MOVING TOWARDS BEST PRACTICE FOR BIRD MORTALITY MITIGATION IN WIND POWER PLANNING, SWEDEN

Dissertation in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE WITH A MAJOR IN ENERGY TECHNOLOGY WITH FOCUS ON WIND POWER

UPPSALA UNIVERSITET

Uppsala University
Department of Earth Sciences, Campus Gotland

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Approved by:

Supervisor, Liselotte Aldén

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ABSTRACT

This thesis investigates the potential for moving towards a best practice for bird mortality mitigation within wind power planning in Sweden. Best practice in this sense involves stakeholder collaboration and consensus on methods for reducing the risk of bird mortality at wind farms in Sweden in line with current legislation.

The main objective was to highlight issues and reach consensus on solutions in relation to bird mortality and disturbance of avifauna in onshore wind power development through the engagement of relevant stakeholders. The secondary objective of the thesis was to evaluate the effectiveness of the collaborative stakeholder workshop method used for use within renewable energy planning conflicts of interest.

The primary data collection method or means used for the thesis was a collaborative stakeholder workshop designed and organized by the author, focused upon building trust among relevant real life stakeholders and a co-evolution of stakeholders towards potential mitigation solutions to bird mortality and disturbance of avifauna within onshore wind power development. The workshop was hosted and facilitated by the author on 19th May 2015 at Uppsala University, Campus Gotland. To compliment this approach a semi-structured interview was custom designed for relevant stakeholders unable to attend the workshop. An analysis of court cases relating to bird mortality in wind power planning was also undertaken with the aim of shedding light on interpretations of legislation relating to bird mortality and disturbance in wind power planning.

The results show stakeholders across both data collection methods agreeing upon the importance of pre-screening and siting of wind turbines as the most important step in moving towards a best practice. In addition the majority of stakeholders highlighted the importance of post-construction mitigation technologies such as DTBird and IdentiFlight to be used as a secondary option within low risk areas once validated. In addition the results highlight a general lack of knowledge relating to the interpretations of relevant legislation among stakeholders.

The analytical findings point towards the importance of engagement, consensus, validation and knowledge in moving towards a best practice for bird mortality mitigation in wind power planning in Sweden.

Regarding innovation, the thesis has at least furthered dialogue in relation to best practice of bird mortality mitigation in wind power planning for Sweden and at best put

forward a potential solution in an adaptive planning model for the island of Gotland in Sweden using IdentiFlight technology for further discussion and/or development. The thesis also highlights the potential of community planning influenced stakeholder engagement to applied problems within wind power planning in Sweden. Finally the author's collaborative method designed for the workshop was considered useful through a stakeholder evaluation survey and could perhaps be developed further.

The major limitations of the thesis related to the logistics behind organizing a stakeholder workshop. It was difficult to have a fully representative sample at a national level and in this regard the workshop was considered to be of more relevance for the island of Gotland. The complimentary stakeholder interviews were designed to partially compensate for this bias, but again were limited due to finite time and resources.

Keywords: wind power, birds, avifauna, deliberate disturbance and killing, Sweden, Gotland, stakeholder workshop, collaborative planning, mitigation, adaptive planning model, IdentiFlight, DTBird.

ACKNOWLEDGEMENTS

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Last but not least I would like to thank my loving partner Emma and son Levon for their patience, support and love throughout the thesis and for agreeing to come on this life changing journey with me. I dedicate this thesis to you both.

NOMENCLATURE

EU	European Union
SDS	Sustainable Development Strategy
SOF	Swedish Ornithological Society
EIA	Environmental Impact Assessment
CAB	County Administrative Board
PP	Planning Permit
GPS	Global Positioning System
RES	Renewable Energy Systems
GIS	Geographic Information System
NGO	Non-governmental Organization

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CHAPTER 1. INTRODUCTION

The introduction describes the objectives and the content of the thesis as it unfolds in the subsequent chapters. Research problems will be introduced within the chapter together with justification of the research. In addition to this, research relevant definitions will be included and the methodology briefly described before the study is outlined and delimitations provided.

1.1 Background

Wind energy is expected to continue significant growth in being a clean and renewable generator of electricity within the EU moving forward. It is important to ensure that such a rapid expansion is sustainable in all respects and is done in accordance with relevant legislation. The strong tradition of bird watching and mapping of birds through amateur ornithologists and the Ornithological Society of Sweden shows a diverse and plentiful avian biodiversity in Sweden. The large number of migratory birds adds extra responsibility for Sweden to protect at a European level. Against this backdrop, recent planning applications for wind turbines in Sweden have been met with difficulty relating to the impact of the proposed turbines on avifauna. It has been debated within the courts for certain cases that the development of wind power is considered to be deliberately disturbing and killing birds. This debate has arisen through a very literal translation of Article 5 of the EU Wild Birds Directive into Article 4 of the Species Protection Ordinance. However the EU's sustainable development strategy (SDS) highlights the importance of biodiversity alongside, climate change and renewable energy as key operational objectives and demonstrates the need for a sustainable approach to the co-existence of wind power development and endangered species moving forward. It is widely agreed within the literature that detailed planning is the most important phase in mitigation (Bright et al., 2008), (Tierney et al., 2012) (Lie Dahl et al., 2012), (Langston and Pullan, 2003), (Brannisch et al., 2015), (Rydell et al., 2012), (May et al., 2015). However, recent research findings discussed within the literature review of this paper

highlights a need to evaluate the effectiveness of alternative mitigation strategies in parallel with pre-screening. The evaluation of post construction mitigation options therefore appears relevant if the future deployment of wind power is to harmonize with species protection.

1.2 Research Question

This study aims at researching mitigation best practice in relation to protection of avifauna within the wind power permitting process for Sweden through the engagement of relevant stakeholders. Best practice in this sense involves stakeholder collaboration and consensus on methods for reducing the risk of bird mortality at wind farms in Sweden in line with current legislation.

1.3 Justification of Research

Recent wind power permitting cases have highlighted a conflict of interest for future development. Protection of species and in particular protection of avifauna has been highlighted as reason for planning permissions being rejected or referred for further judgement. Within this scope, a lack of formality in what is expected at the pre-screening stage and a lack of knowledge on post construction mitigation options and how legislation is applied in relation to these has led to uncertainty within the industry. It is anticipated that moving closer to best practice in relation to the problem will minimize harm to species and encourage strong sustainability in development of wind power projects moving forward. In addition to this it is hoped the discursive and shared knowledge approach can add to the debate of mitigation best practice within the planning process for onshore wind and its impact on avifauna. Furthermore it is hoped the methodology of collaborative working groups used in this thesis can prove successful and be adapted as an important problem solving tool for future conflicts of interest within the wind power industry.

1.4 Methodology Outline

The review of literature and an analysis of court cases attempts to frame relevant issues relating to protection of avifauna in the wind power planning process and are assumed to lay the foundations for what will be discussed within a stakeholder workshop and to help frame stakeholder interview questions. Together these elements make up the methodology for the thesis. The stakeholder workshop is based around issue pooling or brainstorming, discussion and review within working groups and acts as a platform for the co-evolution of a variety of relevant stakeholders towards best practice of mitigation of bird mortality within wind power planning through a discursive and collaborative planning approach. The stakeholder workshop was organized and designed by the author and its interactive approach takes influence from community planning approaches such as Planning for Real (Planning for Real, 2015) (Community Planning, 2015) (The World Bank Group, 2001). Stakeholders were sent an information pack prior to the workshop as a discussion aid which included technical information on two potential mitigation technology options for bird mortality at wind farms, DTBird and IdentiFlight. These mitigation options and the information pack are presented in detail within Appendix A. At the workshop the stakeholders were asked to brainstorm issues and concerns relating to the mitigation options provided within the information pack alongside of other possible solutions or concerns regarding bird mortality and disturbance at wind farms. For stakeholders unable to attend the workshop a semi-structured interview relating to bird mortality mitigation was designed with a view to complimenting the workshop data. All three elements to the methodology are discussed in greater detail within chapter 3 below.

1.5 Outline of the Thesis

The literature review is laid out in the following chapter and attempts to develop a theoretical framework for the thesis work to take place within. Chapter 3 will make up

the relevant research method used for the collection of data and takes the form of a collaborative stakeholder workshop designed by the author based around issue pooling, discussion and review and semi-structured interviews relating to bird mortality mitigation. The next chapter will focus on the application of the methodology, in this case the stakeholder workshop, data collected and the results. Chapter 5 will then discuss the results obtained and the analytical findings before the concluding chapter will draw conclusions and state implications of the study inclusive of recommendations moving forward.

1.6 Definitions

This section defines thesis specific terminology used throughout this document.

1.6.1 Relating to Birds

Ornithologist - A person who studies the science of birds.
Avifauna - The birds of a particular region or habitat.
EU Habitats and Wild Birds Directives – the cornerstone of conservation for European habitats and species including the far reaching protection of Europe's wild birds.
Artskyddsförordning - Species Protection Ordinance or legislation guidance concerning all species and their protection within Sweden.
Biodiversity - The variety of plant or animal life within a particular habitat.
Raptors - Birds of prey such as eagles or hawks.
Inventory - A complete list of items to be included.
Mitigation - The action of reducing the severity, seriousness or painfulness of something.

1.6.2 Relating to Method

Stakeholder - A person with an interest or concern in something or someone who is affected by an issue.
Collaborative - Working together with others in a joint intellectual effort to accomplish a goal.
Discursive - Involving discussion.
Workshop - A meeting at which a group of people engage in intensive discussion and activity on a particular subject or project.

1.7 Delimitations

This section will outline the scope of the thesis study specifically highlighting delimitations. The research could be extended within the future but given a finite and limited amount of time and resources, boundaries have been placed to help focus the research.

The thesis does not go into depth on mortality rates for specific species and instead attempts to introduce within the literature review the broader picture of impacts and potential impacts to the avifauna population within Sweden.

The focus for this particular research was on the onshore wind power planning process. It should be noted that a similar study could be tailored for the offshore planning process.

Regarding the information pack sent to stakeholders only two mitigation methods were chosen to encourage debate. The author has chosen a market leader, DTBird, alongside technology currently being developed, IdentiFlight, as the two options but it should be noted that there are numerous post construction mitigation technologies available on the market alongside of other alternative options.

The identification of the stakeholders attempts to be inclusive of diverse backgrounds and opinions but is in no way exhaustive.

Initially it was proposed just to have a stakeholder workshop as the method. However with not all stakeholders able to attend it was decided to include a semi-structured interview for those who could not attend in a bid to compliment workshop data and have a full range of stakeholder opinions albeit it outside the collaborative workshop environment. It should be noted that the dynamic of semi-structured interview and a collaborative workshop are different and the data must therefore be treated as such.

The current study does not attempt to come to a definitive solution regarding mitigation but instead to further the debate on mitigation best practice moving forward and co-evolve stakeholders towards a more informed decision making process.

1.8 Conclusion

The introduction has framed the scope of this thesis. The research has been introduced inclusive of its justification, limitations and specific terminology used throughout the document. In addition to this the methodology has been outlined. The subsequent chapters give a detailed description of the research inclusive of literature review, methodology, data, results, discussion, recommendations and conclusions.

CHAPTER 2. LITERATURE REVIEW

This chapter will review literature in the context of the research question set out in the previous chapter and aims to develop a theoretical framework for the thesis moving forward. The first sub-section will briefly look at the occurrence of birds in Sweden and their interactions with wind turbines before a brief outline of the permit process in Sweden will put the issue in context. A discussion of court cases relating to this will highlight issues arising from interpretations of EU legislation (Habitat and Wild Birds Directives) and Article 4 of the Species Protection Ordinance (Naturvårdsverket, 2009) specifically with regard deliberate disturbance and killing of birds and bird protection. In addition European Commission guidance with regard biodiversity and wind power development will be discussed prior to reviewing potential mitigation methods for avifauna interacting with wind power. Finally the literature review will outline the importance of stakeholder engagement with regard decision making in wind power planning decisions, protocol relating to this and how this can be applied to the current thesis.

2.1 Impacts on Avifauna

A continuous tradition of bird watching by amateur ornithologists through the Swedish Ornithological Society (SOF) has led to the accurate mapping of avifauna in relation to distribution and the number of species. The figure below shows the number of bird species according to SOF in Rydell et al (2012).

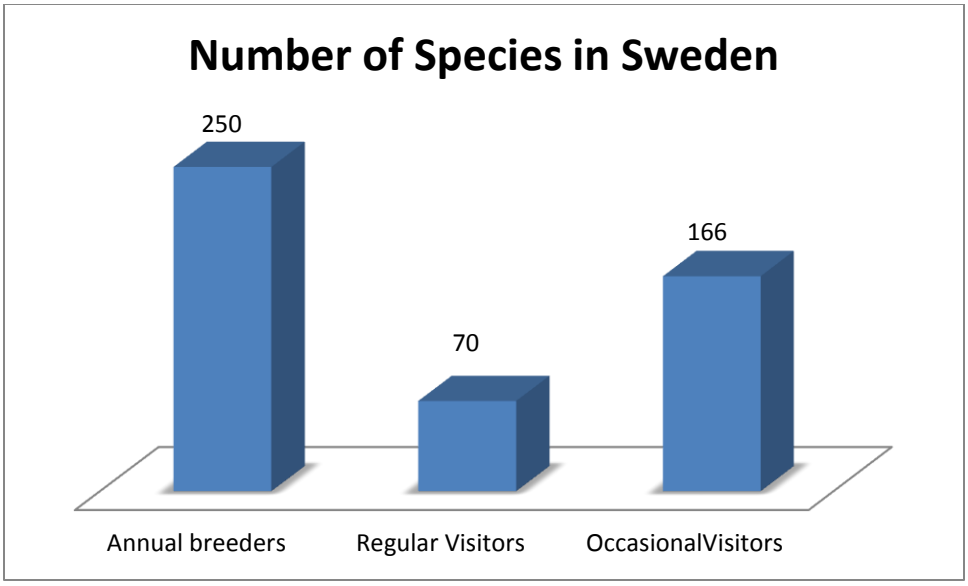

Figure 1 Number of species in Sweden. Data from Rydell et al (2012). (McNally, 2015)

Of the 486 species above, there are an estimated 70 million breeding pairs with an unknown number of non-breeding individuals. 80% of these breeding birds are migratory. According to Gärdenfors (2010) and Rydell et al (2012) there are 95 species of bird on the Swedish Red List, showing unfavorable population trends. The listing is based on an estimated risk of extinction within a certain time frame. The figure below goes into greater detail on this for birds. The Swedish Red List is a catalogue of species in Sweden whose survival and the species in each threat category are listed as such so that priorities can be defined (Naturvårdsverket, 2009). According to the International Union for Conservation of Nature (2013), Sweden hosts a large proportion of species that are threatened at the European level and therefore has an important responsibility for protecting these species within its territory with species in Sweden requiring greater action to improve their status.

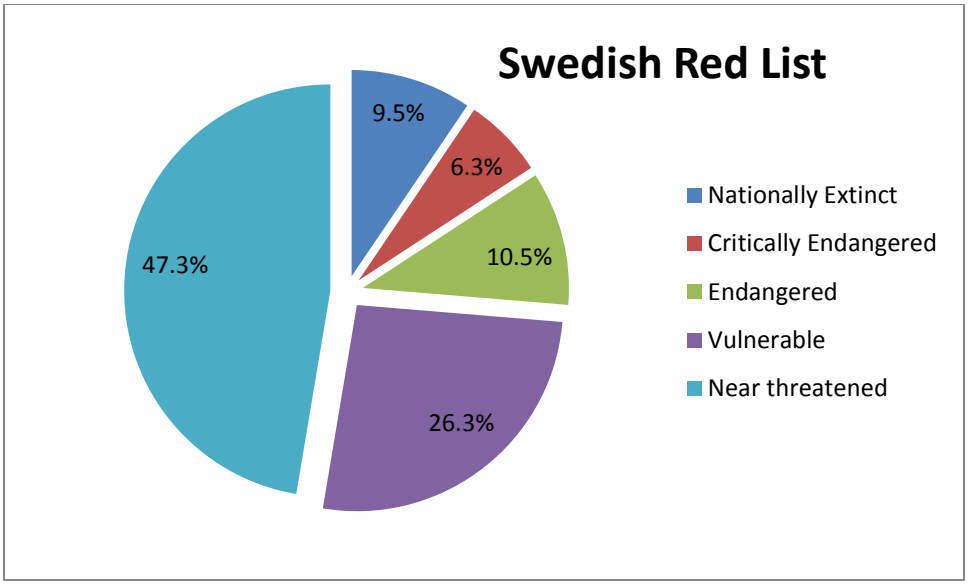

Figure 2 Swedish Red List. Data from Rydell et al (2012). (McNally, 2015)

With regard further specified requirements of protection, list 1 of the EU wild bird directive includes 66 species regularly occurring within Sweden (Directive 79/409/EEG on the protection of wild birds) (Rydell et al, 2012). The directive protects all populations of naturally occurring bird species and their habitats. According to (Naturvårdsverket, 2009), under the Birds Directive, Member States must take the measures necessary steps to keep bird populations at a level that meets ecological, scientific and cultural requirements, while taking account of economic requirements and recreational needs of society. Rydell et al (2012) state that an increase in wind power development is compatible with the preservation of viable populations of all bird species within Sweden once sufficient mitigation methods are carried out. The resulting document, 'The effect of wind power on birds and bats: A synthesis', attempts to provide guidance relating to Environmental Impact Assessment and the planning and permissions process. In this regard the location of potential wind farms/siting in relation to local topography and its surrounding habitat is the primary factor for the number of birds that will be killed. Risk of birds being killed by turbines is low compared with other industry and human activity and evidence according to Rydell et al (2012) does not show bird populations being affected at a national level. Eagles and other large raptors as

well as waders risk being affected at a local or regional scale however. According to Langston and Pullan,(2003), DeLucas et al. (2004) (2008), Hötker et al. (2006) and Rydell et al (2012), various long-lived raptor species are most at risk and receiving greatest attention due to low reproductive rates and late maturity allowing a minor increase in mortality to greatly effect populations. In fact said species are at higher risk and research according to Rydell et al (2012) reporting these species tend not to learn from experiences with turbines and therefore fatality rates are not declining. Hjernquist (2014) highlights fatality rates for raptors such as eagles from turbines between 9.3 and 33.7 annually for the island of Gotland. Nationally in high density raptor areas it is reported as 0.07 raptor deaths per year per turbine according to Rydell et al (2012).

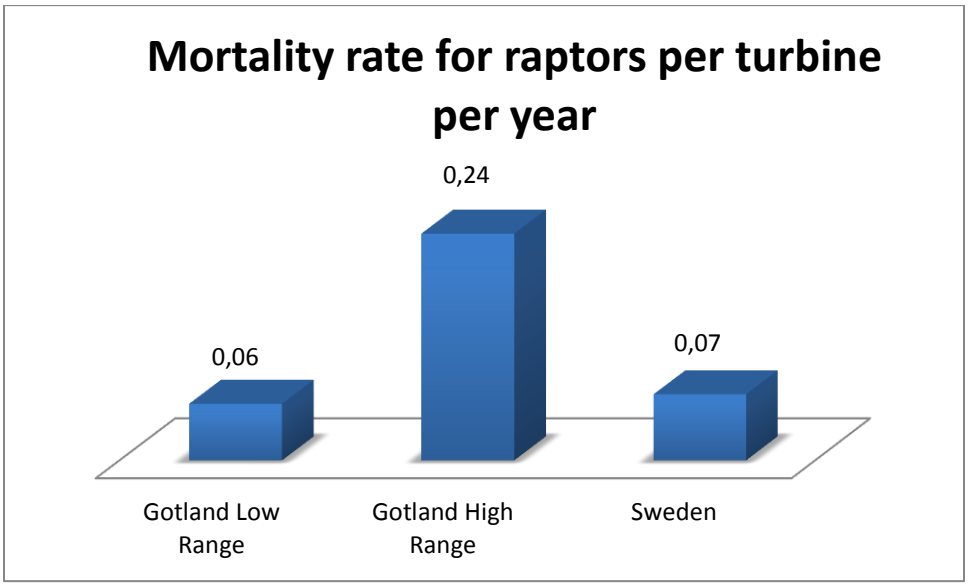

Figure 3 Data taken from Hjernquist (2014) and Rydell et al (2012). (McNally, 2015)

In 2010, 7 species of raptors were found dead under turbines according to a survey carries out by Ahlen (2010). Both Ahlen (2010) and Hjernquist (2014) agree that most raptor fatalities occur during breeding season. Collisions with turbines can vary from habit, behavior and reaction to the structure, to turbine height, swept area of the blade and location in relation to birds of primary importance according to Drewitt and Langston (2008) and Rydell et al (2012) and in agreement with Ahlen and Hjernquist above, time of year is an important factor. Other factors include habitat loss and barrier

effects. Dr. Martin Green of Lund University states in Vindkraft och miljö, “We spend too much energy and resources for occasional deaths for individual species, and too little to protect the habitats themselves” (Vindval, 2015, pp. 7). Green continues that a more holistic approach is needed whereby to protect the species one needs to preserve the environments where that species thrives. The consequence of disturbance differs depending upon the value associated with the area for birds. This can lead to displacement, potentially greater competition in a new habitat, lower survival rates and potential decline in population according to Kuvlesky et al. (2007), Langston and Pullan (2003), Peterson et al (2006) and Rydell et al (2012). Hjernquist (2014) in a control program for the Näsudden repowering project reports the need for a longer term study relating to this to ascertain a clearer picture. In conjunction with this the avoidance of the vicinity of a wind farm will alter certain bird’s flight courses. Specifically this relates to migratory birds and can lengthen the passage route thereby increasing energy consumption between feeding, breeding and resting areas. It is important therefore to know situations along entire migration routes to prevent impact on survival and breeding success of such species (Rydell et al, 2012). Ahlen (2010) states that it is quite evident that better accounts of avifauna are required at the location of wind turbines. In this respect the purpose of the thesis is to evaluate mitigation methods in line with the general protection of avifauna in siting and post construction options for wind farms.

2.2 Court Cases and Decision Factors

As discussed above the permission process for wind turbines is complex. This leads to varying degrees of interpretation regarding environmental focus and demands upon the permit. A better understanding of interpretations of Article 5 of the European Wild Birds Directive into Articles 4 of the Species Protection Ordinance alongside a detailed evaluation of mitigation methods could perhaps bring more clarity to the issue. Recent cases have seen the debating of deliberate disturbance and killing of species through wind power development that is highlighted in Article 5 of the EU Wild Bird Directive

and Article 4 of the Species Protection Ordinance. Previously the courts had stated practices for bird protection such as distances of developments to nesting sites, breeding areas and migration routes for birds (Rydell et al, 2012). However these buffer zones have been questioned by Dr. Martin Green in Vindval (2015) as not scientifically valid and not within the legislation. They are based upon what is known as the precautionary principle or the farther away the less risk (Braunisch et al, 2015), and based on recommendations of the Swedish Ornithilogical Society for guidance. Green states the need for a holistic approach to conflicts of interest. The court cases listed in the results section of this thesis from Vindlov (2015) highlight decisions and interpretations of all court cases since October 2010 relating to the protection of avifauna in wind power planning applications. These cases can be read in greater detail from Vindlov (2015).

