity analysed in EIA in Sweden?]*. Uppsala, Centrum för biologisk mångfald, Uppsala Universitet och SLU.
- Der Deutsche Bundestag. (2002) *Gesetz zur Neuregelung des Rechts des Naturschutzes und der Landschaftspflege und zur Anpassung anderer Rechtsvorschriften (BNatSchGNeuregG)*. G 5702. (Translated by prof. Bunge at the Federal Environmental Agency in Berlin). Bonn, Bundesgesetzblatt teil 1 22.
- Der Rat von Sachverständigen für Umweltfragen. (2002) *Umweltgutachten 2002. Für eine neue Vorreiterrolle*. [online]. Bundestags-Drucksache 14/8792. Stuttgart, Metzler-Poeschel. Available from: <http://www.umweltrat.de/02gutach/umwelt.htm#u2002> [Accessed 23 March 2003].
- Des Jardins, JR. (2001) *Environmental Ethics: an introduction to environmental philosophy*. Canada, Wadsworth/Thomson Learning.
- Duelli, P and Obrist, MK. (2003) Regional biodiversity in an agricultural landscape: the contribution of seminatural habitat islands. *Basic and Applied Ecology*, 4(2), 129-138.
- Eden, S *et al.* (1999) Environmental restoration: Environmental management or environmental threat? *Area*, 31(2), 151-159.
- Elliot, R. (1982) Faking Nature. *Inquiry*, 25, 81-93.
- Emanuelsson, U *et al.* (1996) *Aktionsplan för biologisk mångfald vid byggd miljö*. Karlskrona, Boverket.
- Emmelin, L and Lerman, P. (2004) *Miljöregler - hinder för utveckling och god miljö? Research Report 2004:09*. Centre for Spatial Development & Planning/CTUP. Karlskrona, Blekinge Institute of Technology.
- Eriksson, I-M and Lingestål, I. (2004) *Environmental Impact Assessment within the Road Sector in Sweden, Handbook, Part 2 Methodology*. [online]. Borlänge, Vägverkets Tryckeri. Available from: http://publikationswebbutik.vv.se/shopping/ShowItem_1491.aspx [Accessed 9 October 2007].
- European Commission. (2005) *Natura 2000 Conservation in partnership*. [online]. Luxembourg, Office for Official Publications of the European Communities. Available from: http://ec.europa.eu/environment/nature/info/pubs/paper_en.htm#natura2000 [Accessed 23 October 2007].
- European Environment Agency. (2004) *Ten key transport and environment issues for policy-makers. TERM 2004: Indicators tracking transport and environment integration in the European Union. EEA Report No 3/2004*. [online]. Copenhagen, EEA, OPOCE. Available from:

