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3rd to 8th July, 2016 | Mykonos island, Greece

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PROTECTION
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OF THE
ENVIRONMENT
XIII

Artwork of Rigas Kougkolos

Strategic sustainable development and ecotourism in natural ecosystems with archaeological heritage resources: The case of "Korikion Andron" Trail at the Parnassos National Park

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Abstract

The mountain of Parnassos, crisscrossed by a dense network of trails, is one of the ten Mountainous National Parks of Greece (Parnassos National Park). Parnassos network of trails includes numerous hiking and mountaineering routes, with various thematic interests and degrees of difficulty, among which is the "Korikion Andron" trail, which is the subject of the present research. This trail, is of particular ecological, archaeological, geological and scientific research interest.

The main purposes of the present research are: a. the promotion of natural environment, biodiversity, landscape, geology, geomorphology, archaeology and mythology, b. the management and protection of the ecosystems and archaeological heritage resources and c. the strategic of sustainable development and ecotourism, in the wider area of the cave "Korikion Andron" at the Parnassos National Park. The appropriate signage and maintenance of the "Korikion Andron" trail, are prerequisites for the promotion and the safe use of the trail.

Keywords: ecotourism; sustainable development; natural ecosystems

1. INTRODUCTION

The mountain of Parnassos, crisscrossed by a dense network of hiking trails and mountaineering routes, is one of the ten Mountainous National Parks of Greece. Due to the modern lifestyle, trail walking and hiking offer unique opportunities for contact with nature, biodiversity, ecology and cultural heritage, ecotourism of each region [1].

In the past, most trails were opened to facilitate communication of mountain areas with the lowlands and larger towns, and between the villages. Many trails, especially those in rural areas, were also opened to serve the movement of people and animals, the local logistical needs and generally the agricultural and pastoral life of the residents. In modern times most of these trails are being used in different ways or have been abandoned altogether.

Nowadays, many of these trails, in the area of Mt Parnassos, have been mapped, upgraded and maintained under the responsibility of the relevant Forest Services, Parnassos National Park Management Body, Hellenic Federation of Mountaineering & Climbing, Hellenic Alpine Club of Arahova, and various groups of volunteers, leading to different degrees of alternation in their routes. In this way, they can be used both for outdoor recreation and for the promotion of

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environmental, archaeological heritage resources, traditional and mythological features. Certain trails have been marked with appropriate direction and description signs (trailhead information signs, information/interpretive signs, destination signs, reassurance markers/blazes, You-Are-Here signs, identification signs, etc.). An important factor to increase a trail's functionality and traffic is the proper (pre) design with specific technical specifications, to highlight its particular characteristics in tandem with the safe movement of visitors. This is also a factor to reduce maintenance costs and promote the rational management of a trail. Main tools to achieve this is the proper trail signage which makes visitors feel safe and comfortable, and the explanatory signs that promote public awareness [2].

In addition, the "ecotourism routes" in "Protected areas" and "Natural Parks" are among the most important "tools" that experts use in order to illustrate the environmental features, but also historical, archaeological data and culture of certain areas, such as the "Korikion Andron" trail at the Parnassos National Park.

2. MATERIALS AND METHODS

2.1 Geographical location of the study area

A dense network of trails are can be found at Mt Parnassos (Figure 1). "Korikion Andron" trail, the subject of this present research, is located in the south- eastern side of Mt Parnassos in Central Greece, in the prefecture of Fokida. Mt Parnassos, with Liakoura (2,456 m), Kalogiros (2,397 m), and Gerontovrachos (2,396 m) being the highest peaks, is one of most impressive and steep mountains of Roumeli (Central Greece). The main nearby villages are Eptalofos, Arachova, Delfi and Chrissa.

