Mapping and management of mountainous routes with GPS for sustainable development and management

Vasileios C. Drosos* Dimitrios E. Farmakis and Christos C. Stamatiou
Institute of Forest Engineering Sciences and Surveying Department of
Forestry and Management of the Environment
and Natural Resources Democritus University of Thrace
Ath. Pantazidou 193 str., GR-68 200 Orestiada, Greece
vdrosos@fmenr.duth.gr, Dimitrios.Farmakis@vodafone.com, stamatioy@gmail.com

Abstract:

The terms "sustainable development" or "sustainability" or "viable development", have dominated the last decade as an ideological-scientific trend in the fields of economy and geography, in the sense of the use of renewable natural resources. The knowledge of the routes and the use of proper cartographical material are of great importance for activities such as logging, fire suppression, climbing mountains, trekking etc. In this paper, a survey of existing routes used for those purposes the significance of the accurate mapping of routes is underlined. A procedure for the measurement of those routes with the aid of the Global Positioning System, GPS is also described. Although the form and structure of the various management systems vary from country to country, depending on the specifications, requirements and technical capabilities, the centerpiece of their philosophy remains the same: the main components of the concept of management is the rational evaluation and programming.

Keywords: mapping, management, mountainous routes, sustainable development

1 Introduction

"Multiple-use" forest management practices adopted during the last decades (after the 1970s); have shaped the concept of sustainable forest management and development. The scope of this concept has been broadened by sustained yield management and nowadays it includes additional features such as forest operations quality, biodiversity and quality of life.

The terms "sustainable development" or "sustainability" or "viable development", have dominated the last decade as an ideological-scientific trend in the fields of economy and geography, in the sense of the use of renewable natural resources (Figure 1).

The knowledge of the routes and the use of proper cartographical material are of great importance for activities such as logging, fire suppression, climbing mountains, trekking etc.

Logging especially in sensitive Greek Mediterranean forest where man and animals (draught or load) are the main logging means want these routes for a successful economic, technical and friendly with the environment sustainable development and management of the forests. Forest management is oriented to production of high-quality wood along with ecological and social functions of forests.

The first route (footpath or trail) was built by man in the woods, who hunted for or persecuted looking for more security or searching goods for his survival.

A general classification of routes will be distinguished two categories:

A) Routes in the broad sense and
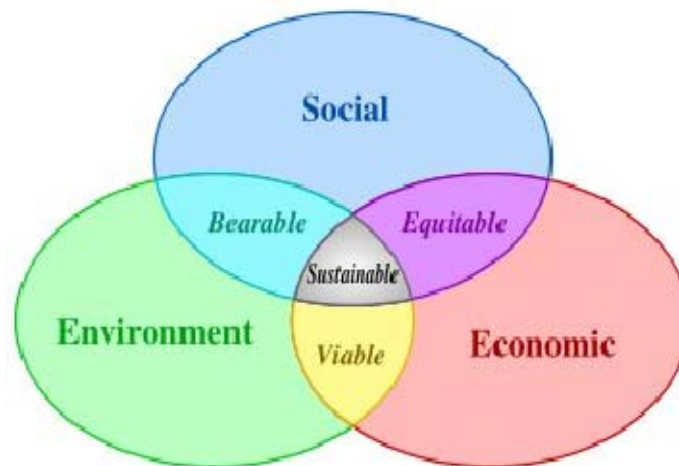
B) Routes in the narrow sense

Figure 1: Scheme of sustainable development: at the confluence of three preoccupations. Source: Wikipedia.

The trails are part of the second category because it contains a narrow strip of surface or underground soil layer, which strips are formed after long use (footpaths, paths).

Greece, a country with rich biodiversity, history and culture; has many elements that bear witness to continuous human presence in this geographical area for thousands of years. Among these elements is the old "paths". By this we mean "shaped routes or walks of pedestrians and animals that join together sites that have for man a certain special interest". For many years these paths were the only terrestrial road network to facilitate communication and transport. Depending on their importance in most cases they were accompanied by constructions that were designed for their delimitation and ensuring their passability. With the development of transport in its current form, the practical importance of these pathways decreased significantly and today many of them, those not destroyed by bulldozers, have been substantially covered by vegetation or destroyed by landslides.

