The mitigation hierarchy upside down - A study of nature protection measures in Danish infrastructure projects

Larsen, Sanne Vammen; Kørnøv, Lone; Christensen, Per

Published in:
Impact Assessment and Project Appraisal

DOI (link to publication from Publisher):
10.1080/14615517.2018.1443260

Publication date:
2018

Document Version
Accepted author manuscript, peer reviewed version

Published in Impact Assessment and Project Appraisal 2018

The mitigation hierarchy upside down - A study of nature protection measures in Danish infrastructure projects

Sanne Vammen Larsen, Lone Kørnøv and Per Christensen

The Danish Centre for Environmental Assessment, Aalborg University

Abstract

This paper presents a Danish study of mitigation directed at nature protection in Environmental Impact Assessment (EIA) of infrastructure projects. The study is based on a document analysis of EIA reports, a workshop held with EIA professionals, and a study of two cases. The paper takes a point of departure in the mitigation hierarchy as a central conceptual framework, identifies which mitigation measures have been suggested in the EIA reports, and compares this to the mitigation hierarchy. Further, the paper explores the dynamics behind which mitigation measures are chosen and later implemented. The findings point to a discrepancy between the prevention principle embedded in the mitigation hierarchy and the actual EIA practice with increased use of nature compensation. Further, the research reveals significant variation in the design of mitigation measures, e.g. in the level of detail used in describing them and the level of clarity as to aims and actions.

Keywords: Environmental Impact Assessment; Mitigation; Mitigation hierarchy; Infrastructure projects; Nature protection

1. Introduction

A pivotal part of achieving the goals of EIA, in terms of creating more sustainable solutions, is identifying measures that can mitigate potential negative impacts identified and analysed in the assessment (Tinker et al. 2005; Glasson, Therivel and Chadwick 2005). According to the International Association for Impact Assessment's best practice principles for EIA, mitigation is one of the main objectives of the process: '*To anticipate and avoid, minimise or offset the adverse significant biophysical, social and other relevant effects of development proposals*' (Senécal et al. 1999).

Mitigation measures can take many shapes, however in this paper we operate with five categories: Avoid, minimise, repair, compensate, and enhance. These categories are explained in the following table 1.

[Table 1 here]

The first four categories of mitigation measures are often arranged in a mitigation hierarchy, meaning that the first priority is to avoid impacts, second priority to minimise impacts and so forth. Compensation is the last step in the hierarchy, and is defined by Kuiper (1997) as creation of new values, which are equal or similar to the value lost. Enhancement is increasingly focussed upon in international literature (see e.g. João, Vanclay and Broeder 2011) and takes a point of departure in enhancing positive impacts.

Research has studied mitigation from different perspectives. As stated there has been a focus specifically on enhancement, mainly in relation to SEA and the potential of using this type of mitigation (see e.g. McCluskey and João 2011; João, Vanclay and

Broeder 2011). Researchers have focused on how practitioners in specific sectors (here a power company and biodiversity) choose mitigation measures and developed frameworks to guide this process (see e.g. Marshall 2001; Tallis et al. 2015). Further, Tallis and colleagues (2015) focused on mitigation of impacts on biodiversity as a specific environmental aspect. Mitchell (1997) focuses on a broader guideline with recommendations for practice. Phylip-Jones and Fischer (2013) focus on EIA of wind farms and reports on types of mitigation measures included in the EIA reports. Finally, Tinker et al. (2005) present a broad study of which mitigation measures are identified in EIA reports, comparing the results to the mitigation hierarchy, and whether the mitigation measures are translated into conditions for approval. The results of previous studies will, where relevant, be included in the discussion of results in section 3 and 4.

This study seeks to add to the existing knowledge base concerning mitigation by reporting on practice from another jurisdiction, in this case Denmark. The study follows the line of research presented by Tinker et al. (2005), Phylip-Jones and Fischer (2013) and McCluskey and João (2011), reporting on which mitigation measures are used in EIA practice, and how this relates to the intentions of the mitigation hierarchy. Further, this study is focused on researching and discussing the design of the mitigation measures, meaning the way the mitigation measures are presented in the documents. This is also touched upon by Mitchell (1997) and Marshall (2001), but here subject to recent empirical studies. Where most of the previous research is based on document studies, this study is supplemented with a workshop and case studies to explore the reasons behind the results of the document study.