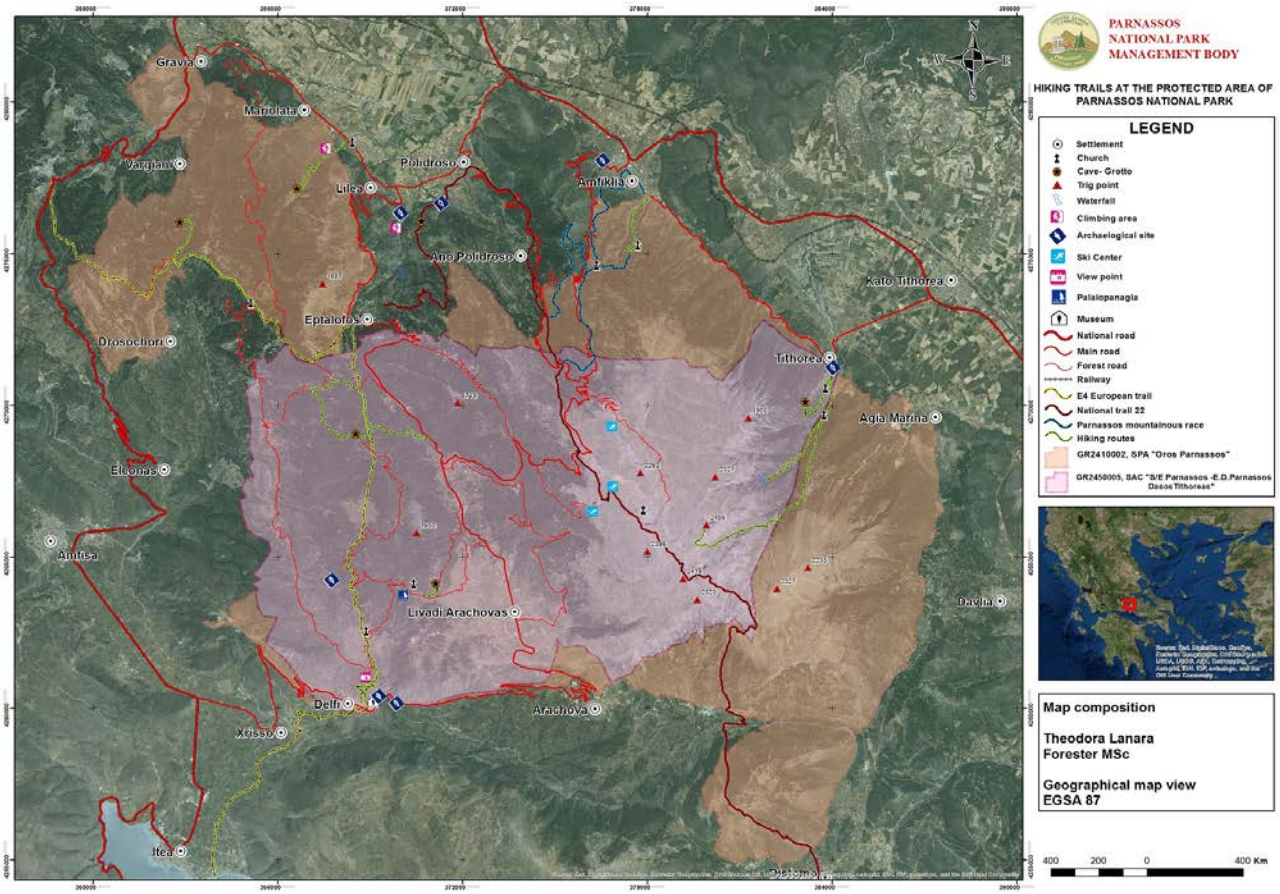

Figure 1: Map of hiking routes at the protected area of Parnassos National Park.

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"Korikion Andron" trail (Route I) starts from Palaiopanagia near Livadi Arachovas and ends after 1 hour to the Cave of "Korikion Andron" (Figure 2). From Palaiopanagia with South-South-West direction, a hiker can follow the route (Route II) that ends to archaeological site of Delphi, after of 3-3:30 hours of hiking, an alternative route having as starting point the archaeological site of Delphi through European trail E4 and at to the Cave of "Korikion Andron". Southern Parnassos and especially "Korikion Andron" trail, is accessible to the visitor that comes from Athens via Livadia to Arachova village and then to Livadi Arachova. A trip from Athens to Arachova is 175 km long (around 1h 40m by car), while from Lamia to Livadi Arachova is 80 km long (around 1h 15min by car).