Paths are cultural elements continues human presence and action. Also are passing through areas with natural beauty and great biodiversity and along or to their final destinations we find a wealth of cultural elements associated with the daily activities and services to residents (floors, water mills, terraces, inns, bridges) but with the religious and other traditions (churches, monasteries).

In Greece, in recent years, efforts have been celebrating these pathways to develop the areas where they cross, while preserving the historical and cultural elements. For example, the paths to Amorgos (Kouroupaki 2001), footpaths on Andros (Bretou et al. 2001), the paths in Mani (Saitas 1995), the paths to Skopelos (Vlami & Zogkaris 1997) the paths of Nafpaktos (Pountzas 1998). Apart from Greece and various countries of Europe, as in Cyprus (the nature trails in the Akamas) (Cyprus Tourism Organization 2009), UK (National Park Midlands, English) (Nicholls 1996), the Isle of Gomera in Canary Islands (Gomez et al. 1987) and elsewhere were opened old paths and were drawn to the new ecotourism development in the region.

Mass tourism is Greece's heavy industry; the implementation of the ecotourism model can be an alternative for its development and that, because ecotourism is a form of sustainable development based while respecting the environment and promote environmental education. According to it the relevant data (www.greekecotourism.gr), ecotourism is expected to increase in coming years at a rate five times higher than conventional tourism.

Creating environmental awareness should start from school because today's students are tomorrow's consumers and managers of the environment. The objectives of the adoption of positive attitudes and change behavior of students in the environment cannot be achieved in the context of traditional teaching, but needed other pedagogical approaches as those applied in environmental education (Hungerford & Volk 1991).

Consequently the various elements of the Greek region that could form the focus of these activities are the old paths and this, because of the direct connection with human activity and passing through areas with aesthetic and cultural value (Harakida 2005).

The fact that someone knows the coordinates of his position is not often enough in the sense that if he does not know the use of the map he cannot be oriented either with or without these coordinates. What would be useful in any case is to have the analytical production of the crooked zigzag (traverse) that is every route, where the coordinates for each vertex will be available. The accurate mapping of the routes is a job that has not been done yet, but it is absolutely necessary to do so for support of eco-tourism, and for reasons of security, protection, etc.

In this paper, a survey of existing routes used for those purposes the significance of the accurate mapping of routes is underlined. A procedure for the measurement of those routes with the aid of the Global Positioning System, GPS is also described.

2 Material and Methods

2.1. Research area

The forest land "Isenli" is located east of the settlement Triadi, to the northeast boundary of the Municipality of Thermi. The northern, eastern and southern boundaries of forest land overlap with administrative boundaries of the municipality, while the borderline of the western boundary, starting from the top Thermo of Mount Lanari, following the northwestern direction until the stream Kourou, downstream of the dam Triadiou, from where towards the north meets the administrative boundaries of the municipality. The Municipality of Thermi which forest land "Isenli" belongs is located in the SE part of the agglomeration of Thessaloniki and just 15 km from its center (Figure 2).

The area of the forest land "Isenli" is 1173.5 Ha; particularly 636.8 Ha i.e. 54.52% is reforested areas of coniferous and broadleaves, 500.6 Ha i.e. 42.67% is shrubs of evergreen broadleaves and 33.1 Ha i.e. 2.82% is abandoned public rural lands – grasslands.

The height above the sea level is from 40 to 700 m, has an average slope of about 20%, the aspects are varied, the terrain is relatively mild and woodlands covered by holly and wild pear tree (*Pyrus spinosa*) and reforestation with pines. Under cross several streams, where there is water flow for long periods of the year, depending on the distribution and duration of precipitation. Also, there are small torrents that lead to these streams (Figure 3). There are two dams of Thermi and Triadi.

The climate of the region belongs to the limits of the semi-arid and sub-humid bioclimatic floor with cold winters (method Emberger) (Emberger 1945). The rock formations that dominate the study area are those of peridotiton and west boundaries are found and slates.