In terms of scope, this paper is focussed on the application of mitigation measures for impacts specifically on nature, in EIA of infrastructure projects. Here, infrastructure projects are defined as the physical structures that make up connections between places, and through their linear design provide the possibility to transport something from one place to another. In a Danish context, infrastructure projects are special in two senses (Larsen, Kørnøv and Christensen 2015):

1. They potentially have significant impacts on nature because of their geographical spread, plus there are continuously many and major infrastructure projects carried out in Denmark.
2. In a Danish context, there is very limited follow-up and monitoring on infrastructure projects compared to other types of projects that require an EIA, so previous knowledge about mitigation measures is very limited.

Based on this the following research questions are pursued: *What types of mitigation measures are used in EIA reports, and how do these results reflect the mitigation hierarchy? What is the design of the mitigation measures in EIA reports?* Based on the results of these analyses, the choice of mitigation measures in the EIA reports is discussed. Mitigation is a complex phenomenon, it can take many forms and emerge during all stages of the EIA process. While recognising this, this study is focussed on building knowledge about the specific mitigation measures, which are deliberately chosen on the basis of the impact assessment and documented in the EIA reports.

2. Methodology

To shed light on the research questions, three activities have been carried out; a document study of EIA reports, a workshop with EIA professionals, and two in-depth case studies of infrastructure projects.

2.1 Document Study

The document study includes 67 EIA reports for infrastructure projects. The reports were found through three methods:

- Internet search, both generally and with key words, plus through searching the websites of known main proponents and the responsible authorities.
- Use of overviews of EIA reports from previously published research projects.
- Asking the EIA professionals participating in the workshop (see section 2.2) to identify any EIA reports missing in the preliminary list.

The study includes all identified EIA reports dealing with infrastructure projects, as defined above in section 1.

The included EIA reports are dated from 1991 to 2014 with 11 reports from 1989-2000, 35 reports from 2001-2010 and 21 in the period 2011-2014. The study includes relatively few reports from the years between 1989, when the EIA Directive was implemented in Danish legislation, and 2000. This is because relatively few EIAs were carried out during the first years, and because EIA reports from this period can be difficult to gain access to, since there is no central Danish archive or database, and they have usually not been published online.

The reports cover projects concerning roads, railways, bridges/tunnels, oil- and gas pipes, power lines and rail signals, as shown in table 2.

[Table 2 here]

It can be seen from table 2, that relatively many road projects are included in the study. A very important actor in this area is the Danish Road Directorate[1], which is responsible for 17 of the included EIA reports, both road projects and bridges/tunnels.

Each of the included EIA reports, was read by one of the researchers behind the study. Each mitigation measure suggested for nature in the reports was registered, and the questions in table 3 were answered.

[Table 3 here]

Before employment, the analytical framework was tested in a pilot of 4 EIA reports and corrections were made. The results of the document analysis were registered in a spreadsheet, and then transferred to the statistical software SPSS for analysis. To enhance the consistency of the analysis, one of the researchers went through all the spreadsheets and made corrections.

2.2 Workshop

The workshop took place in May 2014 in Copenhagen, attended by 17 practitioners within the field of EIA, including the following.

- 7 public servants representing Aalborg Municipality, Aarhus Municipality, Danish Nature Protection Agency, Danish Road Directorate and BaneDanmark[2]

[1] The Danish Road Directorate is a national authority responsible for the state roads in Denmark.
[2] A state-owned company responsible for the construction and maintenance of railway tracks as well as railway traffic controls in Denmark.