2.2 Investigation method

For the depiction of the environmental situation (vegetation, flora, fauna, geology, geomorphology, water resources, landscape), archeology and mythology, of Mt Parnassos and of the "Korikion Andron" trail, involved a series of different stages: the study of bibliographical references, systematic in situ observations (field-work), measurements using the Global Positioning System (GPS) satellite signals, observation and direct digitizing on the basis of different aged aerial photos and satellite images (Google Earth). Also, have been used topographical maps (Hellenic Military Geographical Service, scale 1:50.000 and 1:100.000), geological maps (Institute of Geology and Mineral Exploration, scale: 1:50.000), Digital Elevation Model (DEM) data (National Cadastre & Mapping Agency S.A.), hydrological data and forest maps of vegetation and land uses (Ministry of Reconstruction of Production, Environment & Energy, scale: 1:200.000). All primary data were imported in an apposite database and were transferred in topographical map and onto DEM data using ArcGIS for Desktop 10.3. Measurements were taken using the Trimble Juno 3D Series embedded with software ArcPAD 10.2.

2.3 Institutional frame of the region - Mt Parnassos Protection status

Mt Parnassos includes areas that are covered by a protection status at a National and Community level [3, 4]. These are more specifically the following: a. The Parnassos National Park, founded in 1938, for the protection of the mountain's rich natural beauty. b. The Aesthetic Forest of Tithorea (200ha), for its special natural beauty and ecological importance. c. The Special Protection Area (SPA)-"Oros Parnassos" Code GR 2410002, for the protection of birds (NATURA 2000). d. The Special Area of Conservation (SAC)-"N.A. Parnassos-Ethnikos Drymos Parnassou-Dasos Tithoreas" Code GR 2450005, for the protection of types of habitats and species of flora and fauna (NATURA 2000) and e. The Parnassos National Park Management Body, founded in 2002, aiming mainly to the protection, conservation and sustainable management of the above mentioned protection areas and f. The Area of Outstanding Natural Beauty of Delphic landscape, for its aesthetic value and remains appreciably natural.

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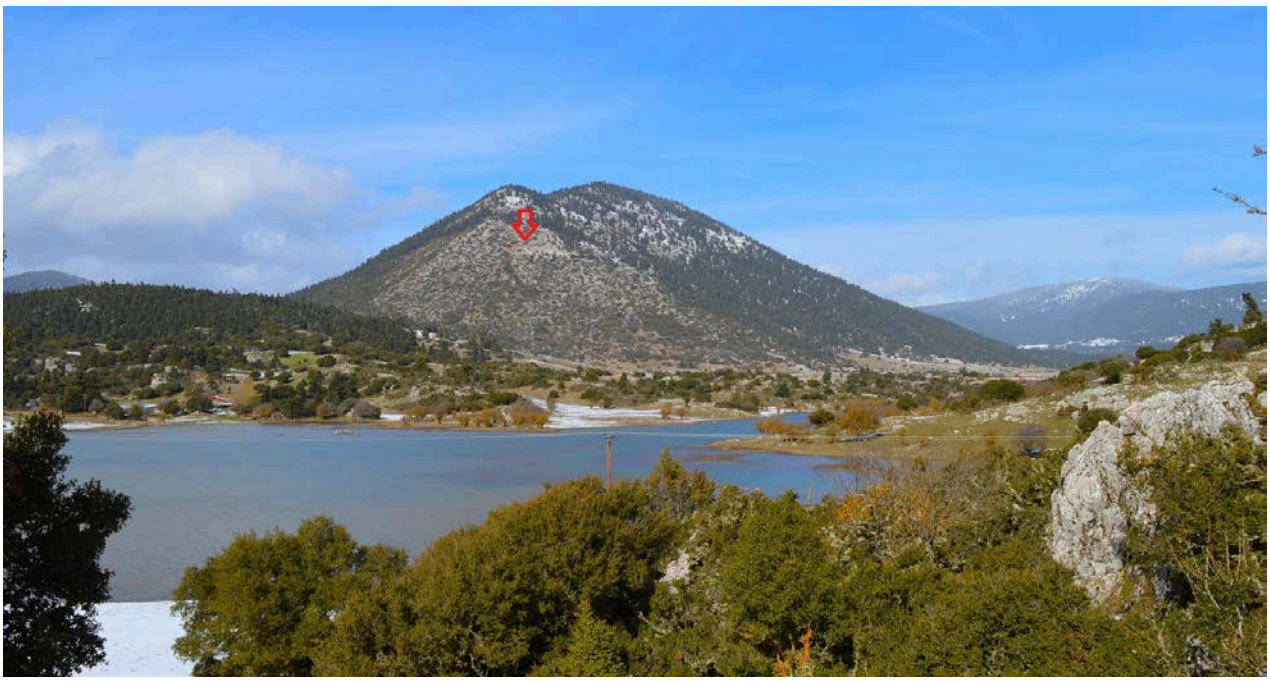

Figure 2. Palaiovouna Mt. (1,650 m) where "Korikion Andron" cave is located and the polje at Livadi Arachovas (Photo by Lanara T.).