The area belongs to the Mediterranean vegetation zone (*Quercetalia pubescentis*) and sub zone of Hop hornbeam (*Ostryo - Carpinion*). This area was the natural place of spreading oak forest. This vegetation is gave way under pressure from human activities (grazing, clearing, illegal logging, fires) leading to their gradual replacement by more resistant species.

Moreover, the special circumstances of the region, as the relatively intense relief, the importance for the environment of the area and the diet of water, the suburban character of forest land, the contiguousness to built-up areas, increased demand for recreation by residents of the region, and the fact that the reforestation areas have undergone substantial assistance after planting, reinforce the need for measures to enhance fire protection conditions in the forest land.
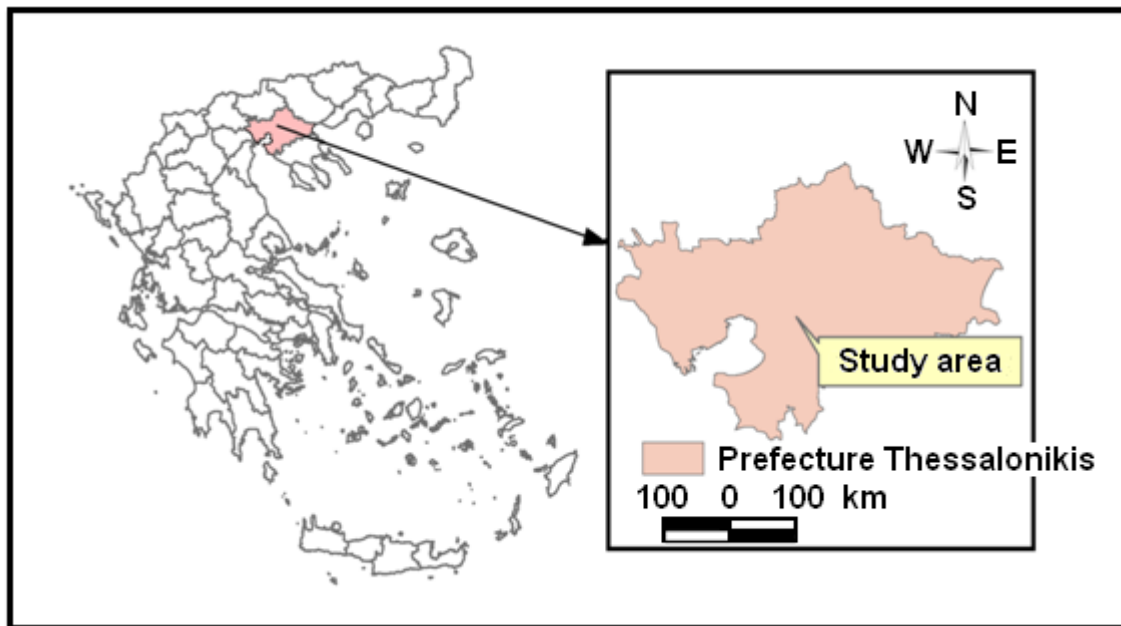
Figure 2: Orientation map of the research area

Figure 3: Ephemeral stream

2.2. Methodology

Its aim is to obtain an accurate record of the routes, route maps. Digital recording, mapping and disposal of these data to all who want to catch them. We will use the navigator Garmin Nuvi in order to collect data. Storage, digital mapping, imaging and availability of these data will be carried out by the use of the MapSource of Garmin program.

2.2.1. Data collection

The logic of the recording is to create a file (track) which will contain consecutive points that will make the route.

The recording of signs, the creation of the track and information using the navigator Garmin Nuvi automatically when the browser is running on each new point where you moved it. The result is visible by

selecting, viewing log file, showing the data as a blue line. To be useful the information collected suggested the following methodology:

• Define starting point, which we will mention in the comments.

• Turn off the navigator when we're at the point and then activates it.

• Trace the route to the last point and when we get to that deactivate the navigator.

The above procedure turn on and off the navigator before start and shut down of its operation after the arrival, is done in order to have a separate track which then we will manage.

Alternatively once we reached to the end we can create Track referencing this as a starting point and final destination a point in the way back. Registration for the course is interactive and does not depend on the starting point and final destination.

