

## Project information

### Keywords

monitoring, socio-ecological systems, climate, spatial use, ecosystem services, local perceptions and values, adaptive management

### Project title

ES Arctic: Taking into account heterogeneity in ecosystem services monitoring and climate change adaptation (ES Arctic)

### Year

2017

### Project leader

Vera Helene Hausner

### Geographical localization of the research project in decimal degrees (max 5 per project, ex. 70,662°N and 23,707°E)

70°29'01"N 29°32'26"E

### Participants

Per Fauchald, Norwegian Institute for Nature Research (**NINA**),

Sigrud Engen and Lorena Munoz PhD students, **UiT**.

## International partners

Christopher Monz **Utah State University**,

Greg Brown **California Polytechnic State University**.

Ashley D'Antonio, **Oregon State University** (previously Utah State University)

### Flagship

Terrestrial

### Funding Source

Terrestrial Flagship,

CultEs, Environment-2015, Norwegian Research Council

UiT

NINA

## 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 protected areas 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 locals 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, and the main marked trails, 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 most related to DNT cabins. ***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.***

We have taken in total 2754 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 will speed up the process of recording sample points which will be used for assessing heterogeneity in spatial extent, intensity, and type of ecosystem services at the scale of Varanger peninsula next year.

Master and PhD-students involved in the project

Lorena Munoz (UiT) and Sigrid Engen (UiT) have both been involved as PhD students 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 reliably 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

Engen, S., Runge, C., Brown, G., Fauchald, P. & Hausner, V.H., 2017. Assessing local acceptance of protected area management using public participation GIS (PPGIS). *Re- submitted after revisions to J. of Nature Conservation.*

Muñoz, L., Hausner, V. H., Brown, G., Runge, C., Fauchald, P. 2017. Identifying spatial overlap in the values of locals, domestic- and international tourists to protected areas. *Re-submitted after revisions to Tourism Management.*

Brown, Greg; Pullar, David; Hausner, Vera Helene. 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.

Hausner, V. H., Fauchald, P., Broderstad, E.G. 2017. Values-as-relations identified by mixed-methods participatory mapping. *To be submitted Ecological Economics.*

Munoz, L., Hausner, V. H., Fauchald, P. & Runge, C. 2018. The use of social media and web-based PPGIS for ecosystem services mapping, draft to be submitted in 2018.

Runge, C., Hausner, V. H., Fauchald, P. & Brown, G. 2018. Identifying latent and realized cultural ecosystem services, draft to be subm. in 2018.

Ancin, X., Munoz, L. Fauchald, P., & Hausner, V. H. 2018. Mapping of ES supply at a landscape scale by PIM in ground images, draft to be subm. in 2018.

Hausner, V. H.; Fauchald, P. & Broderstad, E.G. (2017). Contact with nature as an indicator of sociocultural values in the Artic, 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, 2<sup>nd</sup> prize poster session, European Ecosystem Service Conference, 19.-22 september, Antwerpen.

We also plan to submit one more paper on the sample point on landscape scale and one paper synthesizing all our results.

#### Communicated Results

Leaflets and reports associated with internet PPGIS

Presentation to Norwegian Environmental Agency during workshop in BIO-3007

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, and most activities next year will be scientific dissemination. We continue with the sample point next year 2018 and 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.

Could results from the project be subject for any commercial utilization

No

If Yes

No

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 Next year we will link these data to spatial analyses of ecosystem services supply using modelling and the sample point approach.