Project information

Participants

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        International partners

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Summary of Results

The main purpose of ES Arctic, and the NFR project CultEs, was to develop methods for monitoring socio-ecological systems and ecosystem services taking into account both spatial heterogeneity and differences in peoples' use, values and perception of climatic-related risks.

We have used both web-based and paper-based PPGIS as one of our main tools to capture spatial heterogeneity and differences within local communities. We have analyzed the spatial dimensions of ecosystem services using maximum entropy (MAXENT) modelling with vegetation layers, accessibility, land tenure, and protected areas as explanatory variables. Using these models, we found that accessibility and governance (PAs and tenure) are more influential on the mapped values than land cover. The explanatory factors had approximately the same relative importance for the spatial value heterogeneity in south and north, which again *indicates that the digital PPGIS is a reliability tool for monitoring peoples' values. We also show how we could use the data for spatial tradeoff analysis.*

Web-based PPGIS in two national parks aiming at testing the method on both local communities and tourists in the south showed that tourists and locals do not differ much with respect to ecosystem services appreciated, but they differ with regard to where they are in the park. *This underscores the need for spatial monitoring of use in responses to climate change*.

Users have complained not being able to draw polygons. We developed a software at UiT where participants first draw the polygons and then attach values in the next step. We received complaints that it takes too long time for people to map using this software, so we need to figure out ways of simplifying the mapping. *Based on our experience, we do not recommend the use of web-based polygon mapping for monitoring, unless for people that have in-depth knowledge and interest in the monitoring program.*

Paper-based PPGIS provides much richer information about the importance locals ascribe to places, and their priorities for adaptive management in relation to climate-related risks. We are able to explain the spatial heterogeneity to a much larger extent than with digital PPGIS, but on the other hand it is demanding to use non-digital tools for precise monitoring. *We recommend a mixed methods approach as the digital PPGIS monitoring allows identification of spatial patterns at a broad scale, but paper-based PPGIS could identify why values and priorities are distributed as such, and target those user groups of highest interest for the monitoring program.*

Social media is increasingly being used as a proxy for tourism ecosystem services. We have compared internet PPGIS with data from Flickr using maximum entropy modelling. Tourists prefer areas close to the main touristic attractions, such as mountain tops and main glaciers, while locals have a more dispersed mapping of ecosystem services. However, internet PPGIS map different things than the georeferenced pictures in Flickr that are correlated mainly to road access, except from social values which are mostly related to trails. *We advocate for a careful use of social media as a tool to map visitor values in protected areas due to the importance of road access influencing the spatial location of these.*

Mobile apps are increasingly being used for tourism and citizen science. We implemented a pilot project by testing a mobile app for visitor monitoring and value mapping and used our experiences and existing literature to write a review on mobile apps for tourism management and monitoring. *We suggest developing a clear mobile app implementation protocol and devoting time and resources to recruitment to the mobile app, as this is probably the main bottleneck for successful use in monitoring.*

We have taken in total 3227 photos 1 x 1 m for assessing the spatial distribution of ecosystem

service supply at the Varanger peninsula. The sample point approach is laborious and we decided to estimate number of pins needed to estimate the optimal number of pins for detecting presence of ecosystem services above 5% coverage. We estimated that 20-30 pins is sufficient for our purpose. This has allowed for more efficient image analyses where all the photos have already been analyzed and further models are being developed.

Based on the 3227 photos taken in the Varanger peninsula, we have developed models to include in a prediction ensemble to assess suitability for different ES based on climate, bedrock and altitude data. High-resolution maps that are derived from the models can be used to improve management: in addition, using the CMIP-5 climate models (obtained from www.worldclim.com) we can predict the suitability changes relating to climate scenarios. **We identify areas that have higher risk of habitat changes that can be detrimental for ES.** Using the resulting present ES distribution maps, we estimate how reindeer feeding preferences are related to the mapped ES: this information can be used to infer past vegetation distributions based on previous reindeer grazing patterns.

Master and PhD-students involved in the project

Two PhD students have been involved in the project.

For the Management

We have evaluated different monitoring techniques using web-based and paper-based mapping tools and social media data to record ecosystem services on the scale of Varanger. Our results show that our tools could reliable monitor the values and priorities of a large number of people at the landscape scale. The tools is a cost-effective way to collect data on local and tourists values and preferences. The resulting maps cover large areas and will be made available for the relevant users.

Published Results/Planned Publications

Muñoz, L., Hausner, V.H., Monz, C. 2018. Advantages and limitations of using mobile apps for protected area monitoring and management. Society and Natural Resources. *Accepted.*

Hausner, V. H., Fauchald, P., Broderstad, E.G. 2019. Contact with nature as an indicator of sociocultural values in the Arctic. *To be submitted Ecological Economics*.