2.4 Vegetation - Flora - Fauna

The vegetation zones encountered at the study area are: a. *Quercetalia pubescentis* (or deciduous broadleaf zone), consisting mostly of Quercus genus. forests. b. *Quercetalia ilicis,* consisting mostly of phrygana and maquis vegetation. The main plant species that occur in the study area are: kermes oak (*Quercus coccifera*), fir (*Abies cephalonica*), stinking juniper (*Juniperus foetidissima*) (Figure 3a), prickly cedar (*Juniperus oxycedrus*), jerusalim sage (*Phlomis fruticosa*), pink rock-rose (*Cistus creticus*), common hawthorn (*Crataegus monogyna*). At Palaiovouna area and the steep slopes of southern Parnassos Mt. above Delphi, a large number of rare and endangered plant species are found and are included in Annex II of Directive 92/43/EEC. Two endemic species of Parnassus are located in the area (*Centaurea musarum, Silene guicciardii*). The mountain of Parnassos is also important for the significant number and variety of protected aviauna species, particularly birds of prey. In Annex I of the Directive 2009/147/EC fifty five (55) birds (e.g. *Circaetus gallicus, Aquila chrysaetos, Bubo bubo, Dryocopus martius, Dendrocopos medius Dendrocopos leucotos, Sylvia rueppelli*) of the region are listed. As for other fauna species, thirteen (13) mammals (e.g. *Rhinolophus hipposideros, Rhinolophus ferrumequinum, Myotis myotis, Barbastella barbastellus, Dryomys nitedula)* six (6) amphibians (e.g. *Bombina variegata, Rana graeca, Triturus alpestris*), fourteen (14) reptiles (e.g. *Testudo marginata, Podarcis muralis, Lacerta viridis*) and ten (10) invertebrates (*Zerynthia polyxena, Parnassius mnemosyne, Parnassius apollo, Lucanus cervus, Grossuana delphica, Morimus funereus*), are listed in Annex II of the Directive 92/43/EEC. More common species such as the fox (*Vulpes vulpes*), weasel (*Mustela nivalis*), marten (*Martes foina*), wild boar (*Sus scrofa*) and wolf (*Canis lupus*) are also present at the area.

2.5 Geological setting - Geomorphology - Water resources

The morphology of the land relief, in the wider region of the Parnassos National Park, is defined by the mountainous massif of Parnassos with steep slopes, gorges and intense morphological contrasts. Mt Parnassos is the third highest mountain in Central Greece (Sterea Ellada), after the mountains Gkiona (Pyramida 2510 m) and Vardousia (Korakas 2495 m). The dominant structural elements are its limestone steep tops, with highest peaks Liakoura (2456 m), Kalogiros (2397 m), and

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Gerontovrachos (2396 m). The area near “Korikion Andron” cave is dominated by midslopes, while over Delphi large limestone precipitous slopes are encountered known as “Phaedriades”, creating a compact and impressive natural wall which is a morphological discontinuity of several kilometers length [5]. From the “Phaedriades” gushes the Castalian spring which was very important for both the sanctuary of Apollo and the Oracle of Delphi (Figure 3b).


Figures 3a,b. Stinking juniper (*Juniperus foetidissima*) at “Kroki” area (Fig. 3a).
The twin rocks of the Phaedriades (Fig. 3b) (Photos by Lanara T.).

Due to the predominance of limestone (76.6%) on Mt Parnassos, karst phenomena are formed from its dissolution. As a result, Mt. Parnassos is mostly characterized by an underground drainage system and lack of surface flow, with sinkholes and caves, forming many karst springs at the foot of the mountain. Other karst formations are dolines and poljes [6]. Karst formations are an important element of the landscape and geomorphology of the region, such as the Eptastomos Sinkhole, the Karkaros of Lilaia, the polje of Livadi Arachova, Korikion Andro Cave (or else, Korykio Andro - Korikio Andro - Corycian Cave - Korykian Cave) and Neraidospilia Cave.


Figures 4a,b. The entrance of “Korikion Andron” cave (Fig. 4a).
The inside of “Korikion Andron” cave (Fig. 4b) (Photos by Lanara T.).

