TECHNICAL STUDY FOR THE ESTABLISHMENT

OF UNDERWATER TRAILS IN GYAROS AND SYROS ISLANDS.

Photo by WWF Greece/ G.Rigoutsos

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CYCLADES Life: Integrated monk seal conservation of Northern Cyclades

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SUMMARY

Gyaros is an uninhabited, historic Island in the centre of the Northern Cyclades complex, and forms the epicenter of the Marine Protected Area (MPA) proposed by the CYCLADES LIFE EU Project. MPA's when combined with marine spatial plans and ecosystem based management, are capable of restoring and managing the natural heritage harbored in the Natura 2000 NISOS GYAROS KAI THALASSIA ZONI GR4220033. Globally, diving tourism flourishes in established MPAs or UNESCO sites. Current experience has shown that tourism is among the first sectors that benefit from the establishment of an MPA. The positive ecological consequences resulting from the protection of biodiversity attract a large number of visitors not only within the protected zones but in the adjacent regions as well, in this case Syros and Andros Islands. For this reason, the creation of a network of Underwater Trails (UWT) in Syros and Gyaros is proposed. The UWTs constitute an excellent means of attracting visitors and stakeholders to the area, in order to discover and raise awareness about the conservation of the fragile fauna and flora diversity present on Gyaros. In addition, Gyaros has a significant advantage in being a declared historical site and an important heritage site for Greece. Until now, the lack of a specialized legal framework designating this unique activity has hindered the promotion and creation of UWTs in Greece.

To this end, WWFs field team surveyed a total of eleven marine, coastal sites in Gyaros and Syros, limiting the area surveyed by the exclusion of the Mediterranean monk seals habitat and the most exposed sites to northern wind. All sites are here described and assessed. Three final sites were selected after survey sites were assessed for their potential according to the four criteria proposed by MedPAN (Baude *et al*., 2012). Two UWTs were selected for Gyaros Island, "Easter Island" and "Prison Reef" and one UWT in Syros in "Kokkina Beach". All UWTs serve a dual purpose, accommodating snorkelers and divers and were designed for free or guided use. Visitors will be able to follow a delineated route visible from either the surface or below the water (for UWTs in the MPA, only). WWF field team in collaboration with volunteer students from the University of Aegean, created a set of bilingual Identification Cards and Underwater Maps as a means of environmental interpretation of the UWTs. The final management of the UWTs will be decided by the Consortium of Stakeholders, initiated by WWF and the CYCLADES LIFE Project.

UWTs were selected in a way as to divert expected visitors on less vulnerable areas, however, monitoring and evaluation systems are needed to ensure that the goals and objectives of the MPA are achieved. We suggest a combination of methods in order to assess frequentation numbers by visitors while generating sustainable finances for the MPA management. An initial species list for selected UWTs has been completed but in order to ensure minimal impact of the environment by the expected visitor increase to the suggested areas, a monitoring scheme for fish and algae is proposed based on the protocol used by (Claudet *et al*, 2010) for a snorkeling trail the Mediterranean.

ΠΕΡΙΛΗΨΗ

Η Γυάρος είναι ένα ακατοίκητο, Ιστορικό νησί στο κέντρο των Βόρειων Κυκλάδων και αποτελεί το επίκεντρο για την Θαλάσσια Προστατευόμενη Περιοχή (ΘΠΠ) που έχει προταθεί από το Πρόγραμμα ΚΥΚΛΑΔΕΣ LIFE. Οι ΘΠΠς, όταν συνδυάζονται με θαλάσσιο χωροταξικό σχεδιασμό και οικοσυστημική διαχείριση, μπορούν να αποτελέσουν τη βάση για την ανάκαμψη και διαχείριση της φύσης που σε αυτή την περίπτωση περικλείονται εντός της περιοχής, Natura 2000 Γυάρος και Θαλάσσια ζώνη GR4220033. Παγκοσμίως, ο καταδυτικός τουρισμός ανθίζει σε ΘΠΠς και σε χαρακτηρισμένες περιοχές UNESCO. Η εμπειρία έως τώρα έχει δείξει ότι ο τουρισμός είναι ο πρώτος τομέας που επωφελείται με την ίδρυση μιας ΘΠΠς. Η προστασία της βιοποικιλότητας και οι θετικές επικείμενες οικολογικές επιπτώσεις αυτής, προσελκύουν μεγάλο αριθμό τουριστών όχι μόνο στην προστατευόμενη περιοχή αλλά και τις γειτονικές περιοχές, όπου σε αυτή την περίπτωση είναι η Σύρος και η Άνδρος. Για αυτό το λόγο προτείνεται η δημιουργία ενός δικτύου Καταδυτικών Μονοπατιών (ΚΜ) στη Σύρο και τη Γυάρο. Τα ΚΜ είναι ένα μέσο προσέλκυσης καταδυτικού τουρισμού στην περιοχή, ενώ παράλληλα δρουν ως τρόπος ενημέρωσης για ευαισθητοποίησης του κοινού για την προστασία των ευαίσθητων πληθυσμών χλωρίδας και πανίδας της Γυάρου. Παράλληλα, η Γυάρος έχει συγκριτικό πλεονέκτημα καθώς είναι κηρυγμένος Ιστορικός χώρος. Η έλλειψη νομοθετικού πλαισίου για την δημιουργία ΚΜ στην Ελλάδα δεν έχει προωθήσει την δημιουργία τους, εντός των συνόρων.

Η ομάδα πεδίου του WWF Ελλάς διερεύνησε σε σύνολο έντεκα θαλάσσιες περιοχές στην Γυάρο και τη Σύρο. Αποκλείστηκαν περιοχές που είναι εντός του βιοτόπου της Μεσογειακή φώκιας και αυτές που είναι εκτεθειμένες στους επικρατέστερους Βόρειους ανέμους. Όλες οι περιοχές περιγράφονται εδώ. Οι τρεις τελικές περιοχές επιλέχθηκαν αφού αξιολογήθηκαν όλες οι περιοχές με βάσει τα τέσσερα κριτήρια που προτείνει το MedPAN (Baude *et al*., 2012). Δύο ΚΜ επιλέχθηκαν στη Γυάρο, το «Νησί του Πάσχα» και η «Ξέρα των Φυλακών» ενώ στη Σύρο επιλέχθηκε η «Παραλία Κόκκκινα». Όλα τα ΚΜ μπορούν να έχουν διπλή χρήση από δύτες και snorkelers ενώ σχεδιαστήκαν με τρόπο που επιτρέπει είτε την ελεύθερη χρήση τους, είτε με οδηγό. Οι επισκέπτες θα μπορούν να ακολουθούν τις σηματοδοτημένες περιοχές από την επιφάνεια ή κάτω από το νερό (ΚΜ εντός ΘΠΠ). Η ομάδα πεδίου του WWF, σε συνεργασία με εθελοντές φοιτητές του Πανεπιστημίου Αιγαίου, δημιούργησαν δίγλωσσες, κάρτες αναγνώρισης ειδών και υποβρύχιους χάρτες ως τρόπο περιβαλλοντικής ερμηνείας των ΚΜ. Η διαχείριση των ΚΜ θα αποφασιστεί από την Επιτροπή Συνδιαχείρισης Γυάρου, που συντονίζει το WWF Ελλάς.

