# Ecological compensation and mineral extraction

A rocky path

*Annie Burman*

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Supervisor: Sanna Stålhammar, LUCSUS, Lund University

## Abstract:

Ecological compensation builds on the idea of substitutability, meaning that destroyed values can be replaced or substituted with new values that are equal to the ones lost. Through this equivalence between "lost" and "gained" values compensation is meant to allow dynamic economic development without causing irreversible biodiversity loss. Compensation is increasingly used as a means to reduce the conflict between development interests such as mineral extraction (mining) and conservation interests. In Sweden the most frequently occurring compensation projects are connected to the mining industry. Despite the use of the concept, the national legislations around compensation gives room for interpretations and the actuality of equivalence between values is questioned. These two problems are examined through a case study of an ongoing compensation project for a chalk quarry in Slite, Gotland, South-Eastern Sweden. The case embodies the tension between conservation and developmental wills by both showcasing societal benefits and large determents to nature. In addition to the background research of the case study, stakeholders and actors were interviewed and crucial data was collected from grey literature such as compensation plans and legal documents. A compensation-effectiveness framework developed by Maron et al. (2012) was used to analyze the case study. Based on the analysis factors uncertainty, time-lags and inability to measure, from the framework, I found that the Slite case, due to current legislations and room the for interpretations risks allowing a "license-to-trash" scenario. This means the national legislations may fail to protect the intended nature and instead give legitimacy to the damages, which was concluded by this case. It was also found that achieving an equivalence between ecological values in this case is highly difficult, as a lot of the values involved are either irreplaceable or very rare. The results show that this compensation case has a high risk of ineffectiveness especially because there is an uncertainty surrounding what values can actually be compensated for in practice and how the surrounding legal framework should be interpreted. Additionally, when addressing the tension between conservation and development wills, this case highlights, on a wider scale, if demand for minerals does not decrease, the development that is conducted today will need quarries such as the Slite one. Even though ecological compensation is far from fool proof and in fact filled with uncertainties, on could also say as one of the interviewees, "at least it's better than nothing".

**Keywords: No-Net-Loss, License to trash, Sustainable development, Conservation, Mining, Biodiversity offsets.**

**Word count: 11 715**

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# 1. Introduction

If one assumes that economic activities in the form of land exploitation in today's society will follow a business as usual scenario, some form of compensation for ecological values lost would be needed to achieve sustainable development. According to Munasinghe (1993) and his arguments regarding environmental economics, compensation for lost opportunities when ecological values and system dynamics are destroyed is a vital part of sustainable development. Ecological compensation builds on the same idea of substitutability as environmental economics and the theory of weak sustainability do (McElwee, 2017). The idea being that destroyed values can be replaced or substituted with new values that are equal to the original ones. Achieving this equivalence between values is both a challenge and a key part of the compensation mechanism and its functionality (Calvet, Napoléone & Salles, 2015). Through the equivalence between "lost" and "gained" values, compensation is meant to allow dynamic economic development without causing irreversible biodiversity loss and achieve what is called a "No-Net-Loss" (Koh, Hahn & Ituarte-Lima, 2017; Maron et al., 2012). Compensation is increasingly used as a means to try to reduce the conflict between development interests such as mineral extraction (mining) and conservation interests of areas classified with a high biological value, i.e. areas containing rare habitats or endangered species (Maron et.al 2012; Suding 2011; Ten Kate, Bishop, Bayon, 2004; Virah-Sawmy, Ebeling & Taplin, 2014). Mining projects have a large impact on the environment and inevitably leads to biodiversity loss in the form of, for example, loss of habitat structure or ecological continuity. However, at the same time they represent an economic opportunity in association to infrastructure development and economic growth (Virah-Sawmy, Ebeling & Taplin, 2014). These types of projects represent a clear visualization of how development interests clash with conservation. Compensation has been applied with the purpose of "solving" this dispute by reducing environmental damages to surrounding ecosystems (Apostolopoulou & Adams, 2015; BBOP, 2009; Bayon, Carroll & Fox, 2012).

However, compensation as a tool is a very controversial mechanism and has attracted a lot of criticism. There is a frequent concern, both in Sweden and in the EU, that an ambiguous legislation surrounding the topic might lead to a "license-to-trash" (LLS) scenario. If compensation is made too "easy" or "cheap" it opens up the possibility for development firms to exploit the environment at a cheap price. The "license" refers to the idea that through the proposed compensation, the exploitation is approved by higher legislative powers and the developer then has legitimacy behind their actions: thus a "license" (Apostolopoulou & Adams, 2015; Eftec & IEEP et al., 2010). As mentioned by the European Environmental Bureau (2014), LTT might occur if actors take advantage of the compensation policies

put in place. Some indications have been made that this has already happened in Sweden (Enetjärn et al., 2015). Additionally, there is no nationally standardized way of applying the compensation mechanism to actual projects (Enetjärn et al., 2015). Several authors have raised critiques towards the absence of clear guidelines and frameworks, as it can be detrimental to the practice as well as greatly limit the success of conducted projects (Gardner et al., 2013; McElwee, 2017). One of the other big critiques of the compensation mechanism is the idea of an equivalence between values (Maron et al., 2012). A proposed equivalence between values assumes that ecological values can be replaced, which is highly controversial from an ecological standpoint, e.g. because of the complexity of biodiversity. However, the replacement of values is much in line with the idea of substitutability between values that the theory of weak sustainability advocates for (Arsel & Büscher, 2012).

As a critique for compensation Dunne (2016) argues that we need to shift the focus away from compensating for damages to nature and instead focus on the underlying causes of biodiversity loss, such as land exploitation e.g. housing development or mining expansions. Nevertheless, I choose to work with ecological compensation in the same way as Virah-Sawmy, Ebeling & Taplin (2014) do, and not only critique the mechanism of compensation but rather evaluate how it works within the current frames of society.

### 1.1 Aim and research questions

Ecological compensation as an applied tool is still relatively new to Sweden and has mostly been applied to large scale project with a perceived societal benefit (Enetjärn et al., 2015). For the large part, it has been applied to mining projects (Apostolopoulou & Adams, 2015; EPA, 2016; Enetjärn et al., 2015). Mining projects embodies the tensions between development and conservation by displaying how interests collide. Firstly, the interest for both economic and infrastructure growth, as well as housing development through providing essential minerals to foster this growth. Secondly, since most quarries in Sweden physically overlap with nature areas that are classified as valuable (Apostolopoulou & Adams, 2015), there is a strong interest to conserve ecological and biological values in these areas. This thesis aims to examine this tension by looking at a specific compensation case: the expansion of a chalk mine called Slite in Gotland, Southeastern Sweden, and more specifically an area called File-Hajdar. The Slite quarry provides 75% of Sweden's total cement demand for infrastructure development (Bergab, 2017). The area for the quarry expansion is also inhabited by rare species of both flora and fauna, additionally, the area has rare types of habitat and landscape structures. With this background in mind two research questions have been defined for this thesis:

***Research question 1.*** *How does the current Swedish legislative framework on ecological compensation affect the quarry expansion project in Slite? Does this specific case display a risk of a "license-to-trash" scenario?*

***Research question 2.*** *How has the equivalence between predicted lost and gained ecological values been addressed in the expansion plans for the Slite quarry case?*

The first research question will address the potential occurrence of an LTT scenario in this specific case of Slite and examine if it has been avoided or if, in fact, this compensation project can be seen to demonstrate the scenario. The second research question focuses on the critiqued but essential factor for the compensation mechanism, the equivalence between values. This question was asked in order to examine how this particular case reasoned around equivalence and how the difficulties of establishing an accurate equivalence have been dealt with.

## 1.2 Origin and development of the compensation mechanism

The idea of compensation, initially in the form of mitigation, originated from the work with wetlands in the USA in the early 1990s (Bayon, Carroll & Fox, 2012; Robertson, 2006). This mitigation scheme was enabled by the Clean Water Act (Robertson, 2006) and has received a lot of critique for enabling exploitation while not securing ecological benefits (Roberts, 1993). However, over the last decade, in the EU, there has been a sharp increase for requirements regarding compensation following economic activities and exploitation. One of these directives is the Environmental Liability Directive that was adopted in 2004. This directive aimed to create a liability towards environmental damage in the same way as the 'polluter pays principle' by clarifying who bears the responsibility and thus also the cost of the damage (Kriström & Bergman, 2014). The principle enforces the "polluter" to restore the affected environment towards its initial state and compensate for that which cannot be restored (EPA, 2016). This can be done by for example re-establishing habitats by creating new biomass. A very influential initiative is the Business and Biodiversity Offsets Programme (BBOP). The BBOP is an international cooperation between different disciplines to create a "best practice" in the work with ecological compensation (BBOP, 2009). The BBOP have created 10 guiding principles (See Table 1) that are universally applicable and aim to guide stakeholders everywhere in their compensation work (BBOP, 2009). In the EU, by 2011, there was a visible increase of countries that had implemented some version of a compensation scheme in their country (Madsen, Carrol, Kandy & Bennett, 2011).

**Table 1.** Biodiversity offsets: 10 guiding working principles when designing a specific offset (BBOP, 2009)

| Biodiversity Offsetting: 10 Guiding principles | |
|---|---|
| 1. Adherence to mitigation hierarchy | Following all appropriate steps of the hierarchy before offsetting the residual adverse impacts from the development. |
| 2. Limits to what can be offset | Some values simply cannot be compensated for, such as biodiversity values with vulnerable or irreplaceable character. |
| 3. Landscape context | The offset needs to be implemented with a landscape-context focus to achieve a more comprehensive and complete outcome. |
| 4. No Net Loss | The offsetting should result in a measurable outcome that displays a no net loss or gain of biodiversity. |
| 5. Additionality | The offset needs to achieve a positive result that would not have been achieved without the offset. |
| 6. Stakeholder participation | The stakeholders that are affected by the offset should be involved in the offsetting process all from design to implementation and monitoring. |
| 7. Equity | The offset needs to be both designed and implemented in an equitable manner in regard to rights, responsibilities, risk and reward. |
| 8. Long-term outcomes | The offset needs to be implemented with the aim of securing a positive outcome over a longer period of time. |
| 9. Transparency | Communication regarding the design, results and implementation should be done in a transparent way. |
| 10. Science and traditional knowledge | The work with biodiversity offsets should be conducted in accordance with sound science as well as traditional knowledge. |

### 1.3 Discursive clarification regarding compensation in Sweden

Ecological compensation is used as an umbrella term in the EU while biodiversity offset has a narrower focus on achieving a “No-Net-Loss” of biodiversity (Hahn et al., 2015). However, in the Swedish context Ecological compensation and biodiversity offsets are mentioned as the same (EPA, 2016). The framing of the concepts as synonymous in the Swedish context is adopted by large official organs such as the

Swedish governments official reports (2017), and thus the choice to do the same in this research seems justifiable.