- <http://reports.eea.europa.eu/TERM2004/en/TERM2004web.pdf> [Accessed 10 April 2007].
- European Environment Agency. (2005) *The European Environment - State and outlook 2005*. [online]. Copenhagen, EEA, OPOCE. Available from: http://reports.eea.europa.eu/state_of_environment_report_2005_1/en/ [Accessed 10 April 2007].
- Faculty of social sciences at Lunds University. (2007) *Sociology of Law*. [online]. Available from: <http://www.soclaw.lu.se/o.o.i.s/4047> [Accessed 15 June 2007].
- Fischer, TB. (2003) Strategic environmental assessment in post-modern times. *Environmental Impact Assessment Review*, 23(2), 155-170.
- Flyvbjerg, B. (2001) *Making Social Science Matter*. Cambridge, Cambridge University Press.
- Flyvbjerg, B. (2006) Five Misunderstandings About Case Study Research. *Qualitative Inquiry*, 12(2), 219-245.
- Fog, H *et al.* (1992) *Mark, politik och rätt. Om plan- och bygglagen i praktiken*. Stockholm, Byggeforskningsrådet.
- Fog, H and Åström, K. (1994) *Makten över marken. Om tillämpningen av regler för förändrad markanvändning och bebyggelse i fem länder i Europa*. Stockholm, Kommentus förlag.
- Folkesson, L. (1999) *Uppföljning av naturmiljöeffekter i MKB för väg- och järnvägsprojekt: Utgångspunkter och uppläggning*. VTI meddelande 880. Linköping, VTI.
- Forman, R. (1999) Horizontal Processes, Roads, Suburbs, Social Objectives, and Landscape Ecology. In: Klopatek, JM and Gardner, RH (eds) *Landscape Ecological Analysis. Issues and Applications*. New York, Springer. p. 34-53.
- Forman, R *et al.* (2003) *Road Ecology. Science and Solutions*. Washington, Island Press.
- Fox, W. (1984) Deep Ecology: A New Philosophy of Our Time? *The Ecologist*, 14, 194-200.
- Fox, W. (1990) *Toward a Transpersonal Ecology*. Boston, Shambala Publications.
- Gillham, B. (2001) *Case study research methods*. Cornwall, TJ International Ltd.
- Glasson, J *et al.* (2004) *Introduction to Environmental Impact Assessment*. London, Spoon Press.
- Grip, E *et al.* (1999) *Den som ger ska ta igen. Balansering – ett rättvist system för miljöhänsyn i byggandet?* Research Report 1999:2. Lund, Department of Sociology.
- Gunn, AS. (1991) The Restoration of Species and Natural Environment. *Environmental Ethics*, 13, 291-310.
- Habermas, J. (1987) *The Theory of Communicative Action. Volume Two*. Cambridge, Polity.
- Healey, P. (1997) *Collaborative Planning. Shaping places in fragmented societies*. London, Macmillian Press LTD.
- Hedlund, A. (2007) *Betydande miljöpåverkan – positiv eller negativ?* Ultuna, MKB Centrum.

- Higgs, E. (1997) What is Good Ecological Restoration? *Conservation Biology*, 11(2), 338–348.
- Hobbs, RJ and Harris, JA. (2001) Restoration Ecology. Repairing the Earth's Ecosystems in the New Millennium. *Restoration Ecology*, 9(2), 239–246.
- Hörnberg-Lindgren, C. (2005) *Miljökonsekvensbedömningar som ett rättsligt verktyg för hållbar utveckling*. Umeå, Juridiska institutionen, Umeå Universitet.
- IAIA. (1999). *Principles of Environmental Impact Assessment best practice*. [online]. UK, IAIA. Available from: <http://www.iaia.org/modx/index.php?id=74> [Accessed 11 September 2007].
- Isaksson, K. (2006) Fernissa eller förändring? In: Blücher and Graninger (eds) *Planering med nya förutsättningar*. [online]. Linköping, Stiftelsen Vadstena Forum för samhällsbyggande, Linköpings Universitet. p. 107–121. Available from: <http://www.ep.liu.se/ea/is/2006/006/> [Accessed 11 September 2007].
- Iuell, B et al. (2003) *COST 341. Habitat Fragmentation due to Transportation Infrastructure*. Brussels, KNNV Publishers.
- Jarman, R. (1995) Habitat restoration - recanting the status quo. *ECOS*, 16(2), 29–39.
- Johansson, R. (2004) Types of generalisation from a Single Case. *Journal of applied psychology*, 6(3–4), 215–221.
- Johansson, R. (2005) On case study methodology. In: Vestbro, DU et al. (eds) *Methodologies in housing research*. GB, The Urban international Press. p. 30–39.
- Johnmark, J. (2006). Kompensationsåtgärder – ett kraftfullt och synnerligen viktigt styrmedel. In: Länsstyrelsen i Skåne län (eds) *Vägval för miljön – hur styr vi rätt?. Uppföljning av Skånes miljömål och miljöhandlingsprogram. Skåne i utveckling 2006:13*. [online]. Malmö, Länsstyrelsen i Skåne län. p. 25–26. Available from: http://www.m.lst.se/m/Publikationer/Rapporter/2006/2006_13.htm [Accessed 11 September 2007].
- Jongman, R and Kamphorst, D. (2002) *Ecological corridors in land use planning and development policies. National approaches for ecological corridors of countries implementing the Pan-European Landscape and Biological Diversity Strategy. No 125*. [online]. Committee for the Activities of the Council of Europe in the Field of Biological and Landscape Diversity. Council of Europe Publishing. Available from: http://www.coe.int/t/e/cultural_co-operation/environment/nature_and_biological_diversity/publications/SN125-E.pdf [Accessed 11 September 2007].
- Jongman, R et al. (2004) European ecological networks and greenways. *Landscape and Urban Planning*, 68, 305–319.
- Jordan, WR. (2000) Restoration, Community, and wilderness. In: Gobster, PH and Hull, BR (eds) *Restoring Nature*. Washington, Island Press. p. 23–36.
- Katz, E. (1992) The big lie: Human restoration of nature. *Research in Philosophy and Technology*, 12, 231–241.
- Katz, E. (2000) Another look at restoration: technology and artificial nature. In: Gobster, PH and Hull, BR (eds) *Restoring Nature*. Washington, Island Press. p. 37–48.