2.6 History and Archaeology

The trail leads to the famous Korikion Andron Cave (Figure 4a), which, according to Pausanias reports (Fokika) is "the most worth visiting of all the caves I saw"[7]. The Korikion Andro, sacred

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to the Corycian Nymphs and the Muses, and a place of worship for Pan, may be the first religious center and the first oracle of the wider area of Delphi. Excavations inside the cave report findings dating from the Neolithic (4th millennium BC) to the Roman period (2nd century BC.).

At the south foot of Mount Parnassos, set within a most spectacular landscape, lies the Pan-Hellenic Sanctuary of Delphi, with the most famous oracle of ancient Greece. Delphi was regarded as the center, or navel, of the world. Traces of settlements are rare and very fragmentary until the 8th century BC. That is when the cult of Apollo prevailed and so began the development of both the Sanctuary and Oracle. The first stone temples of Apollo and Athena were built towards the end of the seventh century BC. Between the sixth and fourth centuries BC, the Delphic oracle, which was regarded as the most trustworthy, was at its peak. It was delivered by the Pythia, the priestess, and interpreted by the priests of Apollo. Cities, rulers and ordinary people would consult the Olympian god expressing their gratitude with great gifts which gradually filled the Sanctuary [8]. The archaeological site of Delphi, due to the global historical value as aesthetic and artistic significance monument has been included in the World Heritage List of UNESCO. [9]

3. RESULTS AND DISCUSSION

3.1 “Korikion Andron” trail at the Mt Parnassos - The route

The suggested trail starts from “Paleopanagia”, leading uphill on the eastern slope of “Palaiovouna” Peak (1650 m) to the Korikio Andro. The fastest way to get to the starting point is to follow the provincial road from Arachova to Eptalofos. After 8 km, on the left side of the road is a sign to the Korikio Cave at an altitude of 1120 m (Table 1). After about 20 minutes on the main forest road there is a sign suggesting the trail. It is signed with a triangular white and red frame, surrounded by scrub vegetation dominated by yew and semirocky ground, becoming rocky as we move uphill. After a 30 minute walk, a stunning view of the polje “Livadi” and “Gerontovrachos” (2396 m), the second highest peak of Parnassos Mt is being unfold. Climbing the carved stone steps a small plateau appears along with the small triangular entrance of the Korikio Andron Cave. Inside the highest height of the cave is 50 m and the length is approximately 100 m (Figure 4b). Stalactites and stalagmites compose impressive "sculptures". The cave was excavated in 1970-1971 by Pierre Amandry. The findings date back from the Neolithic to classical period, and mostly are painted pottery, figurines, jewelry, shells and animal bones had votive character [10].

From mentioned above plateau the panoramic view of the Corinthian Gulf and the mountains of the Peloponnese in the south, Kirfi Mt. in the southeast and “Livadi Arachovas” in the east is outstanding. The more adventurous hikers, after returning to “Paleopanagia” may head south - southwest on the forest road for 4000 m to meet E4 trail (Figure 5). After 800 m, following the trail-signs, the junction that leads to the worth visited view point "Kroki" is found. Continue on the E4 trail that leads to the archaeological site of Delphi (Figure 6a). The 3000 m zig zag trail is included in the Delphic landscape and coincides with the European trail E4.

Table 1. Main characteristics of “Korikion Andron” trail (Route I & II)