Τα ΚΜ επιλέχθηκαν έτσι ώστε να εκτρέπουν τους επισκέπτες από πολύ ευαίσθητες περιοχές. Η παρακολούθηση και η αξιολόγηση των πιθανών επιπτώσεων σε αυτές τις περιοχές είναι απαραίτητες για τη διασφάλιση των στόχων που έχουν τεθεί για την ΘΠΠ. Προτείνεται ένας συνδυασμός μεθόδων για την αξιολόγηση των αριθμών των επισκεπτών και την παράλληλη συλλογή εσόδων για τη διαχείριση της ΘΠΠς. Αν και δημιουργήθηκε ένας ποιοτικός πίνακας ειδών για κάθε ΚΜ, για να διασφαλίστεί η ελάχιστη επίπτωση στις περιοχές από τους αυξημένους επισκέπτες, ένα πρωτόκολλο παρακολούθησης ψαριών και φυκιών που χρησιμοποιήθηκε σε Μεσογειακό ΚΜ από τους Claudet *et al*., (2010) προτείνεται για τα ΚΜ της Γυάρου.

1. Introduction

The Mediterranean Sea is characterized by a great biodiversity, with a high rate of endemism. Approximately 8500 species of macroscopic marine organisms live in the Mediterranean Sea, corresponding to between 4% and 18% of the world's marine species. This is a conspicuous figure if one considers that the Mediterranean Sea is only 0.82% in surface area and 0.32% in volume as compared to the world ocean (Bianchi & Morri, 2000). Among its emblematic species, a lot are threatened but some are protected *i.e. Posidonia oceanica*, *Monachus monachus*, *Pinna nobilis.* The Mediterranean Sea is ecologically vulnerable. Since the last century, it has been prone to increased human pressure (demography, pollution, increased resources exploitation, tourism and maritime transport, exotic species). These factors cause various degradations of the marine environment and have a direct negative effect on the species and their habitats, involving their regression and sometimes their disappearance.

The protection of sites of great natural value is consequently of primary importance. The creation of Marine Protected Areas (MPA) is an effective tool to provide durable protection (Garcia-Charton *et al*, 2008). The MPA when combined with marine spatial plans and ecosystem based management, allow for the restoration and the managed use of this natural heritage. In the 21 countries which border the Mediterranean Sea, there are approximately 75 MPAs and about thirty projects of creation. The scientists and the international organizations involved, consider that it would be necessary to protect 10% to 15% from the marine environment to ensure its conservation effectively (Dalias *et al*, 2007).

To this end, the CYCLADES LIFE project aims at establishing through demonstrative and innovative methods a unique protected area in the Natura 2000 site: NISOS GYAROS KAI THALASSIA ZONI GR4220033 and its adjacent waters. This effort will be based on the Ecosystem Based Management (EBM) approach, forging the participation and active involvement of local stakeholders of the adjacent islands of Andros and Syros in the responsibility of protecting the area's valuable marine biodiversity.

Project objectives:

Briefly, the objectives of this initiative are the following:

1. The conservation and protection of the local population of the critically endangered Mediterranean monk seal of the Natura 2000 site NISOS GYAROS KAI THALASSIA ZONI GR4220033.
2. The protection and the improvement of the conservation status of the Posidonia beds', the reefs and the partially submerged marine caves' habitats included in the 92/43 Habitats Directive, which are threatened with downgrading due to human pressures.
3. The overall protection and improvement of the conservation status of the Natura 2000 site: NISOS GYAROS KAI THALASSIA ZONI GR4220033.
4. The active participation and involvement of local stakeholders in the conservation and co-management of the protected area of Gyaros, according to EBM principles. The significant positive change in local stakeholders' conceptions, attitudes and conduct, towards the marine environment of their area.

2. Site Area

Gyaros is an uninhabited, historic Island measuring 17.5 km^2, which belongs to the Northern Cyclades archipelago, along with its two smaller satellite islets, Fouis and Glaronisi. Baseline data collected

during the CYCLADES LIFE project has re-inforced its designation as a NATURA 2000 site by highlighting the existence of protected species, as follows:

A) Mediterranean monk seal (*Monachus monachus*) along with the habitat types the species prefers. Recent scientific evidence suggests that Gyaros is the most important biotope for the reproduction of the monk seal not only for Greece, but for the whole Mediterranean (Mom, 2015). The island's beaches and underwater caves are used for resting and reproduction by the estimated 65-70 individuals identified, composing 18% of the global population. The seal roams the marine zone of Gyaros until the depths of 200m and may travel great distances (Adamantopoulou *et al*, 2011).

Picture 1. *Seal pup in South Gyaros, photographed by WWF Greece/Andrea Bonetti during field surveys.*

B) Yelkouan shearwater (*Puffinus yelkouan*) is an endemic species of the Mediterranean, distributed mostly in the central and eastern basin. Recent scientific data (CYCLADES LIFE) show 1.000 breeding pairs at least, highlighting Gyaros as one of the 3-4 biggest colonies of the species in Greece, and on a single Island. Gyaros geological formations are perfect habitat for the birds' nest, which breeds from April until May, laying a single egg. Rafts of hundreds of birds are present in the area and may be spotted while waiting for total darkness, before they fly to their nests.

***Picture 2**. Yelkouan shearwater rafts resting 2 nm South of Gyaros. Photo by WWF Greece/E. Samara.*

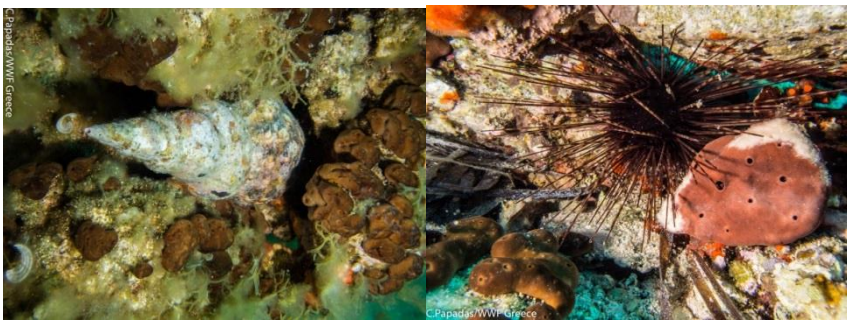
C) Posidonia (*Posidonia oceanica*) is an endemic species of the Mediterranean, well known for its high ecological importance. Gyaros is one the better mapped marine areas in the Aegean, with recent scientific data from CYCLADES LIFE mapping out that Posidonia meadows make up 3.5% of the area. The meadows are mostly un-disturbed, however signs of deterioration have been discovered on the eastern side of the island, where most recreational anchoring is observed. (**Picture 3**)

***Picture 3**. Posidonia oceanica photographed by George Rigoutsos.*

D) Coralligenous composed of thick rodolithic beds (**Picture 4**) make up 47% of the mapped area, from a depth of 40 to 110m. Coralligenous is a habitat type constructed by benthic calcareous algae forming crusts, further colonized by a variety of organisms, hence being considered a very important biodiversity hot spot in the Mediterranean. This high priority habitat in Gyaros is in pristine condition, suggesting that trawl fishing has not disturbed the area. Coralligenous habitats are not well studied, however recent scientific evidence from CYCLADES LIFE add to the importance of coralligenous as a fishing ground, as indicated by the high proportion (~45%) of the total biomass provided by species of high commercial value (like the spiny lobster, the common pandora, the red porgy and the striped red mullet).