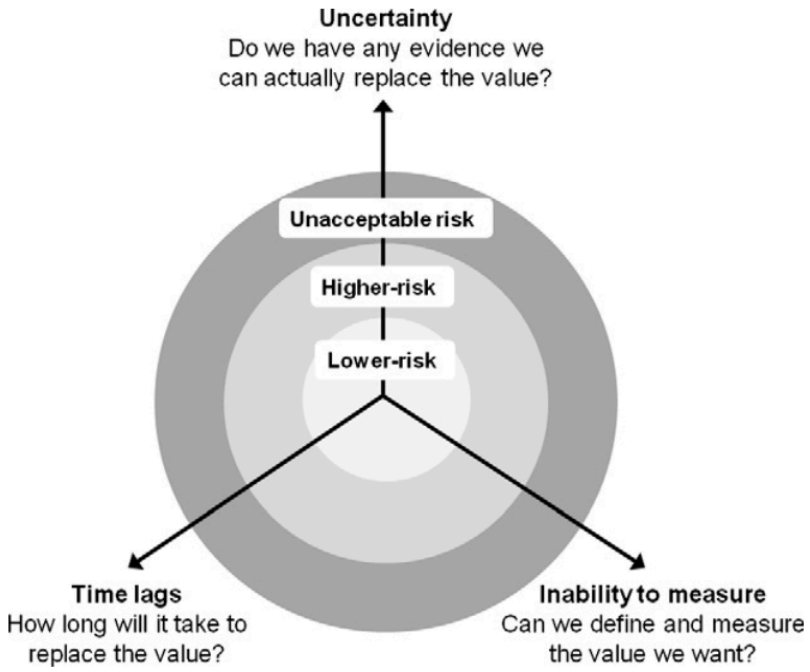
# 2. Theoretical framework

## 2.1 Substitutability and equivalence

The theoretical standpoint of weak sustainability starts from the principle of substitutability between values (Arsel & Büscher, 2012), just as compensation does (McElwee, 2017). Meaning that natural capital, i.e. environmental assets such as biodiversity, can be replaced with man-made capital, e.g. money and capital assets that can create more wealth (Arsel & Büscher, 2012). This type of substitutability assumes that as long as the total sum of capital, regardless of what kind of capital, is not declining then sustainability is achieved (Gutés, 1996). In an ecological compensation context, this means biodiversity lost to a housing development project could be replaced with the financial benefits from the project, in the form of rents and other services. That would mean that while biodiversity, as the natural stock is decreasing, the economic gains from the project in the form of man-made capital is increasing, thus the total stock of capital will stay the same (Arsel & Büscher, 2012). From an ecological perspective, this assumption of substitutability is highly detrimental since not all values are in fact replaceable (Gutés, 1996). The theoretical standpoint of strong sustainability on the other hand, does not see natural and man-made capital as interchangeable but rather complementary to each other. This view suggests that there are some natural values and parts that cannot be substituted or duplicated by man-made capital, such as ecosystem services and biodiversity (McElwee, 2017). Substituting this type of natural capital with monetary values creates a commodification of nature into goods (Neuteleers & Engelen, 2015). This substitution can negatively affect our wellbeing through the degradation of ecosystem services that we rely on, for instance water filtration, in exchange for money (Calvet, Napoléone & Salles, 2015; Martin-Ortega, Mesa-Jurado, Pineda-Vazquez, & Novo, 2019). In an ecological compensation context this would mean that in order to be sustainable, the natural capital that is lost to exploitation must be replaced with other forms of ecological features rather than monetary compensations (Calvet, Napoléone & Salles, 2015). This type of "replacement" of values with an equivalence is both crucial for the compensation mechanism but also one of the biggest challenges (Calvet, Napoléone & Salles, 2015; Maron et al., 2012; OECD, 2016).

Maron et al., (2012) displays the difficult aspects that limit the technical effectiveness of compensation (see figure 1). The conceptual visualization could as well be applied to smaller parts of the compensation mechanism, such as equivalence to visualize the issue clearly.

**Figure 1.** Conceptual visualization of main factors that limit the effectiveness if biodiversity offsets ecological compensation (Maron et al., 2012). The diagram shows three axes: the increasing uncertainty of what we can actually compensate for (or ability to restore), increasing time lags between lost and gained values, and decreasing measurability of the values to offset. The diagram is meant to show that compensation can move along any of the axels from the center. A compensation proposal can rank differently on the three different axes. The level closest to the core represents a domain of reasonable success of a project. A further step out represents a higher risk of the compensation project failing, which would mean other measures would have to be taken as well, such as risk management. The last domain represents a range where compensation is inappropriate because of the unlikeliness of a successful outcome (Maron et al., 2012).




One of the objects of interest in this research is the possibility of equivalence between values. If applying equivalence to the model, starting in the middle of the visualization, a determination would have to be done per axis: uncertainty, time-lags, and inability to measure. The object of observation, in this case the equivalence, can end up at different domains: lower-risk, higher-risk, and unacceptable-risk at each of the different axes. This evaluation would show if the time-lag between of lost and gained values are low-high or unacceptable, if the equivalence is measurable/quantifiable and how large the uncertainty surrounding establishing an equivalence is. The collected knowledge would give a picture of which domain the success of the equivalence for a project would end up in.

The other object of interest is the legal aspect of compensation, the LTT scenario. The factors from the visualization, uncertainty, time-lag and inability to measure, can also be used to analyze the LTT scenario. By investigating the factors in relation to LTT it can visualize the likeliness of the scenario occurring, low-, higher- or unacceptable-risk.

## 2.2 The tension between conservation and development

The theory of weak sustainability risks increasing the conflict between economic development and environmental protection in society (Apostolopoulou & Adams, 2015). As Büscher (2012) argues, when calculating the monetary price that would have to be paid to conserve an ecosystem, it actually has nothing to do with conservation but rather the circulation of capital (Büscher, 2012). The focus lies on the monetary value rather than the importance of the conservation effort. This puts the economic interests before the ecological interests and could result in a degradation of nature and valuable ecosystems (Büscher, 2012; McElwee, 2017). Sullivan (2013) describes the tension between development and conservation in the context of compensation as;

> *"Through ecological compensation environmental harm is provided with the appearance of being environmentally "good" or "green" in such a way that it also enhances economic value.* (*Sullivan, 2013, p. 83)"*

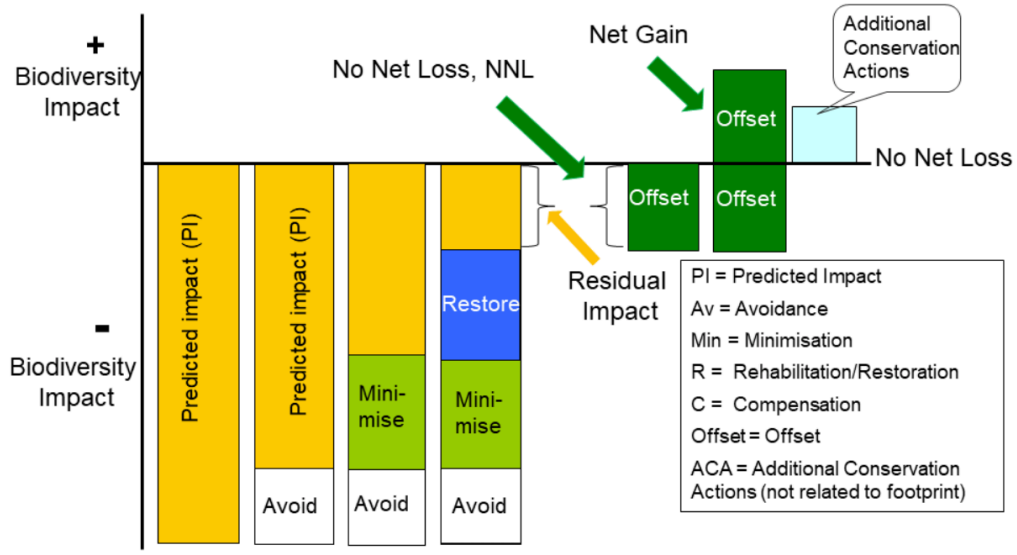
This way of expressing it goes hand in hand with how Gutés (1996) writes about weak sustainability and the substitution between capital. By framing compensation as we do today, it also discursively ties conservation to economic growth and land development; this interlinkage in many ways overshadows the actual problems with the mechanism (Apostolopoulou & Adams, 2015; Dunne, 2016). According to Apostolopoulou and Adams (2015), the linkage between the two sides breaks the previously conventional idea that the sides stands in contradiction to each other and the linkage reframes conservation as more of an extension of development.

## 2.3 Ecological compensation and the mitigation hierarchy

The BBOP advocates strongly for the use of mitigation hierarchy (see figure 2) when working with cases of compensation. The mitigation hierarchy is a framework for how to avoid and mitigate damages before compensation is brought up as an option (BBOP, 2009; EPA, 2016). The first step in the hierarchy is 'avoid' which emphasizes that damages should be completely avoided when possible. The second step is to 'minimize', meaning exploitation damages should be minimized as much as possible (BBOP, 2009). The third step in the hierarchy, which has to be taken into consideration before compensation measures are implemented, is the rehabilitation and restoration stage (Sullivan, 2013). This means that measures have to be taken to restore and rehabilitate an affected area as much as possible. After all these steps are considered, compensation can occur as the fourth and final step in a project as a sort of last resort after exhausting all other previous steps in the hierarchy (EPA, 2016). The lower in the

hierarchical steps, the lower the environmental protection degree is, with the last step being the compensation (Apostolopoulou & Adams, 2015).

**Figure 2.** Mitigation hierarchy (BBOP, 2009). Figure showing all steps of the mitigation hierarchy from left (without measures) to the right (with all parts of the hierarchy considered).




## 2.4 The Swedish Environmental code

The Environmental Code aims to protect nature's ability to produce ecosystem services (EPA, 2016). This is enforced by ensuring that encroachments on nature's ability to produce these services must be compensated for (EPA, 2016). The Environmental Code was initially also instated to ensure a sustainable development for future generations (EPA, 2003). The Code is mostly powerful when it concerns large encroachments or exploitations of areas of protected nature; for example, wetlands or Natura 2000 areas. However, it lacks power to always enforce compensation measure and thus falls short in many cases (Koh, Hahn & Ituarte-Lima, 2017). Judicial practitioners want to see the demand for compensation measures collected under one section in the Environmental Code to avoid misunderstandings surrounding applications and possible measures (Ullerstam, Johansson & Nordenberg, 2018).

The Environmental Code has also been accused of being ambiguous and leaving too much room for interpretations (Enetjärn et al., 2015). Here are some examples taken straight from the Environmental code that displays this ambiguity. In **2 chap. 7 §** the third paragraph states that;

*"The compensation should increase the possibility to follow the environmental quality norms in an extension that is not insignificant"*.