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	Route I (short trail): From Palaiopanagia, Livadi Arachovas, to "Korikion Andron"	Route II (long trail): From "Korikion Andron" to Delphi
Starting Point/Trailhead location:	Paleopanagia (Livadi Arachovas)	"Korikion Andron" cave
Trailhead elevation:	1,120 m	1,360 m
Finish- Korikion Adron cave (elevation):	1,360 m	----------
Finish- Delphi settlement (elevation):	----------	570 m
Minimum elevation:	1,120 m	570 m
Maximum elevation:	1,360 m	1,360 m
Altitude difference:	240 m	590 m
Route distance/Length:	1,000 m	10,000 m
Estimated Duration:	1:30 hour (including the return to the starting point)	3-3:30 hours (not including the return to the starting point)
Type:	Rocky trail (800 m), semi-rocky trail (200 m)	Semi - rocky trail (5,700 m), rocky trail (4,300 m)
Degree of difficulty:	Easy to Moderate	Medium to Moderate
Trail markings:	Good directional signs (red-white triangular frame)	Good directional signs (red - white square mark) and from Kroki to Delphi signs E4 trail (yellow - black - white square frame)
Vegetation:	Low bushes (*Quercus coccifera, Juniperus oxycedrus, Crataegus mongyna)* to the greatest sections, *Abies cephalonica*, *Juniperus foetidissima* in some parts	Low bushes to the greatest sections, dense fir forests (*Abies cephalonica*) in some parts, the clump of stinking juniper (*Juniperus foetidissima*) near "Kroki"
Points of interest/ Trail features:	Livadi Arachovas' polje, outstanding view, the beautiful chapel St. Triada surrounded by perennial kerme oaks, "Korikion Andron" cave, the entrance of cave: the panoramic view towards the gulf of Corinth, Kirfi Mt. and Gerodovrachos (2396 m), flora and fauna of Mt Parnassos.	The traditional settlement of Delphi and the archeological site, outstanding views, the wild beauty of the steep slopes, rocky cliffs "Phaedriades", wildflowers, "the landscape of Delphi": the panoramic view towards the gulf of Corinth, the settlements Itea – Crissa , Amfissa' Olive grove.
Recommended visitor season:	February to November	February to November

Source: Observations of the study group and various literature sources and existing reports.

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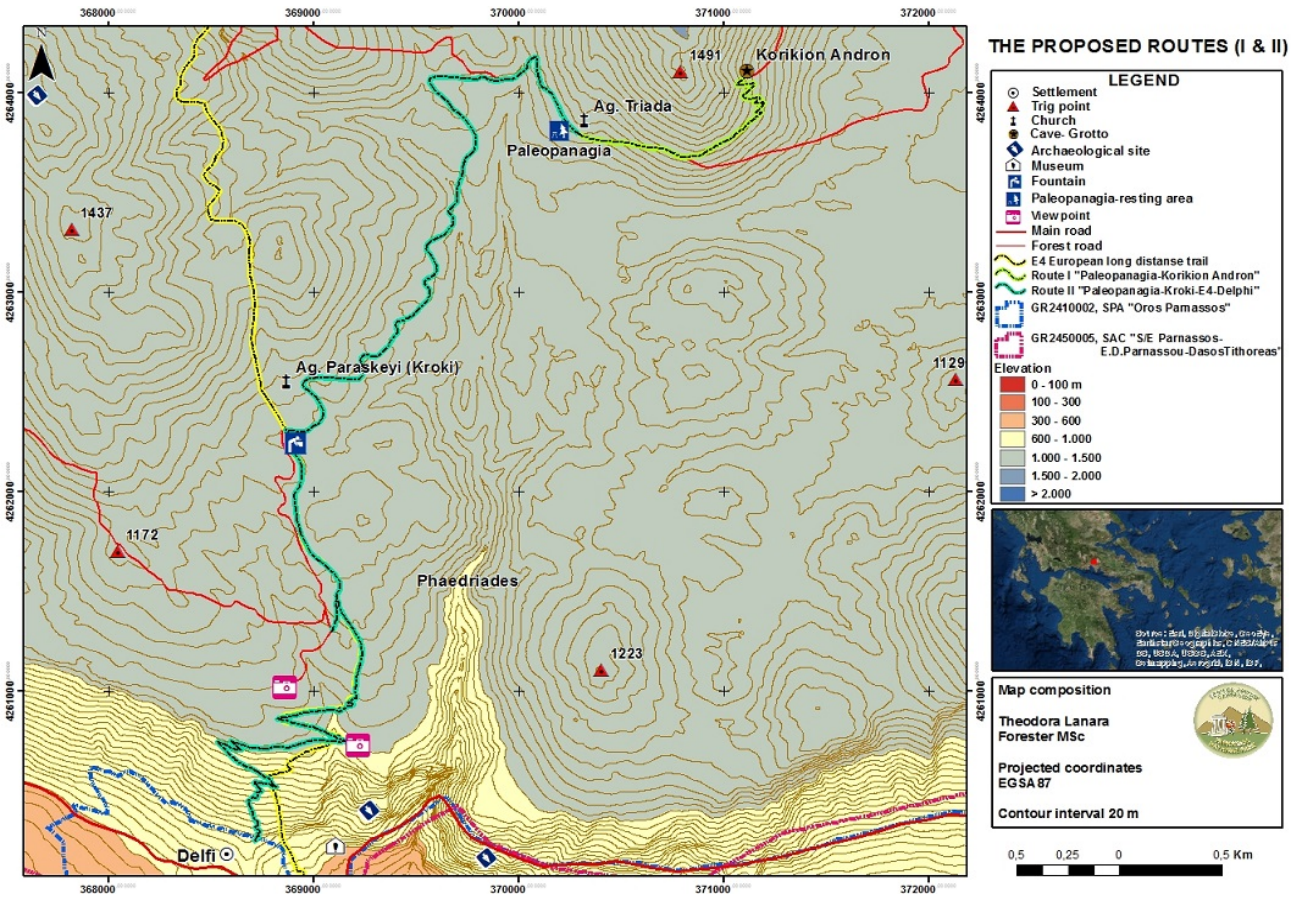