Picture 4*. Rare views of rodolithic beds, image provided by HCMR.*

E) Field data gathered over 40 S.C.U.B.A dives around the Island while scouting for appropriate Underwater Trails (UWT) have revealed a plethora of additional protected marine species, including *Pinna nobilis, Centrostephanus longispinus, Charonia variegata, Tonna galea* (see species list) (**Picture 5**).



Picture 5. *A giant tun shell (Charonia variegata) and the rare sea urchin Centrostephanus longispinus, photographed by WWF Greece/C.Papadas on the Prison Reef Trail.*

3. Diving Tourism

Current experience has shown that tourism is among the first sectors that benefit from the establishment of an MPA (López Ornat, 2006). The positive ecological consequences resulting from the protection of biodiversity attract a large number of visitors not only within the protected zones but in the adjacent regions as well (Badalamenti *et al*., 2000). Globally, diving tourism flourishes in established MPAs or UNESCO sites. Greece is not an internationally established diving tourism destination, since there are only two established MPAs- Marine Parks, while there are no Greek marine sites that are inscribed on the World Heritage List. Nevertheless, each year more than 0.5 million commercial dives are realized with a market value of about 20 million euros, according to the Greek Diving Federation that has a registry of 260 diving centers in Greece, nine of which are located in Cyclades island complex. According to the most recent published data from diving associations in 2013 some 230.000 divers from abroad and their families visited Greece, showing a 10% increase in comparison to 2012 (209.000 divers) and a 40% increase in comparison to 2011 (162.000 divers).

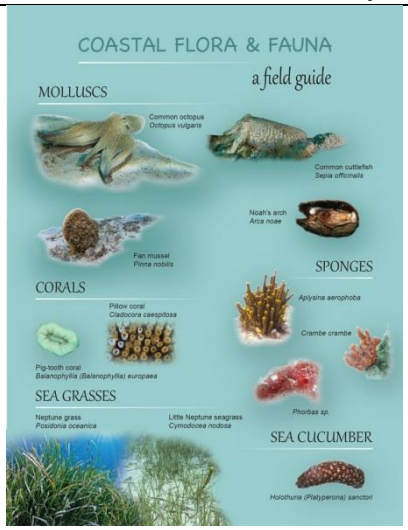
Greece has an impressive 16,500 kilometers of coastline suitable for SCUBA diving and snorkeling activities. There are more than 20,000 shipwrecks on the Greek seabed, of which 6,000 have been formally recognized. Diving in Greece costs about one-third of that in other diving destinations such as Malta, Italy, Croatia, Turkey and Cyprus. Moreover, the Greek Seas are characterized by a high level of water clarity, compared to the more eutrophic Western Mediterranean basin boasts high geomorphologic complexity, mild Mediterranean climate (warm temperatures for an extended period of time) and quite safe swimming conditions. All these characteristics offer not only a good basis, but a considerable advantage for the development of diving tourism in the country, as a powerful and sustainable tool for attracting visitors (Gerovassileiou *et al*., 2009). According to figures from the international Diving organization PADI (Professional Association of Diving Instructors), more than 20 million certificates have been issued globally. Given that 3.5 million of those certified divers are from Europe and 800,000 of them travel abroad each year for new diving experiences, it is readily apparent that the Aegean Sea has immense prospects of potentially becoming even their top destination. As such, the market opportunities for sustainable diving tourism arising from the establishment of a new MPA in the Cyclades are significant, especially if the visitors are offered a new and innovative diving experience combining natural and cultural elements.

Picture 6. *Gyaros MPA, a unique combination of pristine wilderness and cultural elements in the center of the Cyclades. Photo by Angela Brisnovali.*

4. Underwater trails

The creation of a network of Underwater Trails (UWT) in Syros and Gyaros, constitutes an excellent means of attracting visitors and stakeholders to the area, in order to discover the underwater world. Accompanied by teaching aids (e.g. ID cards), the UWT can also be used as a tool for raising awareness for the conservation of the fragile fauna and flora diversity present on Gyaros. In addition, Gyaros has a significant advantage in being a declared historical site and an important heritage site for Greece. UWTs will not only be limited to S.C.U.B.A divers, but the general population as well. They will allow visitors of all ages and skill level, using only basic equipment like fins, mask and a snorkel to discover the diversity of the marine life from the surface. Both playful and educational, the establishment of discovery paths for the underwater environment makes it possible to offer rewarding experiences in nature to the general public, while generating income for the management of the MPA.

For the above reasons, UWTs have been used extensively in tropical areas with favorable results, while Mediterranean MPAs have caught up recently, so today Europe possesses approximately 20 operational UWTs and rising (e.g. Cabrera, Medes Islands, Torre Vieja, Miramare, Porto Cesareao, Cinqueterre, Asinara, Brijuni National Park, Murter Channel, Cerbere Banyuls and more). Particularly for Greece, the lack of a specialized legal framework designating this unique activity has hindered the promotion and creation of a robust diving product. Two initiatives worth mentioning became operational only this summer (2016), one in the National Marine Park of Zakynthos (N.M.P.Z.) and one in Karpathos and Saria.

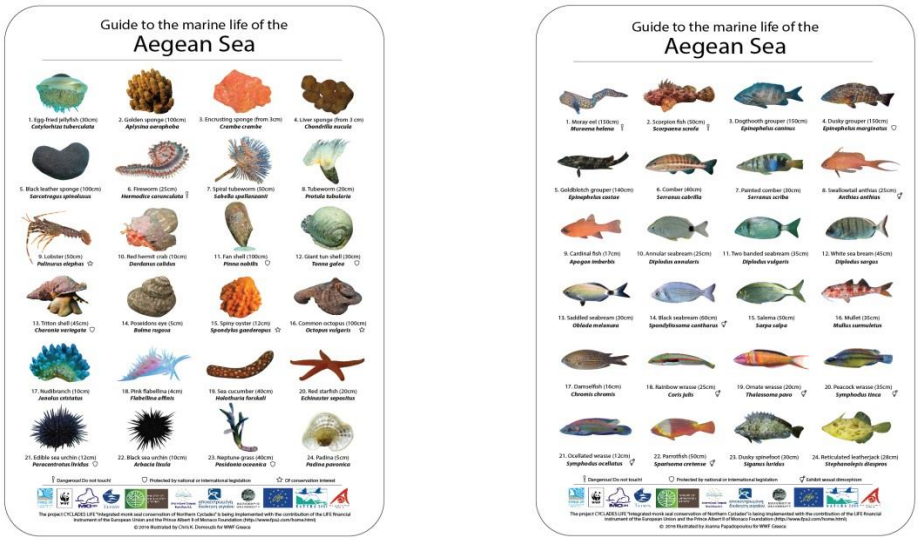


Picture 7. *ID guide to the coastal flora and fauna of Karpathos and Saria UWT.*

A critical parameter for the successful implementation of UWTs relies on the site's accessibility. Although Gyaros Island has many advantages for initiating this activity, it lays 20 nm from Hermoupolis, 16nm from Posidonia or 13nm from Kini, by boat. Taking into account the strong Northerly winds prevailing in the area, accessibility will not be easy. Additionally, the only docking place on the island was built around the 1950's and the remaining structure is not secure, making safe docking impossible. For the above reasons, a network of UWTs will be created, beginning from a very sheltered bay in South Syros. This site may be used all year round (except with strong south winds) and is accessible both from land and sea (1nm from Foinikas or 100m from Kokkina beach).

