The management and promotion of Tithorea's trail at the Parnassos National Park for the sustainable touristic development of the region

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Abstract
The trails and especially the so-called "thematic trails" such as the "Nature Trails", "Geological Trails", etc, besides the outdoor recreation and physical activity that offer to a modern man, they are also significantly "tools", used by the specialists for highlighting the characteristics of the natural environment, the geological-geomorphological characteristics, as well as the historical background and tradition of certain areas. Typical example of this is the northeastern side of Parnassos National Park, which is traversed by the Tithorea's trail, at the "Aesthetic forest of Tithorea, near the village of Tithorea.

The purpose of the present research is to highlight the specific characteristics of Tithorea's trail concerning biodiversity, landscape, geomorphology, history and culture, as well as to offer proposals about its management in the protected area of Parnassos National Park. The management and promotion of Tithorea's trail could become a model for alternative forms of tourism in mountainous areas and it will help to integrate the protected area in the wider ecological, economic and social environment for the sustainable development of the region.
Keywords: Aesthetic forest; Mt Parnassos; National Park; nature trail; Tithorea's trail.

1. INTRODUCTION

The appropriate signage and maintenance are prerequisites for the safe use of the trails. Consequently, trails have to be managed systematically, namely to be maintained in a satisfactory level of cleanliness and safety conditions. This applies to the maintenance of constructions too. The proper design and construction of new trails or "improved" routes in the pre-existing trails can reduce the cost of maintenance and management while increasing the promotion of the surrounding area and the quality of information provided to the visitor. Combining the above can create favorable conditions for the attainment of the purposes the trail is created for. The right timing and frequency of the maintenance checks are some more of the needed actions. According to M.A.R.D. & E -Department of Forests (2011), the only way to maintain appropriate service levels is developing an annual program of inspection, maintenance and cleaning for each trail.

Sign maintenance is critical to the operation of a quality trail system. Well maintained signs that are repaired promptly convey a sense of pride and reduce further vandalism. Signs are a highly visible representation of the quality of the trail. Their maintenance or lack of maintenance leaves the visitor with a positive or negative impression about the trail. Signs convey many kinds of information and it is critical that they be in good shape [2]. The maintenance cost of various constructions, signs etc., as well as the cost of cleaning can be reduced if the visitors are prompted to avoid vandalism and misuse of the constructions (boardwalks, wooden steps, information signs, kiosks, destination signs, etc.).

ISBN: 978-960-6865-87-9, Mykonos island, Greece , June 14-18, 2015

2. MATERIALS AND METHODS

2.1 Geographical location of the study area

A dense network of trails can be found at Mt Parnassos (Figure 1). Tithorea's trail, the subject of this present research, is located in the eastern side of Mt Parnassos in Central Greece, in the prefecture of Fthiotida. Mt Parnassos, with its highest peaks Liakoura (2,456 m), Kalogiros (2,397 m), and Gerontovrachos (2.396 m), is one of most impressive and steep mountains of Roumeli (Central Greece) (Figure 2). The main nearby villages are Tithorea (or Velitsa), Amfiklia, Agia Marina, Kato Tithorea and Elatia.

