A conceptual model for assessing wildlife vulnerability to human activity at visitor sites in Svalbard

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Introduction

Increasing human activity in Arctic areas, call for awareness to avoid negative effects. There is an apparent lack of knowledge related to effects of human activity on arctic wildlife (Hagen et al 2012 a, b). Protection of Arctic wilderness combined with politically wanted human activity in Svalbard (our study area) is challenging. The precautionary principle is often central in managing biodiversity and protected area, also stated in the Svalbard Environmental Protection Act (2001). When several societal interests are present, there is a risk that strict management precautions, overruling stakeholder interests or local input, could generate conflicts and undermine the legitimacy of management decisions (Stern 2008). Managing authorities need legitimacy and accept for their decisions, underpinning the need for evidence-based knowledge (see Hagen et al 2012 a).

Wildlife species react very differently towards human activity. Although some studies manage to link physiological responses to reproductive responses (e.g. Beale 2007), there is not necessarily an immediate link between responses at local level to effects at population level for species in general. From an ecological point of view disturbance should defined as negative when it has effects at the population level (Vistad et al. 2008). There are few studies on species-specific responses to different types of human activity from Svalbard (Vistad et al. 2008). Nonetheless, using available literature and researcher interviews, it is possible to make a rough grading of the likelihood of negative responses to disturbance for different groups of birds and mammals (Hagen et al 2012 b).

We have developed a conceptual model assessing wildlife site specific vulnerability to human activity based on 1) a large review of disturbance studies, categorizing groups of species to likelihood of negative responses to human activity, and 2) the Red List Status of the species. Vulnerable hotspot habitats or habitats features are also included in the model.

Vulnerability assessment

We categorized species of birds and mammals of Svalbard in three groups related to their likelihood for reduced reproduction when disturbed, based on a broad literature review (e.g. Vistad et al. 2008), and the three categories *Unlikely*, *Possible* and *Very likely* where weighted with scores 2, 4 and 8. The species were also given weight related to Red List status as a measure on "management priority" given the scores; LC=1, NT=2, VU=3 and EN=4. The two scores are multiplied, giving a range of 2–32 in specie specific vulnerability. Additionally 10 hotspot habitats (e.g. seabird colonies, freshwater ponds and wetlands) are given weight based on the function of the habitat (breeding=1, foraging area=0.5), and the likelihood of finding different species in the habitat. Hotspot habitats are further weighted by the species Red List status as a measure for likelihood of presence; LC species = 0.25 and NT species = 0.1. Species strongly associated with the habitat is weighted 0.5 independent of their Red List status.The input data in the assessment is field observations at each site including present and breeding species and hotspot habitats. In the model estimate presence of non-breeding species is given weight 0.75 while breeding species are given weight 1. The sites vulnerability is the summarized score of observed species and presence of hotspot habitats (e.g. table 1).

Results

Our model assessing wildlife vulnerability is illustrated for one landing site (Signehamna) in Table 1.

We assessed sites-specific wildlife vulnerability at 32 land sites used by coast cruise traffic in Svalbard. The preliminary results show that our vulnerability estimates ranged from 0 to 176 on visited landing sites. The assessment revealed that only 4 sites (13 %) had very high potential for negative effects, while most land sites (56 %) had low conflict level.

Discussion and implications

Our vulnerability assessment was developed with two aims; 1) The registration of input data was simplified to make the site-specific registration independent of expert field workers, while 2) still being good enough to capture and differentiate between robust and vulnerable sites.

We have developed a conceptual framework assessing wildlife site specific vulnerability to human activity outside settlements, which can be used as a tool and an evidence based fundament to give priority and focus to the most vulnerable sites with regard to wildlife. Using this approach the management authorities may differentiate regulations at the level of sites rather that large landscapes (as often is the practice today). The model is intuitively understandable and may also contribute to higher societal acceptance of regulations and restrictions at visitor sites when needed. Consistent assessments and evidence based management practice will be the future demand. This conceptual model is one step ahead towards a greater understanding of human impact.

Table 1. The table shows how the vulnerability score is calculated for each visitor site (here Signehamna)

Landing site	Signehamna						
Specie/Group	*Score vulnerability* "management priority"*	*Species observations*	*Score (weight)*	*Hotspot habitat*	*Score vulnerability* "management priority"*	*Observation hotspot habitat*	*Score (weight)*
Red-throuted diver	8	1	8	Solitary lake/ pond	13.4	1	13.4
Barnacle goose	8	1	8	Freshwater breeding islet	12	1	12
Common eider	8	0.75	6	Easily accessible nesting cliff	3.6	1	3.6
Purple sandpiper	4	0.75	3				
Brunnich´s guillmot	8	1	8				
Black guillmot	4	1	4				
Arctic tern	8	0.75	6				
Arctic skua	4	1	4				
Blacklegged kittiwake	8	1	8				
Glaucous gull	8	0.75	6				
SUBTOTAL SPECIES OBS.			61	SUBTOTAL HOTSPOT HABITAT			29
Total vulnerability score							**90**

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