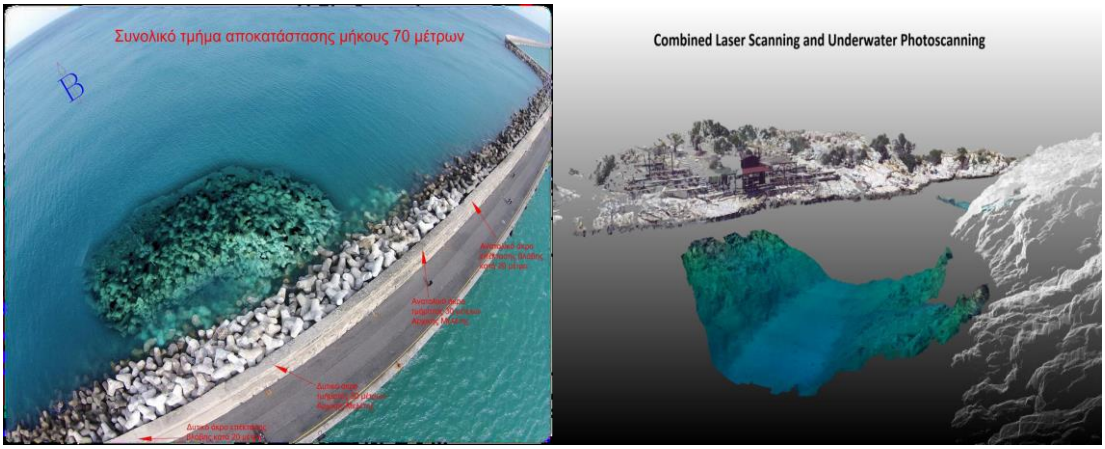
The operation and management of the UWTs will depend upon the results decided within the Committee of stakeholders. Their design and operation was prepared so as to accommodate guided tours or self-guided exploration, depending on the outcomes of the committee. For the CYCLADES LIFE project, 3 UWTs will be delivered to the community with the following characteristics:

A) Bilingual identification cards for 24 fish and 24 invertebrate species, depicting their maximum size, scientific name, common name, protection status and sexual dimorphism. The cards were created with the help of two volunteers from the University of Aegean. After the initial species list was formed, high quality images were collected from the fields' team personal file and other sources. The images were processed with the Adobe Illustrator software by the volunteers, resulting in the pictured guides (**Picture 8**). They are printed on 15x20cm, 250 mics, waterproof PVC material, permitting bending and folding for easier transport and use.



Picture 8: *ID guides of the marine life of the Aegean Sea, prepared as a visual aid for the UWTs, CYCLADES LIFE. They are available in English and Greek.*

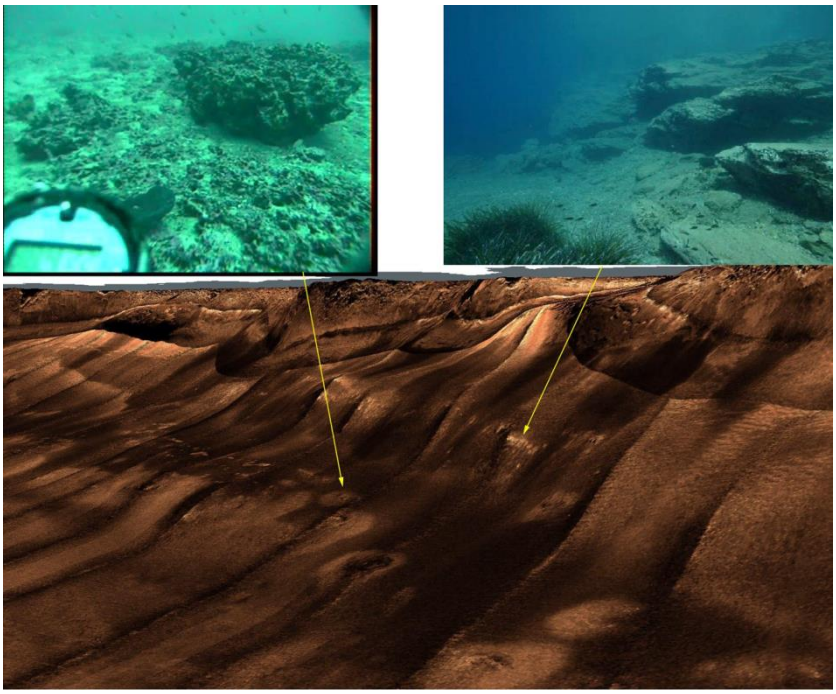
B) Maps designed from underwater modeling surveys or side scan sonar, will be created in order to provide a high end result with esthetic appeal, geo-referenced and accurate to 0.5-1m. The underwater modeling surveys require two extra weeks of field surveys on the selected trails. A specialized team supported by the CYCLADES LIFE field team and vessel will survey the sites and provide accurate 3d models or photogrammetry/photoscanning deliverables. Examples of expected deliverables are pictured below (**Picture 9a**).



Picture 9a: *Deliverable examples, expected from 3D photoscanning surveys in the selected UWTs. (Left UFR Team, right Topogrammiki surveys)*

Another option for the production of 3d models can be produced by the University of Patras, Geology Department. This team is re scheduled to work on Gyaros in May, 2017 as part of action D1.

A working meeting has been scheduled in order to discuss the use of side scan sonar and other technologies on the selected trails in order to produce detailed bathymetric maps (**Picture 9b**).



Picture 9b: *Example of deliverable produced by the Geology Department of the University of Patras, using side scan sonar technology, during the 2014 mapping of the marine area around Gyaros, Action A1.*

Traditional diver sketches have been produced for each site, with an example pictured below (**Picture 10)**.

Picture 10: *Diver (WWF Greece/V.Gavallas) sketch of the South Trail in Gyaros-Easter Island (Nisi Tou Pasxa).*

C) Underwater photographs by a professional UW photographer for the UWTs advertisement to the public. High resolution images of the rich underwater marine life and distinguishing geomorphologic

features of each site will be produced by a celebrated, local, Underwater Photographer, George Rigoutsos. Previous collaboration with this professional photographer has provided continuous high standard results. A set of twenty high quality images for each site was deemed necessary, as they may be used for the production of the maps, the communication of the UWTs in social media, the projects website, informational flyers etc. Some photos taken from the UWT in Alatonisi, Syros are pictured below (**Picture 11**).

Picture 11: *Underwater photographs taken by distinguished, professional photographer George Rigoutsos, for the communication of the UWTs to the public.*

D) Most examples of UWTs have deployed underwater signs depicting representative species and habitats (Baude *et al*, 2012), alongside a suggested route. Underwater signs in this case were deemed restrictive, due to the lack of legal framework concerning their placement on the seafloor and signaling buoy on the surface. In addition, UW boards are not easy to read in choppy weather conditions, sometimes causing crowding and limiting the divers on a pre-delineated route. In this case, we chose a looser route, encouraging active exploration of the area for the species highlighted on the ID cards, following the general route depicted on the detailed models of the UW environment in relation to the landmarks. An alternative to underwater boards is the creation of underwater virtual trails. HCMR researcher, Giannis Issaris has come up with a unique offer for the creation of 2 virtual trails for the Gyaros UWTs. By combining 360^{o} video and 360^{o} photographs, a virtual route can be created, where anyone interested may navigate forward, backwards or around a site and at the same time press on links which provide close up images and environmental interpretation of the species encountered. Finally, used in conjunction with Virtual Reality glasses, any person interested can have a unique submersion in the seascapes of Gyaros Island, without getting wet. The virtual trails will be uploaded on a domain and an android application for smartphones and tablets.