One could then wonder what is insignificant/significant and who determines the significance thresholds? Is the significance based on an objective or subjective, a qualitative or quantitative evaluation of the compensation? In both **2 kap. 8 § MB** and **7 kap. 7 § MB** it is mentioned that values should be compensated for to a reasonable extent. This "reasonable" extent becomes subjective to the individuals who are working with the case in question. In **2 chap. 7§ MB** there is something called the Common Consideration Rule, (Skälighetsregeln). This rule enforces a balance between the compensation gain compared to the cost of implementation. The cost cannot be unreasonably high while the expected gain is deemed low or uncertain. This rule also appeals to individuals own sense of what is reasonable.

The Environmental code has an explicit chapter, **chapter 2:3**, that requires a business to conduct precautionary or protective measure to avoid damages to nature or to human health (EPA, 2003). This chapter specifically includes damages to valuable nature, cultural environments or biodiversity. In connection to a quarry these precautionary or protective measure would mean preserving or instating buffer zones around the production or installing sediment ponds to prevent water pollution (EPA, 2003). By law, business operations cannot proceed before these measures have been conducted (EPA, 2003).

One other example of how the Environmental code becomes vague is how it handles the mitigation hierarchy. The mitigation hierarchy has been implemented in to the Environmental Code to some extent, however, the design by the BBOP is never used. Rather it has been implemented in scattered sections. Enetjärn et al. (2015) has identified sections of the Environmental Code that can be interpreted to have the same function as if the mitigation hierarchy would have been used as the primary tool (see Figure 3). Nevertheless, this way of spreading out the mitigation hierarchy over several paragraphs in the Code adds to the ambiguity of the legislation and opens room for misunderstandings or non-compliance (Enetjärn et al., 2015). Additionally, the vague description of what requirements that have to be fulfilled for every step decreases the effectiveness of the compensation mechanism. This could also give way to problematic situations such as unavoidable loss and LTT (Conway, Rayment, White & Berman, 2013).

**Figure 3.** How and where the mitigation hierarchy is "implemented" into the Environmental code. Showing the different steps of the hierarchy, Avoid, minimize, restore, compensate and what chapter in the environmental code that addresses it. Identified by Enetjärn et.al (2015).

**Avoid**
Chapter 2: Identifying best localisation and technology

**Minimise**
Chapter 6: EIA and consultations. Possibility to avoid on site and describing remaining impact
Chapter 16 Section 2: Permission, approval, or special exemption allowed under certain conditions
Chapter 22 Section 1: Conditions on precautions and minimisation

**Restore**
Chapter 16 Section 3: Remedy of environmental damage and restoration at closure

**Compensate**
Chapter 7 Section 7: Compensation for impact on nature reserves
Chapter 7 Section 11: Compensation for exemption from habitat protection
Chapter 7 Section 29: Compensation for impact on Natura 2000 network
Chapter 11 Section 8: Compensation for impact on natural resources of fishery
Chapter 16 Section 9: Ability to require special measures to compensate for impact on public interests
Species Protection Ordinance: Compensation can be required under certain conditions when environmental injuries occur, such as impacts to reproduction or resting areas for protected species

To avoid compensation enabling development that would not have been permitted without the mechanism, the legal permit-process in Sweden has been split in to two parts. Firstly, the application for a project has to be judged by only the first three steps of the hierarchy and only if the project and possible damage is deemed acceptable (Enetjärn et al., 2015). Then the process moves in to the next legal phase where demands for compensation can be placed or adopted by free will. The two-step legal process is aimed to avoid a "slippery-slope" in the compensation permitting process by not considering compensation measures in the first appeal (Enetjärn et al., 2015; Länsstyrelserna et al., 2019). However, it has been suggested that merely the existence of the possibility to compensate has the potential to cause an underuse of all the previous steps of the hierarchy in the project planning phase (Robertson, 2000). A deficient use of the hierarchy leads to the lowering of threshold for permitting projects and, in turn, can be highly detrimental to the environment (Apostolopoulou & Adams, 2015).

Sullivan (2013) brings up the risk that using compensation as a tool may cause a phrasing of biodiversity loss as "unavoidable". By using the mitigation hierarchy in the compensation process, it supposedly gives the assurance that all other options of conservation and protective measure has been exhausted. Apostolopoulou and Adams (2015) describes the unavoidable aspect in a very pessimistic way by arguing that by accepting compensation as a tool, continued biodiversity loss is presented as the "only option" forward for society. Even when looking outside of the legal aspect, some scholars themselves

also tend to frame the loss and impacts from development as unavoidable (Bull & Brownlie, 2017; Gardener et al., 2013; Sonter, Barret & Soares-Filho, 2014; ten Kate et al., 2004).

# 3. Methodology

The choice of method for this research is in line with Flyberg (2006, p.5) who recommends that; "The choice of method should clearly depend on the problem under study and the circumstances ". With this in mind, a case study method was chosen to be able to answer the research questions of LTT and equivalence. To collect the data for the case study interviews was held and a document analysis was conducted. These data collection methods were chosen to complement each other and increase the validity of the collected data (Yin, 2014). This combination of methods enables a triangulation of data and simplifies verification of details.

## 3.1 Data collection

The data collected for this research is qualitative. The written data was collected through academic literature and data where the majority of data used is publicly available, such a court documents, compensation plans and environmental impact assessments. Additional data surrounding the Slite case was collected through open-ended interviews with stakeholders and actors involved in the Slite case. The data for this case was publicly accessible, the information was gathered by downloading information from various sources including: the company Cementa ABs official webpage, where information and documents regarding the expansion application was collected as well as the environmental impact assessment. The court documents and the appeal documents are public documents and can be found at: domstol.se, which is the official webpage for the Swedish court. The compensation plan was on the other hand provided to me by the consultants Ecogain, the document is publicly available but I was not able to find it. For more detailed info see section 3.2.1 and appendix 2. The sheer amount of data available forced a sorting where the most recent data in time, had priority. This was done because it is an ongoing court case, meaning that statements change and appeals are done, leaving only the most recent ones relevant for this research. The amount of data can be seen as both a weakness and a strength for this research, it can contribute to a very versatile picture of the case and help with validation of information. Nevertheless, there is also a risk that important documents get overshadowed or lost in the pool of data.

## 3.2 Case study

The case study method chosen for this research is a single case study. A case study is a useful method as it can act as direct test of a phenomena or theory in a real-world case and in practice. It acts as a close-in on a situation (Flyvbjerg, 2006). Many scholars argue that it is not possible to draw generalization from the results of a single case study (Gomm, Hammersley & Foster, 2000). However, the issue of generalizability is also very dependent on what kind of case and what kind of research is carried out (Flyvbjerg, 2006). Additionally, Flyvbjerg (2006) writes that one of the biggest misconceptions surrounding a single case study method is actually that since it perceivably has no possibility to generalize it cannot contribute to scientific development. In this research process the answers to the posed research questions, LTT and finding equivalence between values, does not rely on the generalization of the findings. Rather the answering of the research questions will give an opening to a discussion of the bigger aim of the research; conservation versus development. Therefore, generalizability is not a prominent hurdle as the use of a case study in this research is not to generalize but rather give an example.

A mining case was chosen specifically because it embodies the relevant and important tension between two powers, conservation and development. As Apostolopoulou and Adams (2015) write, compensation is specifically popular for businesses who deal with projects such as infrastructure, housing development or mining. Compensation opens up the opportunity for the environmental damage to the framed as positive or to give “new” opportunities. Apostolopoulou and Adams (2015) gives the specific example of where quarries are framed as opportunities for bird habitats that was not previously present in the area. In fact, almost as many as three quarters of all active mines are located on or overlap with nature with a high conservation value (Apostolopoulou & Adams, 2015). This shows that the topic and chosen case angle for this research is both relevant and pressing.

### *3.2.1 Grey literature and documents*

The literature used is mostly grey literature meaning official documents, official court documents, sentences, environmental impact assessment and segments of the Environmental code. The specific documents used for the case are:

- Conservation plan for File-Hajdar Natura-2000 area, conducted by the County Administrative Board at Gotland (2017)
- The appeal of the expansion and compensation plan by the County Board, drawn up by Mauritzson and Mollin (2020)
- A handbook for general advice in the application process for mines, conducted by the Environmental Protection Agency (2003)
- The court case and judging of the expansion and compensation, case M 7575-17. Conducted by Nacka District court (2020)
- Written opinions of the Administrative County Board of Gotalnd on the case of Slite, drawn up by Mauritzson and Mollin (2018) & (2019)
- Application of approval in accordance with the Environmental Code, conducted by Hansson & Bryngelsson from the law firm Manheimer Swartling (2018)
- A technical description of the production in Slite today as well as the proposed production, conducted by Larsson, Teike och Vestin, Bergab (n.d)
- Environmental impact assessment for the expansion of Slite, drawn up by Bergab (2017)
- The ecological compensation plan, drawn up by Ecogain, previously Enetjärn (2017)

See appendix 2 for justification of use and expected data output from each document listed above. There has been a large number of documents produced around this case, from research to action plans, and the case was appealed at the environmental court. This means that there is a significant number of legal documents available including various statements from actors and stakeholders. Because of the sheer number of documents, the active stakeholders were contacted to retrieve documents directly to avoid searching for the documents individually. Nevertheless, as mentioned previously public documents outside of the information passed from the stakeholders were also used to avoid a bias in the collected data and then later in the results. When collecting literature and documents, there is always a risk that not all relevant documents are found. Therefore, holding complementary interviews with stakeholders and actors became very important to fill potential gaps and validate the information.

### *3.2.2 Interviews*

In total 4 semi-structured interviews were conducted for the case study. The goal of the interviews was to fill potential gaps in the information and expand the understanding of the case and the different angles and opinions. The respondents, one from Cementa, one from Ecogain and two from the County Administrative Board of Gotland were chosen specifically with the intention to mirror the case from three very different angles. The County Board are working for the entire region of Gotland and is supposed to be the overseeing organ while Cementa, who is the land owner, is a private company who has their own economic reasons in mind and finally Ecogain who are experienced in compensation projects. By interviewing Ecogain there was also a possibility to see the more technical side of the compensation rather than to only take part of the individual opinions on the topic. The interviews process followed Kvale & Brinkmann (2009) seven steps of interviewing:

1. Thematizing the interview
2. Designing
3. Interviewing
4. Transcribing
5. Analyzing
6. Verifying
7. reporting

The interviews were held via phone call instead of in-person due to both the excessive travel requirements and the COVID-19 pandemic. If the interviews conducted would have been dependent on the interviewee's reactions or body language this type of phone interviews would not have been possible, because the interviewer can then not observe i.e. facial expressions (Kvale, 2007). However, the intended data output from the interviews in this research is independent of personal expressions, the information is rather of a factual character. The interview style is then a less important factors for the data. However, an in-person interview could have other advantages, such as making the interviewee feel more at ease or helping the conversation flow (Kvale, 2007). To address some of these factors the interviews could have been held via a videocall to enable both parties to see each other. However, in this case all interview was held right after the summer vacation and all parties felt a bit stressed for time and preferred to do the interview over the phone instead of a conference call with video. All interviews' audio was recorded and later transcribed. Follow up questions that arose during the interviews were noted to allow the respondent to expand on a topic as they felt appropriate, as suggested by Kvale (2007). The questions in the interviews were constructed in an open-ended fashion to enable conversation to flow organically (Morris, 2015). The interviews were held in Swedish since it was the first language of all interviewees and the interviewer, thereby significantly reducing the chance of misunderstandings between both parties.