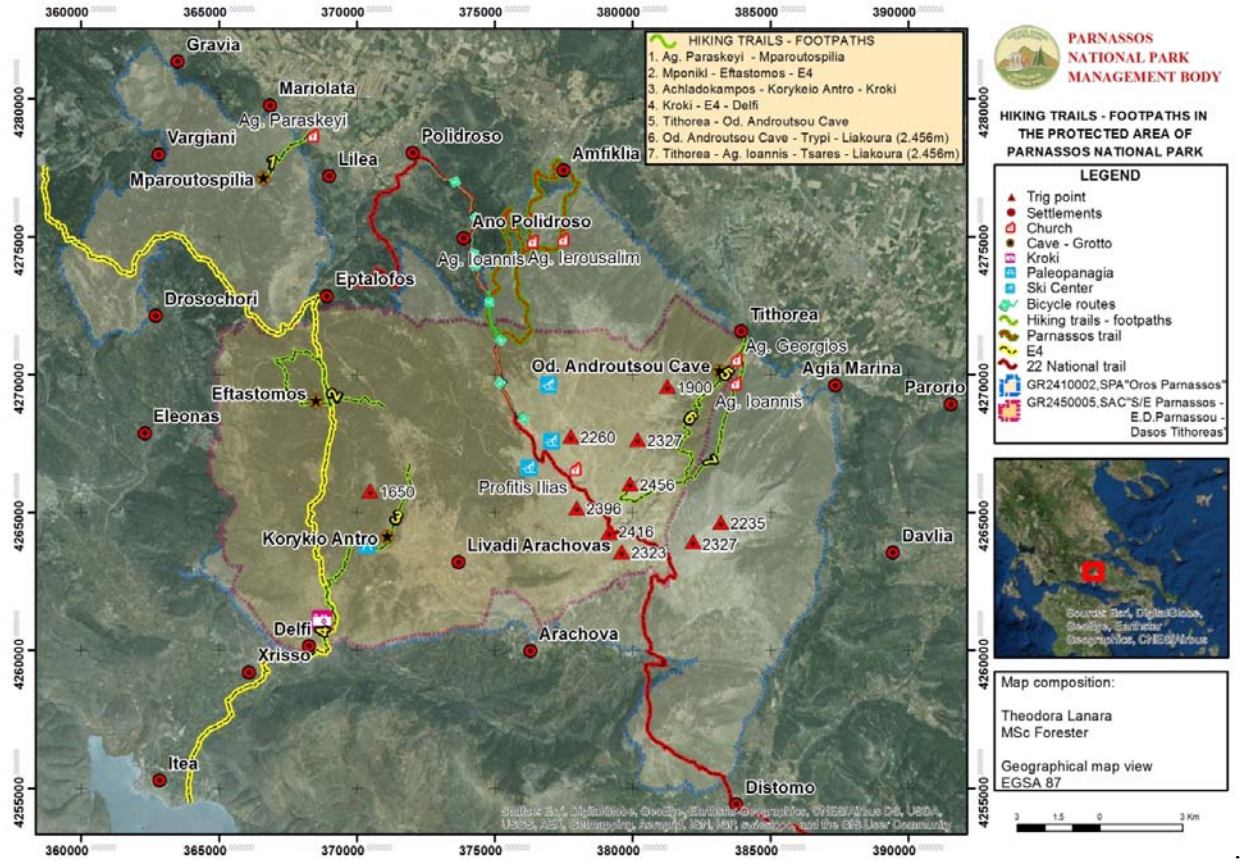

Figure 1: Map of the hiking trails in the protected area of Parnassos National Park.

Tithorea's trail (Route I) starts from the square of Tithorea village (Plakoto' square) and ends after 2 hours to the Cave of Od. Androutsos. Reaching the point (384013,085 X 4270971,789 Y), a hiker can follow the route (Route II) that leads to Liakoura peak, after of 5-6 hours of hiking. Eastern Parnassos and especially Tithorea's trail, is accessible to the visitor that comes from Athens via Kastro and Tithorea (or Velitsa) Village, where the trail starts. A trip from Athens to Tithorea is 165 km long (around 1h50 by car), while from Lamia to Tithorea is 60 km long (around 1h by car).

2.2 Investigation method

For the depiction of the environmental situation (vegetation, flora, fauna, geology, geomorphology, water resources, landscape), history and mythology, of Mt Parnassos and of the Tithorea's 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). Topographical maps have been used as well (Hellenic Military Geographical Service, scale 1:50.000 and 1:100.000), geological maps (Institute of Geology and Mineral Exploration, scale: 1:50.000), 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 satellite images (Google Earth) using ArcGIS for Desktop 10.2.2. 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.

Figure 2. The north-eastern view of Mt. Parnassos. Tithorea village, Kahala gorge, Aesthetic Forest, and the peak Liakoura (2,456 m), can be seen here (Photo by Mertzani As.).

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), holm oak (*Quercus ilex*), downy oak (*Quercus pubescens*), fir (*Abies cephalonica*), jerusalim sage (*Phlomis fruticosa*). At the Kahala gorge and the rocky outcrops of the area a large number of rare and endangered plant species are found that are included in Annex II of Directive 92/43 / EEC. The mountain of Parnassos is also important for the significant number and variety of protected avifauna species, particularly birds of prey. In Annex I of the Directive 2009/147/EC thirty eight (38) birds of the region are listed. As for other fauna species, four (4) mammals (Rhinolophus ferrumequinum, Rhinolophus hipposideros, Myotis blythii, Myotis myotis), two (2) amphibians (*Bombina variegata, Triturus cristatus*), two (2) reptiles (*Testudo hermanni*, *Testudo marginata*) and one (1) invertebrate (*Lucanus cervus*), 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 2,510 m) and Vardousia (Korakas 2,495 m). The dominant structural elements are its limestone steep tops, with highest peaks Liakoura (2,456 m), Kalogiros (2,397 m), and Gerontovrachos (2.396 m). The area is dominated by very intense relief (steep sloping hillsides,