E) Underwater delineation will be provided by submerged forex, printed plates spread out approximately every 50m along the suggested UWT. Divers or snorkelers will be able to spot each sequential plate and navigate towards it, while exploring the surrounding area either while diving or snorkelling. The plates will be attached with rope to non-permanent metal rods in order to be easily and quickly removed seasonally for maintenance/cleaning. The forex plates (20cmx20cm) can be branded with the projects logos and numbered sequentially using liquid ink UV printing. The Forex material to be used is 20mm thick, porous material which floats above the seafloor, without the use of buoys to hold it in place. A sample plate printed with UV liquid ink was submerged as a test in June

2015, in the prison trail area, and still retains all of its color and buoyancy; however cleaning will be required in order to remove algae and bryozoans which use it as a substrate.

F) A short, teaser 360° video is being prepared by Yiannis Issaris, a marine researcher from the Hellenic Centre of Marine Research (HCMR) from footage taken during the NATURA 2000 monitoring expedition, organized in June 2016. Gyaros seascapes including the UWTs were shot by 360° video technology and are being processed. (**Picture 12**).

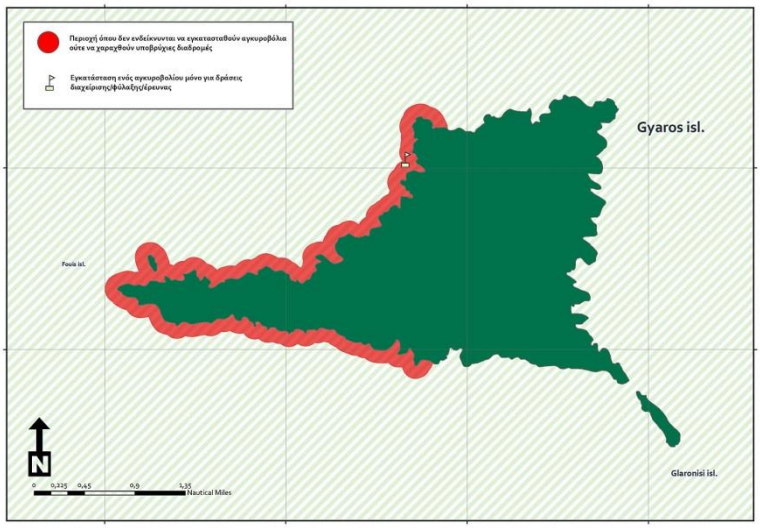
***Picture 12**. 360° video shooting of Gyaros seascapes, by Giannis Issaris researcher from the Hellenic Centre of Marine Reasearch. Photo by WWF Greece/E.Samara.*

The development of UWT tours in Gyaros MPA is expected to have multiple benefits for the local communities. As the marine environment is in relatively better condition than adjacent populated areas and the 3nm NO TAKE Zone is enforced, the marine environment is expected to recover rapidly, attracting even more visitors to the MPA and at the same time "spilling over" fish to adjacent areas (Fenberg *et al*., 2012). A comparative advantage of the area is the possibility of combining diving tourism with other forms of alternative tourism is Syros firstly and gradually on Gyaros. Syros in recent years, has become a popular tourist destination for mainstream but also specialist tourism like Heritage Tourism and Gastronomic Tourism. Even more recent efforts by Syros citizens, are concentrating on the creation of a Geologic Park on the NATURA 2000 area of Ano Meria, with plans to open up alternative tourism like walking trails, birdwatching, traditional culture of organic produce, geological tourism, heritage tourism etc.

5. Sites survey for UWTs on Gyaros and Syros

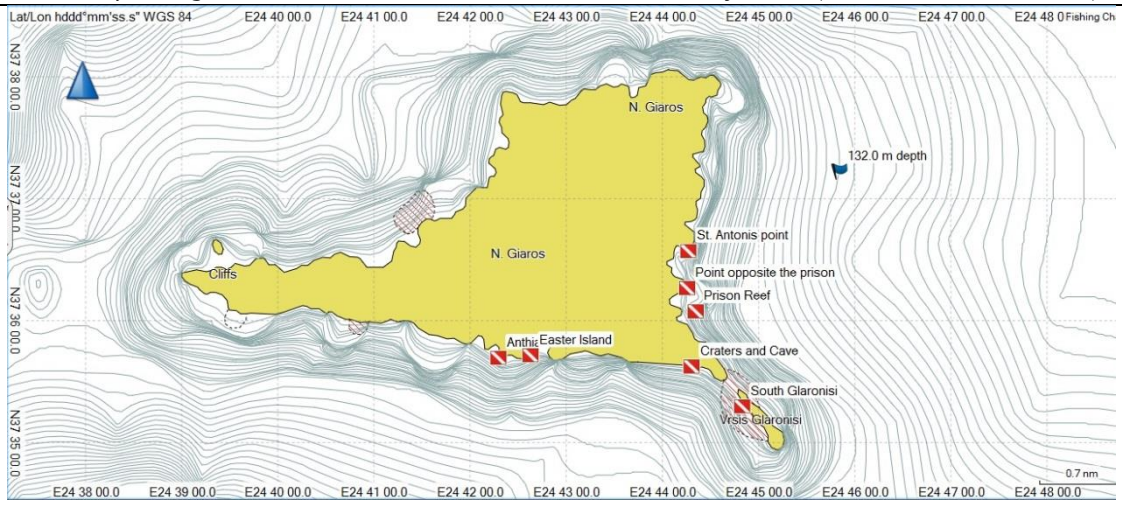
Before the site surveys were initiated, the field team held interviews with the two diving centers (Saltwater Divers and Syros Diving center) on Syros Island, in order to gather information from their past experience but also for their future wishes concerning the establishment of the MPA and the UWTs. The interviews held, revealed that the diving centers on Syros, do not visit Gyaros, as the distance is restricting for their vessels, so they prefer the sheltered bay of Posidonia in Syros.

However, they were positive regarding the creation of the MPA and UWTs, indicating that the best areas for their placement would be on the East and South side of Gyaros as they offer shelter from weather conditions, are closer to Syros and offer interesting dives. Contact with the single diving center of Andros Island (Perakis Hotel), revealed that the diving center was under change of management and was not operational at the time the planned surveys were carried out. Further contact with the new management, although positive, was restricted as the dive center does not operate on Gyaros. The only dive center with interest and means to visit the UWTs in Gyaros is Kea Divers from the neighboring Island Kea. Finally, a meeting with Mom's staff reinforced that the surveys should take place on the East and South side of the Island, as these areas lay outside the monk seals' hotspot, see map below. (**Picture 13**). The North side of the Island was not surveyed as the prevailing winds make it inaccessible most of the times.