The selection of interviewees was aimed to allow for triangulation of the data collected. Thus, different types of stakeholders with different views were chosen to speak up on the topic. By allowing people with central positions from key stakeholders with different views to be heard, in addition to the collected literature material, allows for a more diverse picture and increases the reliability of the data. This way of approaching the interviews makes the sixth step of Kvale and Brinkmann (2009) interview process, the verification, more reliable. If interviewees with similar views and from the same disciplines would have been used the information gathered would likely be very homogenous and biased.

The interviews were structured in a way so that it would be possible to sort the data more easily into the analytical framework (see section 3.2). The same main factors were used as in the framework: **uncertainty**, **time-lags**, and **inability to measure**. More specific interview questions were formed from these factors, See appendix 1 for interview guide. However, all questions were kept open ended (Patton, 1990) to avoid an interviewer bias where the interviewer unintentionally leads the interviewee on to a specific path (Kvale & Brinkmann, 2009).

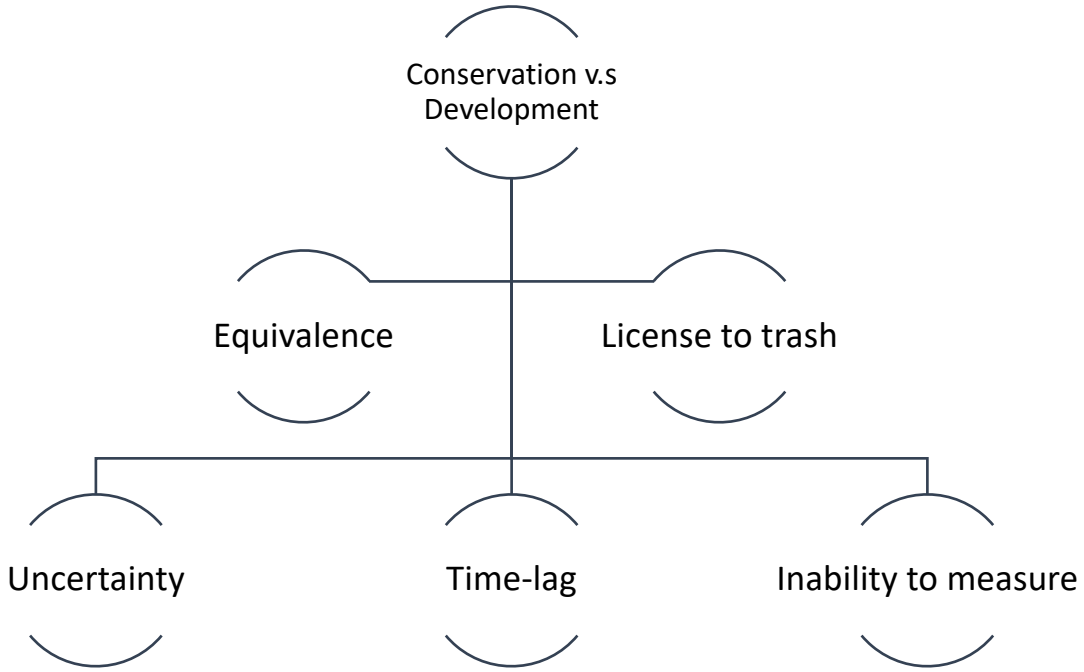
All interviewees are anonymized in both the transcriptions and the research results. This was done primarily for ethical reasons but also because neither names nor titles add important aspects to the research. However, with the permission of the interviewees the names of the company or governmental organ they belong to is used when displaying the results. This was done because it adds value to the research to be able to display from which angle the information is conveyed.

### 3.3 Data analysis

The data gathered was analyzed through the above presented conceptual visualization of the main factors that limit the effectiveness of biodiversity offsets by Maron et al. (2012) (see section 3.1). The framework brings up three main factors: **uncertainty**, **time-lags,** and **inability to measure** (see figure 4). These factors are deemed as important and problematic for the success of a project by scholars (Gibbons & Lindenmayer, 2007; Maron et al., 2012; Sonter et al., 2014; Walker,Brower, Stephens, & Lee, 2009). Hence, it can be seen as important to address these factors to decrease the conflict between development and conservation that occurs in a compensation project, thus linking back to the aim of this study. For the first research question, regarding LTT, the judicial aspects in the form of the ambiguity of the legislation are also seen as a key challenge to ecological compensation (Apostolopoulou & Adams, 2015; Conway et al., 2013; Eftec & IEEP et al., 2010; Enetjärn et al., 2015; Gardner et al., 2013; Enetjärn et al., 2015). For the second question of equivalence, Gibbons and Lindenmayer (2007) as well as many others (BBOP, 2009; Enetjärn et al., 2015; Calvet, Napoléone & Salles, 2015; OECD, 2016) argues that the question of achieving an equivalence between losses and

gains is a crucial limitation to address when working with compensation and central to the compensation mechanism.

**Figure 4.** Analytical framework structure with factors from Maron et.al (2012), visualization of the effectiveness of biodiversity offsets. The analytical framework is structured from the larger overarching aim of the study (the conservation versus development conflict) that stems down to the specific research questions used in this study (equivalence and LTT). To analyze the information gathered to answer these questions, three factors are used, uncertainty, time-lag and inability to measure. (Own illustration)




The factors from the framework, **uncertainty, time-lag** and **inability to measure,** are relevant for the analysis of a compensation process and the success or failure of it. These same factors can be used to look at the judicial part of the compensation process and how, or if, a LTT scenario has been avoided. Additionally, the factors can give an important insight in to the possibility of achieving an equivalence. See further explanation in table 2. If sources, interviews, case study and literature, provided the same answer the validity of the extracted information can be assumed to be high (Thurén, 2013).

**Table 2.** Further explanation of the connection between specific research question and analytical factor from framework. Own illustration.

| ANALYTICAL FACTORS | RESEARCH QUESTIONS | |
|---|---|---|
| | **RQ1. "License-to-trash"** | **RQ2. Equivalence** |
| UNCERTAINTY | Uncertainty if a value can actually be replaced. | Uncertainty surrounding what can actually be replaced, and in that case, with what other value. |
| TIME-LAG | A delay between what was lost and gained could mask a possible LTT scenario. | How long does it take to re-establish what was lost, within what timeframe is reasonable? |
| INABILITY TO MEASURE | Without a precis measure of the loss an equal gain cannot be assured and thus an LTT could be imminent. | How do we choose to measure values, can all values actual be measured? |

# 4. Case description

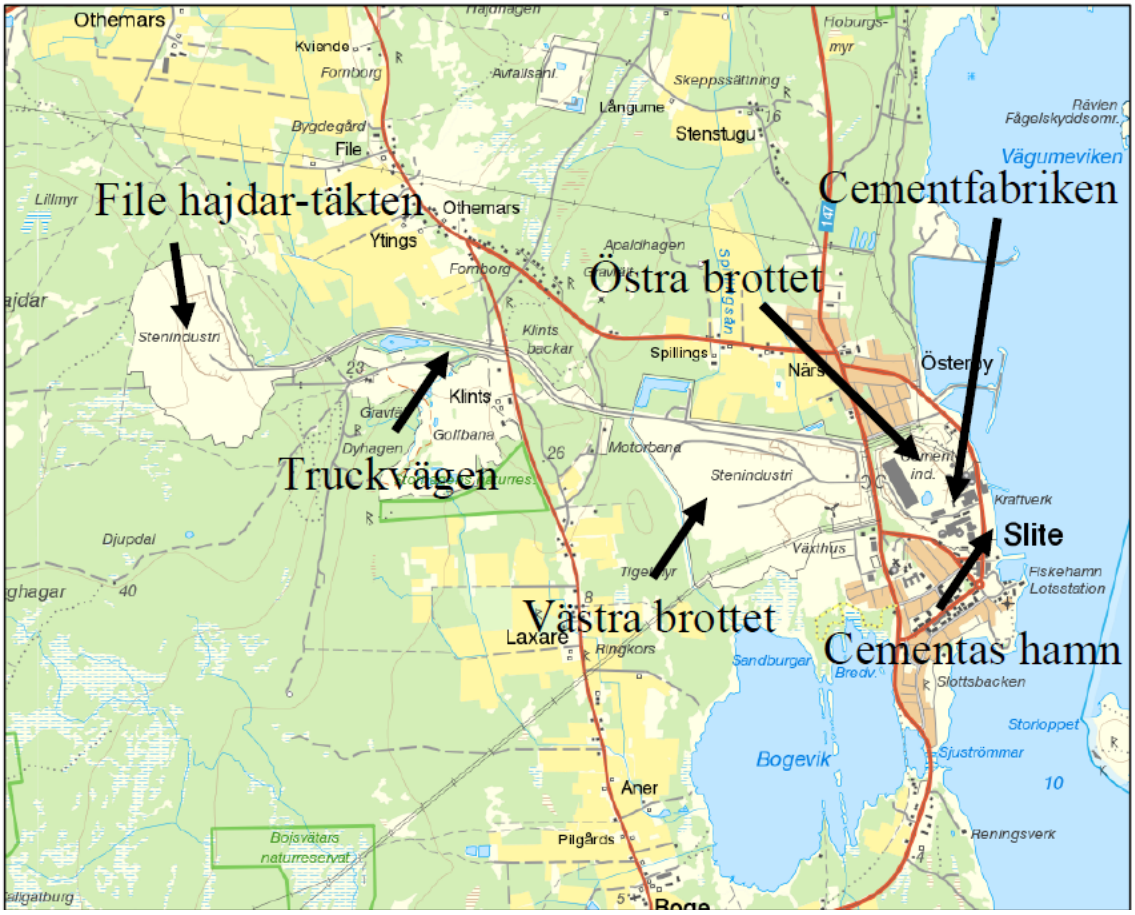
This particular case was chosen for the research because firstly, as mentioned previously, quarries and mining businesses pose an interesting dilemma between conservation and development. Secondly, the case is ongoing which makes it relevant for the present and the outcome of this project has the possibility to affect the outcomes of future compensation projects.