cliffs), and numerous caves at the slopes of the Kahala gorge (once used by the villagers as sheepfolds) (Figures 3a,b). Dolomites are found south of Tithorea. On a steep slope of the Kahala gorge, the cave of Odysseas Androutsos is located, where one can see a natural arc with an aperture of 10 m (Figures 4a,b). Within the cave, smaller caverns interconnected by small tunnels are found.

Figures 3a,b. The Kahala gorge and a waterfall (Photos by Lanara T.).

The diverse geological formations and the presence of limestones define the flow of the surface water as well as its subterranean movement, within the "labyrinthine" network of sinkholes and caves. A large part of the northeastern Mt Parnassos, is draining in the hydrologic basin of Kahala river. The main direction of the hydrographic network development, that drains at this region, is southwest-northeast and discharges in the bed of Kifissos river which flows towards Copais plain and Yliki lake. The hydrographic network is characterized as sparse with a large number of springs due to the prevalence of limestone and intense karstic phenomena [5]. Runoff occurs in limited length of the gorge, during large rainfall and snow melting. A special feature of the area is the groundwater hydrology and the large number of springs found at an altitude above 1,200 m., gushing into limestone formations (i.e. the springs Tsares, Tripi, Potistides, Kourni water supply 230 m^3/h). On the steep slope of the Kahala gorge are detected impressive waterfalls (i.e. Tripis waterfall of 80 m height).

Figures 4a,b. The area from which the Tithorea's trail passes, is dominated by very intense relief, and numerous karstic caves at the slopes of Kahala gorge (Fig. 4a). The cave of Odysseas Androutsos (Fig. 4b) (Photos by Lanara T.).

2.6 History and Archeology

An impressive historical site of the trail is the inaccessible cave "Mavri Troupa" (Black Hole). In this cave, Odysseas Androutsos (Hero of the Revolution of 1821) fled, together with his family using it as a shelter and base during the Revolution. The cave was chosen due to its location - virtually unknown during the Turkish occupation-, offering the conditions to protect from any hostile attack [6].

The ancient city of Tithorea, at the NE of ancient Phocis, was built on the eastern slopes of Parnassos Mt., where the settlement is also located today. Originally, it was built and used as a fortress by the Phocians, after the Third Sacred War, and then inhabited, after the battle of Chaeronea, evolving into a city that flourished during the Hellenistic and Roman times [7]. The fortification of the city is one of the most impressive and best preserved fortifications of its kind in the prefecture of Fthiotida. The extensive walls, starting from the foot of a steep cliff, extend northwards. The east side of the city was "protected" by the Kahala gorge. On the south, the city was protected by the rocky outcrops of the Mt. Parnassos [8]. Today, a small part of the fortification still exists (Figures 6a,b).

3. RESULTS AND DISCUSSION

3.1 Tithorea's trail at the Mt Parnassos - The route

The largest part of the Tithorea's trail, parallels the Kahala gorge (Figure 5). The lower part of the gorge consists of abrupt slopes. Starting point of both routes (I&II) is Tithorea (Velitsa) settlement at an altitude of 450 m (Table 1). At the signposted intersection to Tithorea, turn right and follow the asphalt road for about 5 km. The imposing ruins of the 4th century BC fortress welcome visitors together with the first houses of the village. After a 5 minute walk one reaches the village square with its huge plane tree (*P. orientalis*).