2.2.1 Deliberate Disturbance or Killing

Pehrson et al. (2015) reported that the protection of species legislation Artskyddsförordning is currently being interpreted literally from the EU Directives stating the development of wind power near to specific species is deliberately or knowingly disturbing or killing birds. However as stated in Naturvårdsverket (2009), it is not enough that the directive is introduced in the national legislation but it must be supplemented by rules clarifying how the content of the articles be translated into practice within member states. In this regard the provisions of Swedish legislation emanating from the EU directives are being governed by the closest responsible sector authorities and agencies, the County Administrative Boards and environmental courts under Chapter 8 of the Environmental Code (see Appendix D). In short the interpretation is based upon a translation into Swedish law from the overarching European Habitats Directive and Wild Birds Directive. According to Article 5 EU Wild Birds Directive (2009/147/EC) on the conservation of wild birds, “Member States shall take the requisite measures to establish a general system of protection for all species of birds referred to in Article 1, prohibiting in particular.

(a) deliberate killing or capture by any method;
(b) deliberate destruction of, or damage to, their nests and eggs or removal of their nests;
(c) taking their eggs in the wild and keeping eggs even if empty;
(d) deliberate disturbance of these birds particularly during the period of breeding and rearing, as so far as disturbance would be significant having regard to the objectives of this Directive;
(e) keeping birds of species the hunting and capture of which is prohibited."

It has been phrased differently within Article 4 of the Species Protection Ordinance, in Swedish law that it is forbidden to deliberately capture or kill animals and forbidden to deliberately disturb animals especially during animal breeding, rearing, hibernation and migration and has caused debate surrounding its interpretation in recent cases. Rydell et al (2012) stated that a strict interpretation of this law could result in the halting of the future development of wind power. Two relevant cases are highlighted in the results section of the thesis and discussed in more detail in the discussion section.

2.3 Permission Process

Söderholm et al (2007) and Bergek (2010) state that while general public, national and global energy policies point out that wind power is considerably environmentally friendly, most objections and negative attitudes to its expansion tend to have environmental origins. For example noise and shadow flicker impacts upon humans, societal issues and impact on species which this thesis focuses on in relation to avifauna. The wind industry is relatively new and how legislation is applied in relation to this has not fully matured or aligned within authorities in Sweden. This leads to permits with differing environmental focus (Bergek, 2010) (Nilbecker, 2014). The deployment of wind power involves a large number of laws and actors and how the authorities interpret these laws is of significance to the thesis work. The permission process for wind turbines in Sweden boasts a number of regulations and referral organizations that although essential for democracy, can lead to uncertainty within the industry. Greater levels of

knowledge and experience in handling this process could perhaps aid the process. It must be noted that other industries such as agriculture and forestry are automatically exempt from issues such as the Species Protection Ordinance. According to Dr. Martin Green in Vindval (2015) if the aim is to protect avifauna, invoking the Species Protection Ordinance for wind power and not for other industries, appears illogical. Naturvårdsverket (2009) highlights industries such as agriculture and forestry being exempt from Article 4 of the Species Protection Ordinance. Figure 5 below briefly outlines the trial process in Sweden.

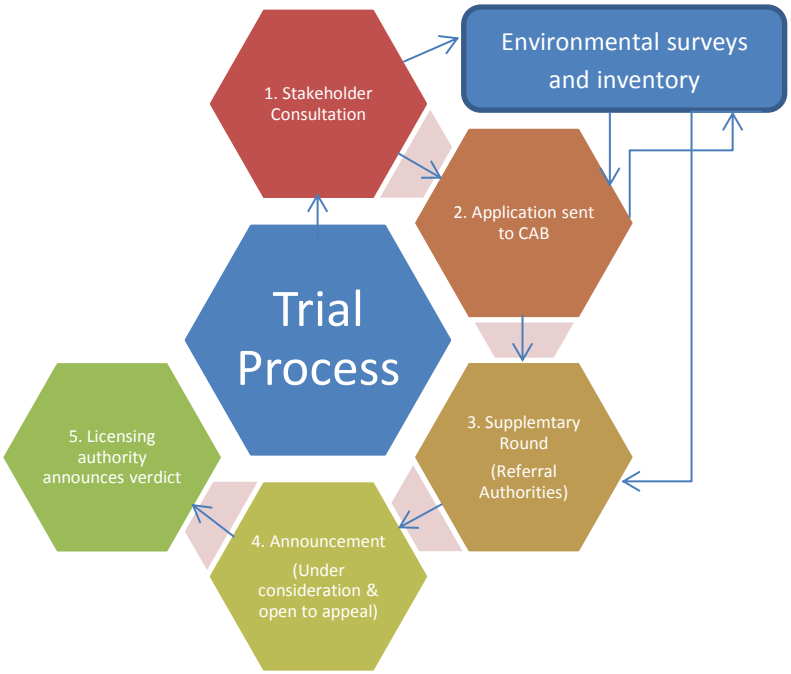

Figure 4 Permit trial process in Sweden (McNally, 2015)

Although the figure above appears to be a relatively simple process, according to Nilbecker (2014), Ramböll, (2012) and Energimyndigheten (2012) the average time for a permit application depicted in figure above is 3.1 years. If appealed, the trial can take another 35 weeks, leaving total time taken ranging between 130-215 weeks. A key actor within the process is the County Administrative Board who executes relevant legislation

and delivers final decisions. Nilbecker (2014) discusses the democratic process for applications highlighting third party comment and appeal against decisions. However within this same process, Swedish local democracy is very important with the Municipalities having the right of veto for wind power applications handled by the County Administrative Board with no appeal (Nilbecker, 2014). This essentially means the municipality has to approve the final decision and do not have to justify the decision to opposition. In conjunction with this different County Administrative Boards have different approaches in dealing with wind power planning applications. Although designed to streamline the wind turbine planning process, local government policy does not always align with national or regional policy in relation to wind power creating greater complexity within the process according to Kahn (2003) and further creates uncertainty within the wind industry. According to Nilbecker's (2014) thesis results, in interview with varying authorities relating to the wind power planning process, one of the most experienced difficulties is the scope and quality of the EIA. It was discussed that it is difficult to know where to draw the line and the amount of information needed to be contained and to compliment the application with a notable lacking of national standard for bird and species inventory. Larsson et al (2014) highlight the appointment of The Environmental Process Commission in June 2007 in an attempt to make administration more efficient specifically with regard EIA, coordination and consultation in the review procedure without bypassing regulations. In this regard best practice relating to mitigation for birds and wind power could be considered an appropriate step for wind power planning in achieving greater clarity regarding EIA and is central to the thesis work.

2.4 EU Legislation & Guidance

According to the European Commission (2011) in a guidance document on wind energy developments and Natura 2000, mechanisms established through the EU's existing environmental legislation can ensure that wind energy is developed in a way that is both sustainable and minimizes impact on the natural environment. Within this scope the EU

'Habitats' and 'Birds' Directives are the cornerstones of the EU's biodiversity policy ensuring all member states work together to protect Europe's most endangered and vulnerable species and habitat types.

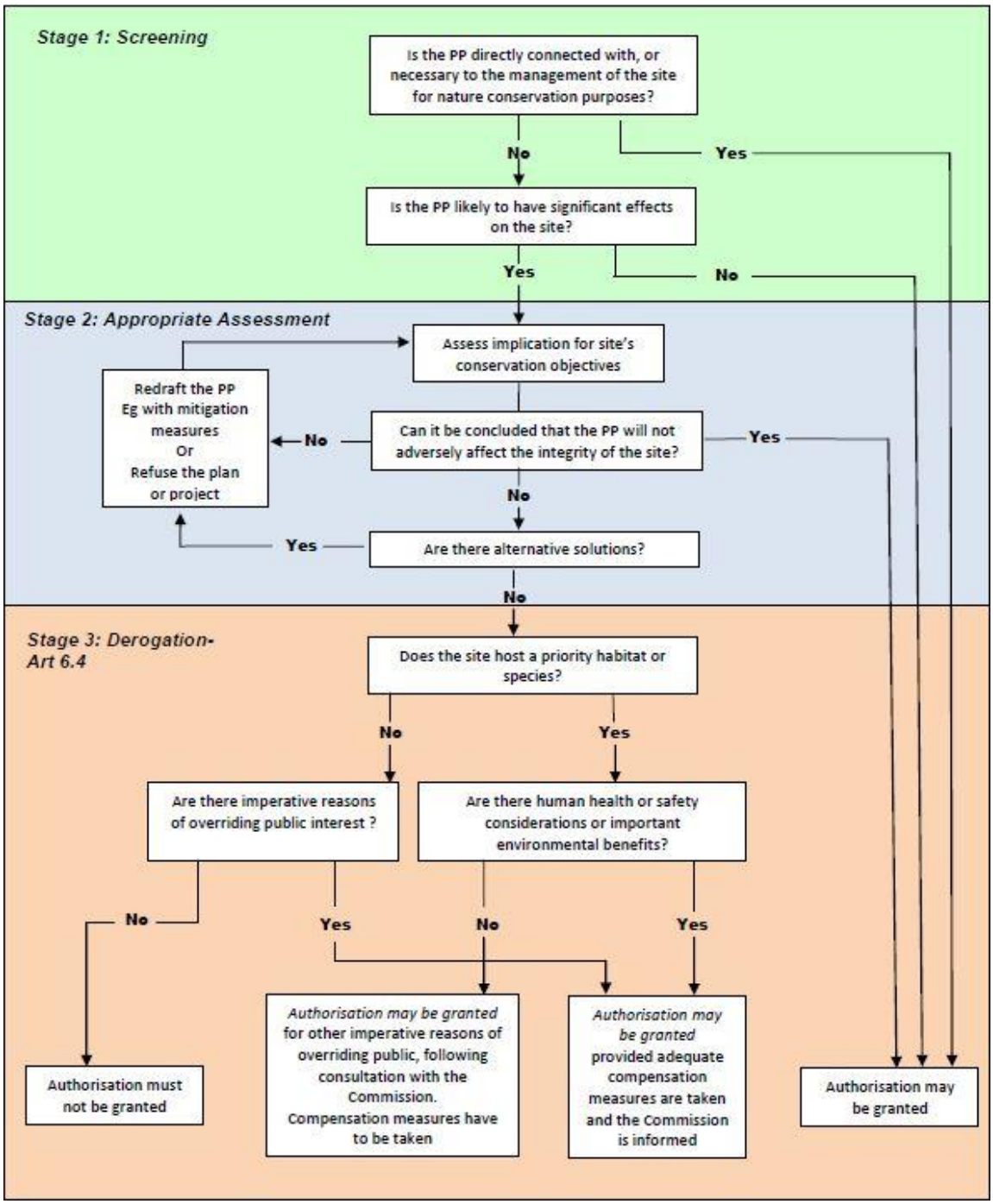

Figure 5 EU Guidance for wind power planning permits (European Commission, 2011)

Central to this is the Natura 2000 network whereby wind farms impinging on these areas must be subject to an appropriate assessment in light of conservation objectives as shown in Figure 6 above. The European Commission (2011) reports that studies are showing species being affected negatively from climate change and exposing them to greater risk of extinction. The EU's sustainable development strategy (SDS) highlights the importance of biodiversity alongside, climate change and renewable energy as key operational objectives and demonstrates the need for a sustainable approach to the co-existence of wind power development and endangered species moving forward. In this regard the European Commission (2011) continues that these directives in relation to the Network's behave as a common legislative framework ensuring human activities, inter alia wind power, are carried out in a way that do not affect the integrity of the sites. The objective of the Birds Directive therefore is to maintain and restore populations of naturally occurring species to ensure long term survival. The directives require that member states establish a general system of protection for all wild bird species throughout their natural range both inside and outside protected sites in relation to Article 5 of the Birds Directive with special attention to those potentially vulnerable to wind farms. Furthermore according to the European Commission (2011), whatever measures are applied to meet the strict protection provisions of both directives, they must be proportional to the assessed impact on the conservation status of the concerned species.

2.5 Existing Mitigation Methods

It is widely agreed within the literature that detailed planning is the most important phase in mitigation with bird sensitivity mapping being highlighted in Scotland and Ireland by Bright et al (2008) and Tierney et al (2012) as well as Lie Dahl et al (2012), Langston and Pullan (2003), Brannisch et al (2015) and Rydell et al (2012) emphasizing the importance of pre-construction studies. However not all factors influencing risk of

collision are considered within pre-screening assessments. Marques et al (2014) suggest future research should therefore focus on the effectiveness of alternative mitigation strategies. Within the aforementioned study the authors have highlighted avoidance (siting of wind farms), repowering (remodeled and based on post construction programs) and minimization (turbine shut down on demand or restriction) as proven options for mitigation. Other methods of high potential included habitat management similar to that discussed in Walker (2008) whereby bird activity is promoted away from turbines and increased turbine visibility. However Rydell et al (2012) disagree in parts with both of these methods. Other possible options discussed within Marques et al (2014) included decoys and attractions and deterrents such as audio and laser displacement. DeLucas et al (2012) and May et al (2015) show positive results relating to selective stopping techniques or temporary shutdown in comparison with other methods such as warning or dissuasion and are considered the best option next to pre-screening. Dr. Martin Green (Vindval, 2015) argues that this will increase wear on the turbines and if the stopping distance is 200m for instance it will not take long for a raptor flying this route and may still risk collision. However May et al (2015), suggest that the first step in implementation of mitigation measures should evaluate site specific species at risk and life-history strategies. Desholm (2009) agrees that it is important to focus attention and direct the resources towards the most sensitive species. May et al (2015) continue that the choice of post construction mitigation is highly dependent upon interplay of a species' sensory faculties, behavior, consequent cognitive perceptions and aerodynamic capabilities for evasion. For example not all species consider turbines as a threat and can be oblivious to danger. According to Langston and Pullan (2003) and May et al (2015), minimization of impacts should be addressed through a mitigation hierarchy of avoid-minimize-compensate whereby collision mitigation always follows a thorough siting process that is tailored to be species specific for each wind farm. Vindval (2015) recently reported on an inventory research project by the University of Agricultural Sciences in Umeå for Vindval whereby flight patterns, habitat and hunting behaviors of Golden Eagles were observed for two years by labelling 43 Golden Eagles with GPS

transmitters. Results from this study reported the birds preferred to hunt at steep slopes and wind power plants should avoid these areas by approximately 50 meters. It was also noted that upland dense young forest would pose less risk to the eagles as they rarely hunted in these types of habitat. The golden eagles were reported to have being chasing the clear cuts within forest and therefore wind turbines should not be within or directly adjacent to the forest clearings. However (Hammarström, 2015) reports in Ledare one fifth of the tagged birds dying from abrasions, dehydration and empty stomachs by October 2013, which highlights doubts surrounding the results of the inventory, and brings into debate questions around deliberate disturbance and killing of species. It is reported that the researchers intend to expand the project although agreement upon funding has not yet been cemented.

2.6 Engagement of Stakeholders

Planning related activities within wind power are frequently vulnerable to conflicts of interest rooted in social power relations, limited knowledge about alternatives and changing circumstances of values and politics. According to Gray et al (2005), one of the crucial constraints of wind farms is the effect of stakeholders. The paper concludes that negative association between stakeholders can stem from poor consultation approaches and a lack of scientific knowledge and data provided. It continues that if these deficiencies are addressed there could develop a more rational and equitable system of stakeholder engagement within wind power development. Aitken (2010) highlights the importance of understanding of varying stakeholder's opinions and shared knowledge in aiding planning approvals. However Ellis et al (2007) and Aitken (2010) suggest that thinking of opposition as something that must be overcome rather than them being knowledgeable and well informed can impact heavily on how a problem is defined and therefore will ultimately affect the conclusions that are reached. It should be noted that understanding among stakeholders is understood as co-evolutionary and respectful of opinion and that although it may not always mitigate opposition or find a definitive

solution, it is important for understanding social constructs more broadly within renewable energy development (Aitken, 2010). Portman (2009) discusses the importance of effective communication within this scope. The presence of transparency among stakeholders is again key in helping promote unbiased presentation of development proposals and helps build trust among the stakeholders which is imperative for continued participation.

2.7 State of the Art - Collaborative Participation

During the 1990's a new form of planning theory emerged known as collaborative or communicative planning led by Patsy Healey and focused on dialogue and open communication instead of power and dominance associated with rational and neoliberal planning theories. According to Healey (1997), it was important to reshape how institutions, processes and decisions were made to be able to deal with modern fragmented society. Although this theory was developed within a community planning sphere it is very much applicable to the wind power or environmental management planning process and varying applied conflicts of interest that may arise. Healey focused upon discourse held among a multitude of stakeholders as a way of working through dilemmas and conflicts of interest within the planning process in a bid to develop shared systems of meaning and ways of acting influenced by Habermas and his theory of communicative action (Habermas, 1984) (Habermas, 1987). Healey (1997) aimed at achieving a flexible understanding of the co-existence of different voices within one place through connecting knowledge with action, mutual learning and the importance of communication within the planning process. Leeper (1996) and Burkart (2007) agree that the major purpose of communication is to facilitate understanding among people and other such systems as organizations, publics or societies. As Healey (1997) simply states the only authority is good argument. It is this good communication in argument that is central to the co-evolution of knowledge and shared systems of meaning among stakeholders. The following sub-sections will look at participation process in more detail

highlighting state of the art features of participation process alongside of collaborative methods and relevant applications to the thesis work.

2.7.1 Participation Process

According to O'Rourke (2014), behind most human-wildlife conflict lies human-human conflict. Therefore it is important to establish effective dialogue and communications among different parties within the environmental planning process in reconciling conflicting objectives (Simao et al., 2009). There has been increasing use of participation as the norm in sustainable development agenda since the 1990's according to Reed (2008) and since the Arhaus Convention (United Nations Economic Commission for Europe, 1998), promoting the rights to access information, public participation in decision-making, and access to justice in environmental matters.

The process involves individuals, groups and organizations (stakeholders) choosing to take an active role in decision making. This process is generally underpinned by a philosophy emphasizing empowerment, equity, trust and learning and the quality of the decisions made through stakeholder engagement is generally dependent upon the nature of the process that leads to them (Reed, 2008). In this regard the process involves the integration of local and scientific knowledge, skilled facilitation and clear objectives.

Different levels of engagement hold different relevance depending on the context and generally stem theoretically from Arnsteins (1969), Ladder of Participation. This ranges from manipulation to active engagement or citizen control and is one of the basis for which the state of the art for participation bases itself upon according to Reed (2008). Warner (1997) highlights the theory of building consensus as being central to participation in attempting to achieve sustainability objectives.

There have been many benefits attributed to participation process according to Reed (2008). According to Richards et al. (2004) it increases trust alongside of the ability to

empower stakeholders and facilitate the co-evolution of knowledge (Greenwood et al., 1993) (Okali et al., 1994) (MacNaughten & Jacobs, 1997) (Wallerstein, 1999). Other important aspects of a participation process involve learning through the development of new relationships, building on existing relationships, transforming adversarial relationships and appreciating the legitimacy of other stakeholders views (Forester, 1999) (Pahl-Wostl & Harte, 2009) (Leeuwis & Pyburn, 2002) (Stringer et al., 2006). Participation also allows for interventions and technologies to be better adapted to local-socio-cultural and environmental conditions and target local needs and priorities as well as developing a sense of ownership that can lead to the long-term support of a project and the active implementation of decisions (Martin & Sherington, 1997) (Stringer et al., 2006).

There has also been criticism aimed at participation process. Kothari (2001) states that participation may have potentially negative interactions within existing power structures and can reinforce existing privilege or group dynamics (Nelson & Wright, 1995). Burton et al. (2004) discuss the potential for consultation fatigue to set in and some (Bororquez-Tapia et al., 2004) (Vedwan et al., 2008) critiquing consultation as 'talking shops' that create ambiguities and delay action o f a project. Abelson et al. (2007) highlight scholars being unsure of what works and what does not when designing participation process and the impacts they have upon participants.

It has been found from the evidence of 239 published case studies in Beierle (2002) that stakeholder involvement within environmental decision making improves the quality of decisions and adds new information, ideas and analysis within the process. Reed (2008) however, warns that the quality of the environmental decisions, are strongly dependent upon the quality of the process that leads up to the decision. In this regard the following sub-section highlights key features in achieving a successful participatory process.

2.7.2 Key features for participation

This sub-section highlights key features for successful participation discussed within the literature.

Luyet et al. (2012) discuss some clear principles for successful participation:

1. A fair, equal and transparent process promoting equity, learning, trust and respect among stakeholders.
2. Integration of local and scientific knowledge.
3. Establishment of rules in advance.
4. Early involvement of stakeholders.
5. Integration of all stakeholders.
6. Presence of experienced moderators.
7. Adequate resources including time.
8. May not always work – cultural, political and historical contexts should be taken into account
9. Involving stakeholders using parallel and varying participatory techniques.
10. Evaluation of stakeholder participation.

Faehnle & Tyrväinen (2013) in evaluating collaborative participatory approaches list the following criteria as important:

1. Improving the knowledge base.
2. Adequate high quality information.
3. Meaningful involvement.
4. Is the participation process worth the effort?
5. Accessibility of information.
6. Opportunities to participate.
7. Aim to realize better plan, better quality of environment and stronger sustainability.

8. Follow up evaluation through further meetings, reflection and evaluation of process.

Reed (2008) discusses a best practice for stakeholder participation below:

1. Underpinned philosophy of empowerment, equity, trust and learning.
2. Importance of early stakeholder engagement.
3. Analysis and representation of relevant stakeholders.
4. Clear objectives for the participatory process at outset.
5. Methods tailored to decision-making context.
6. Highly skilled facilitation.
7. Integration of local and scientific knowledge.
8. Institutionalizing participation.

The key features of successful participation process above are of great importance in laying the foundations for choosing or designing the right public participation mechanism or method. As discussed in Abelson et al. (2007), paying attention to contextual attributes is important in influencing the design and outcomes of the process. The sub-section below discusses particular collaborative methods that can be used and that have influenced the method design in this thesis.

2.7.3 Collaborative Methods

There are many collaborative methods discussed within the literature but it is not the scope of this thesis to discuss them all. The author has chosen particular participatory techniques deemed of relevance to what has been discussed already in the sub-sections above. According to Luyet et al. (2012), the choice of technique is dependent upon the degree of involvement from stakeholders, the types of stakeholders, local and cultural norms, history of stakeholder involvement or past events, intended timing and the

experience of the facilitator. Vacik et al. (2014) have reviewed varying collaborative methods of which the appropriate ones are listed below.

1. 3-6-5 Brainwriting (Rochbach, 1969). This is a group creativity technique generally utilized within a short time period focused upon lots of ideas and points.
2. Action Learning (Revans, 1980). A group process through programing of knowledge to stakeholders and questioning it.
3. Discourse-based Valuation (Wilson & Howarth, 2002). Citizens discuss and evaluate decisions of natural resource management.
4. Focus Groups. Discussion of a small stakeholder group to obtain information for pre-specified issue.
5. Planning for Real (Kingston et al., 2000). Issues on an interactive model or map in workshop environment.
6. Stakeholer Advisory Committees (McGurk et al., 2006). A small group that meets regularly to discuss issues and bring ideas.
7. World Café (Brown, 2001). Group Interaction method aiming to find imaginative ways forward.

