Forestry GIS Applications
Protecting Archaeological Sites in Forested Areas

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Abstract. Approximately 60% of all archaeological sites in Finland, ca. 11 000 sites, lie in areas where forestry is being practised. Modern forestry methods present a tangible threat to such sites, since heavy harvesters are used and the soil is broken for reforestation. The development of forestry GIS systems has made it possible to bring the location of protected sites easily into the different levels of forestry planning systems, from large-scale planning to the harvester drivers. The paper presents some forestry GIS applications and their practical use. Forestry GIS systems are shown to be a powerful tool for integrating information on protected sites to forestry planning. These systems present the most up-to-date technology used within the field of forestry. The paper presents an example of a successful co-operation between heritage protection sector and commercial land use sector.

1. Introduction

The Finnish archaeological heritage is mainly situated in forests, since almost two thirds of the land area in Finland is forested. There are 17 000 known prehistoric sites in Finland. Over 90% of the forests of Finland are harvested, this means they are used for commercial forestry. This leads to a situation where we have a majority of our archaeological heritage in areas where industrial-level forestry is being practised.

The archaeological heritage of Finland is more or less evenly distributed across the country. There are slightly more sites on the southern and western coastal areas than elsewhere, but there are also large and important sites in eastern Finland, in Kainuu, Ostrobothnia and Lapland – in less-populated areas, where forests dominate.

Archaeological sites in forested areas cover all forms of ancient remains from the Mesolithic Stone Age sites to Medieval farms. Some of them are more visible than others. The hill-forts in southern Finland are too prominent to be missed in forestry, and in many cases, are maintained as monuments by the Section of Site Management at the National Board of Antiquities (NBA). Site management work at the NBA is partly aimed at making sites more visible in forests. Maintenance includes also for example the felling of trees from the cairns, since the roots of the trees can damage a cairn very badly.

Most Stone Age settlement or burial sites however are hardly or not at all visible above ground. Stratigrafically they lie very close to the surface due to slow erosion and accumulation of soil in Finland, and are thus very susceptible to damage. Sometimes house depressions can be seen on sites, but it takes a trained archaeologist to discern these (and summer conditions with no snow coverage). Bronze Age or Iron Age stone/earthwork burial cairns are more easily seen, but mostly so badly covered with vegetation that they are obscured from view and not noticed during harvesting.

2. Large-Scale Forestry and Site Protection

Forestry is a big and important industry in Finland, and harvestable forests are effectively utilised. Around 40 % of Finland’s net export earnings come from the trade in forest industry products. This proportion is larger than in any other country calculated per capita. The development of harvesting methods has lead to a situation where most of the harvesting is done with heavy machinery, harvesters and loaders. There are no more loggers cutting down trees on foot with a chain saw, but harvester drivers who never leave the booth of their machines. These heavy machines present a tangible threat to archaeological sites, both above ground and subterranean, since the sheer weight of the machines will break the soil, at least during summer harvesting.

Another threat to sites is reforestation, which includes a method where the soil is broken or harrowed to facilitate regrowth after harvesting.

Modern harvesters can perform all the necessary work tasks during harvesting: felling the trees, preparing the logs, loading and carrying. They are also much automated, and for example vehicle computers with GIS capabilities are already widely in use.

We do not have exact figures for the number of sites that are – mostly unintentionally – damaged each year in harvested forests, but each year several sites are damaged this way. Some simple measures such as marking the sites beforehand in areas where harvesting is about to happen have been taken before, but the real problem has been in the lack of proper means in distributing information about the location of the sites to relevant actors in the harvesting operations chain. It is only with the development of GIS systems and the availability of electronic spatial information on archaeological sites in Finland that we have found a new and effective channel for the dissemination of information vital for the preservation of sites.

3. Forest Certification and a Complicated Field of Actors

The protection of sites in modern forestry has been made easier by the application of forest certification. A certified forest means a forest where during harvesting certain agreed criteria are fulfilled, and among these is one that requires that protected sites are taken into account and not damaged. Eventually, obtaining a certificate for a forest or timber means the producer will get a higher price for his timber. This has lead to the happy situation where parties involved in forestry have started to actively seek knowledge about protected sites in forests in order to fulfil the certification criteria.

Finland follows certification criteria of its own, called the Finnish Forest Certification System (FFCS), which is accepted by the international PEFC-system. FFCS criterion no. 34 states that: "Cultural-historically important ancient monuments are protected from forestry measures." There are all in all 37 different criteria to be fulfilled. (FFCS 1999).

The situation is however complicated by the fact that several independent parties are involved in forestry: forest owners, contractors doing the harvesting, governmental bodies, out of which the most important is the Forestry Development Centre Tapio and large and smaller forestry and paper companies.