Figure 5. Map of the proposed routes (Route I &II) points of interest and points of view.

The view across the trial is stunning with the settlements of Delphi, Chrissa, Itea, Galaxidi and the Corinthian Gulf in the background. The archaeological site of Delphi, that has been included in the World Heritage List of UNESCO, appears in all its splendor.

Figures 6a,b. The archaeological site of Delphi from route II (Fig. 6a).
The Landscape of Delphi (Fig. 6b) (Photos by Lanara T.).

3.2 "The landscape of Delphi"

The "Delphic Landscape" is the wider area that includes the area of the archaeological site of Delphi, the traditional Olive Yard "Elaionas Amfissas" and the valley of the Pleistos River (Figure

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6b). It has been declared as a protected area since 1981 and is consisted by two protection zones (A and B zone). Apart from the monuments of the archaeological site of Delphi, the Temple of Athena Pronaia, the Gymnasium and the Castalia Spring, the wider area of the valley includes numerous monuments and archaeological sites, from prehistoric to modern times, with special archaeological, historical, aesthetic value. The mentioned above, together with the natural environment that highlights the Delphic landscape, contributed to a cultural center of enduring value. The area is under special protection and management. Thus, only mild interventions are to be implemented aiming to the preservation and protection of the main features of the landscape.

3.3 "Korikion Andron" trail management – promotion and sustainable development

The preservation plan and some moderate customizations that have been suggested, aim to the conservation and protection of the paths' ecosystem, along with the cultural and archaeological heritage of the area. The plan is based on the fact that a well-structured path network will have minimal implications on the natural landscape, as well as on the path construction. Also, the technical specifications stated in the study aim to resource saving and in minimizing the future maintenance and management of the path (Table 2).

The thematic trails have turned into one of the basic forms of forest recreation serving ecological, educational, nature protection causes, while at the same time, someone can gain important information on the rich history of the area.

The identification, recording and evaluation of the problems that have been encountered as of now in "Korikion Andron" trail, are summarized in Table 2. This table serves as a tool for the trail manager, offering an overall mapping/visualization of problems and deficiencies. To facilitate the visualization and interpretation of the problems identified in the path, mainly related to the lack of constructions such as boardwalks and wooden steps, the insufficient signage, the proper maintenance (trail widening & clearing, tree & shrub trimming, etc.), one can find the geographical coordinates of the corresponding position below (Table 2). The appropriate signage and maintenance prerequisites for the safe use of the trail. According to N.C.N.S.T. (1996), signs are probably the quickest way to leave the trail user with a positive impression. The trail manager can transfer the relevant data (geographical coordinates) on a topographic map, or cartographic basis of his/her choice in order to use it in a more convenient way.

A complete management system aims to the utilization of an areas' specific characteristics: the views, natural and important historical sites, along with the development of forms of alternative recreation (ecotourism, geotourism, cultural-educational tourism) [9]. All the above will aid to the sustainable development of the area. Parnassos Mt is a living laboratory of nature and ecology with its important and sensitive ecosystems. The mountains' broader area could be a model of alternative forms of mountainous areas. The natural and cultural heritage of the region, is able to act as a development keystone and the local community can become the guarantor of its protection [12].