Vacik et al. (2014) also highlight varying multi-criteria methods. In fact, the current state of the art in participation within wind power planning focuses upon integrated approaches such as Multi Criteria Decision Analysis (MCDA) Simao et al (2009) and collaborative virtual environments and e-participation using GIS sieve software and approaches in the siting of wind farms (Bishop & Stock, 2010) (Higgs et al., 2008) (Simao et al., 2009). Although extremely innovative with regard wind power planning, these visualization methods are not applicable to the current conflict of interest investigated within this thesis and the author has based the method design on the more traditional listed methods above.

As stated by Abelson et al. (2007), participation is a complex concept with multiple purposes, meaning, levels and methods. After reviewing the state of the art above it is important to define public participation and its method for this particular study.

The stakeholder workshop design for this thesis takes into account chapter 2.7 of the literature review and is framed by five questions from Healey (1997) which are described in more detail within chapter 3 and influenced by the interactive workshop methods/tools of Planning for Real discussed in (Kingston et al., 2000) (Planning for Real, 2015) (Community Planning, 2015) (The World Bank Group, 2001) and other methods discussed above. The formulation of the workshop method has been designed by the author in response to the key principles of participation highlighted within the literature. To complement the workshop a semi-structured interview has been designed for stakeholders unable to attend and takes influence in its design from Zorn (2010), Bernard (2000) and McCammon (2015) and is described in chapter 3.

The stakeholder method of this thesis takes influence from the above literature in attempting to deliver a transparent and collaborative approach to the protection of avifauna within the wind power planning process in Sweden.

2.8 Conclusion

The literature review attempts to frame the context of the proposed research question relating to best practice for mitigation methods relating to wind powers impact upon avifauna in Sweden. In this regard it is understood that an increase in wind power development is compatible with the preservation of viable populations of all bird species within Sweden albeit that some species are more vulnerable to others and if applicable mitigation methods are put in place. As the wind industry is relatively new and how legislation is applied in relation to this has not fully matured or aligned within authorities in Sweden uncertainty can develop within the industry regarding differing environmental

focus. It was discussed that it is difficult to know where to draw the line with a notable lacking of national standard for bird and species inventory. In this regard, best practice relating to mitigation for bird mortality could therefore be considered within the wind power planning process especially considering recent debate in court cases surrounding the deliberate disturbance and killing of species. The European Commission (2011) states that whatever measures are applied to meet the strict protection provisions of both directives, they must be proportional to the assessed impact on the conservation status of the concerned species. In this detailed pre-screening, bird inventory and post construction mitigation options that can be applied on a case by case basis and in line with European legislation can ensure that wind energy is developed in a way that is both sustainable and minimizes impact on bird populations. Approaching this in a fair and equitable manner through stakeholder engagement and participation is central to the findings of this thesis.

CHAPTER 3. METHODOLOGY & DATA

The methodology outlines and describes the applicable data collection methods chosen for the thesis and defines the data. In this respect the chapter also details justification for using this methodology, the sources of data and procedures, administration, treatment and limitations of the data. Finally, the chapter will highlight any ethical issues that may arise through the application of the methodology before concluding.

3.1 Description of Method

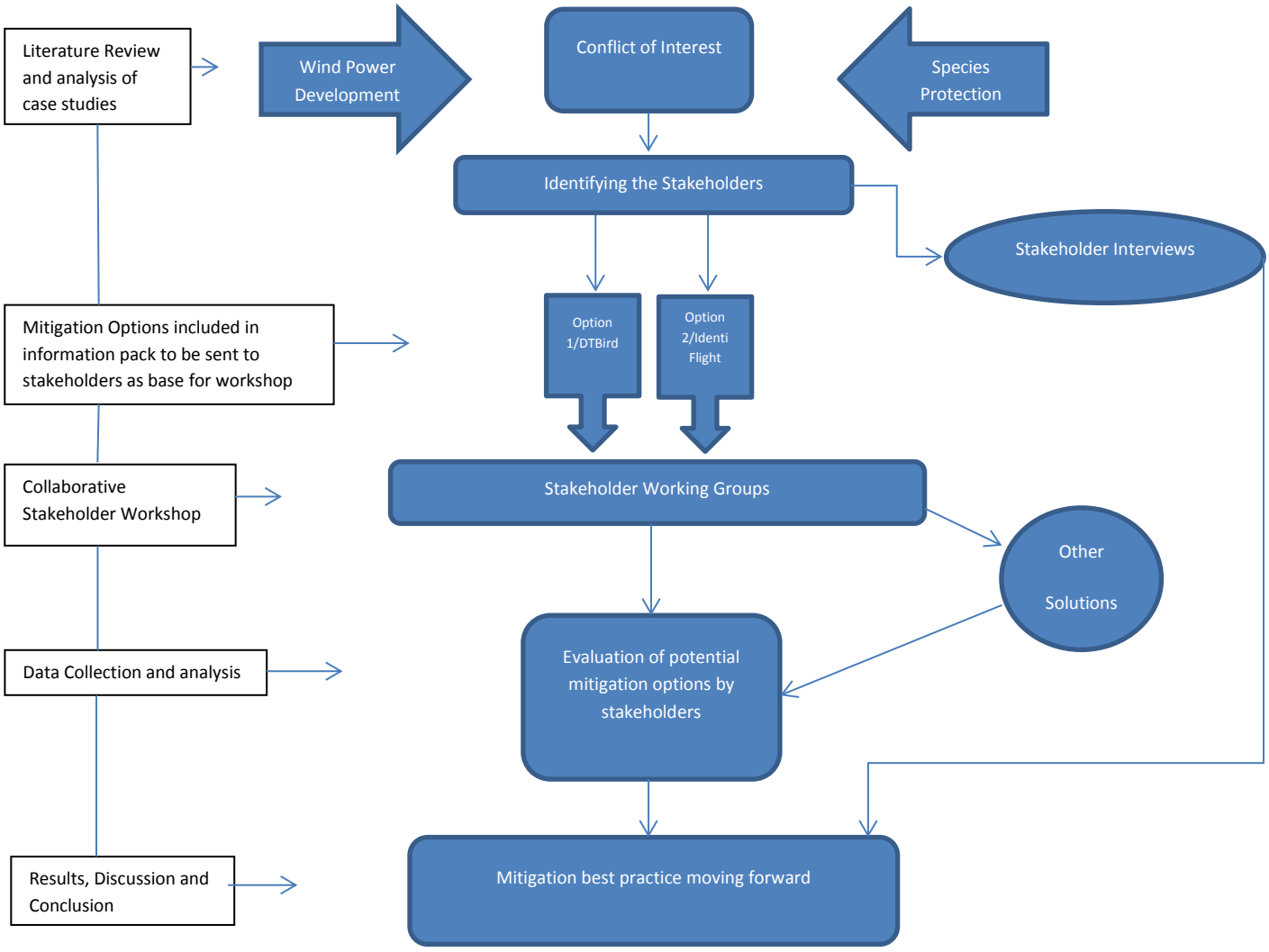

Figure 6 Methodology Outline (Mc Nally, 2015)

In furthering the outline from section 1.4 above, this chapter details the procedure for data collection central to addressing the research objectives. In this regard the methodology is described, sources of data are introduced alongside of procedures, justification for the methods and limitations. The chapter will also detail the treatment of the data alongside of any ethical issues that might arise before concluding.

3.1.1 Analysis of Case Studies

On completion of the literature review an analysis of court cases was decided upon for framing relevant issues relating to protection of avifauna in the wind power planning process. Uncertainty relating to bird protection and the interpretations of deliberate killing and disturbance of avifauna within Artskyddsförordning highlighted the need to investigate relevant wind power permit court cases.

Using the Vindlov (2015) wind power planning tool the author will chronologically review all cases relating to bird protection from October 2010 to March 2015. The cases will be analyzed in detail and the result of each case will be recorded and a small summary made. This information will then be worked into graphical data and be shown in the results section of the thesis.

3.1.2 Stakeholder Workshop

Following on from section 2.6 in the literature review the engagement of relevant stakeholders is central to the thesis work. It was decided that a collaborative workshop should be the method used to obtain transparent and integral data relating to the research question. The workshop is scheduled to take place on 19th May 2015. The author has decided to influence the design of the workshop around Healey's (1997) five questions listed below and take influence from interactive brainstorming and discursive approaches of focus groups, action learning and Planning for Real approaches (Planning for Real, 2015) (Community Planning, 2015) (The World Bank Group, 2001). The

Planning for Real tool builds around a community-assembled model on which problems and improvements are identified through pictorial ‘option’ cards. Although no model exists within this thesis method, an issue pooling technique takes influence from the interactive use of cards as a means of exchanging views and information. This will hopefully provide a common reference point to structure inputs, and allow for a broader perspective of issues as well as providing a physical base for placing suggestions.

1. Where will the workshop take place?

The workshop should take place within a neutral venue to ensure all stakeholders are placed on an even platform and to help detract any power relations that may exist within the stakeholder group. In this regard the venue that will be used is room E35 in Uppsala University, Campus Gotland. It should also be noted that the room choice is based on the large size of the room and the natural light that occurs there from one wall of windows. The author believes as natural an environment as possible will help put stakeholders at ease and hopefully encourage natural discursive behavior.

2. What style will the workshop take place within?

The style of the workshop will attempt to be un-formal and interactive. There will be no presentations at the workshop. Again the positioning of knowledge will attempt to extract power relations among stakeholders. Each stakeholder is seen as being as knowledgeable as the next and it is hoped the collaborative approach will allow knowledge to be shared openly. Stakeholders will gather around a table as the focus point for the workshop highlighting the importance of face to face discussion and co-evolution within working groups. The author’s role will be one of chairperson or facilitator who ensures the itinerary runs smoothly and to time while recording the workshop minutes.

3. How can issues be sorted?

It was decided on an interactive approach where issues are first discussed within mixed stakeholder working groups to encourage debate and compromise. The working groups will be given approximately 30 minutes to discuss relevant issues relating to protection of avifauna and potential mitigation options moving forward. Within these groups stakeholders must brainstorm issues and make a list of keywords. Each key word should be written on a provided piece of card. After the working group the keyword cards are collected by the chairperson and posted within an issue pool on the white board within the room. From here the issues are then sorted into positive and negative issues.

4. How can a discourse of the problem be created?

Discourse is created by systematically going through each issue one at a time and inviting the stakeholders to further discuss the issues highlighted within the keyword cards. The keyword cards will be moved to another part of the white board as they are discussed with notes being made on the whiteboard as the discussion progresses. The floor is now open for debate on each topic and it is hoped that relevant knowledge is shared from stakeholder to stakeholder in an effort to co-evolve solutions to each issue. This process attempts to be transparent in its approach.

5. How can an agreement be reached while continuing to adapt?

The final part of the workshop includes a review session. The chairperson will lead the stakeholders through the issues and discussion that took place and highlight the areas of agreement or disagreement, solutions if any and potential approaches in moving the discussion forward if needs be.

For a more detailed look at the methodology a step by step guide to procedures and instruments is included in Appendix G.

3.1.3 Semi-structured Interviews

Due to the challenging logistical conditions of bringing together a diverse group of stakeholders from varying organizations to take part, it was decided to compliment the stakeholder workshop with a stakeholder interview to collect data from important stakeholders within the process that are unable to attend the workshop. It was decided to design a semi-structured survey for this purpose. This open ended approach is considered to have most in common with the discursive element of the stakeholder meeting and it is hoped that the results will complement one another. The survey is designed by the author and reviewed by the supervisor and advisor and can be viewed within Appendix B. Considering the time constraints of the thesis the survey will not be able to go through a stricter verification process or a test run. Zorn (2010), Bernard (2000) and McCammon (2015) outline the important variables when developing a semi-structured interview and have been used to influence the application of this research method for the thesis. In this regard the semi-structured interview is built around identifying stakeholder specific insight and perspective into the issue being proposed in the research question. The gathering of focused qualitative data is central to this with the balancing of a structured survey and the flexibility of an open ended interview. This hopefully will allow the interview to move from general topics to more specific insight.

The interview design is guided by the following criteria discussed in McCammon (2015):

1. Use open ended questions.
2. Bias – Avoid any leading questions.
3. Language – Use understandable terms taking into account language, knowledge and cultural background.
4. Concise – Use short and specific questions and do not attempt to pose two questions in one.
5. Frame – Avoid questions with strong negative or positive association.

A guide to procedures and instruments is included within Appendix H.

3.1.4 Evaluation of Stakeholder Workshop

To evaluate the stakeholder workshop section of the methodology a structured survey will be developed and handed out to the participants at the end of the proposed workshop. The stakeholders will be asked to fill out the survey individually. It is hoped the evaluation will highlight the usefulness of the workshop method in addressing the research question and within the broader context of wind power and renewable energy planning in understanding social constructs and as a potential decision making tool in the future. The survey will use a mainly structured, closed question approach to allow graphical representation of the data which can be viewed in the results section of the thesis. The survey form can be viewed within Appendix C.

3.2 Justification of Methodology

The primary objective of the thesis is to move towards best practice for bird mortality mitigation for wind turbines. The review of literature and an analysis of case studies will attempt to frame the conflict of interest and highlight relevant stakeholders involved within the conflict. The engagement of relative stakeholders therefore is seen to be an unbiased approach to data collection given the diverse opinions relating to the protection of avifauna in wind power planning within Sweden. In addition a collaborative workshop approach hopes to allow all opinions present be discussed in a fair and equitable process and to provide a platform for shared knowledge and transparency between stakeholders. The design of the workshop looks to gather issues, concerns and opinions of the relevant stakeholders within a mutual learning environment rather than information being presented to the group with already decided upon solutions. The learning by doing approach therefore is designed to detract power relations from the workshop and focuses upon the co-evolution of stakeholders towards a more informed decision making process and potential solution. Although this discursive or argumentative approach can be a potentially more drawn out process it allows

stakeholders the opportunity to meet on a level playing field where compromises must be met in developing a shared journey.

A complimentary data collection method will look to address logistical limitations in stakeholder attendance at the workshop. Semi-structured interviews on stakeholder groups unable to attend the workshop will be carried out. The open ended questions are designed to simulate some of the broader topics of dialogue that are expected at the workshop. Although a different method from the collaborative working groups it is hoped these open ended questions will be complimentary to the thesis work as a whole and ensure a full range of stakeholders are addressed regarding the research question. The choice of methodology is also applied to infer whether such an approach is useful within the broader context of wind power and renewable energy planning in understanding social constructs and as a potential decision making tool.

3.3 Sources of Data/Unit of analysis

The sources of data for the methodology are the court cases published within Vindlov (2015), the stakeholders that will take part within the workshop alongside of interviewees. The relevant stakeholders within the scope of the thesis are those involved within bird protection and the onshore wind power planning process in Sweden. This will include members of the County Administrative Boards (Länsstyrelsen), the municipalities, wind power developers, ornithologists, the environmental courts, academics, wind farm applicants and experts on the specific mitigation technologies DTBird and IdentiFlight presented within Appendix A.

3.4 Data Collection Procedures/Instruments

The data collection commenced through the review of literature and analysis of the case studies. The analysis of court cases helped frame the research question and structure the stakeholder workshop and its participants. The planning of the workshop highlighted the

full range of stakeholders that would be present and in this regard made apparent those stakeholders that could not attend or that would be beneficial to the data collection. At this point it was decided to continue with the stakeholder workshop but to develop a complimentary section to the methodology whereby semi-structured interviews were carried out with those who could not attend.

A step by step description of the procedures and instruments for the stakeholder methodology and interview are outlined within Appendix G and H.

3.5 Limitations of Methodology

This sub-section details potential limitations of the methodology. Regarding the analysis of the court cases, the cases will be translated from the Vindlov planning tool from Swedish to English and the drawbacks of using an online translation tool will mean numerous review sessions of the data with a Swedish speaking supervisor. This is expected to be a time consuming process. The main drawback of the stakeholder workshop will be the logistics of bringing together a diverse group from varying organizations to take part. It is difficult to schedule all relevant stakeholders to attend a workshop at the same time and place due to the demands of varying organizations day to day work. Due to time and resource limitations the majority of the stakeholders included within the workshop will be from the island of Gotland. Results of the workshop would vary depending on other municipalities and County Administrative Boards being present. The workshop is not designed to deliver a definitive solution to the problem. Instead it is used as a process to work towards finding a solution. Potential absenteeism must also be taken into account as a limitation and due to the relatively small sample size within the workshop this could significantly affect the results. The semi-structured interview is not without its limitations either. The level of data recorded will be dependent on the skill of the interviewer in developing the conversation and also on the articulacy or level of language of the respondent. The interviewer may also give off

unconscious signals that unintentionally guide the respondent. The reliability of this method could also be questioned as it is difficult to exactly repeat previous conversations which can lead to the interview being non-standardized. This however may also be considered a strength if it unintentionally unearths some relevant information not previously considered by the author. Other relevant limitations which might also be considered for the stakeholder workshop are the relatively small sample size, difficulty in analyzing the qualitative data and the validity of a stakeholder's participation. It is possible that a stakeholder could have a political motivation to behave in a way that lacks integrity. It should also be noted that the list of stakeholders is not exhaustible and criteria for selection was based on availability and willingness to participate.

3.6 Ethical Issues

Ethics relates to interpersonal behaviors and highlights the importance of the quality of these interactions (Wilcox and Ebbs, 1992). The framework for this thesis methodology attempts to base its foundations on this concept. The initial thesis abstract was to evaluate bird protection mitigation technologies for the wind industry. However due to complexity of stakeholder opinion within wind power planning and specifically with regard protection of avifauna it was decided that the thesis would be more ethical and perhaps hold more value if the stakeholders were facilitated a platform to evaluate potential mitigation options among other issues themselves. In this regard how knowledge is situated is given careful thought to alleviate power dominance within the social relations. Although representatives from two technologies are invited to the workshop, they will not be afforded the opportunity to present information at the workshop. Instead the workshop will focus upon the equal sharing of knowledge between stakeholders within a collaborative environment. In this regard information distributed within the information pack (Appendix A) prior to the workshop will be made clear to be a discussion aid and should not be considered as the only solutions to the conflict of interest. Within this information pack the author will present the

published information on the technology options DTBird and IdentiFlight in an unbiased manner. It is also important that the author, whether as facilitator or interviewer, remains in the neutral position of objectivity throughout the running of the methodology. Although difficult to achieve, this will be attempted through continuous self-reflection both in the design of the methodology as well as throughout the process of the workshop and interviews taking influence from the literature in section 2.7 above. This will be assessed in part within the workshop evaluation survey to be handed out to the workshop stakeholders at the end of the workshop. In this regard, the ethics surrounding power relations and objectivity is a cornerstone of the thesis work and must be taken into account if replicating the methodology.

3.7 Conclusion

The analysis of court cases, stakeholder workshop and semi-structured interview were described in detail within this chapter inclusive of data sources, justification and limitations of the method alongside a step by step approach to procedures and instruments highlighted in Appendix G and H. Data treatment and ethical issues that could arise when conducting the research were also described.

The data collected throughout the methodology is intended to address the research objectives of achieving the thesis goal of moving towards a potential solution for bird mortality mitigation within the wind power permitting process for Sweden through engagement of the relevant stakeholders. A secondary research goal will attempt to evaluate the collaborative workshop design put forward for future use within the broader context of renewable energy and wind power planning.

Chapter 4 highlights the application of the methodology outlined above, the analysis of the data and delivers the results.

CHAPTER 4. APPLICATION OF THE METHODOLOGY & RESULTS

4.1 Introduction

Having established the methodology in the previous chapter, the current chapter attempts to present the results in relation to the research question. In this regard the results will be interpreted but no discussion, comparison or conclusions will be made until the following chapters of the thesis.

4.2 Subjects

The subjects for the methodology were the stakeholders available for the workshop and the semi-structured interviews. It was attempted to include a wide variety of stakeholders involved within the onshore wind power planning process in Sweden. The subjects are listed below.

4.2.1 Stakeholder Workshop

For the stakeholder workshop, which took place on the 19th May 2015 at Uppsala University, Campus Gotland, it was attempted to gather a wide range of stakeholders relevant within the wind power planning process in Sweden and experts in the field relating to bird mortality mitigation and are listed in the table below.

Table 1 Workshop Stakeholders

Name	*Role*	*Representing*
Alan Derrick	*Technology Expert 1*	*Renewable Energy Systems (Identiflight)*
Fredrik Litsgård	*Technology Expert 2*	*Ecocom (DTBird)*
Mårten Hjernquist	*Ornithologist*	*Nässudden Control Program*
Anna-Lena Fritz	*Länstyrelsen*	*Länstyrelsen Gotland (Head of Environmental Protection unit)*
Gunnar Gustafsson	*Municipality*	*Head of unit at Region Gotland*
Marianne Ansen Nilsson	*Municipality*	*Region Gotland*
Madeleine Johansson	*Municipality*	*Wind power representative at Region Gotland*
Andreas Wickman	*Project Developer*	*Vice Chairman GVP*
Josefin Knudsen	*Project Developer*	*Regional Wind Coordinator*
Liselotte Alden	*Wind Power Academic*	*Uppsala University*
Pontus Bornold	*Wind Farm Applicant*	*Farmer on Gotland*

The stakeholders were randomly split into mixed working groups and undertook a brainstorming exercise. Each working group was given a different color pen (Blue, Red or Green) to decipher issues from group to group and to aid legibility in discussion for the workshop facilitator/author. The groups are listed in the table below.

Table 2 Working Groups at workshop (McNally, 2015)

Blue Group	*Red Group*	*Green Group*
Fredrik Litsgård (Ecocom)	Gunnar Gustafsson (Region Gotland)	Madaleine Johansson (Wind Power Rep. Region Gotland)
Anna-Lenna Fritz (Länstyrelsen Gotland)	Andreas Wickman (Vice Chairman GVP)	Alan Derrick (Identiflight – RES)
Josefin Knudsen (Regional Wind Coordinator)	Liselotte Alden (Uppsala University)	Marianne Nilsson (Region Gotland)
	Pontus Bornold (Wind Farm Applicant/Land owner)	

4.2.2 Semi-structured Interviews

The semi-structured interviews were used for complimentary data in a hope to make up any stakeholder participation shortcomings from the workshop. The interviewed stakeholders are listed below.

Table 3 Interviewed Stakeholders

Name	*Role*	*Representing*
Ingemar Stenbeck	*Project Developer*	*Vasa Vind*
Joen Morales	*Technical Expert to Courts*	*MMD Vänersborg*
Maria Paijkull	*Environmental Legal Representative*	*Gärde Wesslau*
Sara Huss	*Länstyrelsen*	*Jämtland Läns*

4.3 Treatment of Data before analysis

For the purpose of the case study analysis, the cases were first translated using an online translation tool and the translations were reviewed with a Swedish speaking supervisor. The result from each case was then recorded with a brief summary/outline of the case within a timeline for ease of use in analysis. This was done using excel software. In conjunction with this a histogram was produced within excel showing the results/outcomes of the court cases again for ease of use when analyzing and to help visually represent the data.