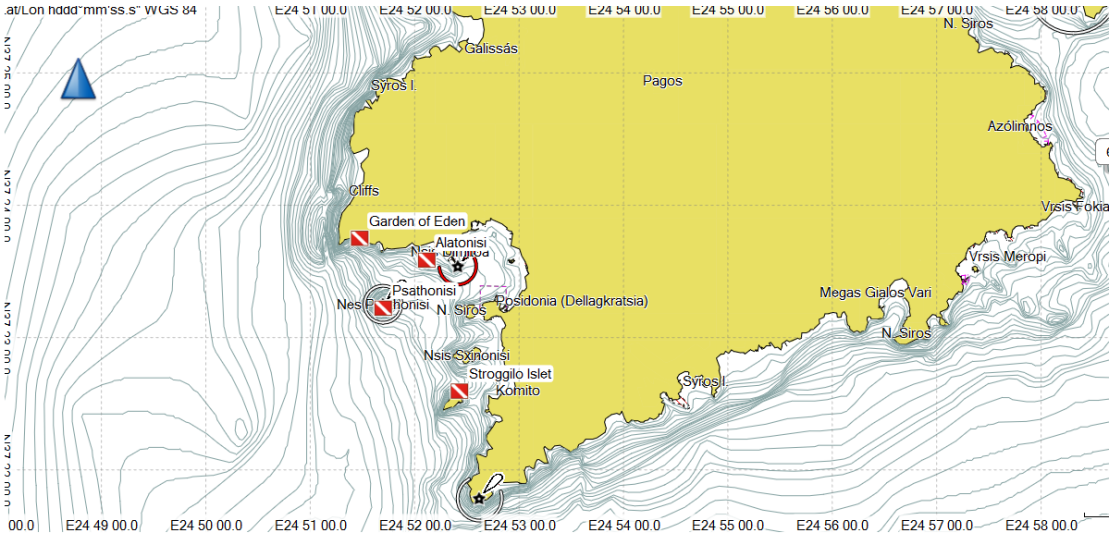


***Picture 13**: Map provided by MOm's staff, red area designates the monk seals' hotspot.*

In total 7 sites were surveyed in Gyaros, with concentrated efforts on the suggested areas (**Picture 14**). Four more sites on the Western side of the Island were visited as suggested and in collaboration with local Free Diving Instructor G. Dounavis, however they are not included in this report as the data collected were of preliminary nature due to the sites' being in the monk seal habitat. In Syros Island four sites were surveyed (**Picture 15**).



***Picture 14**: Map depicting the Island of Gyaros bathymetry, taken from Homeport, Garmin. Dive flags correspond to the survey sites.*



***Picture 15**: Map depicting the South side of Syros Island and its' bathymetry, taken from Homeport, Garmin. Dive flags correspond to the survey sites.*

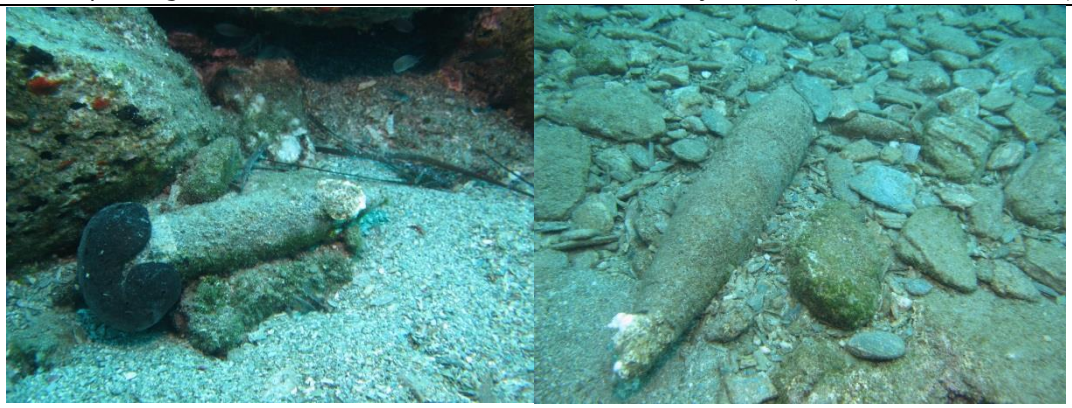
5.1 St. Antonis Cape

Island: Gyaros
Sub-area: East Gyaros, 1st prison bay
Co-ordinates: N37 36 34.0 E24 44 16.2
Dive level: Snorkelling, Open water (20m).
Habitat types: Rocky reefs, Posidonia meadows, sand patches.
Dive description: Rock reef with gentle slope, alternating with sand patches and tufts of Posidonia. Interesting geomorphology accompanied by a rich variety of Eastern Mediterranean fauna and flora. However, the area was sporadically covered by broken amphora shells, bottles and other large items scattered along the reef including one unexploded missile. Finally, the area was covered by a lot of sediment, with a lower visibility than usual (10m). (**Picture 16)**
Depth: 0m to 20m
Currents: Weak
Protected species present: YES

Picture 16. *Photographs taken on the 11th of November, 2014 in St. Antonis Cape survey. WWF Greece/E.Samara*

5.2 Glaronisi

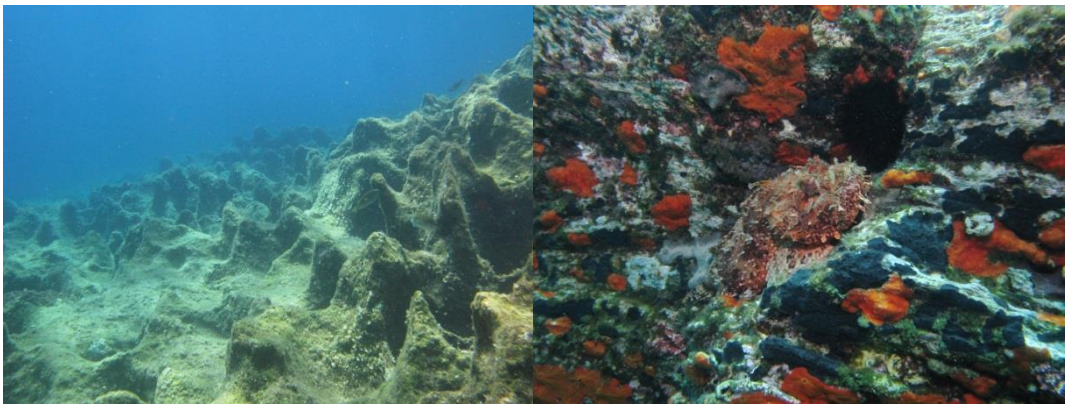
Island: Gyaros
Sub-area: Southeastern Gyaros, protected south side of Glaronisi
Co-ordinates: N37 35 17.6 E24 44 49.7
Dive level: Snorkelling, Open water (20m), Advanced Open Water (40m).
Habitat types: Coarse grain pebbles, Posidonia meadows, rock patches.
Dive description: Rocky slope descending gently to 40m, alternating with rock patches and tufts of Posidonia. Area devoid of interest and sporadically covered by unexploded ordinance, left over from the ex-military bombing site. (**Picture 17)**
Depth: 0m to 40m
Currents: Alternating between weak to very strong
Protected species present: NO



Picture 17. *Unexploded ordinance scattered around Glaronisi. Photos taken on the 14th of November, 2014 during the Glaronisi survey. WWF Greece/E.Samara*