- 11 consultants representing Rambøll, COWI, Grontmij and Amphi Consult
- 3 researchers from Aalborg University (representing the research team) and the Department of Bioscience at Aarhus University

At the workshop a discussion was facilitated around two main questions: 1) Which mitigation measures are implemented/not implemented, why and what is the effect of the measures? 2) How can mitigation in relation to EIA form the basis for improved nature protection? Discussions were recorded partially by rapporteurs, and partly by posters produced by the participants.

2.3 Case Studies

The two cases that have been studied are presented in table 4.

[Table 4 here]

The two infrastructure projects were chosen to cover different aspects:

- They are both fully implemented and in operation, making it possible to follow up on the implementation of mitigation measures.
- Route 18 was chosen because it is a road project, a project type which, according to section 2.1, makes up a large part of the studied EIA reports.
- The power line differs from the road project partly by being one of the oldest included in the study and by being anchored at regional authorities and not at state level.
- Further the power line is fairly passive once it is in place, compared to the road which has a high level of activity. Thus, at this stage they have different impacts.

The analysis of the two cases provides an overview of the connections between the different steps of the process of EIA and implementation of the project, tracking the mitigation measures from the EIA report, to approval or implementation law into the tendering documents and finally in the built project. The aim of the analysis is to see whether the mitigation measures pointed out in the EIA report can also be identified in the subsequent documents and finally in the built project – or whether and where measures disappear or are altered. Thus, for both cases, a document analysis was carried out of the EIA report and the approval/law. For Route 18 a document analysis was carried out of the tendering documents, while these are no longer available for the older case of the power line. In both cases interviews were carried out with a central project manager, and for route 18 an inspection of the final built project was conducted with the project manager. The interview with the project manager for Route 18 was conducted in October 2014, while the interview with the project manager for the power line was carried out in January 2015.

3. Use of Mitigation Measures: Analysis and discussion

The results of the document study show, that mitigation measures for nature protection are included in all of the 67 EIA reports. This varies from an EIA report including one mitigation measure for nature to an EIA report including 98 different mitigation measures. Looking at the categories of mitigation measures, figure 1 shows how many mitigation measures in the different categories were found in the EIA reports.

[Figure 1 here]

It can be seen that most of the identified mitigation measures aimed at minimising impacts, followed by mitigation measures aimed at compensating for impacts, which contradicts expectations according to the mitigation hierarchy. The analysis also shows an increasing tendency to use compensation over the years from 2000-2014. The results shows that enhancement is the least used category of mitigation measures.

More specifically the document study reveals what types of mitigation measures are found in the EIA reports, as shown in figure 2.
[Figure 2 here]

The results show that the EIA reports contain relatively many mitigation measures in the form of specific demands for construction works. For example, this includes demands for when to carry out construction or where to place machinery. This resonates with results from the UK and Germany (Phylip-Jones and Fischer 2013). Also, there are many mitigation measures in the form of passages for wildlife.

Compared to the mitigation hierarchy it is interesting that there are relatively few mitigation measures concerned with avoiding impacts, and rather many on minimisation. This could be linked to the fact that demands for construction and wildlife passages are dominant in the EIA reports, as these would often be aimed at minimising impacts. In contrast, less dominant mitigation measures such as alternative locations/tracks and alternative design/technology are aimed at avoiding impacts, which can be linked to the relatively lesser use of mitigation measures to avoid impacts. The relatively low number of avoidance measures corresponds to the results of Tinker et al. (2005), who also register a very high level of reducing

