

Project information

Keywords

Ecological restoration, vegetation ecology, remote sensing, assessment methods, biodiversity, north Norway

Project title

Improving Methods to Assess Ecological Restoration in North Norway (EcoRest)

Year

2015

Project leader

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Participants

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Flagship

Ocean Acidification

Funding Source

This is a new pilot project funded by the MIKON Flagship.

Summary of Results

For WP 1: Landsat and WorldView-2 images of the Nikel study site were analyzed to assess changes in productivity/greenness (via NDVI) and vegetation type. A positive trajectory of NDVI and natural recovery of local vegetation types are expected due to reduced emissions from the copper and nickel processing plant in Nikel, Russia. We assessed two areas, one rehabilitated by our colleagues in Russia (Lukina, Nikonov and Isaeva) and one control site. Preliminary results show that there was an increase in the near peak summer NDVI based on Landsat data from the pre-rehabilitation phase in 1993 to 2013 (Figure 1) from 0.19 to 0.33, while the control area (no rehabilitation) showed NDVI values of - 0.004 for 1993 and 0.069 in 2013, respectively. The NDVI values from 2015 showed a reduction for both sites – probably due to a later acquisition of the Landsat data this year. The WorldView-2 images were analyzed for the years 2014 and 2015, and the average NDVI values for the rehabilitated site were 0.65 and 0.66, and 0.11 and 0.105 for the control site. The large difference between NDVI values from Landsat and WV-2 from the same year is partly due to different bandwidths of the sensors and spatial resolution (a pixel in the Landsat image covers 900 m² while one in the WV-2 image covers 4 m²).

Analyses of a portion of the rehabilitated site situated closest to the Cu-Ni processing plant showed a significant increase in peak summer NDVI from Landsat data. NDVI values in the most damaged/denuded area in 1993 were between -0.1 and 0.05, and in 2013, they were between 0.20 – 0.25. In addition, WorldView-2 images from 2014 and 2015 were analyzed for the same site, and the average NDVI values in this region were 0.33 – 0.40, and 0.35 – 0.43 for these years, respectively, showing what could be a trend of an increase between two consecutive years. In addition, another analysis will be carried out in late 2015 (possibly going into the beginning of 2016) to further study these trends by analyzing yearly peak of the season NDVI/integrated NDVIs from MODIS and GIMMS_{3g} data, and from additional Landsat imagery. A classification of the 2013 Landsat imagery was completed to extend a previous analysis to assess changes in vegetation types in the region since 1973. The previous temporal range was 1973-1999, and is now extended to 2013. The major trends from 1999 to 2013 found were that in concert with the reduction of SO₂, areas dominated by lichen heaths and forests increased significantly, while the industrial barrens and damaged areas declined.

For WP 2: Hagen used literature and discussions with military personnel to identify sites undergoing natural recovery or assisted ecological restoration on military training grounds. Hagen set up appointments with key personnel at the military training sites that fit best with our criteria for study sites in north Norway, and

Taff and Hagen visited these sites with the military personnel. Together with the military personnel, we determined multiple study locations within each military training site that we can use in development of our larger proposal on development better assessment methodology for ecological restoration in north Norway (a primary goal of the EcoRest grant). At each study location, we collected a GPS point, photographs, and wrote a short summary about the type of ecological disturbance and any restoration activities that have occurred at that location. Study locations were identified in ecologically damaged locations in military training sites in Karasjokfjellet, Porsangmoen, Mauken-Blåtind, and Setermoen. For approximately 20 study locations, we identified the disturbed area that is undergoing restoration, in some of these we found disturbed areas not undergoing restoration, and in the majority of these areas we found nearby undisturbed areas of the same original vegetation type for control. Photos of some of the sites are enclosed.