5.3 Craters

Island: Gyaros
Sub-area: Southeastern point of Gyaros
Co-ordinates: N37 35 37.2 E24 44 18.2
Dive level: Snorkelling, Open water (20m), Advance Open Water (cave penetration requires immaculate buoyancy).
Habitat types: Rocky reef, Posidonia meadows, sand patches, submerged underwater cave.
Dive description: Eroded rock surface, covered in cavities like "swiss cheese", resulting in a very interesting geological formation that looks like "craters", reaching to a depth of 7m. Below 7m, sand, rock and posidonia patches are alternated. At 9m depth a very spacious (15m wide), completely submerged cave with a sandy bottom and photophobic species makes up for a beautiful but very shallow dive. Finally some unexploded ordinance are spread out at a depth of 10m. (**Picture 18**)
Depth: 0m to 20m
Currents: weak
Protected species present: YES



Picture 18. *Photographs taken on the 4th of March, 2015 and June 2016 in SE Gyaros survey. WWF Greece/E.Samara*

5.4 Easter Island

Island: Gyaros
Sub-area: South side of the Island, Fyllades Bay.
Co-ordinates: N37 35 38.7 E24 42 34.5
Dive level: Snorkelling, Open water (20m), Advanced Open Water (40m), Technical Diving (55m).
Habitat types: Rocky reef, Posidonia meadows, sand patches, surface cavity.
Dive description: Rock reef with stepped plateaus until the max depth of 55m. Sand patches and posidonia tufts interchange within the reef. Surface wall has 1 indentation resulting in a small cavity with some photophobic species. Shallow boulders forming a pyramide shape (5m) towards the end of the dive provide a perfect safety stop. Interesting geomorphology accompanied by a rich variety of Eastern Mediterranean fauna and flora. A rock boulder opposite the dive site looks like the Moai statues of Easter Island, hence the name. (**Picture 19**)
Depth: 0m to 55m
Currents: weak
Protected species present: YES

Picture 19. *Shallow boulders (5m) and protected species (Tonna galea). Photographs taken on the 19th of June, 2016 during the South survey, in Fyllades Bay. WWF Greece/E.Samara*

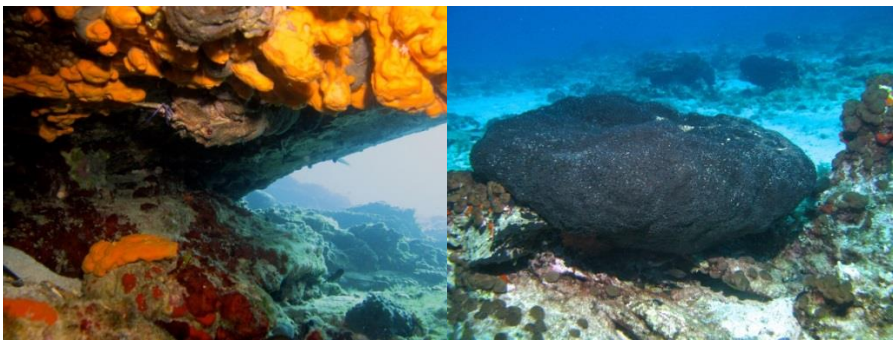
5.5 Anthias

Island: Gyaros
Sub-area: South side of the Island, 1 bay west of Fyllades bay
Co-ordinates: N37 35 41.5 E24 42 17.7
Dive level: Snorkelling, Open water (20m), Advanced Open Water (40m), Technical Diving (55m).
Habitat types: Rocky reef, Posidonia meadows, sand patches.
Dive description: Rock reef with stepped plateaus until the max depth of 55m. Sand patches and posidonia tufts interchange within the reef. Interesting geomorphology accompanied by a rich variety of Eastern Mediterranean fauna and flora. Anthias fish are present from the depth of 12m, hence the name Anthias. (**Picture 21**)
Depth: 0-55m.
Protected species present: YES
Currents: From weak to very strong

Picture 21. *A common octopus and anthias fish from 12m depth. Photographs taken on the 27th of April, 2016 during the South survey, in the bay west of Fyllades. WWF Greece/E.Samara.*

5.6 Prison Reef

Island: Gyaros
Sub-area: Eastern side of the Island.
Co-ordinates: N37 36 04.4 E24 44 20.8
Dive level: Snorkelling, Open water (20m), Advanced Open Water (40m).
Habitat types: Rocky reef, Posidonia meadows, sand patches.
Dive description: As a natural extension of the land, a rock reef extends 250m into the sea, slopping faster on the sides to a depth of 25-30m. The rock reef interchanges with posidonia tufts, sandy patches and shallow canyons. Very interesting geomorphology accompanied by a rich variety of Eastern Mediterranean fauna and flora. Ovoid route beginning at 7m descending slowly over the slope while ascending similarly on the other side of the reef. (**Picture 22**)
Depth: 0-30m
Protected species present: YES
Currents: Weak



Picture 22. *A slipper lobster (Scyllarides latus) and a large Sarcotragus sponge encountered on the prison trail. Photographs taken on the 5th of March, 2015 during a prison reef survey. WWF Greece/E.Samara*

5.7 Point opposite Prison Reef

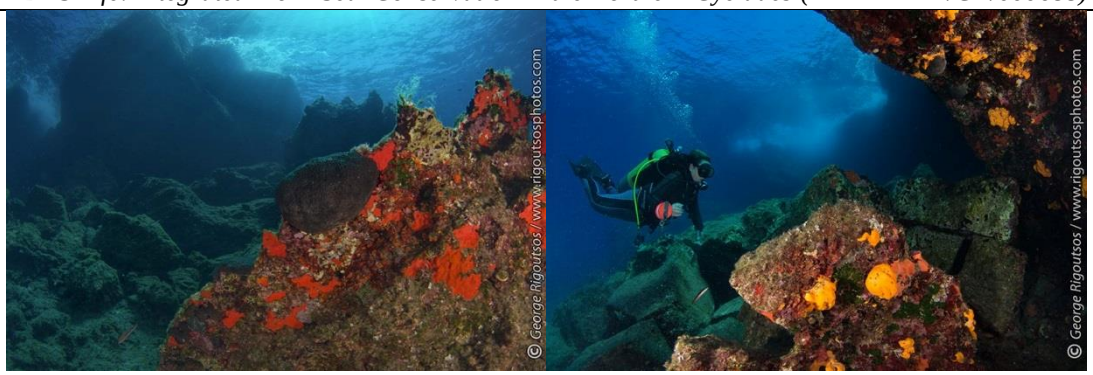
Island: Gyaros

Sub-area: Eastern side of the Island.
Co-ordinates: N37 36 15.8 E24 44 15.4
Dive level: Snorkelling, Open water (20m), Advanced Open Water (40m).
Habitat types: Rocky reef, Posidonia meadows, sand patches.
Dive description: Rock reef with gentle slope, alternating with sand patches and tufts of Posidonia. Interesting geomorphology accompanied by a rich variety of Eastern Mediterranean fauna and flora. The area was covered by a lot of sediment, with a much lower visibility than usual (3m) (**Picture 23).**
Depth: 20m
Protected species present: YES
Currents: Weak

Picture 23. *A piece of flotsam encrusted with the crustacean, cosmopolitan species Lepas anatifera, encountered during this survey on the 9th of November, 2014.*