## 4.1 Case study: Slite chalk mine

The unit of observation in this research is Slite on Gotland where a company called Cementa AB (hereafter Cementa) produces chalk (See map 1). Cementa is one of the biggest providers of chalk used for cement in Sweden (Hansson & Bryngelsson, 2018). Cementa produces around 3 million tons of cement per year from all of their factories where as 75% of Cementas total production output is produced in Slite. Chalk has been mined in Slite since the 1700 and Cementa has been mining in a specific area of Slite, File-Hajdar (See map 1), since 1976. The production is still focused to this area and the expansion to which this compensation concerns is the expansion of the File-Hajdar area. The

File-Hajdar area is a “Hällmarksområde” which is a habitat type that is characterized by low nutrient values (Hansson & Bryngelsson, 2018). File-Hajdar is also home to “Allvarsmark” which is a natural landscape type containing a thin layer of soil on top of a chalk bedrock and is also characterized by low nutrient levels, such as a heath (Bergab, 2017). What also makes File-Hajdar unique is its mosaic natural structure in the area; it varies from needle forest to wetlands and dense vegetation to light openings, making the conditions very diverse (Bergab, 2017).

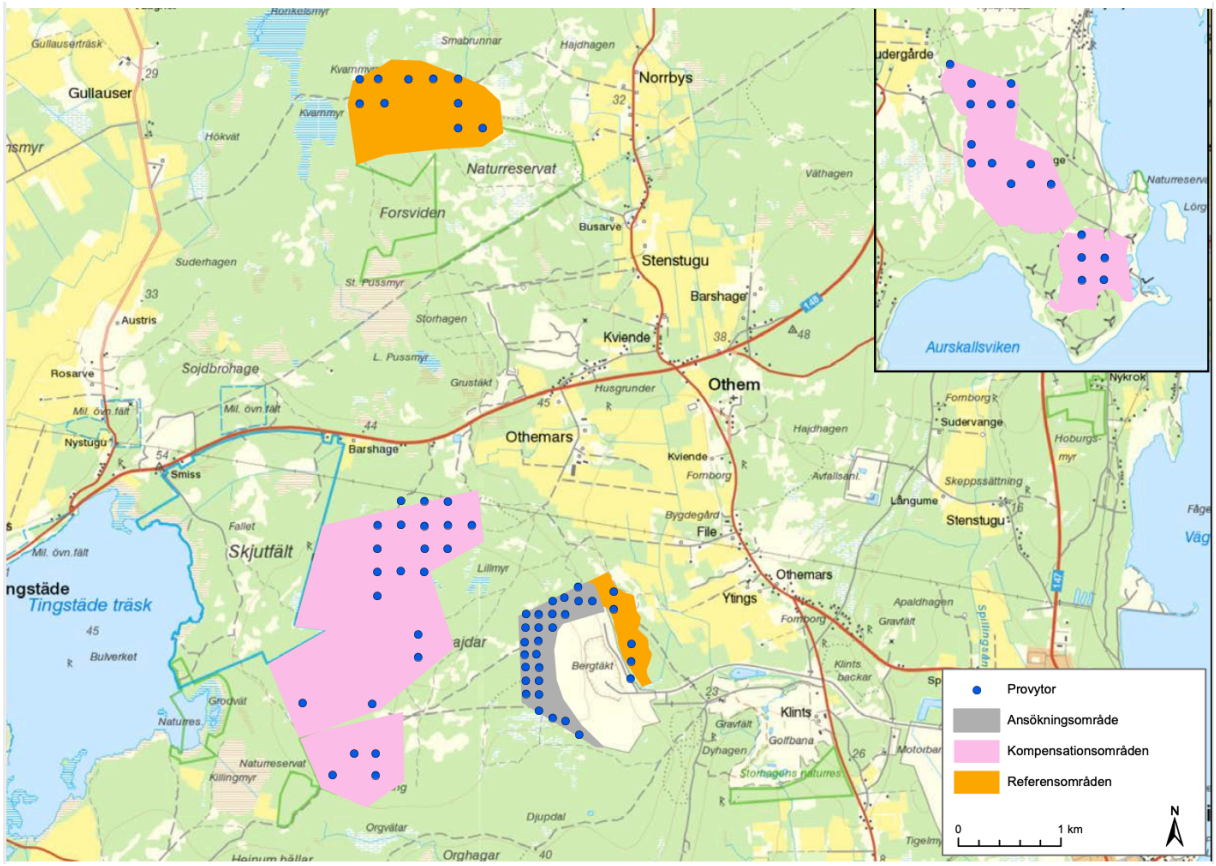
**Map 1.** Map of the production area in Slite. Showing the File Hajdar area (File-Hajdar-täckten), the transportation road (truckvägen), the west quarry (västrabrottet), the east quarry (östra brottet, the cement factory (cementfabriken) and the 18arbor (Cementas hamn). (Bergab, 2017)




The expansion and mining permission are motivated by Cementa and their law firm by addressing the societal need for the products they produce. The cement that is produced in their factory will be used for concrete in housing development and infrastructure projects, amongst other projects (Hansson & Bryngelsson, 2018). To keep up with the Swedish political vison of housing development pace, there is a need to build around 700 000 new accommodations until 2050 (Hansson & Bryngelsson, 2018). To reach this goal it would require a significant amount of building material in the form of cement (Hansson & Bryngelsson, 2018). The cement factory in Slite accounts for 75% of the entire Swedish cement production (Nacka District court, 2020). Cementa and the SGU highlights the site’s critical

societal importance because of its large contribution to the Swedish cement demand (Nacka District court, 2020). In this specific case, Cementa has voluntarily taken on the responsibility of conducting ecological compensation for its encroachments on the surrounding environment (Enetjärn Natur AB, 2017). The compensation plan is based on extensive testing (see map 2), quantitative calculations, measurements, and knowledge building research (Enetjärn Natur AB, 2017).

**Map 2.** Map of the Slite area. The grey area shows the proposed expansion area of the quarry. While the pink shows the proposed compensation area and the orange area shows a reference area. The blue dots represent all areas where tests have been taken in the nature. Map from the compensation plan (Enetjärn Natur AB, 2017).




### *4.1.1 Affected values*

The three main aspects that will be affected by the expansion, as identified by the environmental impact assessment, are nature values, groundwater and surface water (Bergab, 2017). These aspects were taken into special consideration in the work with the compensation plan. The expansion also affects Natura 2000 areas which are located right next to the File-Hajdar site (Nacka District court, 2020). In the File-Hajdar areas there are also a dense population of red-listed and protected species such as the blue wing and the Marsh fritillary butterfly and the flower, cupids bow (Anemone patens) (County Administrative Board Gotland, 2017). The nature that will be affected is also largely forest areas with an extensive ecological continuity and high environmental values (Larsson, Teike & Vestin,

n.d.). In general, one of the main effects that a quarry has on the surrounding environment is on the groundwater levels. Bergab (2017) mentions that in Slite this is also a factor that has to be taken in to consideration. The level decrease may affect private wells in the nearby area and as long as the quarry is active there will be a lowering of the groundwater levels in the area to keep water away from the quarry (Nacka District court, 2020).

### *4.1.2 Compensation plan*

The work towards drawing up a compensation plan for the expansion application for 2021 began already in 2016. Since then extensive research has been conducted in the area to build knowledge and to take stock of what values are present (Enetjärn Natur AB, 2017). The goal of the compensation is to, as far as possible, amend the damages to nature and biodiversity which follows Cementas planned activities (Enetjärn Natur AB, 2017). The compensation plan is limited to address only the ecological values and biodiversity, not any other national interests in the area such as recreational values, groundwater supply or ecosystem services (Enetjärn Natur AB, 2017). The plan has been conducted through using the BBOP methodology, applying the 10 guiding principles with a large focus on achieving quantitatively measurable variables for an objective value process. The quantitative nature of the project becomes important to be able to weigh losses against gains but also to be able to evaluate the compensation measures (Enetjärn Natur AB, 2017).

Except a plan for the specific threatened species in the area the compensation is aimed at a landscape level. This means that the aim is partially to reestablish the same type of landscape image as the original (Enetjärn Natur AB, 2017). It is important to take in to account a landscape perspective when trying to achieve a long-term compensation outcome (BBOP, 2012) as is the aim in this case. Enetjärn Natur AB (2017) expresses explicitly in the compensation plan that a “like-for-like” equivalence is not a realistic aim in this particular case.

### *4.1.3 Actors and stakeholders*

The main actors in this case are Cementa AB, who are the owners of the quarry, the County Administrative Board of Gotland, and the consultancy firm Ecogain who formulated the compensation plan. The environmental court is excluded as an actor, despite its obvious and vital role in a case such as this. The court is supposed to be a non-biased state organ and thus will not be classified as its own stakeholder. Private actors, are also excluded from the key actors in this instance because they do not necessarily have a sway over the compensation process since the case site is privately owned land by Cementa.

***The county administrative board of Gotland:*** is opposed both the expansion and the proposed compensation measures (Mauritzson & Mollin, 2020). The board has appealed the Environmental Courts approval of the project on the grounds that the case diverts from current case law and thus should be denied (Mauritzson & Mollin, 2020). In addition, the board claims that the baseline scenario is based on misleading standpoints and thus the cumulative effect of the project is underestimated and the compensation measures will be insufficient (Mauritzson, 2018).

***Cementa AB:*** is the main stakeholder in this case. They are the company who both owns the land, the quarry and the cement production (Cementa, n.d.). It goes without saying but the company is positively situated in the question regarding the expansion. It would secure their business for another 20 years at the site (Enetjärn Natur AB, 2017).

**Ecogain**: formerly Enetjärn Natur AB, is an environmental consultancy firm that has worked with Cementa to establish the environmental impact assessment and the compensation plan for the quarry. They have also been actively contributing to the project by conducting knowledge building research in the planning phase before the compensation plan was established (Ecogain, n.d.).

## 4.2 Implemented compensation example from Sweden

In 2014, the Environmental supreme court decided that the owners of the Aitik mine in Norbotten, North Sweden, Boliden Mineral AB, would be required to compensate for lost ecological values as a result of the expansion (Forsgren et al., 2016). In 2016, the compensation plan was approved for the expansion. The compensation included, amongst other things, the 'relocation' of an old growth forest with natural characters and the re-creation of high habitat quality (Forsgren et al., 2016). The "success" of this project has however not been evaluated yet. Suding, (2011) writes that studies have shown that the likelihood of restoring pervious functions or values are highly uncertain, partly because of the sheer complexity of ecosystems. Thus, the success of compensation projects is far from a given (Suding, 2011).