- Kiemstedt, HV *et al.* (1996) Methodik der Eingriffsregelung. Vorschläge zur bundeseinheitlichen Anwendung von § 8 BNatSchG. *Naturschutz und Landschaftsplanung*, 28(9), 261-271.
- Korn, H *et al.* (2003) *Report of the International Workshop on the "Further Development of the Ecosystem Approach"*. Bfn - Skripten 78. [online]. Bonn, Bundesamt für Naturschutz. Available from: <http://www.biodiv.org/doc/meetings/esa/ecosys-01/information/ecosys-01-inf-01-en.pdf> [Accessed 4 April 2007].
- Kuiper, G. (1997) Compensation of environmental degradation by highways: a Dutch case study. *European Environment*, 7(4), 118-125.
- Kvale, S. (1997) *Den kvalitativa forskningsintervjun*. Lund, Studentlitteratur.
- Lantz, A. (1993) *Intervjumetodik*. Lund, Studentlitteratur.
- Larsson, M-L. (1999) *The Law of Environmental Damage*. Stockholm, Kluwer Law International, Norstedts Juridik.
- Leitão, A and Ahern, J. (2002) Applying Landscape Ecological Concepts and Metrics in Sustainable Landscape Planning. *Landscape and Urban Planning*, 59(2), 65-93.
- Lerman, P. (2000) Miljöbalken utmanar den fysiska planeringen. In: Skärbäck E *et al.* (eds) *Planering för Landskap*. Lund, Movium. p. 103-117.
- Lerman, P. (2001) *Lärobok om MKB. En handledning om miljökonsekvensbeskrivningar tvärs över systemen. Del 1 Grunder, översikt och sammanhang*. Nätraby, Lagtolken PI AB.
- Light, A. (2000) Ecological Restoration and the Culture of Nature: a pragmatic Perspective. In: Gobster, PH and Hull, RB (eds) *Restoring Nature*. Washington, Island Press. p. 49-70.
- Lo, YS. (1999) Natural and Artifactual: Restored nature as subject. *Environmental Ethics*, 21, 247-266.
- Loman, J. (2004) *Inventering och åtgärdsförslag för konfliktpunkter mellan groddjur och statlig väg i Skåne län*. Kristianstad, Vägverket Region Skåne.
- Merriam, BS. (1994). *Fallstudien som forskningsmetod*. Lund, Studentlitteratur.
- Morrison, D. (1987). Landscape Restoration in Response to Previous Disturbance. In: Turner, MG (eds) *Landscape Heterogeneity and Disturbance*. New York, Springer Verlag. p. 159-172.
- Morrison-Saunders, A and Arts, J. (2004) *Assessing Impact. Handbook of EIA and SEA Follow-up*. UK, Earthscan.
- Morris, P and Therivel, R. (2001) *Methods of Environmental Impact Assessment*. London, Spon Press.
- Müller-Pfannenstiel, KV and Rössling, H. (2000) Konzeptionelle Vorbereitung der Eingriffsregelung. Neue Aufgaben für die Landschafts- und Regionalplanung? *Naturschutz und Landschaftsplanung*, 32(4), 106-111.
- National Research Council. (1992) *Restoration of aquatic ecosystems; science, technology, and public policy*. Washington, National Academy Press.
- National Research Council. (2001) *Compensating for Wetland Losses under the Clean Water Act*. Washington, National Academy Press.