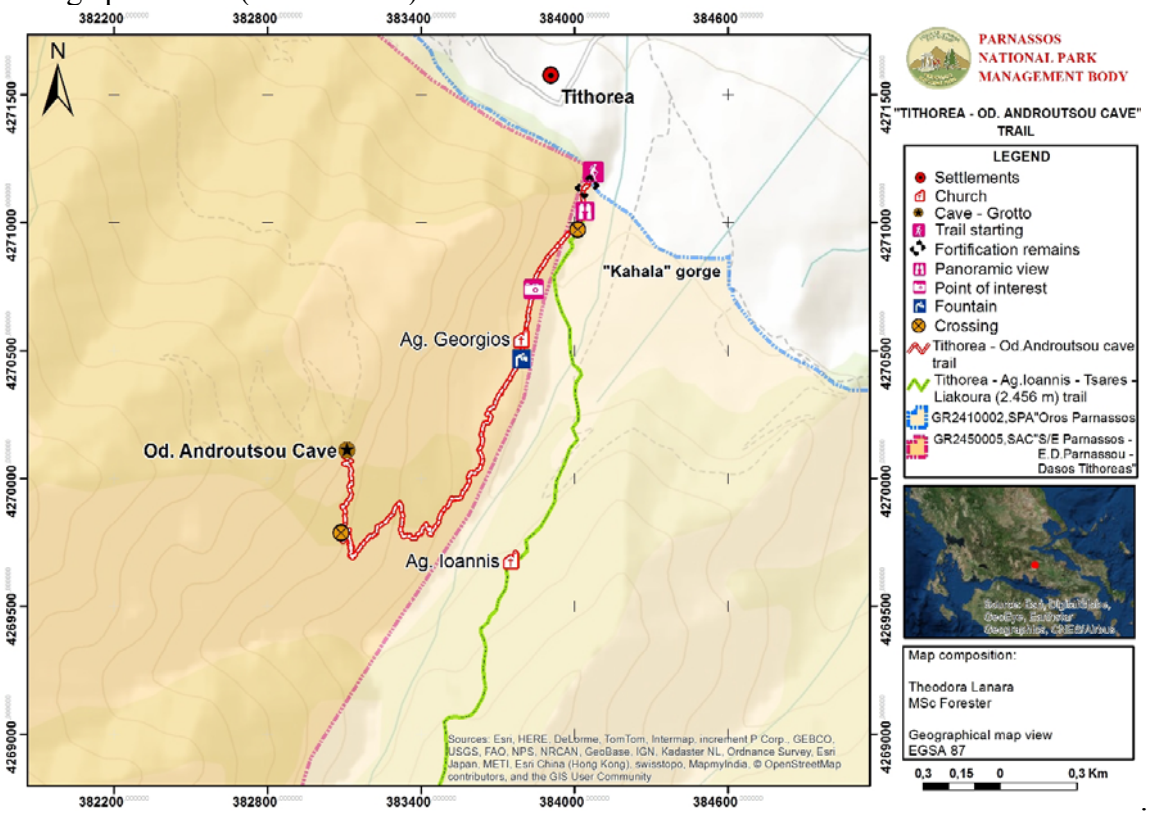

Figure 5. Map of Tithorea's trail (Route I) points of interest and points of view.

About 800m from there is the starting point of the trail. Move S-W alongside Kahala gorge with towering limestone-karstic formations and the scattered small caves. Across the trail there is a sign that leads either in the Od. Androutsos cave or at the route II to the highest peak of Parnassos Mt. Liakoura (2.456 m). Chapel of St. George is located after an about 40-minute walk, surrounded by huge oak trees. Ahead is the imposing Liakoura (2,456 m.) and Kalogiros (2,397 m.) peaks.

Table 1. Main characteristics of Tithorea's trail (Route I & II)

	Route I (Short trail): From square of Tithorea to Od. Androutsos cave	Route II (Long trail): From square of Tithorea to Liakoura peak
Starting Point/ Trailhead location:	Square of Tithorea (Plakoto')	Square of Tithorea (Plakoto')
Trailhead elevation:	450 m	450 m
Finish - Od. Androutsos cave (elevation)**:**	1,040 m	----------
Finish - Liakoura peak (elevation)**:**	----------	2,456 m (Liakoura)
Minimum elevation:	450 m	450 m
Maximum elevation:	1,040 m	2,456 m
Altitude difference:	590 m	2,006 m
Route distance/Length:	3,176 m	10,900 m
Estimated Duration:	2:30 - 3 hours (including the return to the starting point)	5-6 hours (not including the return to the starting point)
Type:	Dirt trail (1,000 m), rocky trail (1,000m), semi-rocky trail (1,200 m)	Semi-rocky trail (4,600 m), rocky trail (6,300 m)
Degree of difficulty:	Easy to Moderate	Moderate to Difficult
Trail markings:	Good directional signs (red - white square mark)	Good directional signs (red - white square mark)
Vegetation:	Low bushes (*Quercus coccifera, Quercus ilex, Phlomis fruticosa*) to the greatest sections, dense fir forests (*Abies cephalonica*) in some parts.	Low bushes to the greatest sections, dense fir forests (*Abies cephalonica*) in some parts, shrub, phryganic and herbaceous species from the upper limits of the fir forests and reaches up to the peak of Mt. Parnassos (Liakoura)
Points of interest/ Trail features:	The traditional settlement of Tithorea, Kahala gorge, waterfall, outstanding views, ruins of ancient fortification, the wild beauty of the steep karstic slopes, the beautiful chapel St. George surrounded by perennial oaks, Od. Androutsos karstic cave, flora & fauna of Mt Parnassos, the fir forest (*Abies cephalonica*)	The traditional settlement of Tithorea, Kahala gorge, waterfall, outstanding views, the wild beauty of the steep karstic slopes, rocky cliffs, karstic caves, the beautiful chapel St. Ioannis, wildflowers, fir forest, Liakoura peak: the panoramic view towards the gulf of Corinth and Euboea island
Recommended visitor season:	April to November	May to September