Regarding the stakeholder workshop, the participation was recorded as minutes of the meeting on a large whiteboard within the room. These minutes were then photographed for the author's records and written up as more detailed minutes and sent to stakeholders to review. Any amendments made by the stakeholders were then recirculated before being interpreted for the results.

For the semi-structured interviews the data was recorded in short hand through phone conversation by the author on a predetermined survey sheet shown in Appendix B. The raw data was then tidied up by the author immediately post phone conversation for ease of use in analysis and to ensure reliability of data.

4.4 Results

The results recorded from the three individual parts of the methodology have been analyzed, interpreted and presented within the sub-sections below.

4.4.1 Court Case Data & Results

This sub section highlights court decisions relating to protection of avifauna within the wind power planning process.

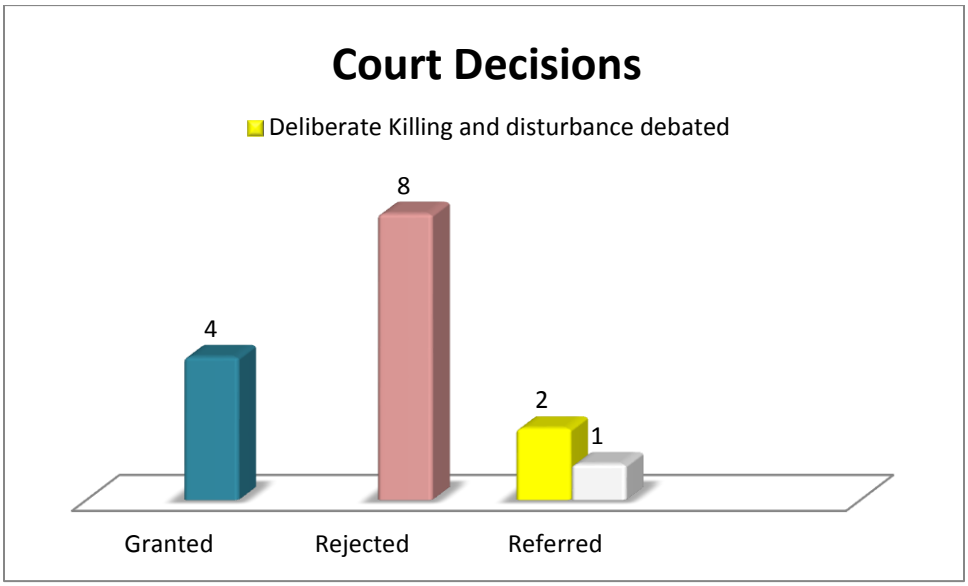

Figure 7 Court decisions. Data from Vindlov (2015). (McNally, 2015)

Figure 7 above and Figure 8 below highlight that 4 permits have been granted, 8 have been rejected and 3 have been referred, 2 of which debated the deliberate disturbance and killing of birds. Decisions on the cases have been decided upon relating to the general protection of birds inclusive of Environmental Impact Assessment, quality of bird inventories and impact or threat to the population versus the importance of the development to public interest. Within two of the cases the deliberate disturbance and killing of species has been debated. This is highlighted in yellow in Figure 12 and summarized briefly below.

Kalmar – M2920 -14

Operation would not constitute the deliberate disturbance or killing of wild birds. Referred for consideration of other issues.

Boge Gotland MÖD – M4937-14

Companies application for exemption rejected relating to Species Protection Ordinance. Building of turbines and argument to use DTBird as a test/validation seen as deliberate disturbance. Case being tried again through the Environmental Code.

Glötesvålen - M10316-09	Gullberg Söderhamn - M7639-11	Gotland, Mästermyr - M8344-11	Ånge - M7865-12	Sällstorp Varberg - M10072-13	Brommö Mariestad - P9722-12	Mora - M250413	Torsås - M9329-13 P9351-13	Aneby - M7168-13	Treriksröset-Halmstad/Hylte/Ljungby - M9473-14	Gullspång - M4358-14	Kalmar - M2920-14	Boge Gotland MÖD - M4937-14	Sävsjö - Hylletofta MÖD - M2538-14	Strängnäs - P5593-1
2010-10-14	2012-05-29	2012-07-04	2013-04-11	2013-08-13	2013-10-09	2014-04-03	2014-04-04	2014-04-16	2014-08-27	2014-11-14	2014-12-22	2014-12-22	2015-02-06	2015-03-09
Granted. Impact on avifauna acceptable due to viable population.	**Rejected**. Shortcomings in EIA and lack of alternative options.	**Rejected**. Too large an impact upon avifauna population.	**Granted**. Limited risk to protected species.	**Rejected**. Buffer zones and severe risk to bird habitat not adhered to.	**Rejected**. Lack of documentation relating to avifauna.	**Rejected**. Company has not shown site is a suitable location due to area's importance as bird habitat.	**Granted**. Site does not pose significant threat to avifauna.	**Reffered**. Appropriate bird inventory not performed and not sufficient for examination to be made.	**Granted**. EIS inclusive of its complimentary investigations was in line with legislation.	**Rejected**. Injunction to seek permission by the CountyBoard relating to impacts on birds/appeal on refferal was rejected.	**Referred**. Operation would not constitute the deliberate disturbance or killing of wild birds. Referred for consideration of other issues.	**Referred**. Companies application for exemption rejected relating to Species Protection Ordinance. Building of turbines and argument to use DT-Bird as a test seen as deliberate disturbance/killing. Being tried again through Environmental Code.	**Reffered**. Avifauna not investigated sufficiently and need for follow up inventory.	**Rejected**. Area of high national interest for avifauna. Siting not suitable to natural values of the area.

Figure 8 Summary of Court Cases. Data from Vindlov (2015). (McNally, 2015)

4.4.2 Stakeholder Workshop Results

The stakeholder workshop was designed to gather information and share knowledge among stakeholders relevant to the research question posed. There were ten people in total invited to the stakeholder workshop. Of the ten invited, one stakeholder was unable to attend due to unforeseen circumstances. This highlighted a 90% attendance rate for the workshop. It must be noted however that one additional stakeholder attended the workshop which increased the number of participants to 10. There were three working groups in the workshop, blue, red and green. These working groups were randomly selected on the day with each group receiving a colored pen to decipher the groups from one another. The issues chosen for discussion by the stakeholders in the working groups are shown in Figure 13 and Figure 14 below. In total the working groups came up with 22 issues for discussion. 8 issues came from the blue working group, 5 from the red group and 9 from the green group. These issues were then sorted by the facilitator and stakeholders within the workshop to highlight five major topics of discussion detailed below. The minutes of the workshop can be seen in detail in Appendix F.

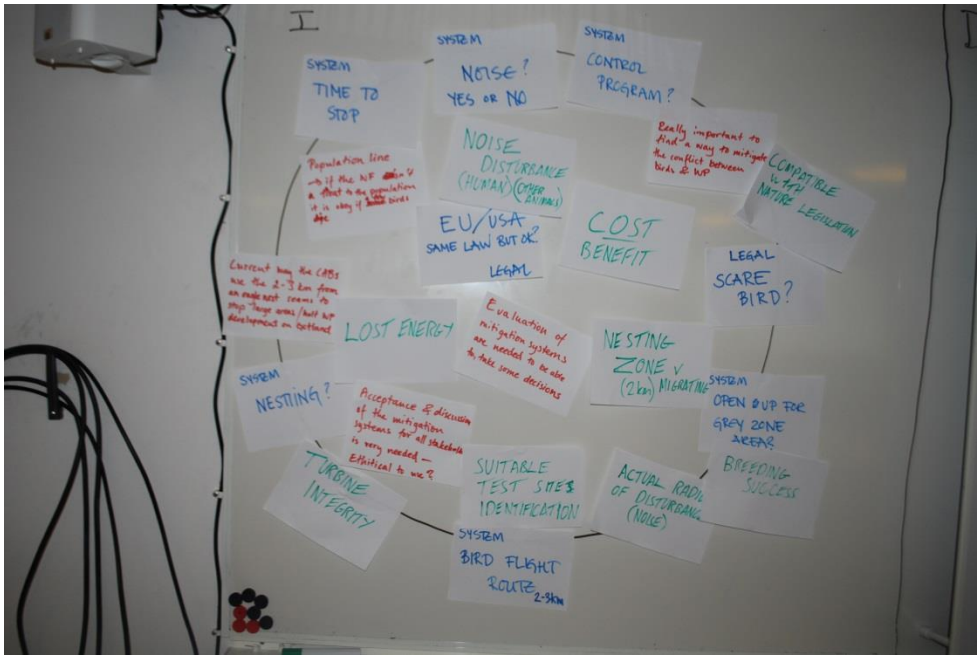

Figure 9 Stakeholder Issues from workshop 19th May (McNally, 2015)

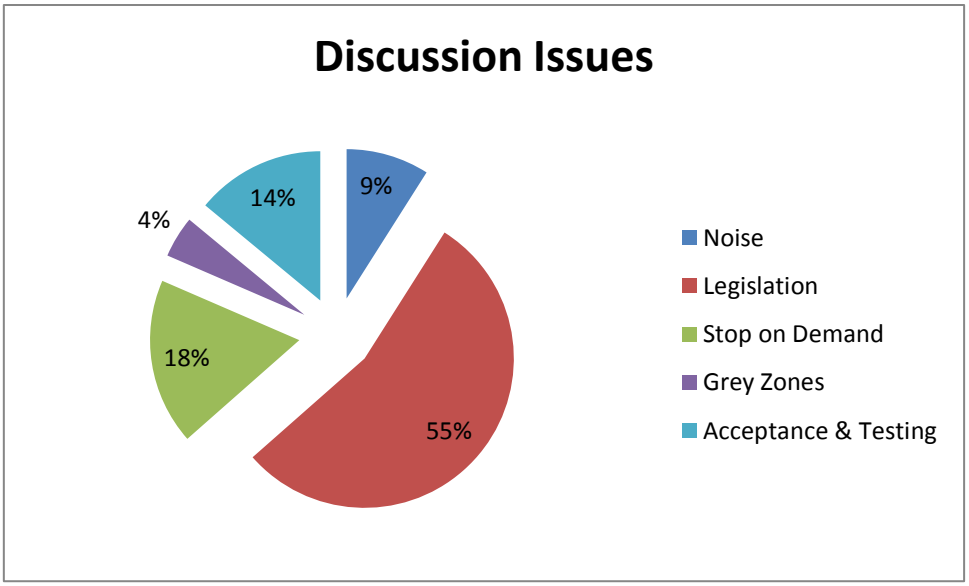

Figure 10 Discussion Issues at workshop (McNally, 2015)

The minutes of the workshop were transcribed from photographs of the white board (as seen in Figure 11 below) and recorded within a word document. This document was sent to the stakeholders that were present at the meeting. Stakeholders were given the opportunity to amend the minutes sent to them if needed. The document was amended by one of the stakeholders which was made available to all again. The amended document was then used as the final results or data from the workshop and is interpreted below.

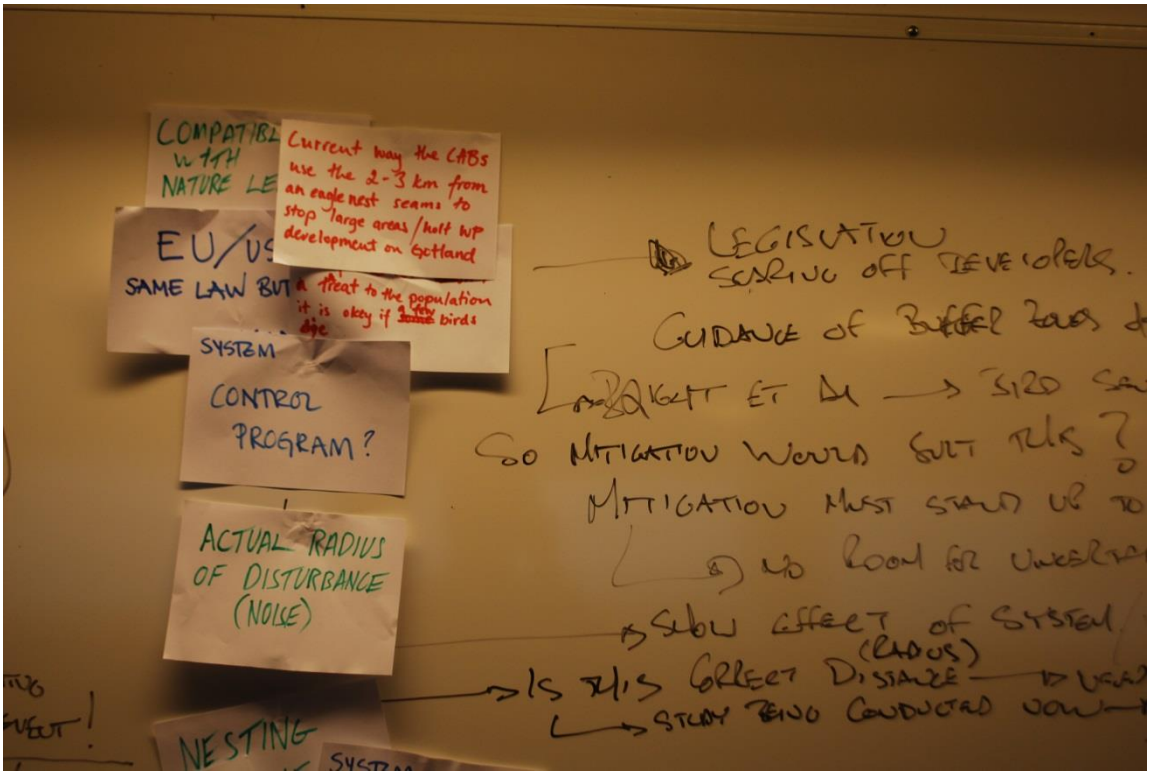

Figure 11 Minutes on white board (McNally, 2015)

a) Noise

9% of the issues chosen within the working groups related to noise. Both the green and the blue group highlighted noise within the working groups. Within the discussion forum it was discussed whether mitigation methods should use noise for warning and dissuasion of species as some considered it to be a disturbance to species. It was also noted that in general adding noise within wind power development is a taboo topic due to societal concerns.

The discussion highlighted the use of one technology DTBird as it uses sound within two of its modules for warning and dissuasion of species which can be read about in more detail within Appendix A. It was noted that volume control was available within the technology and that the company were currently experimenting with different noises, attempting to teach birds to avoid sounds such as the recording of a turbine noise played at a higher volume. Threat and warning calls were also being worked on within the company designed to warn but not scare the birds which was debated as to whether this would cause deliberate disturbance.

The forum also stated that there would be different criteria for nesting birds and migrating birds and asked how could this be addressed.

It was also highlighted within this topic that a recent study using DTBird showed less than 10% dissuasion recorded. However this was due to the system not being calibrated correctly and therefore did not function to its potential and according to DTBird the study was not relevant due to these conditions. It was agreed within the forum that the system required further scientific validation if it is to be used.

b) Legislation

54.5% of the issues chosen within the working groups related to legislation. All three groups came up with multiple issues relating to legislation within the working groups. It was clear that this was the most contentious issue among stakeholders. The issues highlighted related to EU legislation, radial nesting buffer zones, compatibility with Artskyddsförordning, breeding success, flight paths, deliberate disturbance and scaring of birds and the need to evaluate systems for decision making purposes.

It was discussed that legislation was scaring off developers. Specifically how the legislation was being interpreted within the courts was of significance. The question was asked whether mitigation options available would be suitable for legal interpretations. It was noted that the mitigation techniques must stand up to independent scrutiny and due diligence as there was no room for uncertainty for the developers due to high investment costs needed. Therefore it was discussed that the mitigation techniques needed to be tested in relation to radial distances prescribed and whether there was room to alter the prescribed distances. In this regard, an example of current research was given where preliminary results showed birds still breeding within radial buffer zones but that the success of the breeding had lowered.

In relation to geometric constraints it was discussed if the buffer zones should be radial and that examples of eagles being found dead at Nässudden wind farm in Gotland nowhere near nests and probably while hunting. It should also be noted here that the nests are only 1.5km from the nearest turbines at Nässudden. It was suggested that perhaps nesting is not an issue in this regard.

Regarding disturbance, it was noted that it is species specific depending upon sensory sensitivities of aural or visual disturbance. In this regard it was noted that wind farms already disturb. For example, the disturbance of a birds flight path and/ routes of migratory birds.

It was noted at this point that there appeared to be insecurity in where the knowledge lies in relation to data on avifauna such as eagle nest locations and territories and that the level of knowledge within the authorities was uncertain. This was seen by most as a big problem with ornithologists holding the data and knowledge and not being willing to share the data due to general opposing of wind farm development. It was discussed how this mistrust could be solved between the ornithologists and authorities. It was noted that approaches currently being used within an American program by the American Wind Wildlife Institute whereby the authorities handle the data could be a possible approach. It was asked whether the authorities could ask for the data and suggestion of CAB authorities owning data and/or carrying out own surveys. However it was suggested that the ornithologists feared developers getting information or data

from nesting sites as this potentially could lead to corruption. It was put forward that there was room on Gotland for a control program/inventory run by the authorities.

In addition it was agreed that there was room to evaluate and verify different mitigation systems but a need to first categorize mitigation and what will be acceptable mitigation depending on species and behavior.

c) Stopping turbine on demand

18% of issues chosen within the working groups related to being able to stop the turbine on demand. As this was a feature of both proposed mitigation technologies within the information pack there were a number of discussions relating to turbine integrity, energy loss, cost benefit and how long it would take the turbines to stop and restart.

It was noted that stopping the turbines is not a problem but the accuracy of the system stopping the turbine is very important. In this regard normal stops are considered to be the best for turbine integrity. For this to happen time to identify species needs to be compatible with a turbine stop which takes approximately 30-40 seconds depending upon the turbine model. It was highlighted that the IdentiFlight technology had the capability to do this as it is species specific technology with long range detection of between 800m and a 1km. It was noted that random stops are already in place in some wind farms to address noise issues, shadow flicker and ice throw but that in relation to bird stoppages better surveys were needed to predict stoppages and make sure the entire wind farm was not shutting down regularly to ensure minimal energy loss and associated cost. The position of the camera was noted to be of extreme importance for this. The IdentiFlight technology was highlighted again here and it was noted that the system is independent of the turbine and creates a detection zone for every 2-3 turbines. For this to be successful, the height of the camera needs to have a clear view for over a kilometer. Additional technology for stopping turbines from RES was also highlighted at this stage. This involved using eagle ring tracking transmitters placed on the eagles but that the technology was further behind in development currently. Validation of Identiflight was noted as being underway within a wind farm with a bird mortality problem in America and the camera system had detected 200 eagle flights in the first 6 weeks of deployment in conjunction with ornithologists. The verification of

this data will lead on to an agreed control program to replace people with the system operating automatically.

It was asked at this point if the technology used noise to scare birds away similar to DTBird. The IdentiFlight representative stated that the philosophy of RES is to have low sound emissions at wind farms and so the company focuses on video detection and identification and turbine stops. It was noted that currently ornithologists were being used to stop the wind turbines during the validation phase but when in full use the system will be able to automatically stop turbines.

d) Grey zone areas

4.5% of the issues chosen within the working groups related to Grey zone areas. Only the blue group suggested an issue relating to this but it was agreed that it was an important issue to discuss.

The grey zone referred to when there was a risk to species but a small risk. For instance, if there were a lot of eagles but no nests nearby. It was asked how this could be approached. For recommendations to this problem it was suggested that the mitigation options provided within the information pack in Appendix A could help this as well as a long term inventory or control program. Therefore it was asked if the grey zone was a perfect area for mitigation. Here discussion on dense nesting areas arose again for use of mitigation but it was considered that there would be too much risk of disturbance or too much down time for the turbines and would not be a financially viable wind farm.

Again it was highlighted within the group that post construction mitigation was considered a good option only if a good survey was done prior to use as eagle territories will always remain even between eagle generations. A new generation will assume similar flight paths and use old nests which can be a problem.

In general it was agreed that the more knowledge relating to this would lead to more clarity in decision making.

e) Discussion, Acceptance and Testing mitigation

14% of the issues chosen within the working groups related to discussion, acceptance and testing of mitigation technology. Both the red and the green working groups highlighted these issues.

The importance of testing and validating systems within Sweden was seen as very important. It was noted that DTBird was currently being tested on the mainland in Skaraborg.

It was discussed that a trial at Nässudden could be an alternative testing site for Sweden due to good information from the control program performed by Hjernquist (2014). It was noted that this was the longest control program in Sweden currently. It was also stated within the group that without stop on demand mitigation that birds would be killed. In this regard it was asked what level of killing is accepted and what is ethical. It was put forward within the workshop that according to Artskyddsförordning, any level of killing was unacceptable. The group suggested that the problem should be looked at from a level of risk point of view and that this would help put the problem in context. For example a weighting of societal benefit versus a risk to species.

4.4.3 Semi-structured Interview Results

In relation to the semi-structured interview questions posed within Appendix B, this section presents the results. The questions were delivered as semi-structured leading to the phone interviews being conversational.