- Naturvårdsverket. (1995) *Aktionsplan för biologisk mångfald, 4463*. Stockholm, Naturvårdsverkets förlag.
- Naturvårdsverket. (2003) *Natura 2000 i Sverige. Handbok med allmänna råd. 2003:9*. [online]. Stockholm, Naturvårdsverket. Available from: http://nvv005.naturvardsverket.se/F?func=find-b&find_code=WRD&request=natura%202000%20handbok&local_base=nvv01&con_lng=swe& [Accessed 10 October 2007].
- Palmer, C. (2003) An overview of Environmental ethics. In: Light, A and Rolston III, H (eds) *Environmental Ethics*. Oxford, Blackwell Publishers Ltd. p. 15-37.
- Patel, R and Davidson, B. (1994) *Forskningsmetodikens grunder. Att planera, genomföra och rapportera en undersökning*. Lund, Studentlitteratur.
- Peters, W. (1993) Use of Methods and Evaluation Systems of the Impact Mitigation Principle in German EIA. *Journal of Environmental Impact Assessment*, 2(2), 49-53.
- Philips, A. (2000) International policies and protection. In: Benson, JF and Roe, MH (eds) *Landscape and sustainability*. London, Spon Press. p. 78-97.
- Riksdagens revisorer. (1999) *Vägverket, Banverket och miljön. Rapport 1998/99:6*. [online]. Riksdagens revisorer. Available from: <http://www2.riksdagen.se/rr> [Accessed 4 April 2007].
- Rolston, H. (1989) *Philosophy Gone Wild*. New York, Prometheus Books.
- Rolston, H. (1994) Value in Nature and the Nature of value. In: Attfield, R and Belsey, A (eds) *Philosophy and Natural Environment*. Cambridge, Royal Institute of Philosophy, Cambridge University Press. p. 36: 13-30.
- Rundcrantz, K and Skärbäck, E. (2003) Environmental Compensation in planning: a review of five different countries with major emphasis on the German system. *European Environment*, 13(4), 204-226.
- Rundcrantz, K. (2004) Kompensation för förlust av miljövärden – ett redskap för en uthållig utveckling? In: Reiter, O (eds) *Synväндor – en antologi om landskapsplaneringens teori och praktik*. Alnarp, SLU. p. 92-99.
- Rundcrantz, K. (2005) *Enkät om miljömässig kompensation i samband med byggen av statliga vägar*. [online]. Kristianstad, Vägverket Region Skåne. Available from: http://publikationswebbutik.vv.se/upload/898/2005_79_enkat_om_miljomassig_kompensation_i_samband_med_byggen_av_statliga_vagar.pdf [Accessed 10 April 2007].
- Rundcrantz, K. (2006) Environmental compensation in Swedish road planning. *European Environment*, 16(6), 350-367.
- Sadler, B. (1999) EIA and sustainability. *EIA Newsletter* 18, Manchester, EIA centre, University of Manchester.
- Schwoon, G. (1997) Umsetzung von Kompensationsmassnahmen im Strassenbau, Planung ja, Umsetzung vielleicht, Pflege und Kontrolle nein!? *Strasse + Autobahn*, 48(10), 552-561.
- Seiler, A. (2003) *The toll of the automobile: Wildlife and roads in Sweden*. Uppsala, Dept. of Conservation Biology, SLU.
- Selman, P. (2000) *Environmental Planning*. London, Sage.