Sharing knowledge with lots of different actors in the same field requires co-ordination and effectiveness. It is vital for the preservation of sites to make sure that all the parties involved in forestry, down to the harvester drivers, are aware of the sites that exist and that this information is up-to-date. GIS systems developed lately for forestry management provide a channel along which site information can be effectively distributed and updated. One other prerequisite for the use of forestry GIS is the development of the heritage registers of the National Board of Antiquities. The Sites and Monuments Register of the NBA has been under development since the 1980's, but has undergone a more dramatic development under the last couple of years, including the conversion to a new database platform (SQL Server) and the application of a web-based user interface. At the same time, the collation of information was completed and the register now holds data of all known prehistoric archaeological sites in Finland, including midpoint co-ordinates. (Hamari 2003).

The actor field and information flows of forestry can be schematically presented as follows (see Fig. 1.):

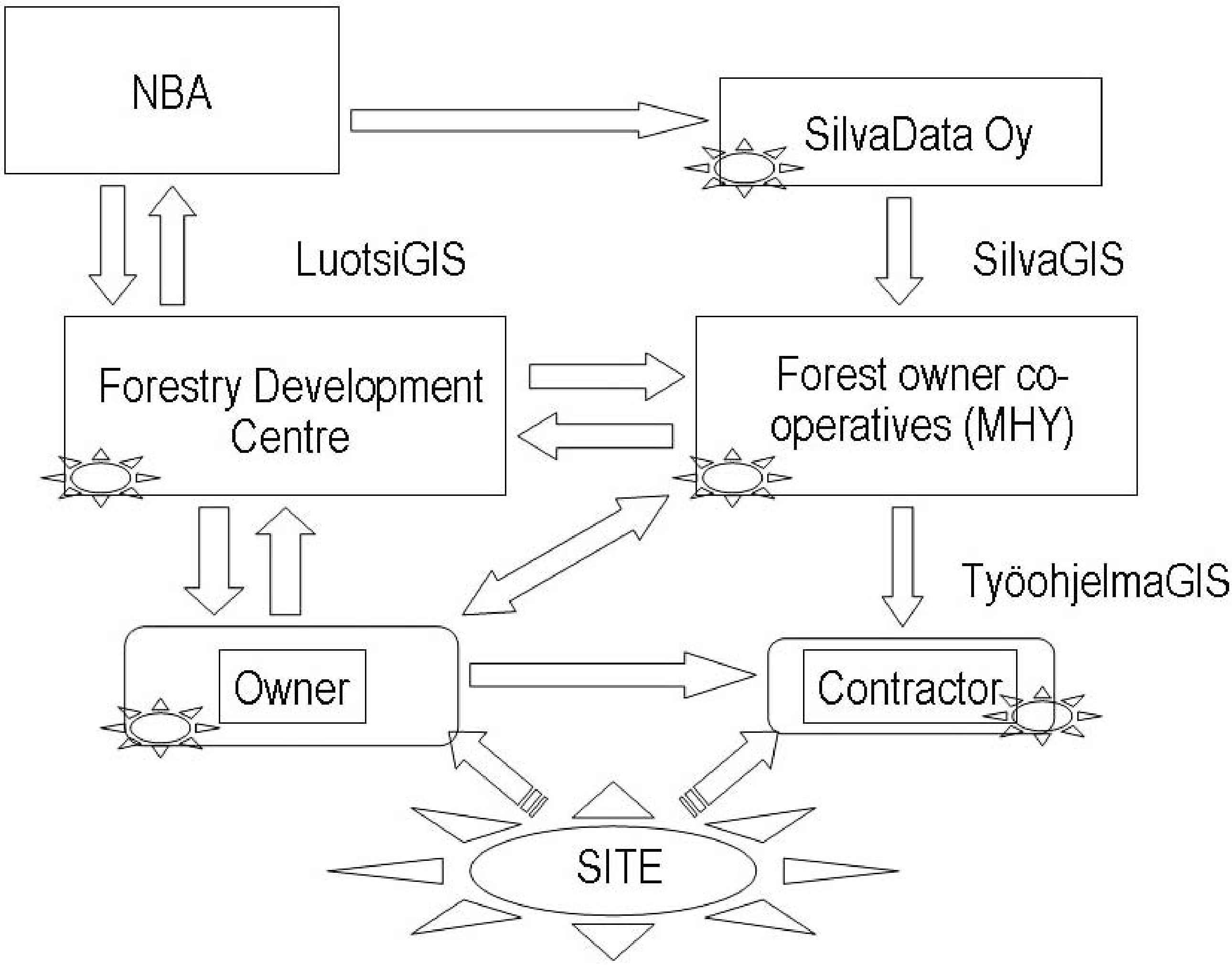

Fig. 1. The complicated net of different actors within forestry makes the preservation of sites a challenge. The key question is how to pass on the knowledge of site locations to different actors. GIS systems developed for forestry have provided a channel for this dissemination of information from the NBA down the chain of operators.