2.2.2. Data Storage

We can manage data from the internal memory of the browser using the program MapSource by Garmin with the following sequence of actions:

• Connect the navigator on the computer

• Powering the program MapSource

• I select Transfer> Receive From Device

• In the options window that appears choose: What To Receive> Waypoints> Routes> Tracks

With the above procedure we transfer and store data. A file is the set of points (Waypoints) and routes (Tracks) that we have saved (Figure 4).

2.2.3. Data processing

To create the travelogue we follow the steps below:

• Create with the program MapSource by selecting, File> New, a new blank file.

• With this option, File> Save As, give the location and file name that has the form ABCDEF-Route Map.gdb, where ABCDEF is the Site Name.

• By selecting copy > paste the file with all data transfer to Waypoint (position of the last point) and track (the route to the last point) in the empty file.

After the above we have a file, which we can place it to the navigator.

2.2.4. Data transfer

To get the latest information must delete from the internal memory of the navigator, after we stored, our data using the following procedure:

• Tools> My data> Points

• Tools> My data> Clear Trip Log

In order to inform the navigator with the travelogue to the final point we need the following procedure:

• Connect the navigator on the computer

• Powering the program MapSource

• choose Transfer> Sent To Device

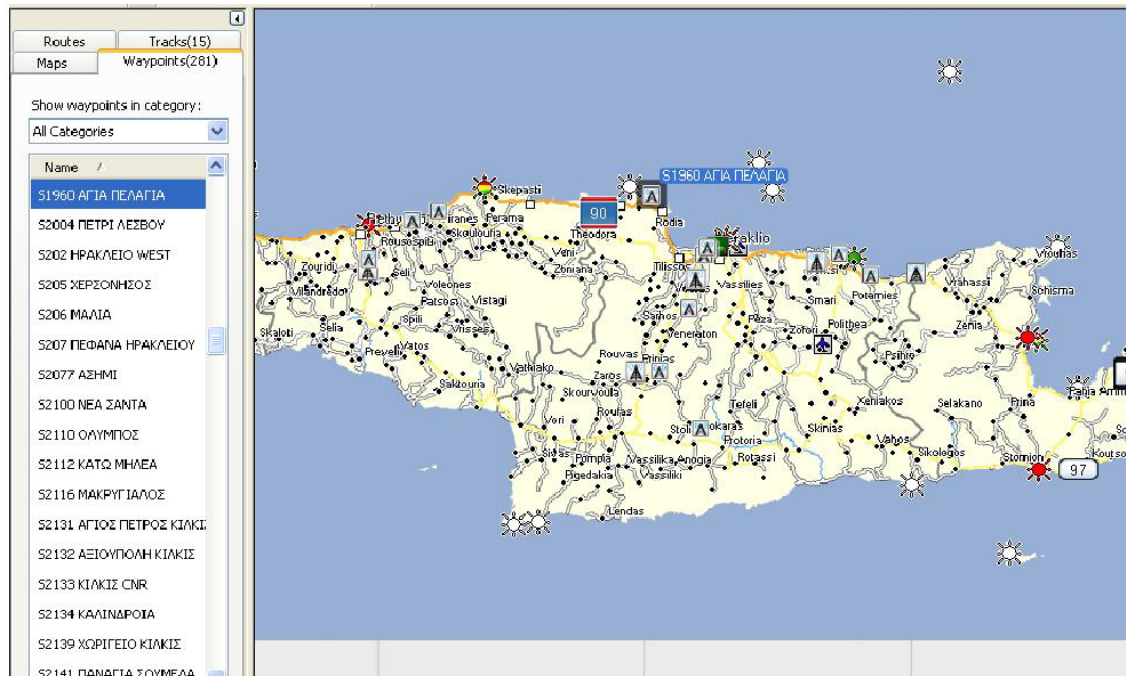• In the options window that appears choose: What To Sent> Waypoints & Tracks

Figure 4: Presentation of Waypoints and tracks

With the above procedure we transfer and store data that are visible in the navigator. By selecting the track back navigation is done by the point where I am on the track with final destination the desired point.