- Skärbäck, E. (2000) Miljöplaneringens utveckling och MKB:ns framväxt i Sverige. In: Skärbäck E et al. (eds) *Planering för Landskap*. Lund, Movium. p. 194-208.
- Slootweg, R et al. (2006) *Biodiversity in EIA & SEA. Background document to CBD decision VIII/28: Voluntary Guidelines on Biodiversity – inclusive Impact Assessment*. [online]. The Netherlands, Commission for Environmental Assessment. Available from: <http://www.commissiomer.nl/ncea/pdfs/biodiversityeiasa.pdf> [Accessed 11 April 2007].
- Stake, R. (1995) *The Art of Case Study Research*. Thousand Oaks CA, Sage Publications.
- Starik, M. (2004) Should trees have managerial standing? Toward stakeholder status for non-human nature. *Journal of Business Ethics*, 14(3), 201-217.
- Stein, ED and Tabatabai, F. (2000) Wetland Mitigation Banking: A Framework for Crediting and Debiting. *Environmental Management*, 26(3), 233-250.
- Stenmark, I. (2000). *Miljöetik och Miljövård*. Lund, Studentlitteratur.
- Stevenson, MJ. (2000) Problems with Natural Capital: A Response to Clewell. *Restoration Ecology*, 8(3), 211-213.
- Stone, CD. (1974) *Should Trees Have Standing? Toward legal rights for natural objectives*. Los Altos, CA, Kaufmann Inc.
- Sundin, J. (2006) *Uppföljning av miljöhänsyn i vägprojekt. (Follow up of environmental considerations in road projects). Report no 2006:8*. [online]. Härnösand, Vägverket Region Mitt. Available from: http://publikationswebbutik.vv.se/upload/2260/2006_8_uppfoljning_av_miljohansyn_i_vagprojekt_hantering_av_utvalda_naturmiljoaspekter_i_20_vagprojekt.pdf [Accessed 12 April 2007].
- Sundqvist, G. (2003) *Uthållig utveckling – mänsklighetens framtid*. Lund, Studentlitteratur.
- Sveriges Regering (Miljödepartementet). (1997) *Proposition 1997/98:45*. [online]. Stockholm, Regeringskansliet. Available from: <http://www.regeringen.se/sb/d/108/a/20089> [Accessed 11 April 2007].
- Sveriges Regering (Näringsdepartementet). (2006) *Moderna transporter. Prop 2005/06:160*. [online]. Stockholm, Regeringskansliet. Available from: <http://www.regeringen.se/sb/d/108/a/60777> [Accessed 11 April 2007].
- Sveriges Riksdag. (1971) *Väglag 1971:948*. [online]. Stockholm, Sveriges Riksdag. Available from: <http://www.riksdagen.se/webbnav/index.aspx?nid=3911&bet=1971:948> [Accessed 22 March 2007].
- Sveriges Riksdag. (1998) *Miljöbalken 1998:808*. [online]. Stockholm, Sveriges Riksdag. Available from: <http://www.riksdagen.se/webbnav/index.aspx?nid=3911&bet=1998:808> [Accessed 30 May 2005].
- Taylor, P. (1981) The Ethics of Respect for Nature. *Environmental Ethics*, 3, 197-218.
- The Swedish Environmental Objectives Council. (2006) *Sweden's environmental objectives - Buying into a better future, de Facto 2006*. [online]. Bromma, Swedish