measures and a relatively low level of avoidance. Compared to the mitigation hierarchy this is critical, since the hierarchy stresses a need to emphasise avoidance of impacts. However, the case study takes point of departure only in the EIA reports, and not what goes on beforehand – unless this is documented in the EIA report. Some of the measures to avoid negative impacts can be expected to lie in the project planning stages before the formal EIA process starts, without being documented in the report. Another issue is that the analysis of alternatives has not been considered a mitigation measure in the document study, which means that some of the types of mitigation measures mainly concerned with avoidance, such as alternative tracks/placement and alternative design/technology, may not have been captured. These considerations emphasise that there can be a long and important process before the EIA. For example as emphasised by the interviewee in the case study of the power line, the planning process has spread over 20 years, including a reservation of land in 1980, an analysis of 7 proposals for the track in 1995-6, and finally the publication of the EIA report in 2000. During this time period, the on-going discussions and analysis may have led to many instances of avoiding environmental impacts not documented in the EIA report. As part of the planning process preceding the EIA, strategic environmental assessment (SEA) might have been employed and lead to avoidance of impacts at an early stage (see e.g. Fischer 2006). For infrastructure projects in Denmark, this is a possibility concerning the municipal projects, where a comprehensive municipal plan and SEA usually precedes projects. The state projects however are usually part of isolated political negotiations in Danish parliament, which are not covered by a requirement for SEA.

It is interesting that the document study shows a significant number of mitigation measures concerning compensation, especially since this is meant to be the last resort according to the mitigation hierarchy. The use of compensation in the infrastructure projects mostly takes the shape of replacement of nature. Within the Danish nature protection legislation, if an activity will cause negative effects on a nationally appointed nature protection area, a dispensation can be given for the activity to go ahead, often on the condition that the disturbed nature should be replaced with a nature area of similar or larger size somewhere else. The widespread use of replacement nature seems to contradict the Danish legislation and guidance on nature protection, as well as the practice enforced by boards of appeal, which points towards a very restrictive practice. Here, replacement of nature is identified as a last resort, to be used only when it can lead to improvement of nature, and when the planned activity has significant societal importance (see e.g. Naturklagenævnet 2005; By- og Landskabsstyrelsen 2009). However, based on discussions at the workshop, practitioners experience the use of compensation and use of replacement nature as a standard in many large projects. The practitioners point to unresolved questions concerning where to draw the line for the use of compensation and replacement nature, and e.g. whether you can change one type of nature for another, as it has been done in Denmark. As stated by Tallis et al. (2015, p. 22) '*a woodpecker is not the same ecologically or in terms of social value as a leopard*'. It also raises critical questions concerning whether an EIA practice with increasing use of nature replacement account for cumulative impacts and the risk of a Danish net-loss of nature.

Table 5 shows that most of the mitigation measures proposed in EIA reports are to be implemented in the construction phase. This includes demands for construction works, but also for example passages, basins for water management etc., that are built during the construction phase, and do not require activity during the operational phase besides from maintenance. On the other hand, table 5 also shows that most of the mitigation measures in the EIA reports are aimed at mitigating impacts that occur during the operational phase.

[Table 5 here]

According to the results mitigation measures for repair are relatively rare, and especially nature management is among the types of mitigation measures rarely used in the EIA reports. Also, generally mitigation measures that must be implemented during the operational phase of the projects are relatively rare. This corresponds to results from the UK showing a lack of focus on measures in the operational phase and measures concerning operational and management controls (Mitchell 1997; Marshall 2001). The interview regarding the case study of Route 18 pointed to two reasons for not building management of nature into the project. First, because it is costly. Second, because it demands continuous resources and an organisation that can carry out the work over the operational years of the project. In the case of Route 18 for example, the experience of the interviewee was that the road agency department with responsibility for maintenance of the road, do not want what the extra work they perceive nature management to be. This resonates with the results from the workshop, which add that even when nature management is identified as a mitigation measure in the EIA report, it is rarely implemented in practice. These issues may be part of the explanation behind the lack of mitigation measures in the categories of repairing and

enhancement as well as nature management. Interestingly, while for the infrastructure projects mitigation measures aimed at end-of-life impacts are rarely used, the study of wind turbines from the UK and Germany shows that these make up a relatively large part of the mitigation measures used (Phylip-Jones and Fischer 2013). This indicates that the focus in mitigation measures vary with project types and their context – perhaps in this case due to longer life spans of some infrastructure projects compared to wind turbines.