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

In just 5 minutes' walk from there, following the signed trail, is a clearing with a small fountain. The trail continues uphill and more caves are revealed on the way. Vegetation becomes denser with greater diversity of species.

Figures 6a,b. The fortification of the ancient city of Tithorea (Fig. 6a). Tithorea's trail and a small part of the ruins of this fortification (Fig. 6b) (Photos by Lanara T.).

The shrubby vegetation gives way to fir (*Abies cephalonica*), the dominant species of Parnassos Mt. (altitude 850 m.). After a 2-hour walk, a typical junction is met, leading either to the impressive cave of Odysseas Androutsos (about 30-minute walk), or, for the more adventurous, to the

impressive waterfall "Tripis" of 80 m height and to the highest peak of Parnassos Mt., Liakoura, through a very difficult and not well-signed path.

3.2 The Aesthetic forest of Tithorea - Management and promotion

Tithorea's aesthetic forest was declared as "Aesthetic" in 1979 due to its remarkable flora and geomorphological formations, which are of particular aesthetic, touristic and historical value (total area 200ha). Vegetation constists mostly of plants of the maquis and garrigue, ecoregions, often in arboreal form. Thanks to the northern orientation of the area and of the resulting environment, species of cooler habitats are encountered, (i.e. the European hop hornbeam, elms, redbuds), even sole Fir trees. Next to the settlement, there is a 40 year old *P. brutia* deteriorate cluster. The Aesthetic Forest of Tithorea is a remarkable and spectacular landscape that needs to preserve its protection regime. Managing and promotion can be achieved through actions such as: fire protection measures (since the forest is located near the settlement), small access projects (i.e. signage), promotion (vegetation, geomorphology, ancient fortifications, churches) and recreation for both residents and visitors to the area.

3.3 Tithorea's trail management and promotion

The efficient management of a trail, the protection and enhancement of the landscape and the natural and built environment that surround it, need compliance to the relevant rules in to be maintained. These rules include proper signage, regular maintenance and, in some cases, monitoring and guarding as well as promotion (Figure 7, Table 2).