For WP 3: A team meeting is planned in Tromsø for December 10 -11 of 2015. At this meeting we will put the results from WP1 and WP2 together and add parts to create a proposal that can be tailored to relevant calls. In addition, we will have discussions about potential funding sources to monitor for such calls. Our proposal will be to develop and test rigorous and generalizable assessment methods which will also merge methods from remote sensing and vegetation ecology. The general assessment framework we developed follows these key points over time for an area under ecological restoration. The first level of our 3-tiered framework assesses the amount of vegetation cover (percent cover – determined via ground data/vegetation ecology perspective) and general vegetation health (via NDVI from a remote sensing perspective), both in comparison to what is typical for that vegetation type in undisturbed areas. The second level is a comparison between area under restoration and nearby undisturbed areas of the same intended vegetation type in terms of coverages of functional plant groups (assessed via ground data/vegetation ecology) and/or the distribution of vegetation types (assessed from remote sensing). The third level is an assessment of how similar the species composition is to nearby undisturbed areas of the same vegetation type (from a ground data/vegetation ecology perspective), and an assessment of the frequency of introduced and/or Red Listed species in the area (determined both from ground data and remote sensing). Ground data and remote sensing data are collected/available at different spatial scales, and the most appropriate form of data may depend on the scale of each restoration project. Ground data (vegetation ecology approach) and remote sensing each present benefits and limitations, and using both methods will have its unique synergies and limitations which will be explored in the project as well. Assuming the call(s) we find support it, we will focus on restoration and time scales relevant to the north Norwegian context.

For the Management

We worked directly with environmental officers for the military on this pilot project, and the environmental officer in Setermoen has indicated a willingness to work directly with us on a larger project to implement our assessment criteria and work on ecological restoration in this military training area in an adaptive management context. Based on the larger proposal we hope to get funded, we plan to create a clear, implementable assessment framework for restoration ecology projects that can be used by the Environmental Agency in Norway and similar agencies in other countries to oversee and enforce restoration ecology projects. In addition, we will present our assessment framework to the Defense Estate Agency, the Roads Directorate, and the Water Resources and Energy Directorate, as well as private companies for use in their ecological restoration projects.

Published Results/Planned Publications

The planned result of this pilot grant is a draft of a proposal to be submitted to a call to be determined in the nearest possible future. In addition, the following manuscripts are under preparation on the basis of the Meadowarm-project and the EcoRest-project:

1. A manuscript concerning natural and man-made rehabilitation around the Nickel processing plant using field data and remotely sensed data is under preparation (see results in figure 1). The working title for this manuscript is: Use of remotely sensed data in monitoring of air polluted areas undergoing natural and man-made rehabilitation.

2. Tømmervik et al. Monitoring the dynamics of the vegetation change around a Cu-Ni processing plant in the Kola Peninsula using multitemporal Landsat data in the period 1973-2013 (see figure 2).

Communicated Results

We informally communicated our plans and basic assessment framework with environmental officers and other military personnel at the study sites, and to different degrees, they are excited to work with us to implement our assessment methods and use the assessments for continued restoration plans. If and when a larger project gets funded, this direct link to land managers in lands in need of ecological restoration will be critical.

Interdisciplinary Cooperation

Our primary interdisciplinary cooperation is between the fields of vegetation ecology (Hagen and Kapfer) and remote sensing (Tømmervik and Taff), as well as the direct link to land management.

Budget in accordance to results

Our overall budget will be as planned. We were able to identify a sufficient number of study sites with fewer field days than planned, so the excess money will be spent on preparation of the draft of the larger proposal.

Could results from the project be subject for any commercial utilization

No

Conclusions

Results show that remote sensing can track general trends in the Nikel study region in vegetation types and vegetation health (using NDVI), and that most of the region continues to recover from the severe ecological damage. While both high and low spatial resolution satellite images show similar trends, the absolute NDVI values differ between spatial resolutions of imagery. These analyses can be incorporated into the framework we are developing for assessment of restoration ecology projects, which will also include ground data from a vegetation ecology perspective. The three levels of assessment will include both remote sensing and vegetation ecology, with the possible exception of the third level, for which remote sensing may not be able to contribute sufficiently in many circumstances due to difficulty in determining species.

We identified several military sites with many ecologically damaged locations undergoing restoration, and these sites will be useful to implement our assessment strategies. If our proposal for a larger project is funded, the project could make significant advances to ecological restoration assessment standards, and therefore promote more frequent and comprehensive ecological restoration activities, overseen primarily by government institutions but also private organizations and NGOs.