By asking about the expansion of wind power and protection of avifauna it was hoped to get stakeholder knowledge on the general conflict of interest. In addition the interviewees were asked to clarify this through their thoughts on legislation and the deliberate disturbance and killing of avifauna through the development of wind power. It was hoped also to acquire a level of knowledge or awareness of mitigation approaches from relevant stakeholders when asked to consider mitigation options available today. Finally it was hoped to initiate

discussion and gather stakeholder knowledge relating to best practice on bird mortality mitigation moving forward.

a) In relation to the co-existing of wind power and avifauna, project developer for Vasa Vind, Ingemar Stenbeck, stated that although it was complex it would be possible. The developer highlighted a lack of available knowledge on nesting and bird behavior as a major problem at the moment relating to the permit process and legislation. Stenbeck believes focus is over cautious which is leading to developer uncertainty due to the large amounts of investment needed in the early phases of planning a project. It was suggested that more knowledge on birds was needed. According to a legal representative, Maria Paijkull, partner from Gärde Wesslau, it was important that the wind farms be erected in a good location and in this regard the work done in the planning and pre-screening process was of most importance. According to Joen Morales the technical advisor for Vänersborg Land and Environmental Court, wind turbines were not as big a threat to avifauna as other industries and stated that good siting was the most important factor in the two co-existing. Finally according to a representative from Länsstyrelsen Jämtland, Sara Huss, good siting is essential to avoid impact on avifauna with one strictly practicing distances to nests and breeding sites during the siting process.

b) In relation to deliberate disturbance legislation, the project developer believed the legal part was linked to knowledge on birds and the value placed upon avifauna. It was also highlighted that industries such as forestry and agriculture were exempt from legislation regarding the deliberate disturbance and killing of species. The developer saw this as unfair within society and made it extremely tough for developers. It was also highlighted that the wind industry was a newer industry using different parts of landscape not used before which had different legal implications. The developer also pointed out that the number of birds being killed needed to be put in context. According to the legal representative from Gärde Wesslau, cases should be looked at on a case by case basis but that deliberate disturbance and killing should be interpreted on an overall population basis and not on impact to individual birds. The legal representative continued that the courts sometimes focus upon the individual bird that is being killed rather than the effect on overall populations. The technical advisor for Vänersborg Land and Environmental Court stated that under the Environmental Code,

Chapter 2 (see Appendix D), one must first locate the turbines on the best location possible. The location must be compared and weighted against other possible locations and the best one chosen. Within this scope, the environmental variables must be compared between the sites. These variables include bird species and potential impacts, noise, shadow flicker and ice throw etc. When this approach is taken, the case will not be interpreted as deliberate disturbance or killing according to Morales. If there is a nest or a feeding area one must compare the sites put forward and pick the one that has the least impact upon the nest. In this regard there must be a compromise on a case by case basis depending upon the evaluation of the sites. However if the potential impact falls within Artskyddsförordning and the risk is too big, the judge must consider the case as deliberate. Deliberate in this sense is when one knows of the risk but goes ahead with the process. However, if the risk is small the judge can graduate the risk whereby the level of risk does not constitute deliberate disturbance. Morales continues that a good analogy of this is a comparison with traffic. When one drives there is a risk of hitting a person but the risk is so small society has accepted it. Therefore the risk of impact upon avifauna must be so low so as to not constitute deliberate. Sara Huss states that the County Board in Jämtland are of the opinion that wind turbines do not deliberately disturb or kill birds and that although it is not an ideal situation with wind farms, if sufficient precautionary measures are taken it should not be considered as deliberate.

c) In reference to mitigation options available today, the project developer Stenbeck believes a mix of pre-screening and post construction technology such as DTBird would be the best approach. By having maneuverability on buffer zones for nesting etc., the developer believes that there is space enough for wind power development within large undeveloped areas. However within high density areas of bird populations such as Gotland, DTBird could be a very interesting option. The developer believes that planners tend to be skeptical, conservative and slow to act on such issues and therefore more data and demonstrations of the technologies are required before anything will change. The legal representative hopes that mitigation options can be useful within the process but that they should not become mandatory for permit cases. A recent demonstration on DTBird in Skaraborg, Sweden, attended by the legal representative, was thought to focus more on the technicalities of installing and less about how it works and conclusions drawn. The legal representative Paijkull’s

impression was that the results were not there for the technology and an air of secrecy surrounded them. It is believed that the Swedish authorities need validated results for technologies to be used in practice and they should not be used as a tick the box approach or smokescreen within the planning process. The technical advisor for Vänersborg Land and Environmental Court believed that technology such as DTBird was very useful technology and could be used within a semi-improper location or grey area to help avoid collisions relating to the graduation of risk. However if there is a risk to the overall habitat being destroyed from the development, the technology would therefore not constitute good mitigation practice. The judge continued that the technology DTBird should be applicable to other industries such as the construction of tall buildings which heavily impacts upon avifauna also (speaking of dissuasion and warning modules of the technology). According to Sara Huss the planning phase of a project is the most important for mitigation. Knowledge gained during the bird inventory is the most important aspect of the process and can then be applied with regard areas of high activity, 2km distance to nests and 1km distances to breeding grounds specifically with regard raptors as these were the most vulnerable species. It was also mentioned that the SLU eagle tracking program that is mentioned in the literature review of this paper was a considered mitigation option but the interviewee did not give detail relating to this. The interviewee was aware of technology DTBird but did not know much about it.

d) According to Ingemar Stenbeck, the project developer, the need to acquire and share knowledge and data was imperative to best practice. Suggestions included GPS trackers on birds at existing wind farms and the collection of study data relating to this. The developer continued that DTBird was a better option for smaller wind farms of around 2-5 turbines but that for large projects inventory, quality of data and good siting practice was the best option. According to the legal representative demonstrations of results and proof of validation for mitigation technology must be achieved before it can be used in reality. It is not possible to rely on a company's results and therefore independent studies must be done. Choice of location for the testing is of most importance and the legal representative believes that the island of Gotland would be an excellent choice due to the high population density of eagles. Finally it was pointed out that if the County Administrative Board owned data and results relating to validation it would certainly ease the planning process in the future.

The technical advisor for Vänersborg Land and Environmental Court highlighted the importance of pre-screening and comparison of environmental variables when considering judgement and in this regard believes that if the risk of impact or disturbance is low then a post construction mitigation technology would be very useful. However, if the development risks destroying a habitat or risks the population being greatly affected than the mitigation technology should not be used. The Länsstyrelsen Jämtland representative highlighted the bird inventory as the base of everything and the most important factor relating to this. The interviewee noted that there was enough knowledge available today in relation to birds and wind turbines and highlighted the County Boards eagle strategy that was in progress in Jämtland. This strategy is looking at identifying available turf or habitat of eagles to be used as a base of opinion in the permit process moving forward and will be made available to the municipality when structuring developing plans for the municipality.

4.4 Conclusion

The results have been interpreted from the analysis of court cases, semi-structured interviews and stakeholder workshop and presented throughout this chapter. The results highlight the interpretation of legislation relating to the deliberate disturbance and killing of avifauna within the courts and the following chapter further analyzes these results in conjunction with stakeholder input recorded on relevant issues to lay the foundations for potential solutions to bird mortality mitigation.

To add some context for the analysis of results and discussion, 2 out of the 15 court cases analyzed had deliberate disturbance and killing debated but none of the permissions were rejected in relation to this.

Within the stakeholder workshop, the main issues that were discussed related to noise being used in mitigation, legislation interpretations, turbine stopping on demand, grey zone areas and acceptance and testing. Stakeholders were skeptical of DTBirds use of noise. It was put forward that there was room on Gotland for a control program/inventory run by the authorities with room to evaluate and verify different mitigation options. The building of trust between relevant stakeholders was seen as an essential step in sharing information and moving towards a best practice.

The IdentiFlight technology, highlighted in Appendix A, appeared to be preferred by stakeholders, once validated. This was due to it having low sound emissions at wind farms with focus on video detection, identification and turbine stopping on demand.

Grey zone areas were highlighted as potential post-construction mitigation sites that could aid clarity in decision making. The importance of testing and validating systems within Sweden was seen as the most important step in moving towards a best practice by all stakeholders.

Within the semi-structure interviews all stakeholders recognized the merit of post construction mitigation options but only as a secondary option and only if validated.

All highlighted the importance of access to further knowledge and data for the importance of pre-screening and siting as the best option moving forward.

It is clear from the results that more knowledge is needed to be shared between stakeholders. Stakeholders across both data collection methods appear to agree on the importance of pre-screening and siting of wind turbines as the most important step in moving towards a best practice.

In addition the majority of stakeholders highlight the importance of post-construction mitigation technologies such as DTBird and IdentiFlight to be used as a secondary option within low risk areas once validated.

The stakeholders at the workshop appear to have preferred the IdentiFlight technology as it does not use noise to warn species away and is considered most in line with legislation relating to deliberate disturbance of species.

It was also concluded that a control program and validation of technology would be welcomed on the island of Gotland by the workshop stakeholders.

Regarding legislation it is now clear that Artskyddsförordning is only invoked if correct care and due diligence is not undertaken within the pre-screening and siting of wind turbines or in areas of high risk to species.

The analysis of results and discussion within the next chapter will attempt to highlight stakeholder input relative to mitigation best practice and suggest recommendations prior to drawing conclusions from the thesis work.

CHAPTER 5. DISCUSSION & ANALYSIS

5.1 Introduction

This chapter will discuss the results in relation to the research question and objective of approaching a mitigation best practice for bird mortality in wind power planning in Sweden focusing on three sub-sections; legislation, mitigation options and the stakeholders. The analytical findings will then be presented for the thesis. Results from the stakeholder workshop evaluation will then be presented to evaluate the secondary research objective of the effectiveness of using this method successfully within conflicts of interest within renewable energy planning and to ensure the methodology was ethical.

Recommendations for a best practice moving forward will then be made by the author on the basis of the stakeholder data presented before concluding.

5.2 Discussion of Results

5.2.1 Legislation

Interpretation of legislation appeared to be the most contentious issue for stakeholders particularly with regard deliberate disturbance and radial distances from nesting sites. In addition there appeared to be insecurity regarding knowledge of avifauna data and the role of authorities in relation to this and how available mitigation was suitable for legal interpretations.

Within the scope of case M2920-14 relating to Kalmar seen in the results section 4.4.1, the European Court of Justice had previously interpreted deliberate killing or disturbance in two cases, C-103/00 and C-221/04, the latter relating to potential of endangered otter species to be impacted upon by the use of legal fox snares. Deliberate in these cases was interpreted as actions performed by a person who knows that in light of current legislation for species and general information directed at the public, the act is likely to cause harm to the species but endeavors to cause such damage or at least consciously accepts the predictable result of the offense through conditional intent.

The stakeholders at the workshop were of the opinion that any level of disturbance or killing was unacceptable within Artskyddsförordning. In this regard issues relating to noise from the dissuasion and warning modules within DTBird were highlighted. In fact a recent application for exemption from the Species Protection Ordinance for research and education purposes in the case of Boge Gotland M4937-14 was turned down with the case being referred as it was unsure how the mitigation technology would impact upon species. The company had applied for an exemption to be granted under Article 14 of the Species Protection Ordinance. The main reason for the exemption was for a test project for research and education purposes and overriding public interest. According to Vindval (2012) and SEPA (2009), exemption from the Species Protection Act may be applied for if the conservation status of the species is not compromised by the exemption and may include post construction mitigation methods. The High Court judged that the company had not presented sufficient basis for how such a test project would go and the project's effect upon the Sea Eagle population. Therefore it was considered there be no reason to grant exemption. The application for exemption was rejected and the case referred to be tried by the Environmental Code. However it should be noted that DTBird is currently being trialed at Skaraborg on the mainland and if results are validated would certainly answer questions regarding its legality in reference to the deliberate disturbance of species.

Verification of the mitigation technologies appeared to be one of the pressing issues within the stakeholder workshop and in the complimentary stakeholder phone interviews. It was discussed at the workshop that the island of Gotland would be an ideal place for an alternative validation study of mitigation technologies due to the high population density of species. As DTBird was being validated currently on the mainland perhaps it would make sense to test the Identiflight technology on Gotland. As the technology focuses on video detection and identification it would not impact species with regard to disturbance highlighted in the case of Boge Gotland M4937-14. If the technologies were to be validated within Sweden it is interesting to discuss what role they might play within the wind power planning process in Sweden. Therefore it is imperative that greater clarity in how interpretations of deliberate disturbance of species within the courts is viewed. In this regard certain interpretations have been put forward which can aid mitigation best practice moving forwards.

Chief Judge at the Land and Environment Court in Vänersborg, Peter Ardö is reported to have stated in Vindlov (2015) that the term deliberately be assessed in light of the risk of wind

power developments killing birds. Ardö continues that since the risk is “relatively limited” works should not be considered to be intentional killing and that instead of applying the species protection ordinance directly there should be regulation on assessment methods and examination in line with the Environmental Code’s general rules of consideration (Chapter 2, Article 6). Ardö believes this approach can help clarify interpretation and decision making.

In interview with a technical advisor for Vänersborg Land and Environmental Court, Joen Morales, this interpretation was backed up by stating that one must first locate the turbines on the best location possible. The location must be compared and weighted against other possible locations and the best one chosen. Within this scope, the environmental variables must be compared between the sites. These variables include bird species and potential impacts, noise, shadow flicker and ice throw etc. When this approach is taken, the case will not be interpreted as deliberate disturbance or killing. In addition the level of risk to species should be weighed against the importance of the development and if the risk is comparatively low the Species Protection Ordinance should not be invoked but if risk is high and cannot be avoided the legislation will be invoked. From the analysis of the case of Kalmar M2920-14, it was adjudged by the Land and Environmental Court that the company’s intention for the wind power development is not to kill or disturb birdlife and that the establishment of wind turbines alone cannot be considered to be contrary to the provisions set out in Article 4 of the Species Protection Ordinance. Therefore the Land and Environment Courts conclusion that the application should be refused on the sole grounds that activities would constitute a deliberate killing or disturbance of birds is not accurate and that the permissibility of the activity be ruled under Chapter 2 of the Environmental Code (see Appendix D)**.** Here it was ruled that the erection of turbines alone would not constitute significant impact on avifauna. It was noted that not all environmental issues of importance were taken into account in the decision such as noise and shadow flicker and therefore not a comprehensive review of the selected site in accordance with Chapter 2, Article 6 of the Environmental Code (see Appendix D). Therefore since all relevant conditions for the granting of the permit have not been verified by the lower courts, the initial judgement is overturned and referred back to the lower courts to be addressed.

Magnus Fröberg, reports that according to the Land and Environmental Court, a company applying for wind power permits under the Environmental Code are considered as not deliberately disturbing or killing in the manner specified in the species protection ordinance although there is a risk birds may be killed (Svensk Vindenergi, 2015). He states that the Land

and Environmental Court reiterates that in accordance with past practice, the Species Protection Ordinance is a clarification of what might follow the general rules of consideration in Chapter 2 of the Environmental Code regarding the protection of species (see Appendix D). This becomes relevant when, despite prescribed precautions and protective measures, the development will still have a tangible impact on bird populations (not individuals) in relation to Section 4 of the Species Protection Ordinance thereby constituting an inappropriate location under Chapter 2, Section 6 of the Environmental Code (see Appendix D). Fröberg continues that according to the Land and Environmental Courts judgements, it should now be considered clarified that the issue of the impact on bird life should be examined in the context of the review which takes place pursuant to Chapter 2 of the Environmental Code and that wind turbines should not be regarded as an intentional interference or deliberate killing of birds and that trials should take place against the importance of the planned construction versus the impact that the planned construction would have on bird populations. This interpretation based on impact to population rather than on an individual is also highlighted in interview with a legal representative from Gärde Wesslau, Maria Paijkull.

It needs to be noted that the above discussion is based upon interpretations and should therefore be only considered as guidance. It is important to know also that court cases are dealt with on a case by case basis, as discussed in interview with Joen Morales and Maria Paijkull, with no one size fits all solution. However with a shared knowledge on avifauna instigated by the authorities for use within pre-screening and surveys, such as the American Wind Wildlife Institute program underway in the United States, a better understanding by stakeholders of how courts can interpret legislation and validated mitigation technologies being used in conjunction with this, it is considered possible to move towards a best practice for bird mortality mitigation within wind power planning for Sweden according to the engaged stakeholders.

5.2.2 Mitigation

It was apparent from the stakeholder interviews that the quality of pre-screening and siting of the wind turbines was the most important factor for the mitigation of bird mortality in wind power planning. None of the interviewees believed that technology such as DTBird or IdentiFlight should be used as an independent solution. It should be noted within the

stakeholder workshop that the issue of grey zone areas arose where there was risk to species but small. Again Ardö and Morales' graduated risk approach to this would suggest that post mitigation technologies described within Appendix A could behave as a secondary mitigation delivering even lower risk of impact to avifauna and stronger sustainability within the siting of wind turbines.

Within the stakeholder workshop it was discussed whether the technologies could help alter the radial buffer zones as both radius and geometry were questioned. As discussed by Martin Green earlier in the thesis, these prescribed distances are just guidelines published by the Swedish Ornithilogical Society as precautionary and are not legally binding. Therefore one would suggest it possible to experiment with these guidelines in conjunction with the post construction mitigation options. Both post construction mitigation options described within Appendix A were discussed in detail during the workshop and representatives of DTBird and Identiflight were available at the workshop to share knowledge with the stakeholders. It was agreed that the use noise emissions from the DTBird dissuasion and warning signals could be an issue both for deliberate disturbance of species and potential for societal disturbance.

However the DTBird representative highlighted that wind turbines already disturb species and that the sounds being worked upon currently by the technology were focused on threat and warning calls that the birds could relate to and volume control was included to prevent too much societal disturbance.

The Identiflight technology representative highlighted the company's philosophy of low noise at wind farms and that the technology focused on video identification which the stakeholders seemed to agree would be a less problematic technology.

However there was a shared concern over the validation of both technologies. In this regard it was acknowledged by both technology representatives that the technologies needed further validation.

It was highlighted that the technologies could also be used in bird inventory or control programs in conjunction with ornithologists and that perhaps there was room on the island of Gotland to validate the technologies within a control program. DTBird was currently being tested within a site in Skaraborg so perhaps testing IdentiFlight on Gotland would be the best

option for gathering as much knowledge as possible. It should be noted that population densities of birds were very different between the two locations as highlighted by Maria Paijkull in interview and it was thought in conjunction with Ingemar Stenbeck in interview that Gotland would be a better place to trial DTBird also. However the higher risk of disturbance associated with the dissuasion and warning modules of DTBird may not be fully suitable for the high population density of species in Gotland. In conjunction with this the turning down of an exemption for the technology to be used at Boge Gotland mentioned previously, might be reason for the video identification technology IdentiFlight being a better option if such a validation was to go ahead. At the workshop it was agreed that the high risk site of Nässudden could be a viable option for the technology validation due to the existing knowledge available from the Nässudden control program conducted by Hjernquist (2014).

Through the validation of the represented technologies it is possible to gain more knowledge regarding accuracy and effectiveness which can certainly aid mitigation best practice moving forward. Again the accumulation and availability of knowledge is key to the discussion.

5.2.3 The Stakeholders

The methodology design of the thesis attempted to incorporate key features for successful state of the art participation highlighted in section 2.7.2 of the literature review. In this regard, the author focused upon an underpinned philosophy of promoting equity, learning, trust and respect. This was achieved through how knowledge was positioned at the workshop and the mechanics of the workshop highlighted in Appendix G was central to this. The integration of local and scientific knowledge was key to improving the knowledge base. The accessibility to available information promoted in the information pack developed by the author and the presence of representatives of both IdentiFlight and DTBird technologies allowed for an exchange of knowledge with the varying authorities, developers, applicants and others present.

The analysis and representation of relevant stakeholders was central to the thesis results but it is important to look at the limitations associated with stakeholder choice, availability and dynamics to get a clear picture of the results that were obtained.

The stakeholder workshop was certainly Gotland representative heavy and perhaps good for discussing a potential control program but cannot be considered fully valid at a national level. It could be argued that perhaps the research study results have more relevance for Gotland. In saying this however, the population density of birds on Gotland highlights a good testing ground for these issues to be resolved within.

The bias was partly evened through using parallel participatory techniques such as the engagement of alternative stakeholders through semi-structured interview. However it needs to be noted that this group of stakeholders was small and did not have the all-important opportunity to engage within the workshop dynamic. However in saying this, the contributions within the interviews was invaluable to the thesis especially with regard knowledge relating to interpretations of legislation. The dynamic within the workshop was one of positive collaboration from all stakeholders which was a welcomed surprise and certainly aided a worthwhile discussion of issues. Section 5.4 attempts to evaluate the workshop from a stakeholder perspective and for potential future use.

It must be recognized however that there are 21 County Administrative Board's in Sweden (Nilbecker, 2014) with 12 of them being responsible for wind power applications. The engagement of and representation of all 12 of these County Administrative Board's would yield more accurate knowledge and results for the issue at a national level. Hopefully this thesis work can pave the way for furthering dialogue and engagement networks similar to the approach of this thesis in relation to the research question. In this regard, complexity within the municipality veto could potentially hamper a strategic knowledge building approach to the research question as differing political opinions of wind power at the all-important local level can prevent a full picture developing through an unwillingness to share knowledge. This however is the democratic lay of the land and must be taken into account when analyzing and considering engagement of stakeholders.

Generally within the stakeholder workshop there appeared to be a lack of consensus on data relating to avifauna and information on mitigation. However through the collaborative working groups and shared knowledge approach to discussion it became apparent that there was room for validation of the mitigation technologies presented and potential for a control program run by the authorities to acquire data. Within this scope it was discussed that the level of trust between ornithologists and developers was an issue. Unfortunately one of the

ornithologists was unable to attend the workshop due to unforeseen circumstances and prevented further knowledge being put forward in relation to this.

However it should be noted that the bringing together of such stakeholders in a bid to help build trust previously not there, could be a powerful facilitator of shared knowledge relating to mitigation best practice and could help develop regulatory frameworks essential for strong sustainability in the siting of wind turbines moving forward. In this regard the theory behind collaborative planning of Healey (1997) discussed in the literature review focusses upon the process of building trust among stakeholders through good communication and is central to the evolution of knowledge and shared systems of meaning opening up new ways of dialogue among stakeholders.

5.3 Workshop Evaluation Survey

An evaluation survey was used within the stakeholder workshop to help evaluate the effectiveness of the primary data collection method within the thesis. The evaluation form can be read in detail in Appendix C. The two supplementary methods were not evaluated but were addressed within the limitations of the methodology section and ethical issues in chapter 3 as well as in section 5.5 of this chapter. There was a 90% response rate for the evaluation survey. One participant had to leave the workshop early due to time constraints. Participants also had the option of commenting under each response.

Question 1. Were instructions about the workshop clear to participants?

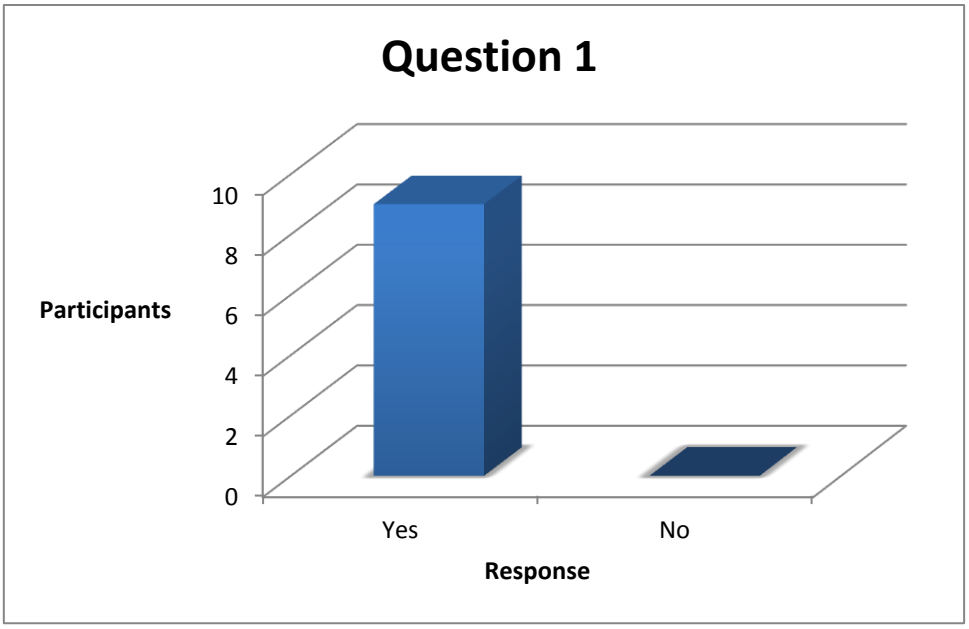

Figure 12 Evaluation Question 1 (McNally, 2015)

The instructions of the workshop were clear to all of the participants who filled out the evaluation form with none of the participants leaving comments in relation to this question.