# 5. Results and analysis

## 5.1 "License-to-trash" in Slite

The possible LTT scenario at Slite and File-Hajdar appears to be a multifaceted problem when looking at it through the analytical aspects of uncertainty, time-lag and inability to measure.

### *5.1.1 Uncertainty*

The first part of the LTT issue, uncertainty, touches upon chapter 2:3 of the Environmental code. This chapter regards the precautionary and/or protective measures that has to be taken before a business that intends to damages nature can be permitted to operate (EPA, 2003).

The County Administrative Board argues that Cementa has not conducted sufficient precautionary and protective measure in the case before addressing the compensation measures. The proposed protective measures are rather compensation measures as understood by the County Board. The County Board gives the example of the re-establishment of habitats at a location further away from the production site. Cementa claims this to be a precautionary measure while the County Board claims it to be a compensation for a habitat that will be lost to the expansion. This might seem like a trivial and unimportant feud over definition but the difference is quite important in the bigger picture, connecting back to the two-split legal process (EPA, 2003). In the first part of the legal process, only protective and precautionary measures are considered in the appeal, not compensations (EPA, 2003). This is to ensure that the compensation, in itself, does not enable damages to nature that would not have been permitted without them. This would also mean that if measures are classified as precautionary or protective measures, instead of compensatory, in the appeal they can be considered in the first part of the judicial process and might change the verdict in favor of permitting the production in question. All actors in the case agree that the judicial process has been kept in two separate parts and in that regard successfully avoid an LTT scenario. However, there are split views on how well the mitigation hierarchy has been complied with, which can also affect an LTT scenario.

Cementa and the consultants assure in the interviews that the mitigation hierarchy has been followed at every step while the County Board is more critical. The County Board do not necessarily disagree that the steps have been followed in the hierarchy but rather strongly questions the extent of which it has been used. As a part of their appeal reasons the County Board writes;

"*The company should have exhausted all possibilities of using protection measures in their operation since compensation measures should be an option first after all other reasonable protection measures have been applied*."

The County Board seems to agree with the Robertson (2000) view that the mere existence of compensation has in this case caused the underuse of all previous steps in the hierarchy.

The environmental court has previously deemed restorations of areas dethatched from an affected site as precautionary measures, not compensatory, as in the case of the company Nordkalk and the expansion of their chalk mining business at a different location on Gotland. This case has set a precedent for future court cases, such as the Slite case. The consultant's opinion is that, in a case such as a quarry, there are large limitations on what is actually possible to implement in the first steps of the hierarchy as precautionary or protective measures. This because of the nature of the project. A quarry will inevitably create a huge change in the landscape and all values previously inside the production limitations will be lost. To quote the consultant at Ecogain, *"no matter how you see it, a quarry is still a huge hole"*. In other words, no values will be left when earth is excavated and bedrock mined, which makes the opportunity for protective and precautionary measures very limited.

### *5.1.2 Time-lags*

The second part of the LTT issue is time-lags. This touches upon the Species Protection Ordinance (Artskyddsförordningen 2007:845). The County Board expressed that, in their opinion, the expansion will break the Species Protection Ordinance set by the government to protect endangered species such as the affected butterflies in this case. The species protection ordinance has its foundation in the species and habitat directive set by the EU (Miljödepartementet, 2007).

Cementa expresses that they aim to compensate for the loss of habitat for these butterflies by re-establishing the same type of beneficial habitat as the one that will be lost to production. This will be done by creating a specific amount of biomass deemed as crucial for the habitation of the species (Enetjärn Natur AB, 2017). By doing this Cementa claims that the protected species will not be hurt in the process and thus an exception from the Species Protective Ordinance does not have to be given for the activity to continue. However, the County Board claims that it is not enough to create a new habitat through biomass but it has to be proven beforehand that the butterflies will actually move to the new habitat and reestablish (Mauritzson & Mollin, 2020). In their opinion It would be disastrous if an activity is admitted by the court and the compensation conducted, but if in aftermath, via time-lags, it is shown that the creation of biomass does not have the expected effect, the butterfly species are in

fact greatly affected and thus the activity has actually breached the species protection ordinance. However, at that point the damage would already be done and most likely be irreversible.

Cementa takes on the responsibility of conducting maintenance in the area over a time period of 100 years (Mauritzson & Mollin, 2018). This gives room to be able to see the effects of some of the time-lags, such as the species protection ordinance, but not all. As the County Board strongly implies, the ecological continuity the production would break will not be able to be restored in this time span and thus the time-lag between losses and gain will be unbalance.

### *5.1.3 Inability to measure*

The third part of the LTT issue regarding the inability to measure touches largely upon differing views of estimations in the case.

Compensation projects in Sweden has so far been characterized by a lack of clear guidance, both in practice and in planning. There is today no standardized way of measuring or valuing aspects in a compensation project (Enetjärn et al., 2015). This lack of "best practice" and a standard to follow opens up room for disputes on how evaluations are done. Both in the compensation plan and the conversation with Ecogain, they expressed the difficulty in establishing a "zero-option" displaying how the area would look without any encroachments as well as a baseline-value (Enetjärn Natur AB, 2017). Mauritzson and Mollin (2020) write for the behalf of the County Board that, in their opinion, the "zero-option" is misrepresented in the environmental assessment report of Slite. This would lead to a faulty assessment of the damages because of the misleading starting point (Mauritzson & Mollin, 2019). It would then also mean that the compensation measures risk being inadequate to alleviate the damages and the loss of value will be far greater than the gain, leading then to an LTT scenario (Mauritzson & Mollin, 2020). The county board expresses in the interview that;

> *"The company has underestimated the expected losses of e.g. natural values and thus also the need for compensation."*

However, Cementa does not agree with the county boards view of the "zero-option" being wrongly assessed, they argue that the sheer amount of research done before the proposed compensation plan has laid down a solid foundation for the arguments put forward. As an example, there has been extensive groundwater modeling done for the area to predict what the exact impact will be and to make sure that the consequences are not unacceptable (Larsson, Teike & Vestin, n.d.).

### *5.1.4 "License-to-trash" or not?*

When looking at the collected data and information on the three factors used, uncertainty, time-lag and inability to measure, there is a risk of an LTT scenario to appear in this case. This is not saying the project should not go ahead or that there are wills trying to exploit the current system for their own benefits. Rather Slite showcases the difficulty of working with these types of projects and that there is a very fine line that has to be balanced. Additionally, this shedding light on the importance of a clear and cohesive legal framework that can give structure as well as clarity to projects. The decreased room for own interpretations would also help alleviate some of the disputes between parties that inevitably occur when differing interpretations are made.

## 5.2 Equivalence at Slite

For equivalence in the Slite case, there is indeed conflicting opinions and standpoints when looking at the issue through the analytical factors of uncertainty, time-lag and inability to measure.

### *5.2.1 Uncertainty*

The first factor that is addressed by equivalence is the uncertainty. The compensation plan clearly states that the planed measures aim to compensate for "as much as possible" of the damages done (Enetjärn Natur AB, 2017). Additionally, the plan does address that some values will not be compensable, such as old growth trees and ecological continuity (Enetjärn Natur AB, 2017). One of the only things that all of the actors agree on is the uncertainty surrounding the case. Uncertainty especially if values can be replaced and if so then to what extent and how. This includes uncertainty of the outcome and the actual effectiveness of the compensation. Uncertainty of success has, since the beginning, been one of the greatest obstacles of compensation in general (Bayon, Carroll & Fox, 2012).

It is widely debated if compensation for specific habitat loss is actually an effective way of dealing with the issue (Burgin, 2008; Gibbons & Lindenmayer, 2007; Maron et al., 2010; Ten Kate et al., 2004;). One of the first questions asked all the actors interviewed was, *"has there been any similar previously done compensation projects like this one and has it been evaluated?".* The answer from all respondents was *"There has not been any done to my knowledge"* or simply *"No"*. So, the uncertainty regarding the success or effectiveness of a project like this is very high since there is really no equivalent case to compare to or learn from. As Ecogain mentioned in the interview, Sweden is still quite far behind in the development and implementation of compensation while other countries, such as Germany, are

quite developed already. However, it is difficult to compare cases between countries since the natural values can differ considerably and thus an equivalence in Germany for a value is not necessarily the same here.

### *5.2.2 Time-lags*

The second aspect that is addressed in connection to equivalence is the time-lags. When working with both long and short time-lags there has to be a decision made whether it is acceptable to allow the temporal gap that will inevitably occur between development and visual compensation gains (Bull et al., 2013a). The County Board brings up two main concerns for time in this project. The first one being, that there is a large uncertainty surrounding what the compensation plan will achieve in short term. The other one being, that the uncertainties are even greater surrounding what the compensation will achieve long-term (Mauritzson & Mollin, 2019).

As the County Board expressed in the interview; a lot of the values involved in this specific case are difficult to set a time frame on. As previously mentioned, Cementa has claimed responsibility for the land over the next 100 years (Nacka District court, 2020) but this, in itself, does not say anything about when equivalence between loss and gain should have been achieved. Compensation allows for ecological continuity to be broken in the affected systems and this cannot be re-established in a foreseeable future. Time also becomes a constraint when trying to restore ecosystems to a mature state (Roberts, 1993) such as the ecosystems affected in this case. The trouble occurs because the losses are instant while the equivalence of a revegetated system needs a considerably long time to establish. This type of time-lag can also create a bottleneck effect where specific species are deprived of their habitat or resources (Maron et al., 2012). This could be the case in Slite where butterfly habitats are affected and during the time-lag between losses and gains there is a considerable increased vulnerability of the species.

Ecogain also confirmed that 100 years is the time-frame of responsibility for the site, however, more specific time-frames have not been decided upon. The fact that the case is not actually settled today does affect the level of these types of details and more specific timeframes can be added at a later stage. Cementa also does not put a specific timeframe for when equivalence should have been achieved but rather expressed it as; *"before the permission for the quarry runs out"*. That being, if the new permission is approved, within twenty years and may be extended if the production keeps running.

### *5.2.3 Inability to measure*

The third aspect that is addressed in relating to equivalence is the inability to measure. The issue of measuring values was mostly addressed on a deeper level in conversations with the consultants who worked on the case, Ecogain. The calculations used in this case regarding damages and compensation values are not standardized but they follow calculation methods used in previous compensation cases, such as the Aitik mine (Enetjärn Natur AB, 2017).

Ecogain, expressed that in the larger picture the notion of measuring things such a biodiversity is inherently difficult and a twisted topic, both because of the sheer complexity of natural systems but also because not everyone agrees that nature should have a numerical value at all. This links back to the weak sustainability approach of substitutability (Arsel & Büscher, 2012) that compensation, to a large extent, builds on, and how equivalence is actually aimed to be achieved through. However, as Gutés (1996) explains, through a purely ecological perspective this type of substitutability is highly detrimental to nature.