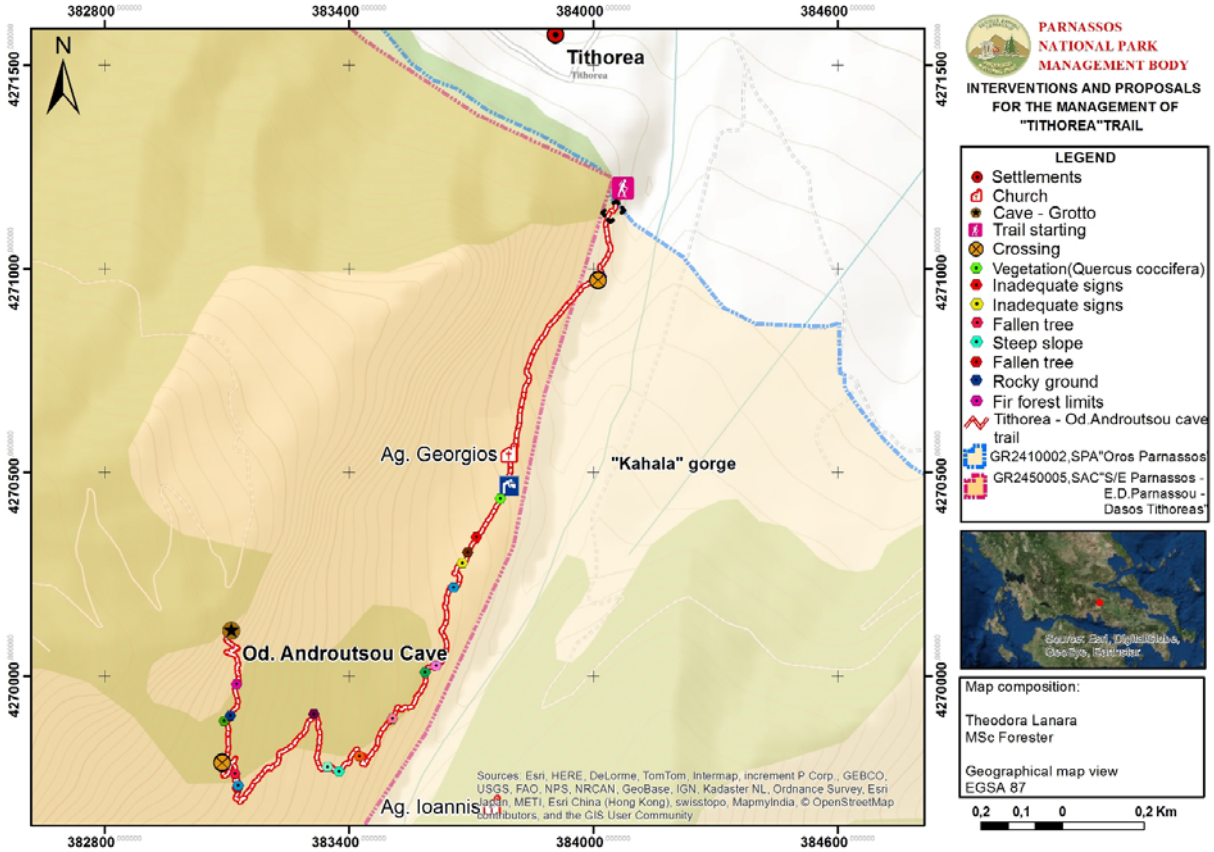

Figure 7. Map of Tithorea's trail (Route I). Interventions and proposals for the trail management

The appropriate signage and maintenance are prerequisites for the safe use of the trails (Table 2). According to N.C.N.S.T. (1996), signs are probably the quickest and easiest way to leave the trail user with a positive impression. If the signs are high quality, well maintained, and properly located, other trail problems which are harder to solve are often over-looked (e.g., wet areas). Consistent signs are the quickest way to increase the trail's identity and the public's support for the trail.

The condition and resulting maintenance demands of a trail is affected by the amount and type of use the trail receives. Each trail has a usage limit. The usage limit however, is determined by more than just the amount of use. The usage limit is influenced by the following factors: environmental conditions impacting the trail, quality of site selection, ground cover and terrain, trail construction, adherence to maintenance requirements, and the volume and types of trail use [9]. It is important to determining the carrying capacity, namely the maximum number of visitors the trail, and the fragile area of Mt Parnassos, can accommodate without degrading the environment and the protected ecosystems. Furthermore, it is considered necessary to inform the visitors about the "Rules & Regulations" of the trail. Also, the visitors should also be encouraged, via proper signage, to reduce the volume of waste the deposition or to depose it in the appropriate bins. At the same time a visitor monitoring & management program should be developed by the competent body.

Table 2. Inventory and Assessment of Tithorea's trail (Route I). Problems & proposals about the Trail Management

			Assessment of Trail Problems & Proposals about the Trail Management-Tithorea's 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 steps)**	**-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**
384074,196 X 4271197,639 Y	Square of Plakoto'	0	●	●	●		●	●	●	1,2,3,4,5,6
384048,945 X 4271141,64 Y	Ancient fortification	65	●	●	●		●	●	●	2,3,4,5,6,7
384042,760 X 4271045,539 Y	Kahala gorge	172	●	●	●		●	●	●	2,3,4,5,6
384020,771 X 4270981,111 Y	Karstic caves	247	●	●	●		●	●	●	2,3,4,5,6
384013,085 X 4270971,789 Y	Trail junction	262		●	●			●		3,4,5,6
383998,745 X 4270964,227 Y	Panoramic view	306		●			●	●	●	3,4
383841,849 X 4270739,337 Y	--------	600		●				●		3,4
383802,277 X 4270544,193 Y	Small chapel	805		●	●			●		3,4,5,6
383794,191 X 4270467,355 Y	Faucet	890		●	●			●		3,4,5,6
383714,365 X 4270340,503 Y	--------	1,045		●				●		3,4
383692,759 X 4270302,709 Y	--------	1,093				●	●	●		8
383680,033 X 4270276,441 Y	--------	1,125		●	●			●		3,4,5,6
383658,397 X 4270216,634 Y	--------	1,215		●				●		3,4
383615,810 X 4270024,310 Y	--------	1,440						●		-----