Question 2. Was there enough time allocated for the workshop?

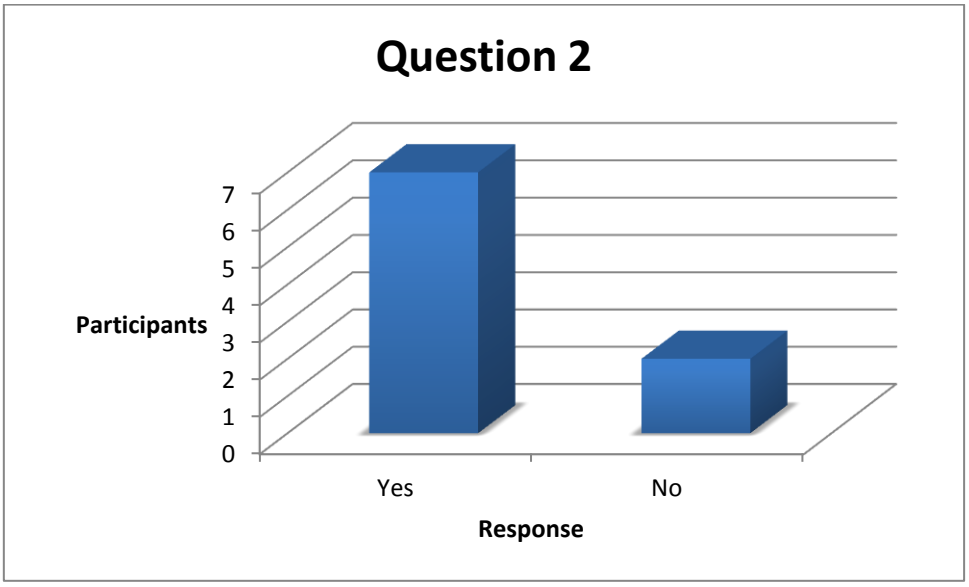

Figure 13 Evaluation Question 2 (McNally, 2015)

7 of the participants felt that there was enough time allocated to the workshop. One of these participants commented that although yes, it was also possible to talk longer and another participant wished to have viewed the information films that were available in the room to be shown prior to the workshop. Of the 2 participants who felt there was not enough time

allocated, 1 participant commented that the discussion would have benefitted with another 30 minutes.

Question 3. Was the information booklet a useful discussion aid?

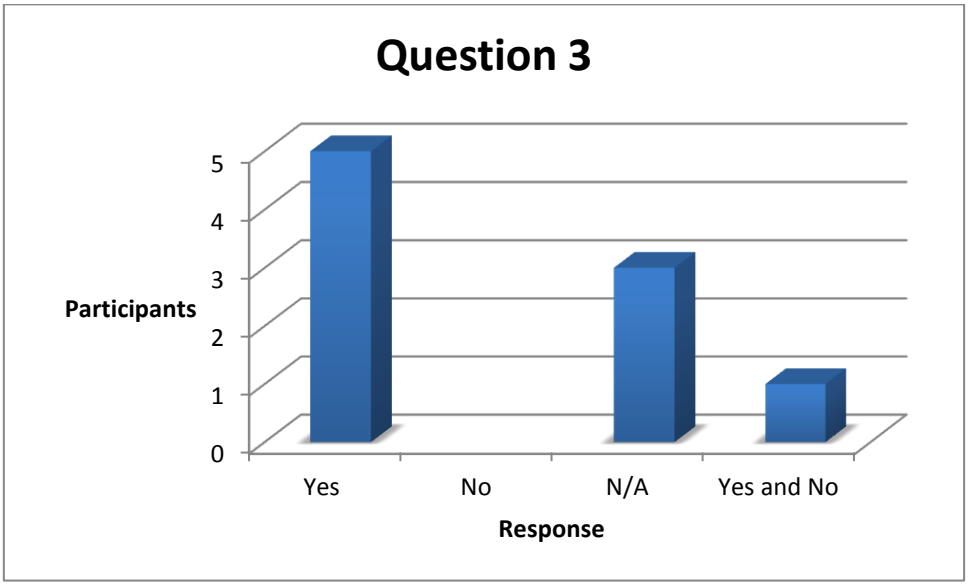

Figure 14 Evaluation Question 3 (McNally, 2015)

Three participants were considered not applicable to this question. The author did not have email contacts of 2 of these participants and one of the participants stated that they did not receive the information pack within the communication email. However copies of the information pack were available at the workshop as well as information films relating to the information pack. The participant who responded yes and no highlighted that the information pack included too much technical information.

Question 4. Did chairperson remain objective throughout the workshop?

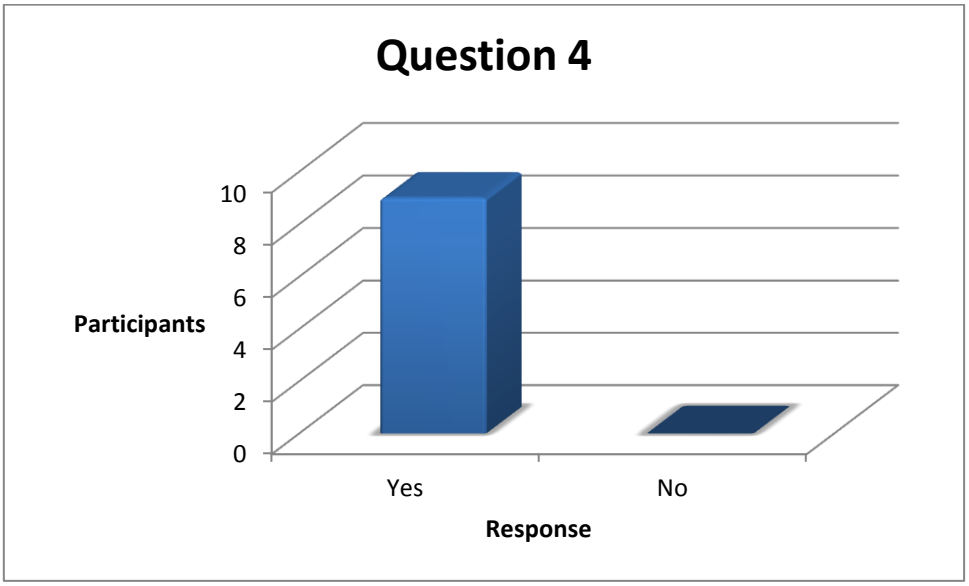

Figure 15 Evaluation Question 4 (McNally, 2015)

All 9 of the participants who filled out the form agreed the chairperson remained objective throughout the workshop with one participant highlighting a well-structured and good way to carry out a workshop.

Question 5. Did you recognize any overly persuasive behavior from any of the participants during the course of the workshop?

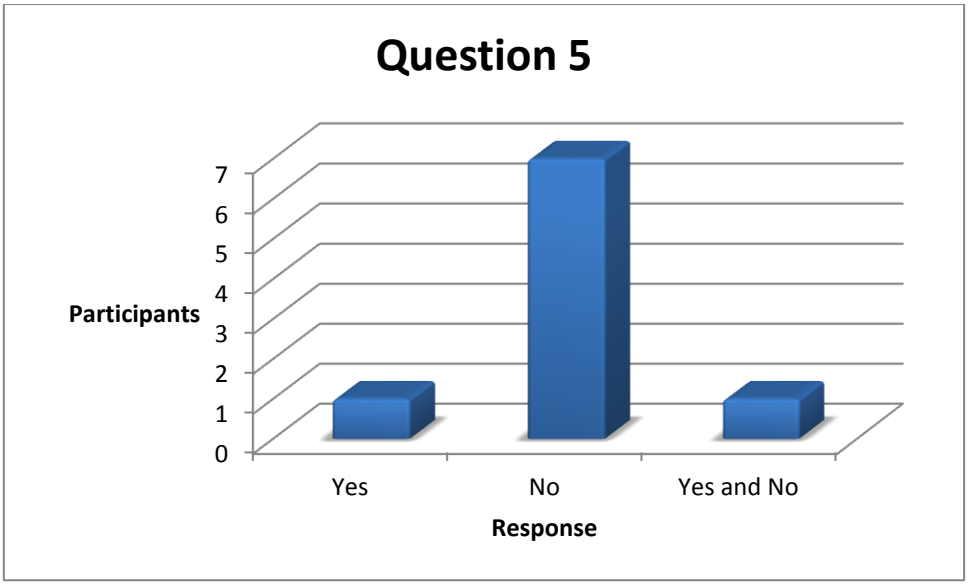

Figure 16 Evaluation Question 5 (McNally, 2015)

7 of the participants responded that there was no overly persuasive behavior from participants during the workshop with one of the participants highlighting that it was a well-balanced

discussion. The participant who responded yes commented that of course there would be different areas of interest within the workshop and the participant who responded yes and no that although most remained quite neutral, there was potential for those selling systems or developers to be overly persuasive.

Question 6. Do you feel the stakeholder workshop has been beneficial in helping to solve the conflict of interest?

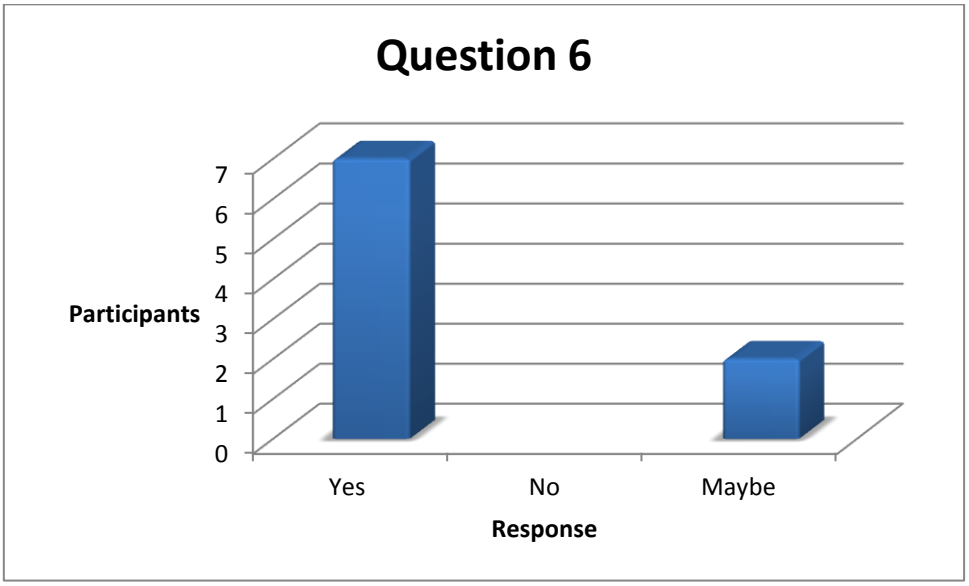

Figure 17 Evaluation Question 6 (McNally, 2015)

7 of the participants responded yes with one stakeholder commenting that there was a sense of collaboration with another stating that the workshop had highlighted a need for authorities to be clearer and take measures to increase bird inventory knowledge. The maybe responses commented that the workshop had helped move the conflict of interest a little bit along the way.

Question 7. Are there any additional comments you would like to add about the stakeholder workshop?

Below are the additional comments that were made.

- Could be perhaps an idea to have a follow up meeting in 6 months from now.
- Workshop carried out very well and looking forward to the report.
- Good initiative

- It would be useful to have some follow up discussions to understand what progress is made as a result of the workshop. Glad the workshop was in English.
- I thought workshop was interesting and learned more about the systems. Had heard something about it before but not much.

The results from the evaluation survey above highlighted the overall effectiveness of the workshop for the presented scenario. Some areas for improvement included more time to be allocated to the workshop, and better communication relating to the delivery of information packs. From the comments made it was noted that a follow up meeting should be conducted to address progress on the issue. The chairperson or facilitator was seen by all to remain objective throughout the workshop and in relation to ethical issues highlighted in section 3.6 this was an important factor in helping to build trust within the group highlighting the collaborative nature of the workshop. In conjunction with this the acknowledgement of the majority of the stakeholders that overly persuasive behavior was not recognized within the workshop was important in how knowledge was situated for the stakeholders and again aided in building a trusting and collaborative atmosphere within a well-balanced workshop free from dominance.

5.4 Analytical Findings

The analytical findings are set out below and highlight key findings relative to the research question and are used later in the thesis work to develop recommendations and draw conclusions.

- Apparent lack of knowledge regarding interpretations of legislation among stakeholders.
- Need for a shared knowledge base relating to avifauna initiated by the authorities.
- An eagle strategy for identifying birds habitats for use in wind power planning currently underway in Jämtland.
- Validation of the proposed mitigation technologies is needed.
- The accumulation of knowledge and validation is key in moving towards a best practice.
- Stakeholder engagement was Gotland heavy and not fully representative at a national level.

- Gotland is an ideal location for a test site for technology and control program.
- Workshop stakeholders appeared to prefer IdentiFlight technology as it did not incorporate noise or disturbance to species within its design.
- Both technologies would be suitable for a control program once validated.
- Consensus on pre-screening and siting as the most effective mitigation technique.
- Potential to use post-construction mitigation as a secondary option in low risk areas once validated.
- Post-construction mitigation technologies should not be used as an independent solution.
- Potential to use mitigation technologies as tools within the inventory and pre-screening process.
- Stakeholder workshop method was effective according to stakeholders – suggestions on follow up meetings/workshops.
- Stakeholder workshop enabled stakeholders of differing opinion to collaborate and work through issues and concerns in a neutral atmosphere free from dominance which helped in building trust.

5.5 Recommendations

Having presented, analyzed and discussed the results the author puts forward a preliminary adaptive planning model as a recommendation. The solution is based upon developing a framework of knowledge which creates a feedback loop focusing upon easy accessibility to knowledge for stakeholders and strong sustainability in deployment. The model could potentially be used within other regions of Sweden or be scaled up to national level. The Figure 22 below outlines the model.

5.5.1 Adaptive Planning Model

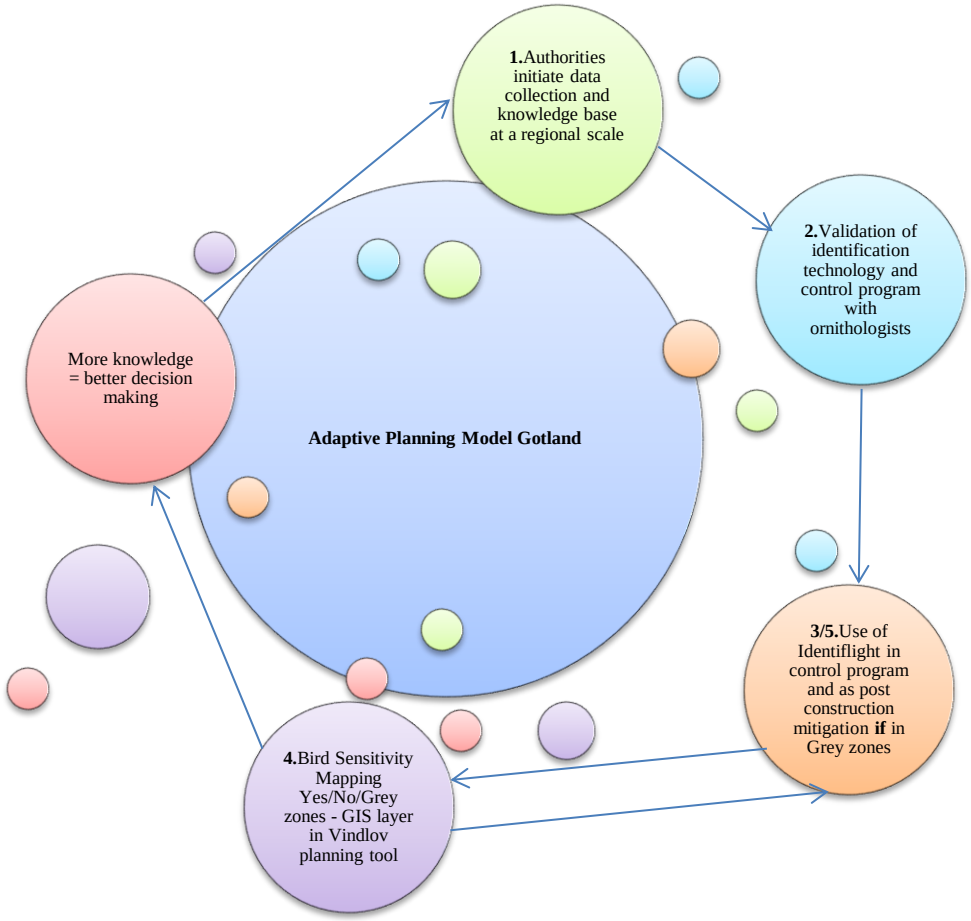

Figure 18 Adaptive Planning Model Gotland (McNally, 2015)

1. The authorities initiate a data collection program for bird species at a regional scale.
2. The IdentiFlight technology should be validated on Gotland with ornithologists. Once validated used the technology should be used as part of control programs in conjunction with ornithologists to gather data.
3. The IdentiFlight technology will be used to collect species specific data for use in Bird Sensitivity Mapping of the island.
4. Bird Sensitivity Mapping will be input as layers of Yes/No/Grey zones within GIS wind power planning tool Vindlov for easy accessibility to knowledge of siting areas for developers and authorities.
5. If a chosen site by a developer is considered to be a Grey zone on the mapping tool, there is potential to graduate the risk and incorporate stop on demand mitigation technology of IdentiFlight.

It was apparent from the stakeholder workshop that further knowledge was need relating to avifauna and a need to build trust between ornithologists and developers. A transparent authority initiated data collection process was highlighted as a potential solution. To further build the trust it was suggested that ornithologists be employed within this process in conjunction with testing and validating proposed mitigation technologies presented at the workshop.

As the IdentiFlight technology was received well at the workshop and the DTBird technology is currently being tested at Skaraborg on the mainland, the author believes IdentiFlight to be the best option for Gotland. In addition, the stakeholders considered the use of noise as a negative within the mitigation methods and DTBird relies heavily upon dissuasion and warning sounds. This in conjunction with high population densities of species on the island and potential for greater disturbance to species from noise, leads the author to believe DTBird is not suitable for Gotland. IdentiFlight also has the capability to be species specific with regard identification which could also aid within the control programs.

However it should be noted that if the detection and turbine stop modules of DTBird were used in isolation then the technology would be suitable in relation to stakeholder concerns.

Once validated, IdentiFlight could then be used to collect data on species within the region to develop a Bird Sensitivity Mapping which could be used as a layer within the already functioning Vindlov GIS online planning tool. Yes and No zones for development could then be easily viewed. As the issue of Grey Zone Areas or low risk areas was something that was highlighted within the workshop, a Grey zone should also be included within the mapping which would highlight the need for further study in the area or the potential use of post-construction mitigation such as stopping the turbine on demand. The technical expert at Vänersborg Land and Environmental Court also highlighted potential for mitigation technologies to be used in these types of situations. It is believed that a model such as this would significantly add to the knowledge base on avifauna, be easily accessible and transparent to stakeholders and aid in better decision making in the wind power planning process in Sweden.

Alternatively furthering dialogue relating to the issue through a broader stakeholder engagement process and the testing and validation of both DTBird and IdentiFlight

independently within Sweden are important steps in moving towards a best practice at a national level. Once validated it is also recommended that the technologies be used within control programs alongside of ornithologists as tools capable of adding to current knowledge. Strong communication/knowledge networks between municipalities and County Boards would also be of benefit in moving towards a best practice.

5.6 Conclusion

This chapter focused upon discussing the results provided within chapter 4 in relation to legislation, mitigation and the stakeholders involved within the process. An evaluation survey highlighted the effectiveness of the stakeholder workshop methodology before the analytical findings were presented and recommendations were made highlighting the need for follow up dialogue on the issues, validation of available mitigation technologies and the presentation of a preliminary and crude adaptive planning model for Gotland.

CHAPTER 6. CONCLUSION & IMPLICATIONS

6.1 Introduction

This chapter contains conclusions regarding the research performed within the thesis, limitations of the thesis and proposals for further research.

The studies contribution to the body of knowledge highlights the potential of collaborative stakeholder engagement to applied problems within wind power planning in Sweden and highlights the need to further validate bird mortality mitigation systems for wind power. The study also puts forward a collaborative method designed by the author taking influence from the state of the art in participation process.

6.2 Conclusions about the research problem

The principle aim of this study was to investigate the possibility of moving towards mitigation best practice for bird mortality mitigation within the wind power planning process in Sweden. The secondary research objective was to ascertain the effectiveness of the stakeholder workshop methodology.

The thesis has at least furthered dialogue in relation to best practice of bird mortality mitigation in wind power planning for Sweden and at best put forward a potential solution in the adaptive planning model for Gotland for further discussion and/or development. In this regard the results hold most relevance to Gotland and highlight the innovation potential of Gotland as a testing ground moving forward.

The thesis has succeeded in bringing together diverse stakeholders of differing opinion within a positive and constructive framework and in a fair and equitable manner. In this regard it has highlighted the importance of discourse and sharing of stakeholder knowledge and co-evolution within conflict resolution and has created a platform of trust between stakeholders to move forward from in relation to the initial research objective. In this regard the author's collaborative method designed for the workshop was considered useful through a stakeholder evaluation survey and could perhaps be developed further.

To summarize the analytical findings, the thesis has concluded a need for more available knowledge and data on avifauna, validation of mitigation technologies, a consensus on pre-screening and the effectiveness of stakeholder engagement in moving towards best practice. The figure below summarizes the main analytical findings in moving towards best practice in bird mortality mitigation and formed the backbone of the recommended adaptive planning model put forward and presents a potential theoretical framework in addressing best practice in general which could be applied for example within the field of project management.

Figure 19 Towards best practice theory (McNally, 2015)

6.3 Limitations

Limitations of the research have been discussed previously within section 3.5 however this section attempts to highlight further limitations that became apparent throughout the research specifically with regard the undertaking of the semi-structured interviews and the running of the stakeholder workshop. As mentioned previously, the time, resources and contacts of the thesis project were limited and therefore impacted upon the participants within the workshop. Due to this the stakeholder workshop was biased (if looking at the relevance of the results at a national level) in that it mainly considered stakeholders from Gotland.

In addition a key stakeholder was not able to attend the workshop due to unforeseen circumstances. This stakeholder was an ornithologist with specific knowledge of control programs on Gotland which would have certainly added further value to the workshop and the analytical findings. In saying this, there was another ornithologist present at the workshop albeit one with a vested interest in one of the mitigation technologies. However as was seen from the evaluation survey the majority of stakeholders felt there was no overly persuasive behavior at play throughout the workshop and the author too, in reflection, believes the stakeholder in question was extremely balanced and knowledgeable throughout the discussions.

In an attempt to balance the stakeholder sample the author engaged alternative stakeholders through semi-structured interview. Although this added knowledge and value to the study specifically regarding interpretations of legislation, the sample was again limited and would have benefitted more from a fully representative sample size. This might include a representative from each Environmental Court, a representative from each relevant County Board and a representative from the respective municipalities.

In an ideal world the author believes the methodology would achieve best results at a national level with a fully representative stakeholder workshop. However it should be noted that such a task would require greater resources, time and logistical planning.