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Table 2. Inventory and Assessment of "Korikion Andron" trail (Route I).
Problems & proposals about the Trail Management

			Assessment of Trail Problems & Proposals about the Korikion Andron trail Management (Works Needed - Operations - Maintenance - Management)							
Geographical coordinates of the point / position	Place name	Point distance from the starting point of the trail (in meters)	-Trailhead information signs, kiosks or Information/Interpretive signs	-Destination signs, Reassurance markers/blazes	-You-Are-Here signs, Identification signs	-Route Improvement (Construction of Trail structures, boardwalks & wooden stens)	-Route Improvement (Trail widening & clearing, new improved route, tree & shrub trimming)	-Trail maintenance (User safety, access, protect adjacent resources, preserve trail investment, garbage, litter bins)	-Promotion & marketing (publicity), visitor monitoring & management	Remarks
370808,536 X 4263675,267 Y	Near Paleopanagia, starting point	0	●	●	●		●	●	●	1,2,3,4,5,6
371156,317 X 4263881,782 Y	--------	420		●				●		3,4,6
371175,550 X 4263925,842 Y	--------	520		●		●	●	●		3,4
371129,433 X 4263967,514 Y	--------	690		●		●	●	●		3,4
371093,185 X 4263974,209 Y	--------	725		●		●	●	●		3,4
383998,745 X 4270964,227 Y	--------	755		●		●	●	●		3,4
371144,229 X 4264040,496 Y	Panoramic view	820	●	●	●	●		●		3,4,5
371062,698 X 4264037,338 Y	--------	920		●		●	●	●		3,4,7
371071,588 X 4264048,239 Y	--------	940		●		●	●	●		3,4,6,7
371087,781 X 4264070,252 Y	--------	970		●	●	●		●		7
371114,081 X 4264106,871 Y	"Korikion Andron" Cave	1020	●	●	●	●	●	●	●	2,3,4,5,6
	Total length	1020								End of the trail (not including the return)

Source: Observations of the study group and various literature sources and existing reports Length.

Note: The dots (●) found at Table 2 indicate a problem/shortcoming in the infrastructure or maintenance of the corresponding point of the route. The dot also indicates that the management, promotion and marketing of the trail has been insufficient (or non-existent) and consequently there are measures that need to be taken both for the proper management and promotion of the trail but also for the protection and promotion of the natural environment of the area.

Remarks:

1: The starting point of the trail is near Palaiopanagia (Livadi Arachovas).

2: "Trailhead information sign/kiosk" or "Information/Interpretive sign". The "Trailhead information sign" should include a double or triple bulletin board structure. The left display panel should contain general information about the trail (trail map/description). It should depict the general location of the trail in relation to other major landmarks [11]. "Information/Interpretive sign", which should contain specific information about: a. Vegetation, flora & fauna of Mt Parnassos, b. Geoloogy – Geomorphology, c. Delphi' landscape, d..Polje at Livadi Arachovas and e. "Korikion Andron" cave.

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3: "Destination signs", show direction and distances to various spots along the trail.
4: "Reassurance Markers", are the paint or nail-on "blazes" that mark the trail. According to N.C.N.S.T. (1996), blazes should be within "line of sight" - when standing at a blaze marker, the hiker should be able to see the next one. Blazes should be continuous - even along road segments and other unmistakable parts of the trail. Blazes should be placed immediately beyond any trail junction or road crossing-even if there is a directional sign.
5: "You-Are-Here signs", may supplement maps at trailhead kiosks and other key locations, such as at trail intersections, along the route [11].
6: "Identification signs". They are simple, routed wood, identification signs which allow the hiker to find their location on a map in relation to what they are seeing. They are short and concise. Generally, an identification sign is appropriate for all sites listed on destination signs [11].
7: Reconstruction of the trail infrastructure or the construction of boardwalks & steps.

4. CONCLUSIONS

Parnassos network of trails includes numerous hiking and mountaineering routes, including thematic trails (nature trails, geological trails, trails, cultural heritage trails). The "Korikion Andron" trail is a combination of thematic trails, since it promotes the unique natural variability of the area, along with its geology, history and culture. The management and protection of the ecosystem and the archaeological heritage, the sustainable development and ecotourism in the area Parnassos Mt., is the main theme of the project. Any interference to the ancient trail that have been made in the past, is minimal and have been conducted by the Forest services. The future work that is proposed on project, based on sustainable development and promotion of the cultural/historical heritage is: a) Work aiming in the conservation and promotion of the paths' unique characteristics, b) Trail-blazing, c) Improvement of the trail and d) Promotion of the unique identity of the place and its history (ecological awareness, cultural heritage, ecotourism, suggested future trails).

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