- Environmental Protection Agency. Available from:
<http://www.naturvardsverket.se/Documents/publikationer/620-1251-7.pdf>
 [Accessed 10 April 2007].
- The Environmental Objectives Portal. (2007) *Environmental Objectives Portal*.
 [online]. Environmental Objectives Secretariat. Available from:
<http://miljomal.nu/english/english.php> [Accessed 15 June 2007].
- The Swedish Environmental Protection Agency. (2007) *Environmental Objectives*.
 [online]. The Swedish Environmental Protection Agency. Available from:
<http://www.internat.naturvardsverket.se/index.php3?main=/documents/objectiv/objectiv.htm> [Accessed 4 April 2007].
- The Swedish Government. Ministry of the environment. (2006a) *Environmental Quality Objectives: A Shared Responsibility. Summary of Government Bill 2004/05:150. Article no. M2006.26*. [online]. Stockholm, Government Offices of Sweden. Available from:
http://www.sweden.gov.se/sb/d/574/a/66979;jsessionid=au38_1-Av1ac
 [Accessed 4 April 2007].
- The Swedish Government. Ministry of the environment. (2006b) *Strategic Challenges. A Further Elaboration of the Swedish Strategy for Sustainable Development. Government communication 2005/2006:126*. [online]. Stockholm, Government Offices of Sweden. Available from:
<http://www.sweden.gov.se/sb/d/2023/a/70183;jsessionid=aZszCKKOW2S9>
 [Accessed 11 April 2007].
- Treweek, J and Thompson, S. (1997) A review of ecological mitigation measures in UK environmental statements with respect to sustainable development. *International Journal of Sustainable Development and World Ecology*, 4(1), 40-50.
- UNDP (United Nations Development Programme). (2006) *Sammanfattning av Human development report 2006*. [online]. Copenhagen, UNDP. Available from:
<http://hdr.undp.org/hdr2006/pdfs/summaries/HDR06Svensk.pdf> [Accessed 10 April 2007].
- UNEP (United Nations Environmental Programme). Secretariat on the Convention for Biological Diversity. (1992) *Convention on Biological diversity. No 30619*. [online]. Rio de Janeiro, UNEP. Available from:
<http://www.cbd.int/convention/convention.shtml> [Accessed 13 Feb 2007].
- UNEP. Conference of parties to the convention on biological diversity. (2000) *Report of the fifth meeting of the Conference of parties to the convention on biological diversity. UNEP/CBD/COP/5/23*. [online]. Nairobi, COP. Available from:
<http://www.biodiv.org/doc/meetings/cop/cop-05/official/cop-05-23-en.pdf>
 [Accessed 11 April 2007].
- UNEP. (2003) *Millennium Ecosystem Assessment. Ecosystems and Human Well-being. A framework for Assessment*. [online]. Washington, MA and Island Press. Available from:
<http://www.millenniumassessment.org/en/Framework.aspx> [Accessed 20 February 2007].
- UNEP. Council of Europe. Committee of experts for the development of the Pan-European Ecological Network. (2006) *Draft Country Sheets on national*