According to Koh, Hahn & Ituarte-Lima (2017) there will always be a controversy surrounding measuring things such as biodiversity. There is an inherent risk with using units to measure a concept that is difficult to define and is so intricate as biodiversity (Büscher, Sullivan, Neves, Igoe, & Brockington, 2012). This often means that measurements will inevitably fall short in accounting for all of the complexity and thus key parts might go missing in the process of converting the complexity into units (Koh, Hahn & Ituarte-Lima, 2017; Palmer, 2009). Additionally, the complexity of nature often results in measurements having to simplify the intricate parts of it to create a tangible result (Guillet & Semal, 2018; SOU, 2017).

The difficulty of measuring specific to this case was explained by the consultant at Ecogain; “the main challenge is the type of nature”. The nature type is, as mentioned in the case description, is something called “Hällmark” and “Allvar”, this type of nature is rare within the bigger landscape picture of Sweden and has been formed slowly over a long time-period. Ecogain explained that because of the rarity of the nature type there has not been any previous compensations projects done which measurements can be compared to. All respondent explained that quantitative measures are important in these contexts. Firstly, to be able to have validity in the project through objectiveness in the valuation and, secondly, that quantitative measures give the opportunity and possibility for a follow-up and a comparison. Without a measurable equivalence, a No-Net-Loss will never be the outcome of a compensation (McElwee, 2017).

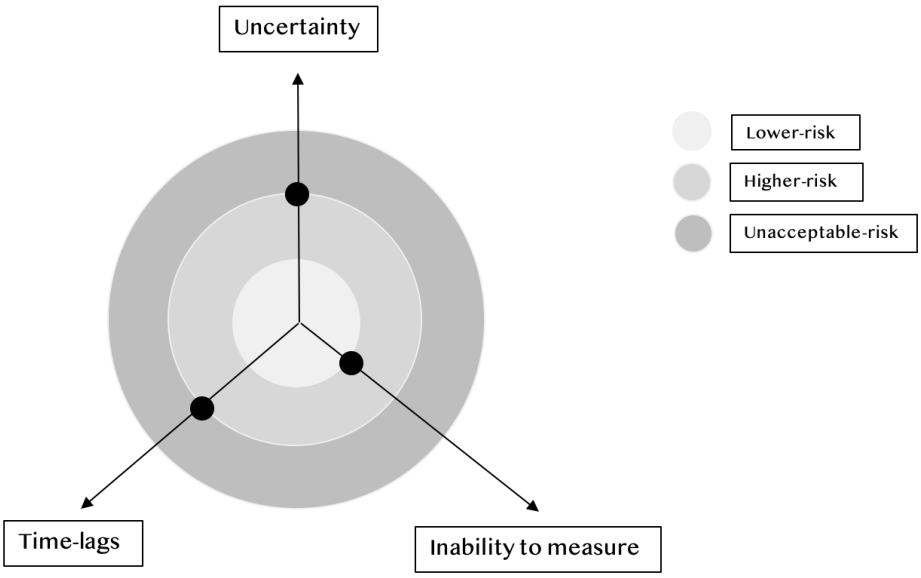
### *5.2.4 Equivalence between lost and gained*

The collected data surrounding this case addresses some of the difficulties with trying to establish an equivalence between what is lost and what is gained in a compensation case. The question of equivalence also really comes to its edge when it concerns an exploitation that completely disrupts the previously present nature to such a high degree as a quarry. In addition to this, the case has rare natural values and protected and red-listed species. The data shows that there are large uncertainties regarding if, what and how values can be compensated for by establishing an equivalence.

## 5.3 Summary

When adding all the gathered info in to the framework for effectiveness made by Maron et al. (2012) it shows a comprised view of the issues (see figure 5). If adding the data from both research questions together, the “uncertainty”-axis shows between a high to unacceptable risk of ineffectiveness. This because of the many uncertainties regarding both legal interpretations surrounding compensation or precautionary measures (see section 4.1.1) as well as uncertainties surrounding what values can actually be compensated for and to what extent. The “time-lag”-axis also shows a result of between high to unacceptable risk of ineffectiveness. This because of how little is known about how long it will take to reestablish values. That the time-plan is, as of now, spanning over 100 years, causing a risk that with time it is shown that compensation measures are ineffective and thus breaking the Species Protection Ordinance (see section 4.1.2). Lastly, because of the fact that the case is not actually settled in court and is therefore missing more detailed decisions regarding timeframes. The “inability to measure”-axis shows a result of between lower and higher risk of ineffectiveness mostly because there has been extensive research and knowledge building done surrounding the case. Measurement methods for the Slite case have been adopted from previously conducted cases of compensation. However, what raises the risk on the axis is the theoretical and practical issues of actually putting a value on complex systems such a biodiversity, so far it is difficult to ensure the preciseness of those evaluations.

**Figure 5.** Own illustration based on the visualization of the effectiveness of biodiversity offsets made by Maron et al., (2012). The black dots on the axles represent and estimation of where this case, based on the collected information, would end up in regards to the three factors and gives a summarizing view of the overall effectiveness or risk of ineffectiveness.




# 6. Discussion

## 6.1 "License-to-trash" and equivalence

If compensation is to work as a proposed environmentally responsible mechanism and achieve its set goals of a No-Net-Loss it needs to be conducted through best practice with clear legal boundaries and without arbitrary decisions. The most common cause of an LTT scenario is an insufficient use of the mitigation hierarchy (eftec, IEEP et al., 2010). However, in this case, even thought the respective parties do not agree, the mitigation hierarchy seemingly has been applied and followed. Nevertheless, as mentioned previously the LTT scenario can occur because of an ambiguous legal framework as well (Enetjärn et al., 2015). Which seems to be the case in Slite. The various different interpretations of chapters of the Environmental code and what actually counts as a compensation or a precautionary measure cause confusion for all parties involved in the matter. Even if the mitigation hierarchy is followed in theory, if it is not clear what measures belong in what steps (Enetjärn et al., 2015), then in practice, the hierarchy falls short and leaves room for an LTT scenario. However, the risk of this scenario is also tightly connected to a compliance with the current frameworks and legislations (Bull et al., 2013a; Burgin, 2008). A non-compliance could originate from unclear definitions of goals, equivalence or simply poor management (Bull et al., 2013a). A lack of clarity both in the legal

framework and in the planning-process may lead to a non-compliance of the compensation requirements, which can result in projects displaying weak compensation measures. An insufficient compensation does also result in an LTT scenario (Carrington, 2013). This problem has been an occurring problem ever since the origin of compensation, the wetland mitigation schemes in the US (Race & Fonseca, 1996)

The historical success rate for compensation projects with the same aim as the one in Slite, to establish a new habitat instead of restoring one, is quite low (Suding, 2011). As seen in section 4.3 the estimation of the Slite projects effectiveness in the framework developed by Maron et al. (2012) shows clearly that there is a high to unacceptably high risk of ineffectiveness and not reaching an equivalence when implementing the proposed compensation plan. The most commonly used equivalence in legislations and in most countries is the "like-for-like" equivalence (Calvet, Napoléone & Salles, 2015; Länssyrelserna et al., 2019). In the Slite case there is no strive to achieve a "like-for-like" type of equivalence because it is not deemed plausible to achieve. The desirable equivalence is rather on a landscape level (Enetjärn Natur AB, 2017). This would represent more of an "out of kind" equivalence, meaning that a lost value can be replace with one of another character but with equal beneficial worth for the larger landscape (Gardener et al., 2013). The "out of kind" equivalence becomes more of a subjective and considerably more difficult to measure (Quétier & Lavorel, 2011). The rare natural environmental types also cause a high level of uncertainty in how to define or measure the values, this adds an additional level of uncertainty to the project. As Maron et al. (2012) writes, the higher the difficulty of measuring or defining the intended biological value of compensation the less we can know about the effectiveness or success of the project. An important point to lift is also that establishing a new habitat by creating new biomass does not ensure an equivalence (Ambrose, 2000). The recreation of biodiversity itself does not ensure that the previous function of the area restored (Ambrose, 2000).

### *6.1.1 Compared to another case of compensation*

To put the results in to perspective it could be compared to another case study of compensation connected to mineral extraction. Kylin (2017) has examined the Aitik mine project I Norrbotten, Northern Sweden. Kylin (2017) also evaluated at the variable LTT for the project and found that this case also displayed a risk of LTT. The compensation measures were shown to the court before the application process started and it cannot be ruled out that the project would not have been approved without the compensation measures. While this is not the case in Slite, the case exhibits other factor that could lead to an LTT scenario, such as a noncompliance with the species protection ordnance (see section 5.1.2) because of significant time-lags and the varying views on precautionary and

compensatory measures (see section 5.1.1). Enetjärn et al. (2015) has also looked at the Aitik project, and although the project worked with different compensation values than in Slite, the overall aim was to recreate the affected species habitats (Enetjärn et al.,2015), similar to the aim in Slite. The values worked with are natural values with long ecological continuity and the compensation plan ran in to the same issues as in Slite, where there is a high uncertainty if the compensation will achieve equivalence because of the complexity of the values themselves and the time-lag between lost and gained that occurs when long continuity is broken (Enetjärn et al.,2015).

## 6.2 Conservation versus Development

### *6.2.1 Sustainable Development*

Folke et al. (2002) writes that one previous assumption when it comes to ecosystems that proved fundamentally wrong was that they would react in a predictable, controllable way. Even though in ecological compensation this assumption has also been written off as false, and there is a consensus that the ecological systems themselves are complex and uncertain (Folke et al., 2002), the method of compensation builds on trying to control and predict. This exemplifies just how difficult the task of compensation is. Which is visible in the case of Slite as well, there are significant uncertainties in the compensation plan, especially in regards to how the compensation measures will evolve and what the effect of them will be. Ecological compensation is intended to be used as a tool to enable development that does not occur on the expense of nature, i.e. a sustainable development (EPA, 2017). As Folke et al. (2002) write, sustainable development has the goal to create beneficial conditions for both humans, economy and ecology. These three systems are seen as interlinked and co-dependent. Humans has the capacity to degrade ecological systems to an undesirable state to benefit economy. However, that will inevitably lead to a decrease in beneficial services from the ecosystems which can lead to a decrease in human well-being (Martin-Ortega et al., 2019). There has to be a balance between the interests in the system and losses has to be weight against gains, just as in ecological compensation.