Models of Garmin navigators for cars that have the ability to track back is 510 and 1490T, all handheld GPS models have this possibility.

The mapping is in the form of the letter Y with several small semicircular routes in the SW part leading to the main axis of the routes forming a network. The points were recorded with GPS then mapped with a CAD or GIS program (i.e. AutoCAD).

3 Results

After the above we have a file, which we can place it to the navigator and its format is as shown in figure 5.

This display format is most suitable for use in programs for P / C (e.g. GIS) to produce cartographic material and other activities by stakeholders.

4 Discussion

Path is a friendly form of road on the forest environment. Therefore it would be good to map the entire route network in Greece. So it would be easier to manage but also to highlight areas of the country.

The proposed mapping of paths can start from the national network of paths and continue with other routes of interest, aiming the maximum flow of information (e.g. for the development of eco-tourism,

development and management of recreation, skidding with animals) and generally serve the various needs of users of trails. The results of these mapping can be included in a printed or electronic material for use by stakeholders. The lists of points' coordinates of each route will be available so that they are used as waypoints to a GPS receiver and guide a walking tour, etc. While the accurate digital mapping of the paths can be the basis for the production of multimedia products for the acquaintance of future visitors to the area's natural, historical and tourist features.
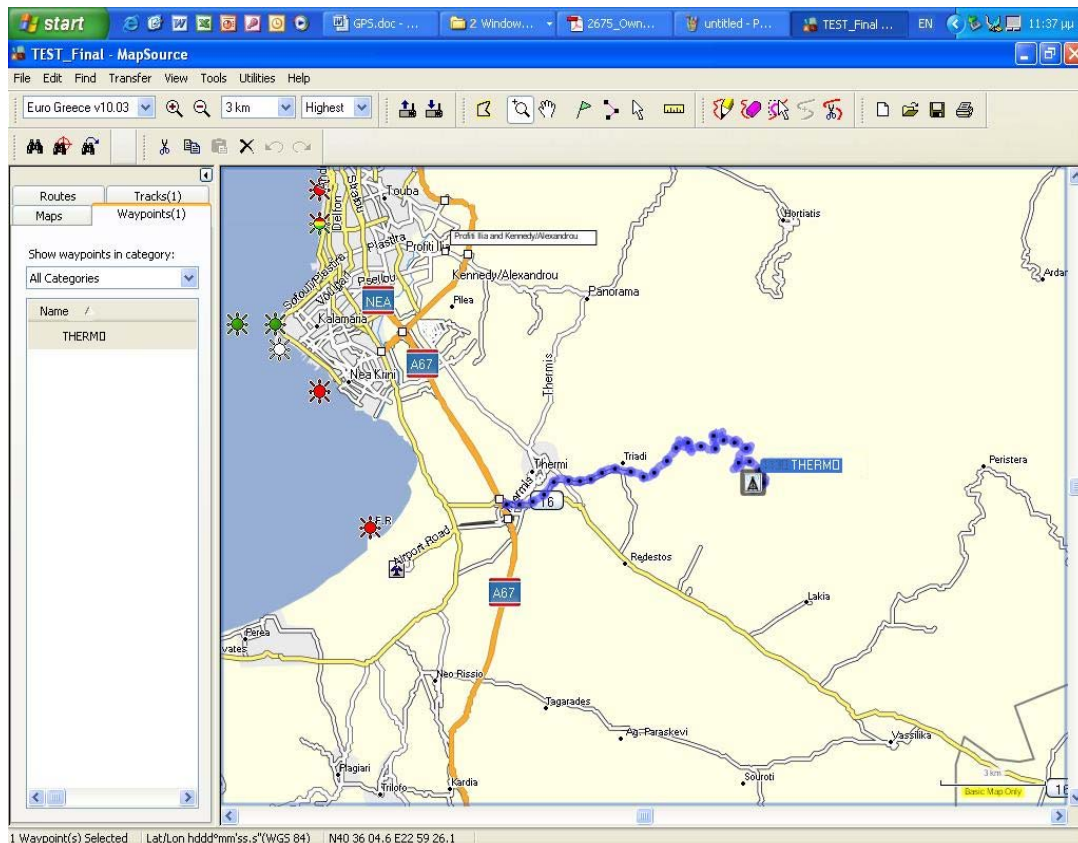