4. Design of Mitigation Measures: Analysis and discussion

A concern regarding the design of mitigation measures is whether it is specified, what they are aimed at mitigating impacts on. The document study shows that roughly half of the identified mitigation measures are aimed at protecting specific species, and the other half are aimed at protecting different types of nature. The focus on species has increased relatively to that on types of nature since 2000. For 3% of the identified mitigation measures in the EIA reports, it is not specified what they are aimed at mitigating impacts on, and for a number of mitigation measures fairly broad terms are used to determine what they are aimed at protecting for example ‘plants’, ‘animals’, ‘wild animals’, ‘small animals’ and ‘wildlife’.

Figure 3 shows how many of the registered mitigation measures in the EIA reports are phrased as something that *must* be carried out, something that *should* be carried out, or something that *could* be carried out.

[Figure 3]

As shown in figure 3, most of the identified mitigation measures are phrased with the word *must,* and thus take shape as demands. Included in this category are also

measures phrased with *will be* because their implementation also appears to be determined. Fewer mitigation measures are worded as *should*, which appears more as a recommendation. Fewest mitigation measures are worded with *could*, which must be characterized as the weakest phrasing, pointing to a possibility rather than a direct recommendation.

Further, the document study shows that for 25% of the mitigation measures a deadline is defined in the EIA report. Mainly two types of deadlines are in used:

- Absolute deadlines determining e.g. the time of year the mitigation measure should be implemented to avoid disturbances in the breeding season.
- Relative deadlines setting a deadline related to other parts of the project, e.g. that replacement ponds should be in place a year before the start of construction in order to give the amphibians a chance to relocate.

For only 9% of the EIA reports (6 reports) responsibility for implementing the mitigation measures have been specifically assigned. The actors who have been assigned responsibility include contractors, authorities and proponents.

Discussions at the workshop identified that the mitigation measures worded as *should be* are often direct demands in legislation or measures that the project must implement to gain a needed approval according to other legislation. For example, replacement nature for a nature area impacted might be a necessity in order to gain approval after the nature protection act. Such a measure would be worded as *should*. Regarding the design of the mitigation measures, the results generally show some issues of unclear descriptions or weak wordings of the mitigation measures. This resonates with results

of a previous UK study showing that descriptions of mitigation measures were often imprecise (Mitchell 1997; Marshall 2001), and a French case study of mitigation in EIA on marine ecosystems finding, that mitigation measures '*need to be enforced and not viewed as a series of non-binding proposals*' (Jacob et al. 2016, p. 95). We would argue that the lack of clarity about mitigation measures, what they are aimed at protecting, whether they have to be implemented or not, and who is responsible, makes their correct implementation less certain and can mislead the politicians and the public. The hypothesis is, that when mitigation measures are vaguely described, it increases the risk that they will not be implemented as assumed in the assessment, or perhaps not implemented at all. This is e.g. because those who should implement them are not sure who is responsible, whether they are obliged to implement them and what the purpose is. At the workshop one issue raised is that when the EIA and the planning stage is over, the project is handed over to other professional for detailed design and implementation, this includes designers, engineers, contractors etc. who might not have any particular knowledge of nature protection. Further, a previous UK study indicates that the project design team might not be in close cooperation with the EIA team (Mitchell 1997). The risk of the mitigation measures being implemented differently from the intentions is a problem, especially since assessments and decisions regarding the project may rest on the assumption that the mitigation measures are implemented.

5. Conclusion

In conclusion, this paper indicates that the mitigation hierarchy is challenged – at least in the Danish context.

One issue is the relatively widespread and increasing use of compensation, which should be the last resort according to the hierarchy. This warrants a discussion of what role compensation should play in EIA? Is the hierarchical nature of mitigation clear in legislation and guidance? Are practitioners using the hierarchy as a stepwise process or jumping to the use of compensation as a standard solution to problems? This indicates the relevance of further research into how mitigation measures are chosen, and what tools and dynamics are in play. In the Danish context, there is also a need to discuss the specific use of replacement nature. Here, practice seems to be evolving without a joint reflection on the potentials and limits for using replacement nature, and how to use this measure in the most expedient way to create real improvements of nature.