- implementation of the Pan European Ecological Network. STRA-REP (2006) 8. [online]. Strasbourg, Council of Europe. Available from: http://www.coe.int/t/e/cultural_co-operation/environment/nature_and_biological_diversity/ecological_networks/agenda/Strasbourg2006_en.asp [Accessed 10 April 2007].
- United Nations. (2005) *The Millennium Development Goals Report 2005*. [online]. New York, United Nations. Available from: http://www.undp.org/mdg/basics_ontrack.shtml [Accessed 20 August 2007].
- van Bohemen, HD. (1998) Habitat fragmentation, infrastructure and ecological engineering. *Ecological Engineering*, 11, 199-207.
- Vägverket. (2005) *Formell Vägplanering*. [online]. Borlänge, Vägverket. Available from: http://www.vv.se/templates/page3_9690.aspx [Accessed 10 April 2007].
- Vägverket. (2007a) *Fördjupningsdokument Miljö. Landskap 2008-2017*. Publikationsnr 2007:49. [online]. Borlänge, Vägverket. Available from: http://publikationswebbutik.vv.se/shopping/ShowItem_2802.aspx [Accessed 11 September 2007].
- Vägverket. (2007b) *Vägverkets forskrifter om samråd och miljökonsekvensbeskrivningar m m i förstudier, vägutredningar och arbetsplaner, VVFS 2007:223*. [online]. Borlänge, Vägverket. Available from: http://www20.vv.se/vvfs/lagrum_dokument_historik.asp?dokumentbeteckning=2007:223 [Accessed 15 October 2007].
- Vägverket och Banverket. (2005) *Vilda djur och Infrastruktur – en handbok för åtgärder. Vägverkets Publikation 2005:72*. [online]. Borlänge, Vägverket. Available from: http://mkb.slu.se/publikationer/rapporter/djur_infrastruktur.pdf [Accessed 10 April 2007].
- Vägverket Region Skåne. (2007) *Skånevägar. Nyhetsbrev från Vägverket Region Skåne. -juni 2007*. Kristianstad. Vägverket Region Skåne.
- Wallén, G. (1996) *Vetenskapsteori och forskningsmetodik*. Lund, Studentlitteratur.
- Wallentinus, H-G. (2007) *MKB. Perspektiv på miljökonsekvensbeskrivning*. Studentlitteratur, Polen.
- WCO (World Commission on Environment and Development). (1987) *Our common future*. New York, Oxford University Press.
- Wende, W *et al.* (2005) Mitigation banking and compensation pools: improving the effectiveness of impact mitigation regulation in project planning procedures. *Journal for Impact Assessment and Project Appraisal*, 23(2), 101-111.
- Vogel, J and Wolf, M. (2004) *Sverige i täten. Valfärd 1: 7-15*. [online]. Stockholm, Statistiska centralbyrån. Available from: www.scb.se/Grupp/allmant/BE0801_2004K01_TI_03_A05ST0401.pdf [Accessed 7 May 2007].
- von Jessel, B. (2002) Nachkontrollen in der naturschutzrechtlichen Eingriffsregelung. Anforderung und methodischer Rahmen. [Controlling of Nature Conservation Measures due to the Impact Regulation - Requirements and Methodology]. *Naturschutz und Landschaftsplanung*, 34(8), 229-236.

WSSD (World Summit on Sustainable Development). (2002) *World Summit on Sustainable development in Johannesburg*. [online]. Johannesburg, United Nations. Available from:
http://www.un.org/jsummit/html/documents/summit_docs.html [Accessed 7 May 2007].

Yin, R. (1994) *Case Study Research. Design and Methods*. CA, Sage Publications.

Acknowledgements

This thesis would not have been completed without the support from many persons; colleagues, family and friends. Although I might forget someone I would like to thank specially the following persons: my supervisor Erik Skärbäck for getting me interested in environmental compensation and research and for his commitment, good ideas and enterprising attitude. Assistant supervisor Ingrid Sarlöv-Herlin for her methodical and positive support, useful remarks and conversations in spirit of confidence. Assistant supervisor Karsten Åström for help with the aspect of sociology of law. I would like to give a general thanks to my colleagues at the former department for landscape planning, especially Maria Kylin, Carola Wingren, Fredrika Mårtensson and Kajsa Hylmö.

Also a general thank to the staff at the Swedish Road Administration in Skåne. Especially the following persons: Stephen McLearnon who has read and corrected the English. My former directors at the Road Administration, Lars Örnfelt and Richard Montgomery who made this research both practically and financially possible. Anne Andersson, Lennart Andersson, Petra Fluor, Kurt Hagenrud and Martin Risberg, who have read parts of the thesis and have given useful remarks. Folke Svantesson and Lars Thorén who have had patience with all of my questions concerning road planning and design.

Others to thank are the staff at the County Administrative Board in Skåne for valuable knowledge about permits and nature protection.

Martin Ljungström for reviewing the final text and giving suggestions for improvements, and the environmental lawyer Peggy Lerman, for crucial information and knowledge about environmental law.

Finally, I would like to thank my family and friends. My sister and brother in law for invaluable help looking after my little daughter Juni. My father, brother and sister in law for their immovable faith in my capacity. Fredrik for your loyalty. Erika, Ina, Jennica and Karin for friendship and practical help with horses. Pernilla, Balahè and Praxis for a calming influence. Mum (1938-2006), thanks for all help, light and love. This thesis is dedicated to you. I don't know if you want it – but you'll get it anyhow.