Figure 5: Travelogue to the final point

The design and layout of trails, is a device that helps greatly to the "educational experience", while minimizing impacts on ecosystems, keeping visitors and nuisances in specific areas. Creating routes of environment interpretation is important because it is a tool that contributes greatly to the promotion of the paleontological findings and is a mean of promotion "live" and immediate. Simultaneously, the setting out of paths helps to the protection of them after it is achieved the control of the visitors in the protection area, organizing the tours, and minimize the damages to the findings.

Each trail network should not only take into account the paleontological value of each region and the ecological and aesthetic value, to propose a route network to the visitor that offers multiple levels of information and recreation. The paths should allow visitors to be informed about the history of the natural evolution of the last million years, while enjoying the beauty of modern natural history of each area.

The proposed routes must meet a wide range of visitors and interest. Developing a network of paths, incorporating existing trails should be designed to unify different elements of the environment, both ecologically and culturally, and to highlight appropriate them while making easier the environmental education and visitor information.

Even the design and construction of trails can serve schools and people with disabilities and enables the possibility of visitors traffic with "environmentally friendly" means (such as bicycles, horses, mules, etc.).

The growing turnout of visitors and the modern conditions of safety and recreational in woodland, create the needs for reformation and promotion of new trails. The restoration and enhancement of ambulatory paths considered as intervention which does not alter the character of an area and its natural environment. It is a complementary activity and a continuous rendering of services, as well as is the link to the various sectors of developing the local economy.

Finally there are some risks arising from creating paths. The greatest risks that may be increased by creating pathways, but not in a particular degree, as a result of increased tourist business in the area are:

- The risk of forest fires, which can be prevented by voluntary initiatives (operation of fire lookout station for the monitoring during the summer), and

- The risk of soil degradation of the route (compaction, erosion).

Both these risks are not assessed as very important and can be prevented by taking precautions.

5 References

Cyprus Tourism Organisation (2009): Nature Trails in Akamas, Leukosia, Cyprus.

Emberger, L. (1945): Uno classification biogeogrphique des climates. *Rev. Trav. Fac. Sci. Montpellier, Bot.* **7**, 3-43.

Gomez, Sal A., Marin, C. & Mendaro, C. (1987): Conserving and Developing the Valuable Human Landscape of La Gomera, Canary island, *Ekistics* No 323/324, 170-175.

Harakida, H. (2005): The management of old paths towards ecotourism and environmental education. The path less Chrisovitsas Thermou Aitoloakarnanias - Bridge Artotivas. M.Sc. Thesis. Department of Biology. University of Patras. 121 pages.

Hungerford, H, & Volk, T. L. (1991): Curriculum development in EE for the primary-school: challenges and responsibilities, Paper for the International Training Seminar on Curriculum development in EE for the primary school, Malta, 1-16.

Kouroupaki, D. (2001): Amorgos: The original is still alive. *Azimuth* **20**, 4-7.

Nicholls, P. (1996): Landscape and Tourism: The New National Forest in the United Kingdom. Edited by Gerda K. Priestley, J. Arwel Edwards, and Harry Coccossis, Sustainable Tourism? European Experiences. Publisher: Wallingford, Oxon: CAB International, ©1996, ISBN: 0851991009 9780851991009.

Pountzas, L. (1998): Investigation of ecotourism opportunities in Mountainous Nafpaktos. Research program of School of Management Economics. TEI Mesolongiou.

Saitas, G. (1995): Tourism and promotion of cultural heritage of Mani. Proceedings of the conference Technical Chamber of Greece, Tourism and Environment. Options for sustainable development, *Technical Cronical* **5**, 96-103.

Vrettou, N., Kouroupaki, D. (2001): Tribute to Andros, in "rock" in the Aegean. *Azimuth* **20**, 12-13.

Vlami, V., & Zogkaris, S. (1997): Ecotourism Development in Skopelos: study of trails and hiking paths. Municipality of Skopelos.

Internet source:

www.greek-ecotourism.gr