Another issue is the limited use of mitigation measures that avoid impacts. As discussed avoidance measures may be part of the process preceding the EIA. Such considerations are supported by previous studies pointing to e.g. the importance of the screening process in creating environmental improvements (Christensen and Kørnøv 2011). In this case though, it might be worth considering whether these efforts to avoid impacts are properly documented in the EIA report even if they took place before the EIA process started, in order to give the public and decision-makers a more complete picture. The study also shows that enhancement is the least used category of mitigation measures, supporting previous studies. Some of the issues with avoidance may be relevant also for enhancement; according to the definition of João, Vanclay and Broeder (2011) enhancement can be direct changes in the project but also measures separate to the project, for example enhancing the resilience of a local community where a project is to be implemented. Such measures might be put in

place through different processes and may not be documented in the EIA report, again meaning that the full picture of activities surrounding the project is not visible.

Looking to the design of mitigation measures, the study reveals variations in the level of details in describing the mitigation measures. For some measures, the aim is unclear, it is unclear who is responsible for implementing them, it is unclear whether there is a real obligation to implement them etc. This can be considered problematic because it could increase the risk of inexpedient or no implementation. It is important especially for measures essential to mitigating identified significant impacts. This points towards a need for more knowledge about what happens in the project process after the EIA is finalised? With a new directive issued in 2014, the EU has set demands for monitoring to be part of the EU process. This may contribute to the knowledge about mitigation measures, however, what form and extent monitoring will have in Danish practice is still to be seen. Thus, questions concerning what happens to the mitigation measures and the results of the EIA are still an issue for research. It relates to the call Brown and Hill (1995) once made for EA to "*learn how the design process works*" - perhaps there is potential to improve the substantive effectiveness of EIA by understanding the lifecycle of projects beyond EIA as well as the choice and implementation of mitigation measures in this process.

Acknowledgements

The study presented in this paper was supported by 15 Juni Fonden.

References

Christensen P and Kørnøv L. 2011. EIA screening and nature protection in Denmark. Journal of Environmental Management 92(4): 1097-1103.

Brown L and Hill R. 1995. Decision-Scoping: making EA learn how the design process works. Project Appraisal 10(4): 223-232.

By- og Landskabsstyrelsen [Danish Agency for Urban and Rural Issues]. 2009. Vejledning om Naturbeskyttelseslovens § 3 beskyttede naturtyper [Guidance on §3 protected nature under the Nature Protection Act]. Copenhagen: Danish Ministry of Environment.

Fischer T. 2006. *SEA and transport planning: towards a generic framework for evaluating practice and developing guidance*. Impact Assessment and Project Appraisal 24(3): 183-197.

Glasson J, Therivel R and Chadwick A. 2005. Introduction to Environmental Impact Assessment – Third Edition. Abingdon: Routledge.

Jacob C, Pioch S and Thorin S. 2016. The effectiveness of the mitigation hierarchy in environmental impact studies on marine ecosystems: A case study in France. Environmental Impact Assessment Review 60: 83-98.

João E, Vanclay F and den Broeder L. 2011. Emphasising enhancement in all forms of impact assessment: Introduction to a special issue. Impact Assessment and Project Appraisal 29(3): 170-180.

Kuiper G. 1997. Compensation of environmental degradation by highways: a Dutch case study. European Environment 7: 118-125.

Larsen SV, Kørnøv L and Christensen P. 2015. Overvågning i VVM – Naturbeskyttelse og infrastrukturprojekter i Danmark: Hovedrapport [Monitoring in EIA – Nature protection and infrastructure projects in Denmark. Main report]. Aalborg: Aalborg University.

Marshall R. 2001. Application of mitigation and its resolution within environmental impact assessment: an industrial perspective. Impact Assessment and Project Appraisal 19(3): 195-204.

McCluskey D and João E. 2011. The promotion of environmental enhancement in Strategic Environmental Assessment. Environmental Impact Assessment Review 3: 344-351.