Ancin-Murguzur, F.J.; Munoz, L.; Monz, C.; Fauchald, P.; Hausner, V. Efficient sampling for ecosystem service supply assessment at a landscape scale scale. Ecosyst. People 2019, 15, 33–41, doi:10.1080/26395908.2018.1541329.

Ancin-Murguzur, F.J.; Munoz, L.; Fauchald, P.; Hausner, V. H. High-resolution mapping and ecosystem service forecasting in the sub-arctic tundra in a changing climate. *To be submitted*

Monz et al., 2019 Research priorities for managing complex interactions between wildland recreation disturbance and climate change, review, to be submitted to AMBIO

ES Arctic in collaboration with CultEs

Engen, S., Runge, C., Brown, G., Fauchald, P. & Hausner, V.H., 2017. Assessing local acceptance of protected area management using public participation GIS (PPGIS). *J. of Nature Conservation.* Volume 43, June 2018, Pages 27-34

Muñoz, L. Hausner, V.H., Brown, G., Runge, C., & Fauchald, P. 2019. Identifying spatial overlap in the values of locals, domestic- and international tourists to protected areas. Tourism Management Volume 71, 259-271. https://doi.org/10.1016/j.tourman.2018.07.015

Brown, Greg; Pullar, David; Hausner, Vera Helene. 2015 An empirical evaluation of spatial value transfer methods for identifying cultural ecosystem services. *Ecological Indicators* 2016; Volum 69. ISSN 1470-160X.s 1 - 11.s doi: 10.1016/j.ecolind.2016.03.053.

Brown, G., Hausner, V.H., & Lægreid, E. (2015). Physical landscape associations with mapped ecosystem values with implications for spatial value transfer: An empirical study from Norway. Ecosystem Services. Volume 15, October 2015, Pages 19–34;

Brown, G., Pullar, D., & Hausner, V. H. (2016). An empirical evaluation of spatial value transfer methods for identifying cultural ecosystem services. Ecological Indicators, 69, 1-11.

Hausner, V.H., Brown, G., and Lægreid, E. (2015). Effects of land tenure and protected areas on ecosystem services and land use preferences in Norway. Land Use Policy 49: 446–461.;

Communicated Results

1. **Communicated results and their channels (i.e. workshops, press, users):**

Hausner, V. H.; Fauchald, P. & Broderstad, E.G. (2017). Contact with nature as an indicator of sociocultural values in the Arctic, Participatory mapping/GIS scientific meeting, San Luis Obispo, 1.-3. August, 2017.

Hausner, V. H.; Broderstad, E. G.; Fauchald, P. (2017). Participatory mapping of socio-cultural values in and outside the Varanger National Park in Norway. 24th International Symposium on Society and Resource Management; Umeå, Sweden, June 19-22, 2017.

Hausner, Vera Helene; Engen, Sigrid; Munoz, Lorena. 2016. Assessing spatially explicit cultural ecosystem services for adaptive management in the alpine north. Guest lecture at USU (Utah State University) 2016-04-18 - 2016.

Engen, S. 2016. What factors are important in determining the distribution of ecosystem values in Norwegian Alpine areas? European Ecosystem Service Conference, 19.-22 september, Antwerpen.

Muñoz, L., Hausner, V. H., Brown, G., Runge, C., Fauchald, P. 2016. Web-based public participatory GIS as a tool for analyzing conflicting landscape values in protected areas, 2nd prize poster session, European Ecosystem Service Conference, 19.-22 september, Antwerpen.

Inhouse presentation of PhD work by Lorena Munoz and Sigrid Engen at UiT.

Interdisciplinary Cooperation

The team build on competences in ecology, geography, political sciences and sustainability sciences. Our work is interdisciplinary as we need social science for mapping the social values and preferences of people using PPGIS, but we couple this data with ecology to identify ecosystem services of importance to local people. This project is also including the knowledge of locals, through community meetings in Varanger and by dialogue with park managers, the advisory councils and local boards.

Budget in accordance to results

The funding has been used as planned. finally we will design the web-based monitoring protocol that will be implemented in Arctic Norway to monitor values, use and climate-related risks. We also plan a community meeting to receive feedback on the monitoring protocol after ES Arctic has finished

Could results from the project be subject for any commercial utilization
　　No
Conclusions

ES Arctic main goal is to develop monitoring schemes that include spatial heterogeneity in ecosystem

services and differences in values and risk perception among different user groups. We have found that digital PPGIS could be used as a reliable monitoring tool for capturing broad patterns in what people consider as important sites and what kind of development they desire in the landscape. Non-digital PPGIS is more resource demanding, but provides richer and more contextual data which could to a larger extent explain why people think certain values are more important than others, and how it related to their willingness to consider climate-related risks. We have also looked at the increasingly popular use of social media as a proxy