In addition it should be noted that communication and logistics among stakeholders proved more difficult than was planned for which meant the stakeholder workshop being run quite late in the thesis work. The result of this was added pressure in delivering results, analytical findings, recommendations and conclusions. In hindsight the thesis would have benefitted from a more focused logistical planning of the workshop and more time.

Questions surrounding the fairness and equity of stakeholder choice for the meetings could also be considered. There was no public invite to the workshop and the stakeholder roles were chosen by the author after reviewing the literature. In this regard the workshop was a closed workshop. One might suggest that if included, stakeholders representing the community at large or NGO’s or environmental justice movements, may have yielded alternative results.

6.4 Further research

This section is aimed at potential further research that has become apparent from the analytical findings.

- Fully representative application of the stakeholder workshops in other regions or on a national level to capture complete picture of the problem and potential solutions for Sweden – further dialogue/build trust/share knowledge.
- Further develop adaptive planning model featured in the recommendations in relation to the research problem. In this regard include the model as a potential solution in moving towards best practice within a follow up meeting.
- Continuation of stakeholder discourse on bird mortality mitigation for wind power planning in Sweden.
- Validation studies of Identiflight mitigation technology on Gotland in conjunction with ornithologists.
- Follow up studies and evaluate DTBird technology being tested at Skaraborg.
- Comparison studies of DTBird and Identiflight once validated.
- Stakeholder evaluation of mitigation technology preferences using Multi Criteria Decision Analysis methods.
- Further reflection and development of stakeholder workshop methodology including more detailed logistical planning for future use.
- Further research and development of theory surrounding ‘best practice’ in general.

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APPENDICIES

APPENDIX A. Stakeholder Information Pack

Stakeholder Workshop Information Pack

'Moving towards best practice for bird mortality mitigation in wind power planning, Sweden'

Tuesday 19th May 2015

UPPSALA
UNIVERSITET

Background

Recent debate of Artskyddsförordning regarding species protection within the wind power planning process in Sweden has highlighted the importance of strong sustainability in the siting and operation of wind farms in relation to avifauna.

Interpretation of legislation is based upon a translation into Swedish law from the overarching European Habitats Directive and Wild Birds Directive. According to Article 5 EU Wild Birds Directive (2009/147/EC) on the conservation of wild birds, "Member States shall take the requisite measures to establish a general system of protection for all species of birds referred to in Article 1, prohibiting in particular. (a) deliberate killing or capture by any method; (b) deliberate destruction of, or damage to, their nests and eggs or removal of their nests; (c) taking their eggs in the wild and keeping eggs even if empty; (d) deliberate disturbance of these birds particularly during the period of breeding and rearing, as so far as disturbance would be significant having regard to the objectives of this Directive; (e) keeping birds of species the hunting and capture of which is prohibited."

This debate has caused uncertainty within the wind power planning process.

It is widely agreed within literature that detailed planning and inventory is the most important phase in mitigation in relation to the protection of avifauna. However not all factors influencing risk of collision are considered within pre-screening assessments and it is suggested future research should therefore focus on the effectiveness of alternative mitigation to compliment detailed planning and strong sustainability.

Engagement of Stakeholders

Planning related activities are frequently vulnerable to conflicts of interest rooted in social power relations, limited knowledge about alternatives and changing circumstances of values and politics. Therefore it is important to engage relevant stakeholders when discussing issues relating to complex decision making process in a bid to co-evolve knowledge in a fair and equitable manner and facilitate understanding among people and other such systems as organizations, publics or societies.

In this regard this stakeholder workshop attempts to bring together a wide range of stakeholders relevant within the Swedish onshore wind permitting process to share differing issues, concerns and knowledge and discuss the potential of moving towards best practice in bird mortality mitigation for wind turbines. The workshop will be based around working groups highlighting key issues and concerns involved in bird protection, a discussion on the issues and concerns and a review of what has been highlighted during the workshop.

Mitigation Options

As previously mentioned detailed planning and pre-screening is considered the most important phase in the protection of avifauna in the wind power planning process. However to compliment this, post construction measures are a potential option to further strengthen sustainability in development moving forward. Two potential technologies are introduced within this document, one currently being used in the market alongside a newly developed technology. It is hoped that the information provided will encourage debate and discussion amongst stakeholders at the workshop. Representatives of the technologies provided in this document will be participating within the workshop and will be available to provide more detailed information and discuss specific enquiries on the day. It should be noted that the options provided by the author are open to criticism and are not an exhaustible list. Other mitigation options and suggestions are encouraged to be discussed at the workshop.

dtbird

All information provided in this section is courtesy of DTBird and Ecocom.

Development of DTBird started in 2005 in Spain through the collaborative efforts of biologists, engineers and conservationists and is used for bird monitoring and mortality mitigation at wind farms in operation at 16 wind farms in 9 countries. DTBird is a trademark of Liquen, a leading Spanish environmental consulting firm specializing in renewable energy throughout the world.

Concept

The bird detection is performed by means of artificial vision techniques, used in military applications. The self-working system involves four modules for use with avifauna which are described below.

Figure 1 DTBird® (2015)

Detection: The module continuously monitors the surveillance area and detects flying birds in real time using high resolution image analysis as seen in the figure below. The features within this module include detection sensors of 4 HD cameras with a 360 degree surveillance area around each wind turbine. The cameras have a detection distance of between 400m and 50m to the wind turbine depending upon species size. Narrow lenses with a range of 1-2km for bird monitoring and pre-screening are also available. The service provides continuous monitoring during daylight (light > 50 lux) and has a bird detectability of > 80%. Recorded data from this module includes video and sound recordings of every flight inclusive of flight time data, environmental variables such as temperature, precipitation, light, wind speed and direction alongside of wind turbine operation parameters. It is also possible to gather information on species and behaviors through review of the video recordings.

Figure 2 DTBird® (2015)

Dissuasion: The dissuasion module can reduce the number and length of flights within the collision risk area around wind turbines. The features of this module include 4 high power speakers which emit sound warning signals to birds flying in moderate collision risk areas of < 200m for large birds (wingspan > 170cm) and 150m for medium and small birds. In conjunction with this sound dissuasion signals are emitted to birds flying in high collision risk areas of < 100m for large birds and < 70m for medium and small birds. The signal triggers in real time and occurs in less than 2 seconds of flight detection in these zones. The signal power can be adjusted to legal requirements and bird sensibility. The signal emission is from a height on the wind turbine to the birds in collision risk areas. There are less than 1.5 false triggers a day with a yearly average of less than 60 seconds/day of sound emission. The module records all warning and dissuasion signal time data alongside of the video and sound recordings of these bird flights during signals.

Stop Control: This modules hardware and software is compatible with all wind turbine manufacturers. An automatic stop trigger is linked to real time detection of bird flights with collision risk which triggers in less than 2 seconds after a flight detection within the collision risk zone. For the rotor to come to a halt it will take approximately 25 – 50 seconds depending upon the turbine model. The stopping length is recommended as at least 120 seconds per flight with the automatic restart of the wind turbine when the collision risk disappears. An automatic email is sent for every stop documenting the trigger time, end time and duration of the stop. It is estimated that a yearly average of less than 2.5 hours of length for the wind

turbine is expected from false triggers. Again as in other modules, time data and video data are recorded for potential analysis.

Collision Control: Four HD cameras are used as detection sensors with a continuous monitoring during daylight of > 50 lux. The surveillance area includes a 360 degree view of the entire rotor swept area and has a > 98% rate of detecting and registering potential collisions. The recorded data for this module includes collision check from video and sound recordings, including birds potentially injured that fly away and video and sound recordings of all bird collisions.

It is suggested by DTBird that best results incorporate when each of the modules are used in conjunction with one another but it is also possible to pick and choose from the available modules. The figure below highlights how the modules work in conjunction with one another.

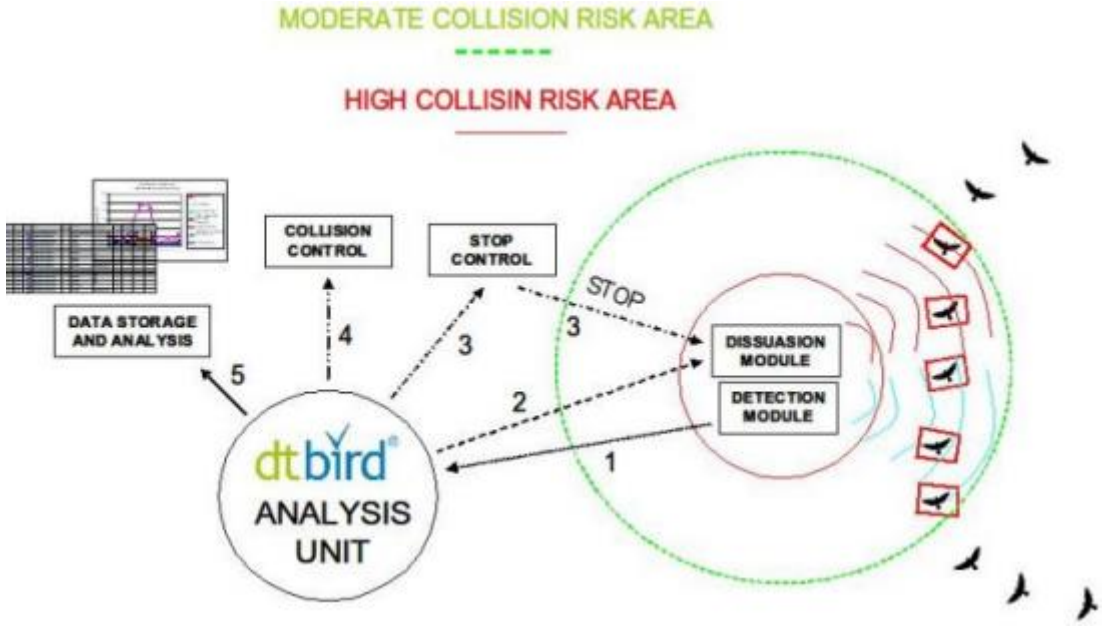

Figure 3 DTBird® (2015)

User Interface

Within the data analysis platform there are three separate levels of access. The first level is Administrator Analyst and is advised to be a professional ornithologist for analyzing the features and behaviors of the birds included in the footage and editing data. This is logged into the system by the analyst. The next level of access is Report. This tool is used to present mathematical flight analysis from recorded data and performed analysis for wind developers to use. The data can be saved as a PDF for use within the environmental courts in inventory and pre-screening with a view to delivering a transparent process. The final level of access is

viewer. This is used for everyday viewing of recordings. The platform screen can be seen below.

Figure 4 DTBird® (2015)

Performance

The system has been tested and in use at wind farms for more than four years. According to DTBird the system provides continuous daylight monitoring. Regarding detectability, the system has an 86-96% success rate within a radius of 150m to the wind turbine. The system has a collision detection capability of > 95% and all data is updated daily within the DTBird Data Analysis Platform available online to clients. Regarding inventory required by environmental agencies, there have been more than 10 positive environmental decisions of wind farms in Spain and Italy since September 2011.

IdentiFlight

Aerial Detection System

All information provided below is courtosy Renewable Energy Systems Americas Inc. - Proprietary and Confidential (2015).

In 2012 RES Americas contracted with Boulder Imaging to develop an automatic detection and classification method to identify raptors in flight and at risk of collisions with wind

turbines. The prototype system was engineered and successfully demonstrated as effective and accurate.

Concept

The system accurately classifies raptor species through artificial learning and identification algorithms at distances of 600-800m away and assesses whether trajectory is likely to result in collision. The classification is species specific and if a real threat of collision is posed the system has the ability to trigger curtailment of the turbine to avoid collisions.

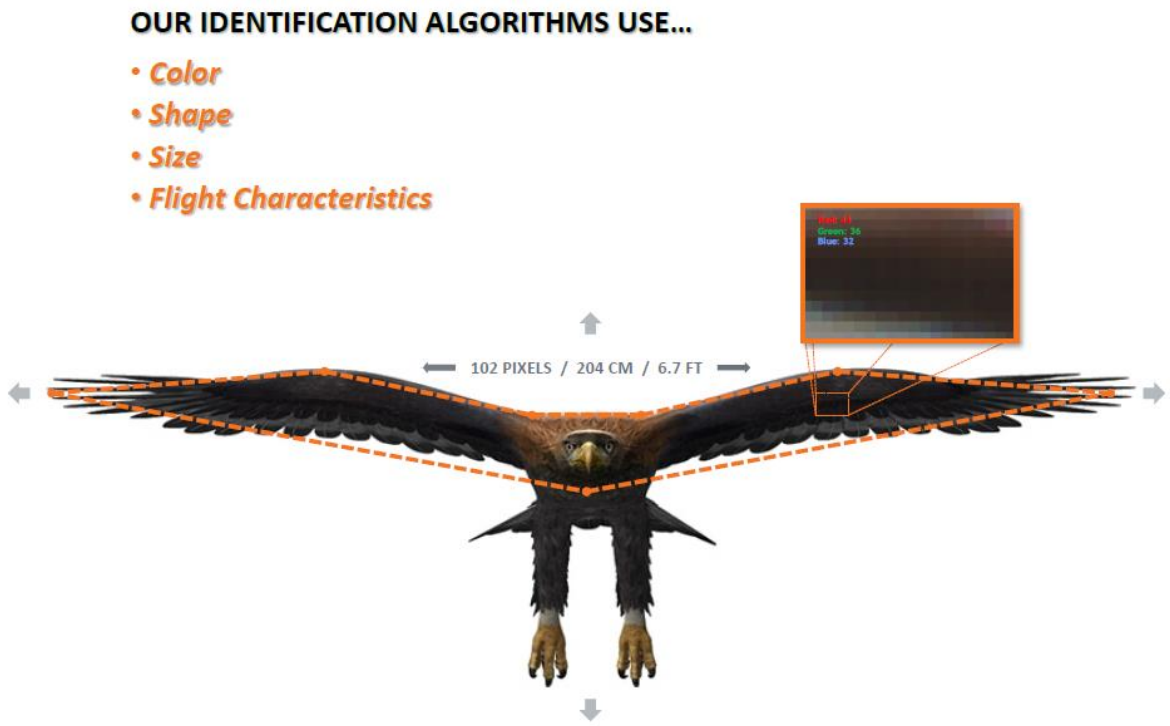

Figure 5 Renewable Energy Systems Americas Inc. - Proprietary and Confidential (2015)

Proximity and velocity are critical to allow direct and instantaneous classification of features and to trigger curtailment. To avoid collsion a rotating turbine has 44 seconds at 18m/s (the average speed of Bald Eagle) from an 800m range and 33 secs at 18m/s from 600m.

Boulder Imaging provides a unique combination of software development and high performance digital video recording and real time video processing expertise to distinguish and classify characteristics in the blink of an eye through non-uniformity correction, contrast enhancement, noise reduction, exposure control, instrumentation feedback, feature detection, measurement and object tracking.

Success is dependant upon the classifying characteristics of large birds to acurately determine which are threatened species and which are not. Important key features determined over long distances include colour of the head, shape of the wings in flight and plumage colour.

The development team worked with a trained Golden Eagle to study specific physical and flight characteristics unique to the species and these features were used to develop bird recognition algorithms. In conjunction with this, complimentary field work collected alternative species features to compare against the Golden Eagle algorithms.

User Interface

The latest Identiflight user interface includes a wide field of view which can display an image of approximately 1000m across and for a distance of 800m away. Images from the stereo camera lenses display a high resolution field of view of approximately 9m across at approximately 800m away. Within this scope, each field of view can be zoomed into for better review of the data as seen in the figure below.

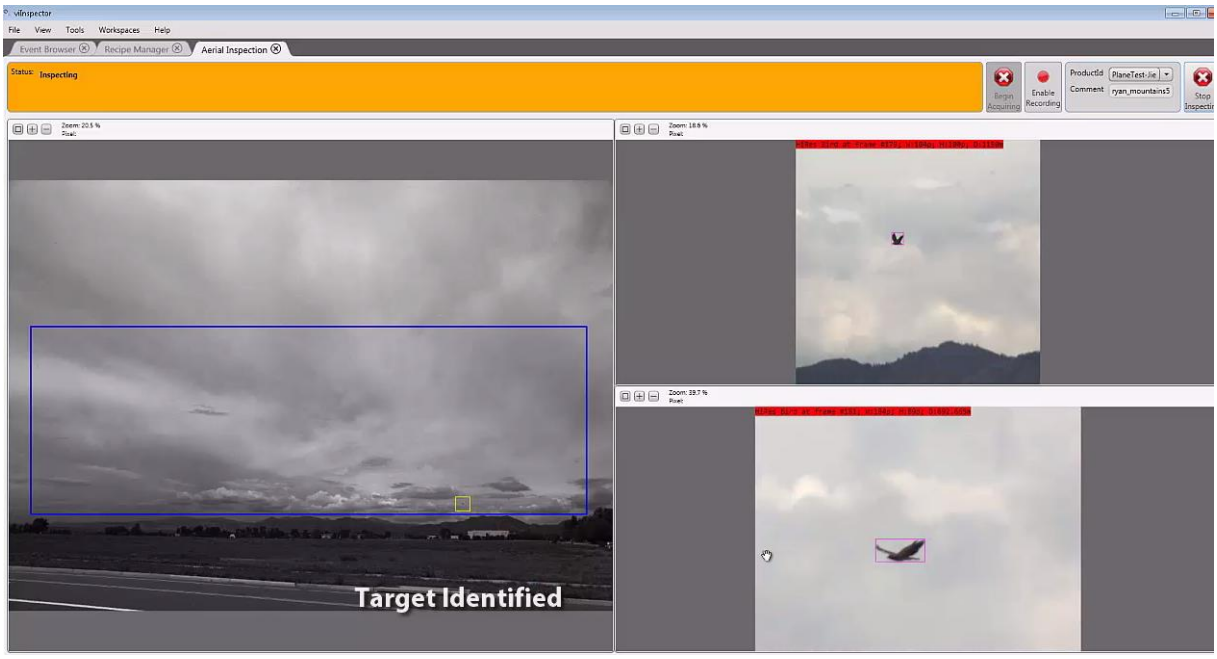

Figure 6 Renewable Energy Systems Americas Inc. - Proprietary and Confidential (2015)

The features of targeted birds captured and tracked in the wide high resolution fields of view are processed and compared with the classification algorithms utilizing Identiflights core vision inspector software. Within the classification configuration, specific features of a variety of species that may be recognized by the system are represented by different colours for quick recognition when detected. The data and image capture of each target inspection feeds into the event browser. From the event browser the user can view details of every image capture and one can double click within the event browser to view specific event details.

Final Design Specifications

Since recent patent fillings for the system in August 2014 work is underway and targeted for installation and operation on wind turbine towers in 2015. Final design specifications will be customized to support 360 degree views from the tower as shown in the figure below.

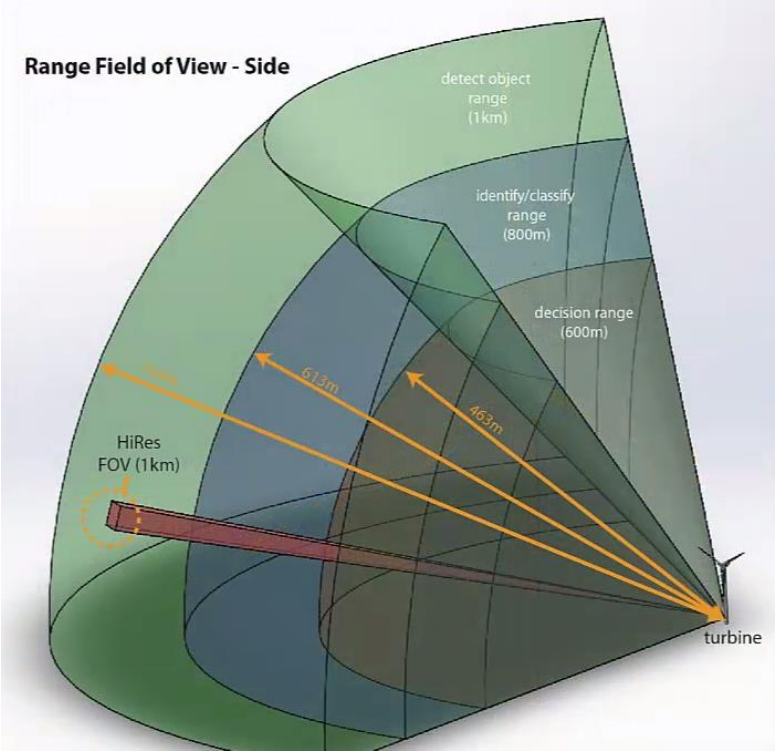

Figure 7 Renewable Energy Systems Americas Inc. - Proprietary and Confidential (2015)

Review

The stakeholder workshop is based around issue pooling, discussion and review within working groups and attempts to co-evolve knowledge of relevant stakeholders towards best practice of mitigation of bird mortality within wind power planning through a discursive and collaborative approach.

Stakeholders attending the meeting are expected to be honest, open, respectful and integral throughout the workshop.

All information provided within this document is for the purpose of the stakeholder workshop and its relevant stakeholders. The document or the information within the document is not to be distributed to other parties or be reused in any way.

www.dtbird.com
http://www.ecocom.se/vindkraft/dtbird
Wenger, E. (2015) Email to Renewable Energy Systems Americas Inc. - Proprietary and Confidential. 15 April.

APPENDIX B. Stakeholder Interview Form

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Stakeholder Interviews **2015-05-11**

Interviewer: Ross McNally

Recording Method: Shorthand Notes

Stakeholder Role:

Consent Signature:

---

a) Can expansion of wind power and protection of avifauna co-exist? Discuss.

b) What are your thoughts on the deliberate disturbance and killing of avifauna through the development of wind power?

c) How do you consider mitigation options available today?

d) Suggestions on best practice moving forward?

APPENDIX C. Sensitivity Analysis Evaluation Survey Form

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'Moving towards best practice for bird mortality mitigation in wind power planning, Sweden'
Tuesday 19th May 2015

Participant Survey – Please fill out both sides.
Name: **Stakeholder Role:**

1. Were instructions about the workshop clear to participants?

   Yes No

   Comment:_____

2. Was there enough time allocated for the workshop?

   Yes No

   Comment:_____

3. Was the information booklet a useful discussion aid?

   Yes No

   Comment:_____

4. Did chairperson remain objective throughout the workshop?

   Yes No

   Comment:_____

5. Did you recognize any overly persuasive behavior from any of the participants during the course of the workshop?

   Yes No

Comment:_____

6. Do you feel the stakeholder workshop has been beneficial in helping to solve the conflict of interest?

   Yes No

   Comment:_____

7. Are there any additional comments you would like to add about the stakeholder workshop?

   Comment:_____

   _____

   _____

   _____

   _____

   _____

   _____

   _____

APPENDIX D. Relative Legislation

DIRECTIVE 2009/147/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 30 November 2009 on the conservation of wild birds

Article 5

Without prejudice to Articles 7 and 9, Member States shall take the requisite measures to establish a general system of protection for all species of birds referred to in Article 1, prohibiting in particular:

(a) deliberate killing or capture by any method;

(b) deliberate destruction of, or damage to, their nests and eggs or removal of their nests;

(c) taking their eggs in the wild and keeping these eggs even if empty;

(d) deliberate disturbance of these birds particularly during the period of breeding and rearing, in so far as disturbance would be significant having regard to the objectives of this Directive;

(e) keeping birds of species the hunting and capture of which is prohibited.