Mitchell J. 1997. Mitigation in Environmental Assessment – Furthering best practice. EA - The Magazine of IEA and EARA

Naturklagenævnet [Nature Board of Appeals]. 2005. Naturklagenævnet Orienterer – Nr. 346 feb 05 [Orientation from the Nature Board of Appeals no. 346 February 2005]. Copenhagen: Nature Board of Appeals.

Phylip-Jones J and Fischer T. 2013. EIA for wind farms in the United Kingdom and Germany. Journal of Environmental Assessment Policy and Management 15(2): 1-30

Senécal P, Goldsmith B, Conover S, Sadler B and Brown K. 1999. Principles of Environmental Impact Assessment best practice. International Association for Impact Assessment and Institute of Environmental Assessment UK.

Tallis H, Kennedy C, Ruckelshaus M, Goldstein J and Kiesecker J. 2015. Mitigation for one & all: An integrated framework for mitigation of development impacts on biodiversity and ecosystem services. Environmental Impact Assessment Review 55: 21-34.

Tinker L, Cobb D, Bond A and Cashmore M. 2005. Impact mitigation in environmental impact assessment: paper promises or the basis of consent conditions? Impact Assessment and Project Appraisal 23(4): 265-280.

Table 1 Explanations and examples of the categories of mitigation measures applied in this paper.

Categories of mitigation measures	Explanation	Examples of measures
Avoid	Avoiding that a negative impact on nature arises.	Adjusting the location or tracks of the structure for example to avoid impacts on protected natural areas.
Minimise	Minimising a negative impact on nature.	Constructing wildlife passages to minimise the impact of the structure as a barrier to wildlife.
Repair	Repairing a negative impact on nature after it has occurred.	Re-establishing natural areas, after the construction works has impacted them negatively.
Compensate	Compensating for an unavoidable negative impact on nature.	Constructing natural areas as a replacement for nature destroyed by the construction of the structure.
Enhance	Enhancing a positive impact on nature.	Designing and management of road borders to make them suitable habitats for sand lizards.

Inspired by (Mitchell 1997; Glasson, Therivel and Chadwick 2005; Tinker et al. 2005)

Project types	No. of reports		Project types	No. of reports
Road	44		Oil and gas pipes	5
Railway	8		Power lines	4
Bridges/tunnels	5		Signal systems (railway)	1

Table 2 The included EIA reports distributed on project types.

Questions in analytical framework
Is the mitigation measure directed towards a species or type of nature? Which species or type of nature?
Which type of mitigation measure from the mitigation hierarchy is it?
In which phase of the project will the mitigation measure be implemented? Construction, operation or closure?
In which phase of the project will the mitigation measure have effect? Construction, operation or closure?
Which specific type of mitigation measure is it?
How acute is the wording of the mitigation measure?
Is responsibility for implementation of the mitigation measure assigned to anyone?
Is a deadline set for the mitigation measure?

Table 3 Questions in analytical framework.

Table 4 The two cases studied

Name	*Route 18: Riis-Ølholm-Vejle (Motorway)*	*400 kV højspændingsledning Aalborg – Århus (High voltage power line)*
Year of publication of EIA report	2005	2000
Proponent	The Road Directorate	Eltra[3]
Level of authority	State – implemented by passing a specific law	Regional

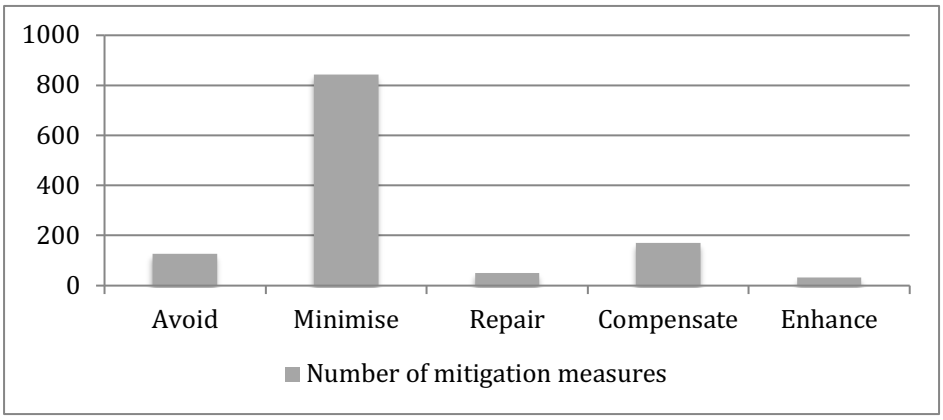

Figure 1 Number of mitigation measures in the categories found in the EIA reports.