1. The main field is dominated by the individual owners of forests (mostly private, partly companies), contractors doing the harvesting, forest owner co-operatives advising and planning forestry measures for owners and the official (Forestry Development Centre) following the forestry procedures. Forestry planning procedures take place between these three (excluding the contractor), and plans are passed on to the contractors.
2. The existence of an archaeological site in a stand to be forested may, however, be completely unknown to any of the actors, and before certification there was no incentive to find out, either.
3. With the introduction of GIS systems for forestry planning, a channel for providing this information came viable.
4. From the SMR of the NBA, spatial data on all known sites in Finland could be incorporated into the different planning systems. The plan is to make this information available to all levels of forestry management, so that the invisible sites in forests become visible to the actors.
5. Since the field already has an in-built reporting aspect, we expect also that some feedback in form of mistakes discovered or new sites found will eventually start coming back to the NBA.

4. GIS Systems in Forestry

The GIS systems themselves in forestry are very effective in planning and managing modern forestry. They bring tangible benefits to the companies, and this means resources have been amply available for developing these systems. Forestry GIS systems in Finland have been developed by major IT companies, and they are well built, comprehensive and powerful.

It is purely an additional benefit that these systems can be used for disseminating knowledge on archaeological sites, but since in forestry other protected sites have to be taken into account as well (for example Natura-areas), these systems had been designed with a capacity to do so, and had no difficulties in incorporating and presenting site information. Introducing site information into forestry GIS systems has brought the archaeological information into the level of practical forestry management and planning procedures.

Two case studies from forestry GIS systems will be presented here. The first is the SilvaGIS system developed by SilvaData Company. It is based on MapInfo and used by the forest owner co-operatives for advisory tasks and general planning. The system runs on a terminal server and utilises digital raster maps overlaid with vector forestry planning data. The site information as point data was incorporated as an additional layer. The data can be downloaded to portable devices for field work, edited and returned to the server. SilvaGIS has also been further developed for harvester vehicle computer use, where data can be used from the co-operative's SilvaGIS server. The portable aspect of the system can be performed for example with a tablet PC. For field work this is connected to a GPS device through a wireless connection. All data is editable on field. Harvesting advice can be given for example to forest owners directly during a field inspection. (Mykkänen 2004). TyöohjelmaGIS is an extension of SilvaGIS for vehicle computers. A number of contractors and harvester drivers already use these. They are generally equipped with GPSs' and RDS differential correction for further accuracy. The harvester driver can follow the digital harvesting plan from a screen, where sites are also presented. In TyöohjelmaGIS, a 50-meter safety buffer zone has been introduced specifically for archaeological sites due to their generally undefined spatial range. The crossing of the buffer zone will give produce a sound signal to alert the driver. The second case study is the LuotsiGIS system developed by the Forestry Development Centre Tapio and implemented by TietoEnator Oy. It is based on Oracle database and the GIS abilities are programmed with Tekla Oyj's own component library. The system is used in official forestry law monitoring and planning procedures, and incorporates several other aspects in addition to GIS capabilities. The system uses digital raster maps and georeferenced orthophotos with vector layers for varied planning data, including protected sites. This system produces over three quarters of all individual stand harvesting maps for private forest owners in Finland, which are used as base plans for harvesting. With these plans (electronic or traditionally on paper) the owner of the forest to be harvested gets spatial information of the sites in the area to be harvested.

5. Evolving Co-operation

The protection of archaeological sites in forests is seen as an important part of the heritage management in general. Project "Archaeological Sites in Forested Areas" was begun in 2002 between the National Board of Antiquities and Forestry Development Centre Tapio, in order to acquaint the forest owners to archaeological remains and to prepare guidelines for the management of sites in harvested areas. As a part of this project, the dissemination of spatial site information was discussed and agreed on. Spatial site information was sent out in late 2003 to both Forestry Development Centre Tapio and to forest owner co-operatives through SilvaGIS Company.

Since this is a new way of making the information flow, educating parties and evaluating impact will be a major task in the future. Educating parties involved in forestry has been started by producing a leaflet and a PDF of simple instructions concerning how to recognise and relate to to archaeological sites encountered in forestry. This material is available (in Finnish) on the internet at the following address:
http://www.metsavastaa.net/tiedostot/dokumentit/8435/ffaa86d1%2Epdf.

Evaluating the impact of this new information flow will be a task for the coming years and shall be done in co-operation with the parties mentioned in the text. The key questions in the evaluation are: if the information reaches the actual harvester driver and if the information is sufficient so that the sites will be better protected. It is important to evaluate in connection with this whether the parties doing the actual work in the forests can act in the right way based on the information provided. One question is if the point data is sufficient for the protection of the sites, but so far it is the only kind available nationwide. Areal spatial data of the sites is being produced all the time, but with the limited resources available for digitisation it will take some years to complete. Another question is whether the technologies used – for example GPS devices – are accurate enough to ensure the protection of the sites. Finally there is the question of the accuracy of the data itself, and in connection with this the National Board of Antiquities is very interested in following how the information flows backwards from the actors in the forests functions.

The National Board of Antiquities will follow the protection of archaeological sites in forested areas more closely than before to evaluate the impact of the measures taken so far in connection with the project. In the future, new ways of disseminating information of our heritage may be found, but at the moment the GIS systems developed for forestry provide us with a very functional and powerful way of protecting archaeological heritage in forested areas.

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