383588,134 X 4270008,618 Y	--------	1,485		●				●		3,4
383508,193 X 4269894,348 Y	--------	1,547		●				●		3,4
383426,248 X 4269802,122 Y	View to Ag. Ioannis	1,729	●	●	●		●	●		2,3,4,5,6
383377,194 X 4269764,544 Y	--------	1,828		●		●	●	●		3,4
383348,307 X 4269775,509 Y	--------	1,870		●		●	●	●		3,4
383128,643 X 4269730,616 Y	--------	2,430		●			●	●		3,4
383120,648 X 4269759,961 Y	--------	2,488		●			●	●		3,4,9
383089,367 X 4269785,947 Y	Trail junction	2,631		●	●			●		3,4,5,6
383094,789 X 4269888,721 Y	--------	2,765		●				●		3,4
383109,358 X 4269901,828Y	--------	2,797				●	●	●		-----
383124,714 X 4269978,744 Y	--------	2,884		●			●	●		3,4
383113,104 X 4270094,954 Y	Cave Od. Androutsos	3,176	●	●	●	●	●	●	●	2,3,4,5,6,10
	Total length	3,176								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 the square of Plakoto (village of Tithorea).

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 [2]. *"Information/Interpretive sign", which should contain specific information about: a. Vegetation, flora & fauna of Mt Parnassos, b. Kahala gorge, c. waterfall, d. Ancient fortification of Tithorea, e. Karstic landscape and f. Od. Androutsos cave.*

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 [2].

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 [2].

7: The removal of the native vegetation is required (climbing plants, etc.) from the surface of the ancient fortification.

8: Reconstruction of the trail infrastructure or the construction of boardwalks & steps.

9: Removal of a fallen tree.

10: Reconstruction of the ladder for safer access in Od. Androutsos cave. There is a worn out metallic ladder and a climbing rope for accessing to the cave.

The results of this monitoring & management program alongside the findings concerning the effects caused by the presence of visitors in the protected areas, can give its managers the possibility to systematically improve and apply a constantly rejuvenated "Rules & Regulations". As a consequence, this process contributes positively to the reduction of the environmental impact of the presence of visitors and use of the trail. Meanwhile, the "revolving monitoring program" of visitors and its systematic updating will help to the accurate identification of the target group of visitors. This will enable the competent bodies in creating the appropriate conditions and infrastructure to meet the needs and requirements of visitors (eg. cyclists, etc.). Additional actions can contribute

positively to the enhancement of the landscape and generally to the rational management of a trail. These actions include the active promotion and attraction of publicity among others.

The identification, recording and evaluation of the problems that have been encountered as of now in Tithorea's 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 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.

4. CONCLUSIONS

A dense network of trails are can be found at Mt Parnassos. Following their route, the traveler can enjoy many of the special features. The management of Tithorea's trail, and the protection and promotion of the environment, namely of the vegetation, flora, fauna, landscape, geology, geomorphology, history and archeology, of this area, constitute the main subject of this paper. According to both recent and older recordings that took place in Tithorea's trail, there are no systematic interventions competent authorities to date. These interventions are suggested for the efficient management of the trail and include: a. Appropriate infrastructure (construction of trail structures, boardwalks & wooden steps, litter bins, etc.), b. Signage (Trailhead information signs, kiosks or Information/Interpretive signs, Destination signs, Reassurance markers/blazes, You-Are-Here signs, etc.), c. Improvement of the trail (trail widening & clearing, tree & shrub trimming, etc.), d. Trail maintenance (user safety, access, protect adjacent resources, preserve trail investment, cleaning, etc.), e. Visitor monitoring & management and f. Promotion & marketing (publicity).

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