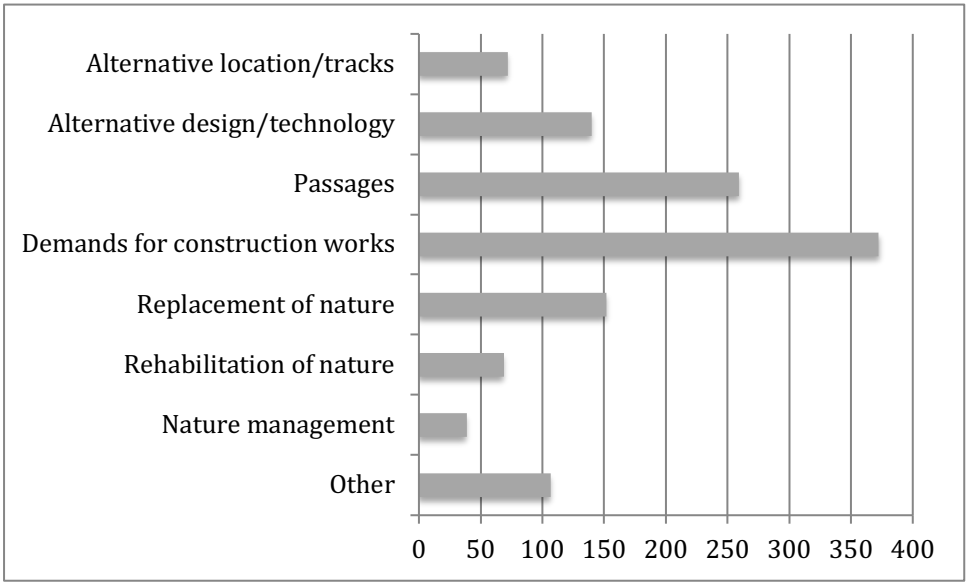

Figure 2 Number of specific types of mitigation measures found in the EIA reports.

[3] Former electricity transmission company with responsibility for the electricity grid in Jutland and on Funen.

	Construction phase	**Operation phase**
Number of mitigation measures to be implemented in each project phase	1004	228
Number of mitigation measures aimed at impacts in each project phase	437	796

Table 5 Number of mitigation measures to be implemented in each project phase, and number of mitigation measures aimed at mitigating impacts in each project phase.

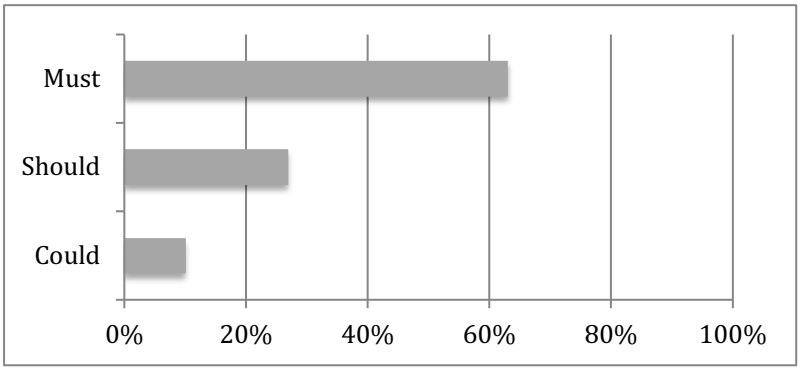

Figure 3 Number or mitigation measures phrased as *must*, *should* and *could*.