Ds 2000:61 - THE SWEDISH ENVIRONMENTAL CODE

Chapter 8. Special provisions concerning the protection of animal and plant species

Section 1 Rules prohibiting the killing, injury or capture of wild animals or the taking of or causing of damage to the eggs, spawn, roe or nests of such animals in the country or any part of it may be issued by the Government or the authority appointed by the Government. Such rules may be issued where there is a risk of a wild animal species becoming extinct or being subjected to exploitation or where they are necessary for compliance with Sweden's international undertakings with respect to the protection of such a species. Nevertheless, these prohibitions shall not apply in cases where such an animal must be killed, injured or captured in order to defend a person or valuable property against attack. Special provisions shall apply to the killing or capture of wild animals of certain species where such an act takes place in connection with hunting or fishing.

Section 2 Rules prohibiting the removal of, the causing of damage to or the taking of seeds or other parts from wild plants in the country or any part of it may be issued by the Government or the authority appointed by the Government. Such rules may be issued where there is a risk of a wild plant species becoming extinct or being subjected to exploitation, or where it is necessary for compliance with Sweden's international undertakings with respect to the protection of such a species.

Section 3 In order to protect wild animal or plant species or the natural environment, the Government or the authority appointed by the Government may issue rules prohibiting, or special conditions concerning, the release of specimens of animal or plant species into the natural environment.

This shall not apply where such regulations exist in other legislation.

Provisions relating to genetically modified organisms are contained in chapter 13.

Section 4 In order to protect wild animal or plant species, the Government or the authority appointed by the Government may issue rules concerning imports and exports, transportation, housing, preparation and exhibition of, or trade in, animals and plants. Such rules may be issued where they are necessary for compliance with Sweden's international undertakings in that area or for other reasons. The rules may also govern any corresponding dealing with eggs, spawn, roe or nests or with other products extracted from animals or plants.

The rules may impose prohibitions against, or the requirement to obtain a permit for, or other special conditions relating to, the measures referred to in the first paragraph.

Section 5 Any rules issued or decisions taken in individual cases pursuant to the provisions of this chapter shall take effect immediately even if they are appealed against.

Chapter 2. General rules of consideration etc.

Section 1 In connection with the consideration of matters relating to permissibility, permits, approvals and exemptions and of conditions other than those relating to compensation, and in connection with supervision pursuant to this Code, persons who pursue an activity or take a measure, or intend to do so, shall show that the obligations arising out of this chapter have been complied with. This shall also apply to persons who have pursued activities that may have caused damage or detriment to the environment.

For the purposes of this chapter, 'measures' shall mean measures that are not of negligible significance in individual cases.

Section 2 Persons who pursue an activity or take a measure, or intend to do so, must possess the knowledge that is necessary in view of the nature and scope of the activity or measure to protect human health and the environment against damage or detriment.

Section 3 Persons who pursue an activity or take a measure, or intend to do so, shall implement protective measures, comply with restrictions and take any other precautions that are necessary in order to prevent, hinder or combat damage or detriment to human health or the environment as a result of the activity or measure. For the same reason, the best possible technology shall be used in connection with professional activities.

Such precautions shall be taken as soon as there is cause to assume that an activity or measure may cause damage or detriment to human health or the environment.

Section 4 In the case of activities and measures for whose purposes land or water areas are used, unless on a purely temporary basis, a suitable site shall be selected with regard to the provisions of chapter 1, section 1 and chapters 3 and 4.

Sites for activities and measures shall always be chosen in such a way as to make it possible to achieve their purpose with a minimum of damage or detriment to human health and the environment.

Section 5 Persons who pursue an activity or take a measure shall conserve raw materials and energy and reuse and recycle them sources.

Section 6 Persons who pursue an activity or take a measure, or intend to do so, shall avoid using or selling chemical products or biotechnical organisms that may involve risks to human health or the environment if products or organisms that are assumed to be less dangerous can be used instead. The same requirement shall apply to goods that contain or are treated with a chemical product or a biotechnical organism.

Section 7 The rules of consideration laid down in sections 2 to 6 shall be applicable where compliance cannot be deemed unreasonable. Particular importance shall be attached in this connection to the benefits of protective measures and other precautions in relation to their cost. The cost-benefit relationship shall also be taken into account in assessments relating to total defense activities or where a total defense measure is necessary.

A decision reached in accordance with the first paragraph must not entail infringement of an environmental quality standard referred to in chapter 5.

Section 8 Persons who pursue or have pursued an activity or taken a measure that causes damage or detriment to the environment shall be responsible, until such time as the damage or detriment ceases, for remedying it to the extent deemed reasonable pursuant to chapter 10. Where this Code so provides, the person may be liable for compensation for the damage or detriment instead.

Section 9 If an activity or measure is likely to cause significant damage or detriment to human health or the environment, even where protective measures and other precautions are taken as required by this Code, the activity or the measure may only be undertaken in special circumstances.

An activity or measure must not be undertaken if it is liable to lead to a significant deterioration in the living conditions of a large

number of people or substantial detriment to the environment.
The provisions of the first and second paragraph shall not be applicable where the Government permits the activity pursuant to chapter 17, section 1, 3 or 4.

Section 10 If an activity or measure is of particular importance for reasons of public interest, the Government may permit it even in the circumstances mentioned in section 9, second paragraph. Nevertheless, this shall not apply if the activity or measure is likely to be detrimental to public health.
Conditions may be attached to decisions taken pursuant to the first paragraph in order to safeguard a public interest.

APPENDIX E. Workshop Itinerary

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'Moving towards best practice for bird mortality mitigation in wind power planning, Sweden'
Tuesday 19th May 2015

Stakeholder Workshop Itinerary

13.00 Welcome and Icebreaker

13.10 Split into working groups

13.40 Issue Pooling

13.45 Refreshments

14.00 Resume workshop – Issue Pooling II

14.05 Discussion of issues – Open Floor

14.45 Review

15.00 Close Workshop

Ross McNally
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APPENDIX F. Workshop Minutes

'Moving towards best practice for bird mortality mitigation in wind power planning, Sweden'

Tuesday 19th May 2015

UPPSALA UNIVERSITET

Stakeholder Workshop Minutes

1. **Present at workshop**
   Anna-Lena Fritz (Länstyrelsen), Gunnar Gustafsson (Region Gotland), Madeleine Johansson (Region Gotland), Marianne Nilsson (Region Gotland), Fredrik Litsgård (Ecocom, DTBird), Andreas Wickman (Vice Chairman GVP/Project Developer), Pontus Bornold (Wind Farm Applicant & Landowner), Josefin Knudsen (Regional Wind Coordinator), Liselotte Alden (Uppsala University), Ross McNally (Workshop Facilitator). Alan Derrick (RES Ltd, IdentiFlight)
2. **Apologies**

   Mårten Hjernquist (Nässudden Control Program) – unforeseen circumstances.

3. **Goal**

   Highlight issues and concerns, discussion and sharing of stakeholder knowledge relating to best practice for bird mortality mitigation in wind power planning, Sweden.

4. **Discussed Issues**

   Noise

   - Use of noise in mitigation methods for warning or dissuasion of species.
   - Adding noise is seen as taboo within wind power development (societal concerns).
   - Should mitigation use noise?
   - DTBird uses sound – Volume control available. How is noise developed? Company is experimenting with different noises. Can it be species specific? Birds get used to sound. Working on scare (I think the words that were used were "threat" or "warning" calls, the point DTBird were making that was they did not "scare" the birds, which could be considered illegal) calls. Are eagles scared of sounds?
   - Have found sounds that are working. Adding recordings of turbine noise at a higher volume. Trying to teach birds to learn to avoid sounds.
   - What about migrating birds? Different criteria than nesting birds. This was seen as a problem in the U.S.
   - Smöla Norway study using DTBird – less than 10% dissuasion recorded. This was due to system not being calibrated correctly and not functioning correctly. DT Bird feels this study is not relevant due to these conditions. Therefore agreed that more validation of the system is required.

Legislation

- EU legislation. Radial nesting buffer zones. Compatibility with Artskyddsförordning. Breeding success. Flight paths. Deliberate disturbance/scaring birds. Evaluation of systems needed for decision making purposes.
- Legislation is scaring off developers.
- Guidance of buffer zones and how legislation is interpreted. Mention of Bright et al (2008) paper on bird sensitivity mapping in Scotland on buffers.
- Would mitigation options available be suitable for this? Mitigation must stand up to independent scrutiny/due diligence. There is no room for uncertainty for developers. Needs to be tested in relation to radial distances prescribed. Is there room to change this distance. Current research – preliminary results showing birds still breeding within radial buffer zones but success of the breeding has lowered.
- To do with geometric constraints – Should buffer zones be radial? Maybe nesting is not an issue in this regard? Example of eagles being found dead at Nässudden in Gotland while hunting and nowhere near nests (which are only 1.5km from nearest turbines).
- Disturbance – disturbance is species specific. Is it aural or visual disturbance – do wind farms already disturb – migratory birds and flight paths.
- Insecurity in where the knowledge (about eagle nest locations and territories) lies – knowledge level in authorities. Who has the knowledge? This is a big problem. Ornithologists seem to oppose wind farms and they hold knowledge and data. Mistrust – How can this be solved?
- Approach of authorities to handle the data as similar to program going on in America currently (AWWI). Authorities ask for data? Suggestion for authorities (CAB) to own data or carry out own surveys. But fear from ornithologists of developers getting information/data on nests. Could lead to corruption?
- Room for a control program/inventory on Gotland run by authorities.
- Room to evaluate and verify different mitigation systems – But need to categorize mitigation and what will be acceptable mitigation depending on species and behavior.

Stopping Turbine on Demand

- Turbine integrity, lost energy, system time to stop, Cost benefit.

- Stopping of the turbines is not a problem but the accuracy of the system stopping the turbine is very important. Normal stops are best for turbine integrity. Time to identify an eagle needs to be compatible with a turbine stop (approx. 30-40secs) – Identiflight has capability to do this – it is species specific and long range detection of between 800m and 1km.
- Already random stops in place for turbines addressing noise, shadow/flicker and ice throw. However better pre-surveys needed to predict stoppages and make sure it won't be entire wind farm and ensure minimal energy loss and associated cost.
- Position of camera is very important for this. Identiflight system is independent of turbine and should create a detection zone every 2-3 turbines. Height of camera needs to have a clear view for over a kilometer.
- Additional technology from RES for stopping turbines using eagle ring tracking transmitters – system further behind development wise.
- Tests in a wind farm in America with bird mortality problem. 200 eagle flights detected by the camera system in the first 6 weeks of deployment in conjunction with ornithologists. Verified data will lead to agreed control program to replace people with system by itself.
- Philosophy of RES to have low sound emissions at wind farms so focus on video detection/identification at long enough range.
- Currently ornithologists stop wind turbines during validation phase but when in full use system can stop.

Grey Zone Areas

- Grey zone – Is it a good or bad thing? – When there is a risk but a small risk. For instance, lots of eagles but no nests. How to approach this?
- What should be recommended in this case? Mitigation would help this. Also long term inventory/control program. Is grey zone perfect area for mitigation?
- What about dense nesting areas? Too much risk of disturbance. But maybe discuss and evaluate buffer zones.
- Mitigation considered a good option only if good survey is done prior to use. Eagle territories will always remain even between eagle generations after a breeding couple are killed, new generation will assume similar flight paths which can be a problem.
- If mitigation used in too densely populated an area will lead to turbine being shut down too often and will not be financially viable for the wind farm.

- More knowledge relating to this = better decision making.

Discussion, Acceptance & Testing Mitigation

- Testing and validating system in Sweden at a demo site. DT Bird on mainland being tested.
- Potential for trial at Nässudden – Good information from here – Hjernquist control program.
- Authorities – without stop on demand mitigation, birds will be killed.
- What level of killing is accepted? What is ethical?
- According to Artskyddsförordning – no acceptance at all – should be looked at from a level of risk point of view – Needs to be put in context.
- A criteria risk weighting of societal benefit vs. risk to species.

5. Agreement

Facilitator to send on minutes from stakeholder workshop to participants prior to use in thesis to ensure transparency in the process and that nothing of relevance was left out.

6. Time

The meeting started at 13.05 and ran to schedule to 15.05. All elements of the itinerary were addressed. An impromptu presentation of one of the proposed mitigation technologies was performed on request from stakeholders at workshop close. This ran for a further 30 minutes.

APPENDIX G. Workshop Procedure

1. Stakeholders were identified with the help of thesis supervisor and thesis advisor. Efficient use of networking alongside of logistical information was key to this process.
2. Stakeholders were contacted and once confirmed for the workshop emailed an information pack PDF (see Appendix A) containing an overview of the research question and details on two proposed mitigation technologies. An itinerary of the workshop was also included.
3. The stakeholders will be warmly welcomed on arrival and invited to take a seat at the discussion table and handed out an itinerary.
4. Once all stakeholders have arrived or the sharp starting time of 13.00 is reached a formal welcome and introduction to the workshop will commence.
5. An ice breaking session will then commence where each stakeholder will introduce themselves moving around the discussion table.
6. Once all have introduced themselves, the stakeholders will be split into mixed working groups for 30 minutes to discuss issues, concerns and ideas associated with the research question.

7. The working groups will receive brainstorming paper, pieces of card and a colored marker and asked to write keywords associated with the issues that come up in the working groups on the cards provided. The color of the marker will differentiate between the working groups keyword cards.
8. Issue Pool I - After the allocated 30 minutes the keyword cards will be collected by the facilitator and placed using an adhesive within a circular issue pool drawn on the whiteboard in full view of all stakeholders.

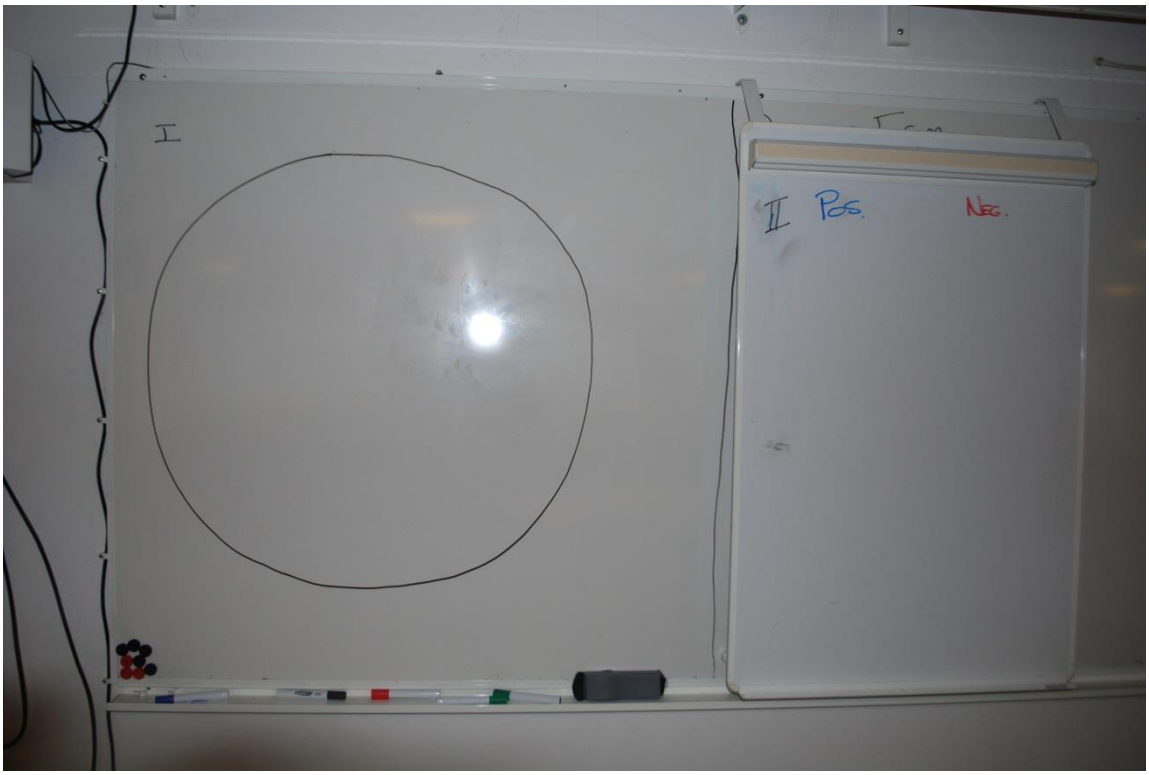

Figure 20 Issue Pools in workshop (McNally, 2015)

9. At this point the workshop will break for refreshments. During the break there will be an information area showing footage of two specific mitigation technologies that were introduced within the information pack that will also be available to view after the workshop if stakeholders wish.
10. Following the 15 minute interval the workshop will recommence with Issue Pool II where the keycards will be sorted from the circular issue pool into a pre-determined table on the whiteboard with positive and negative issues defined in an interactive process with the working groups.
11. From this point the keycards/ are moved one by one to the discussion forum on the whiteboard and stakeholders are invited to elaborate on the key issues put forward in an open floor style with stakeholders sharing knowledge in a discursive manner. The

facilitator will record the main points of these discussions within the discussion forum on the white board and direct procedures if the debate becomes stagnated and/or repetitive.

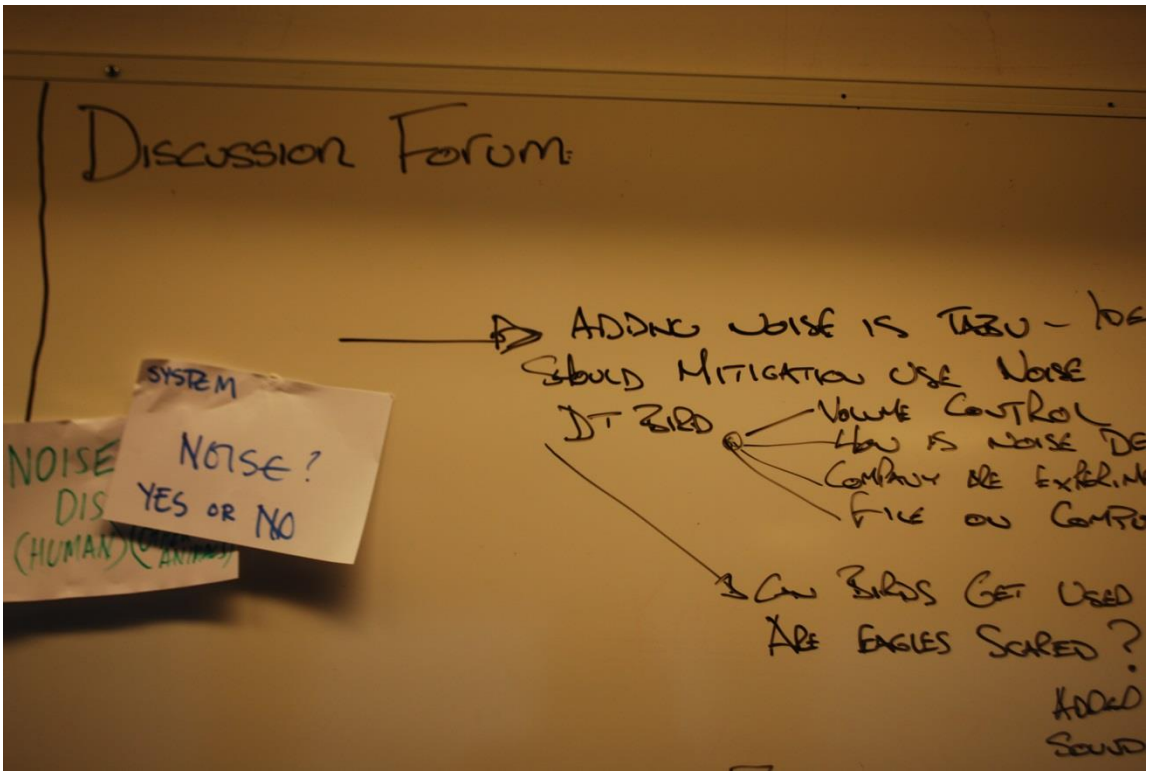

Figure 21 Discussion Forum at workshop (McNally, 2015)

12. Once all of the key issues have been discussed or the time allocated for this process has been used up the discussion forum will close.
13. The workshop will conclude with a review session where the facilitator will walk through the discussion minutes with the stakeholders and attempt to highlight potential solutions, evaluations and/or best practice moving forward. The stakeholders will be asked if there are any other pressing issues that were not discussed or missed out on within the workshop.
14. An evaluation form relating to the workshop will then be distributed to the stakeholders who will be asked to individually fill it out.
15. The stakeholders will then be thanked for their participation in the workshop prior to close of workshop.
16. The facilitator will then document the workshop minutes with a camera and rearrange the room.

The workshop minutes will then be tidied up and detailed for analysis within the thesis.

APPENDIX H. Semi-structured Interview Procedure

1. Stakeholders were identified through networking at the Day of Wind Power on Gotland as well as at a demonstration of DTBird technology hosted by Ecocom in Skaraborg and focused on gaps in stakeholder representation confirmed for the workshop. This included legal and court representatives, alternative County Board representatives and additional project development representatives.
2. Four open ended questions were then developed that stemmed from the review of literature and analysis of court cases and printed for interviewer's shorthand notes.
3. Question a) Can expansion of wind power and protection of avifauna co-exist? Discuss.

   This question attempts to highlight a stakeholders overarching stance on the central issue and by using the word discuss hopes to gain further insight and reason behind stance.
4. Question b) What are your thoughts on the deliberate disturbance and killing of avifauna through the development of wind power?

   This question aims at gathering data on varying stakeholder's interpretations of legislation central to the thesis and attempts to link a stakeholder specific stance on this issue to the analysis of court case data.
5. Question c) How do you consider mitigation options available today?

   This question attempts to unearth stakeholder specific knowledge relating to available mitigation options and individual thoughts and/or evaluations of specific technology. It should be noted that interview stakeholders did not receive the information pack developed by the author highlighting two potential mitigation technologies and this should be considered within the results section.
6. Question d) Suggestions on best practice moving forward?

   This question is designed to elicit knowledge relating to the 3 questions posed before to gather stakeholder specific knowledge relating to best practice.
7. Stakeholders were approached at the demonstration of technology and informed of the interview and asked whether they would be interested in taking part. All stakeholders approached agreed to interview and a date and time was arranged for a phone interview. It was decided not to interview stakeholders at this demonstration as time was limited and stakeholders were focused on the specific demonstration and seminars.

8. The stakeholders were individually contacted by phone and interviews were conducted.
9. The interviewer was open to direct the interview in whatever direction is required depending upon the stakeholders responses to the semi-structured questions.
10. A review and tidy up of shorthand notes was made after each stakeholder phone interview. This was done to ease with data analysis.