In the Swedish Environmental Code, chapter 2:9 states a “Stop rule”. This has been put in place to ensure that no activity is permitted that has unacceptable consequences. This part only becomes relevant if all other chapters of the Environmental Code falls short in providing protection against detrimental activities. However, the stop rule can be overruled by the government if the activity is deemed to have extraordinary significance for the public (EPA, 2003). That would in effect mean that the political wills and goals can override conservation interests if the output of values from a site is deemed too important. If then the goal, as stated earlier by Hansson & Bryngelsson (2018), is to build around 700 000 new accommodations until 2050 in Sweden then there seems to be a big political

incentive to enable crucial industries such as mines. This could cast even more light on mechanisms such as compensation to minimize the biodiversity loss in future projects. Virah-Sawmy, Ebeling & Taplin (2014) writes as a closing argument in their article that;

"*Given the magnitude of global growth in demand for mineral resources and plans for large-scale mining and associated infrastructure developments, the role of biodiversity offsets looks set to increase. If designed and implemented well, they have the potential to help balance economic development with more responsible environmental stewardship."* (Virah-Sawmy, Ebeling & Taplin 2014, p. 6).

### *6.2.2 Ecological compensation as an unconventional linkage*

When talking to all the respective actors in this case it is clear that there are many irritated and disagreeing parties and actors in the discussion. Bayon, Carroll and Fox (2012) mentions that compensation has the ability to connect and link actors together that would normally be opposing in their disciplines such as conservation NGOs and mining companies.

> "*The goal of biodiversity offsets is to prove that profit and environmental conservation is not mutually exclusive but mutually beneficial and that biodiversity markets can create a space where both can expand together*" *(Bayon, Carroll & Fox, 2012, p. 15).*

However, even though the compensation does link the actors together and forces them to cooperate in a non-typical way in this case there is no understanding of mutual benefits between the actors nor a common view of how to expand together (Bayon, Carroll & Fox, 2012). The system forces a cooperation but as this case gives an example of, the discussion becomes very tense and feelings run high. This has led to a situation where decisions have to be taken all the way up to the supreme court because of the appeals from both sides. As Ecogain mentioned, "*it is sad that the parties are so unwilling to cooperate, it is a missed opportunity to make the most of a situation*". A cooperation between the actors is crucial for the success of a project (Bull, Suttle, Singh, & Milner-Gulland, 2013b).

## 6.3 Further research

Bull et al. (2013a) mentions that one of the key challenges that the 21st century faces is the economic development in connection to conservation of biodiversity. That is why there is a need for further research on this topic. If the expansion of the quarry is approved, then a monitorization and follow-up of the compensation process and its effectiveness in achieving equivalences between values would be valuable knowledge for future projects. Bull et al. (2013a) and Bull et al. (2013b) both mention that post-implementation evaluations are today severely lacking and could contribute greatly to the field.

# 7. Conclusion

Through the case study, the mechanism of ecological compensation in a mining setting were explored with the help of two the research questions, the first one being: ***"****How does the current Swedish legislative framework on ecological compensation affect the quarry expansion project in Slite? Does this specific case display a risk of a "license-to-trash" scenario?"* I found that the Slite case displayed a risk for an LTT scenario to occur. This is partly because there are uncertainties in the current compensation legislation regarding how vital parts of the mechanism should be handled, such as time-lag and what measures count as precautionary and what falls under compensatory. The uncertainties in how to interpret the legal framework has affected the case negatively by causing friction between the actors and hindering cooperation. The second research question asked was: *"How has the equivalence between predicted lost and gained ecological values been addressed in the expansion plans for the Slite quarry case?"*. I found that when it come to the equivalence between ecological values, there has been a decision made that a strive towards a "like-for-like" equivalence is not plausible. It is also recognized that not all values lost can be compensated for. Rather, the aim of the compensation is to achieve equivalence on a landscape level, where the overall mosaic landscape structure is recreated and vital habitats for protected species reestablished. There are no securities that the compensation would be a success and this might further the rift between conservation and development interests.

Nature is understandably an issue that many are passionate about and both tensions and feelings flare high when it concerns nature that is being exploited or destroyed. However, if the political goal of Sweden is to sustain the current trend in society of economic and infrastructure growth, we would be dependent on the material being extracted from quarries just like the one in Slite. If we would choose to import the material from another country to sustain the growth trend but alleviate our local nature we are only shifting the problem over on someone else and might contribute to more emissions through transports.

If then quarries are a part of the foreseeable future, one could choose to see ecological compensation in the same light as one of the interviewees; "you have to make to most of a situation, something is better than nothing". Without a paradigm shift maybe this is where we end up, having to make the most out of a situation. I would ultimately like take the same standpoint as both Morris et.al. (2006) and Race and Fonseca (1996) does in the question if compensation should be used as a policy tool. They argue that as long as the limitations and shortcomings of the tool is acknowledged properly then it should not be rejected. However, because of the limited and uncertain success rate of ecological

compensation it cannot be seen as a reliable tool to achieve a sustainable development (Morris et al., 2006). Finally, it should not be forgotten that as Apostolopoulou and Adams (2015) argues, by accepting ecological compensation as a tool we also enable development, as is now, to proceed.

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# 9. Appendices

**Appendix 1.** Interview guide.

| **Factor:** | **Question:** | **Aimed to answer RQ:** |
|---|---|---|
| ***Uncertainty*** | Are there any previous projects that has worked with the replacement of the same values as in the Slite case? | 1,2 |
| | What values are these? Social ecological cultural? | 2 |
| | Has there been any evaluations done of previous similar projects to evaluate the success of them? | 1,2 |
| | What kind of judicial/ environmental protection is given to the compensation site? | 1 |
| | Has the mitigation hierarchy been used in this project? Were all steps exhausted before a compensation was suggested? | 1 |
| | Was the case judged in a two-step legal process? First by the mitigation hierarchy steps and then by the compensation measures? | 1 |
| | Is there any uncertainty surrounding what can actually be compensated? | 1,2 |
| | Was compensation the "only option" forward for the continued production of chalk at Slite? | 1 |
| ***Time-lag*** | Is there and specific timeframe for when an equivalence of values should have been achieved? | 2 |
| | Is there a future management plan included in the project? For how long? | 1 |
| | Will there be any monitoring of the area to evaluate the success of the implementation? | 1,2 |
| ***Inability to measure*** | What measurements have been used to identify the values in the case? | 2 |

| | | |
|---|---|---|
| | Were the losses weighed against the potential gains? How? | 1,2 |
| | Was the compensation targeted at any specific values or functions, which? | 2 |
| | How has an equivalence been decided upon? | 2 |
| | What kind of equivalence has been strived towards? (Like-for-like or out of kind or other?) | 1,2 |
| | Was there an ambition to achieve a no net loss? | 2 |

**Appendix 2.** Grey literature used in the case study.

| Document type | Source | Justification and expected data output |
|---|---|---|
| Environmental impact assessment of Slite | Bergab. (2017). Cementa AB. Miljökonsekvensbeskrivning för ansökan om tillstånd för fortsatt täktverksamhet och vattenbortledning m.m i Slite, Region Gotland | Crucial for the bigger picture of the environmental impacts of the expansion, the document is conducted in a technical manner by environmental consultants and can give a quantitative evaluation of the expected impacts. |
| Conservation plan for File-Hajdar Natura-2000 area | County Administrative Board Gotland. (2017). Bevarandeplan för natura-2000 området SE0340111 File-Hajdar. Nr. 511-3748-2017. | The conservation plan for the area File-Hajdar gives a clear description of what ecological values are present today in the area and what ecological features that the county board considers important for conservation. |
| Appeal of the expansion and compensation plan | Mauritzson, Å. & Mollin, P. (2020). Överklagande av Mark-och miljödomstolen vid Nacka tingsrätts dom den 17e januari 2020 i mål nr M 7575-17. Länssyrelsen Gotlands län. Mark- och miljööverdomstolen. | The appeal of the expansion application states the County Boards reasons of why, in their opinion, the expansion should not be accepted with how the compensations are today designed. It also states larger concerns, such as legal unclarities. |
| Handbook for general advice in the application process for mines | Environmental Protection Agency. (2003). Prövning av täkter - handbok med allmänna råd. Handbok 2003:1. Miljöavdelningen. | The document is a handbook that gives advice for the application process of mines and brings up some important parts of the Environmental code that has to be considered and what implication it can have. This information contributes to greatly to the understanding of an application process and increases the understanding of the document “Application of approval in accordance with the Environmental Code” |

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| The court case and judging of the expansion and compensation, case M 7575-17 | Nacka District court. (2020). Ansökan om tillstånd till fortsatt och utökad täktverksamhet samt vattenverksamhet vid Slite, Gotlands kommun. Mål nr M 7575-17. | The entire court case acts as a collection of all voices raised in the matter during the court process aa well as states the final verdict (before it was appealed again) in the matter and extensive justifications why the court is of a certain opinion. |
| Written opinions of the Administrative County Board of Gotland on the case of Slite | Mauritzson, Å. & Mollin, P. (2018). Yttrande över Cementa AB:s ansökan om tillstånd till fortsatt och utökad täckverksamhet samt vattenverksamhet vid Slite, Gotlands kommun, mark- och miljödomstolens mål nr M 7575-17. Länsstyrelsen Gotlands län.<br><br>Mauritzson, Å. & Mollin, P. (2019). Yttrande över Cementa AB:s ansökan om tillstånd till fortsatt och utökad täckverksamhet samt vattenverksamhet vid Slite, Gotlands kommun, mark- och miljödomstolens mål nr M 7575-17. Länsstyrelsen Gotlands län. | The document gives a detailed picture of the County Boards opinion on both the expansion and the courts judging in the matter. They give reasons for their concern in the matter based on the compensation plan and impact assessment. |
| Application of approval in accordance with the Environmental Code | Hansson, B., Bryngelsson, A. (2018). Ansökan on tillstånd enligt miljöbalken. Manheimer Swartling Advokatbyrå AB. | The legal document where Cementa officially applies to a new permission to min in the chalk quarry of Slite this in accordance with the restrictions of the Environmental code. It is argued in accordance with the legal framework why the expansion should be approved. This document displays what factors of the law that a quarry expansion touch. |
| A technical description of the production in Slite today as well as | Larsson, J., Teike, S., & Vestin, T. (n.d.). Teknisk beskrivning för ansökan om tillstånd för fortsatt täcktverksamhet samt för vattenbortledning m.m i Region | The description of how the production is conducted today in the quarry and in what way it would change if the expansion would be approved. It displays amongst other how transports would change and gives a good |

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| the proposed production | Gotland. Bergab konsulter. Heidelberg cement group. | understanding on how the chalk is actually mined. |
| The ecological compensation plan | Enetjärn Natur AB. (2017). Kompensationsplan-ekologisk kompensation för fortsatt kalkbrytning på File Hajdar. Enetjärn Natur AB på uppdrag av Cementa AB. 2017-12-19. | The compensation plan is a key document in the case and gives a detailed picture over how and what is to be compensated for as well as what the goals and intentions of the compensation is. The information that lays the groundworks for this plan is the knowledge building research that has been done in the area. This document gives insight in the type of equivalence that they aim for and states clear boundaries and limitations to the current plan. |