5.8 Alatonisi

Island: Syros
Sub-area: South Syros outside Foinikas Port
Co-ordinates: N37 23 32.6 E24 52 10.4
Dive level: Snorkelling, Open water (20m).
Habitat types: Rocky reef, Posidonia meadows, sand patches, cavities.
Dive description: Two peaked, rock reef with gentle slope alternating between sand patches and tufts of Posidonia. Interesting geomorphology accompanied by a rich variety of Eastern Mediterranean fauna and flora. At 5m, very interesting maze of rock canyons and cavities.
Depth: 0-20m
Protected species present: YES
Currents: Weak



Picture 24. *Interesting geomorphology encrusted by various sponges and sciophilous communities. Photographs taken on 15th of August, 2016 during the photography survey, in Alatonisi. WWF Greece/G.Rigoutsos*

5.9 Garden of Eden

Island: Syros
Sub-area: Bay before the most Southwestern part of Syros.
Co-ordinates: N37 23 44.8 E24 51 28.4
Dive level: Snorkelling, Open water (20m), Advanced Open Water (40m).
Habitat types: Rocky reef, Posidonia meadows, sand patches, underwater cave.
Dive description: Rock reef with gentle slope, alternating with sand patches and tufts of Posidonia. Interesting geomorphology accompanied by a rich variety of Eastern Mediterranean fauna and flora. An underwater cave lays between the rock formation from 10m to 3m depth with magnificent photophobic species. Although very beautiful, it is a fragile environment for divers' to explore. The bubbles released and accidental fin strokes will bring deterioration to this unique cave. (**Picture 25**)
Depth: 0-40m
Protected species present: YES
Currents: Weak if present

Picture 25*. A triton shell (Charonia variegata) and the shallow exit of the cave. Photographs taken on the 15th of October, 2015 on the Atsiganokatsro survey. WWF Greece/C.Papadas.*

5.10 Psathonisi islet

Island: Syros
Sub – area: South Syros, Foinikas bay.
Co-ordinates: N 37 23 14.79, E 24 51 42.79
Dive level: Snorkelling, Open water (20m), Advanced Open Water (40m), Technical Diving (55m).
Habitat types: Rocky reef, Posidonia meadows patches, sand patches.
Dive description: The dive starts on the north side of the islet descending to at 10m and then descending to a deeper step between 15-25m. Here the bottom is fully covered with amphorae, probably part of an ancient shipwreck. Beautiful dive site with the remains of two ancient shipwrecks combined with a rich variety of Eastern Mediterranean fauna and flora. **(Picture 26)**
Depth: 0-40m
Protected species present: YES
Currents: weak

Picture 26*. Amphorae shells remaining from two ancient shipwrecks and an Axinella sponge from Psathonisi Islet survey. Photos by WWF Greece/C.Papadas.*

5.11 Strogilo islet

Island: Syros
Sub-area: South Syros
Co-ordinates: N 37 22 31.05, E 24 52 22.17
Dive level: Snorkelling, Open water (20m), Advanced Open Water (40m), cavern dive.
Habitat types: Rocky reef, Posidonia meadows, sand patches
Dive description: The dive starts from the south side of the islet. At 5m the bottom is covered with large boulders, full of life (colorful sponges, macro themes etc.) Heading west at a distance of 150m and descending to the depth of 20-25m lays a cave with a large opening and walls covered by colorful sponges. Great place for under water photographers with colorful sea life. (**Picture 27**)
Depth: 0-25m
Protected species present: YES
Currents: weak

Picture 27. *The cave opening and a sand anemone in Strogilo Islet. Photos by WWF Greece/C.Papadas.*

6. Proposed Underwater trails (UWTs)

In order to come up with a final selection, sites surveyed were assessed for their potential according to the 4 following criteria, proposed by MedPAN (Baude *et al*., 2012):

A) The "land" potential-This concerns the nature of the site: the extent to which the coastline is jagged and the profiles that can be seen from the sea are of interest.

B) The "marine" potential-This information was mainly collected during field trips using a combination of several methods : inventory of biotopes, inventory of species.

C) The "safety" potential-Criteria include exposure to prevailing winds and currents, the absence of any dangerous area (barely submerged rocky areas where waves break, risk of falling stones, etc.) and the extent to which the area is used by other potentially dangerous users (motorboats, windsurfers, spearfishermen, etc.).

D) Potential for "access"- This is the key factor that will determine the type of visits and the number of potential users. How do you get to the site, is there mooring provided?

E) Potential "fragility"- It will be necessary to assess the extent to which trail visits may impact the marine environment.

Selected sites are assessed below. The assessment of the remaining sites surveyed can be found in the appendix section.

6.1 Prison Reef

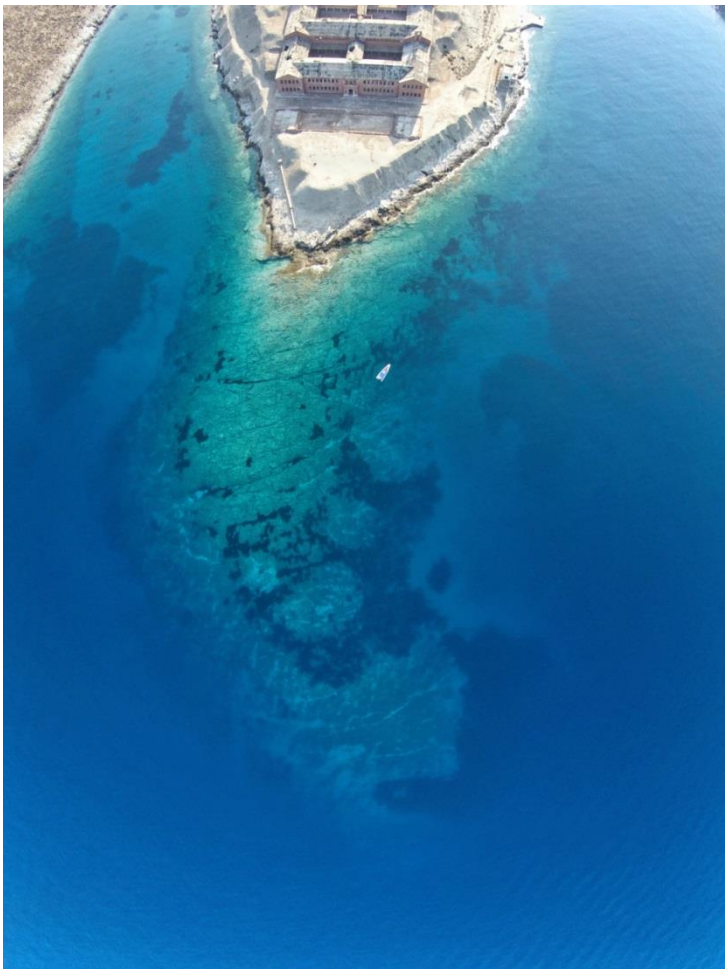
A) Land potential: The prison building is an extraordinary and awe inspiring site viewed at any angle, but when viewed from below and from inside the water it is breathtaking. (**Picture 28**)

B) Marine potential: As a natural extension of the land, a rock reef extends 250m into the sea, slopping faster on the sides to a depth of 25-30m. The rock reef interchanges with posidonia tufts, sandy patches and shallow canyons. Very interesting geomorphology accompanied by a rich variety of Eastern Mediterranean fauna and flora. Protected species of *Pinna nobilis, Charonia variegata, Centrostephanus longispinus* and grouper species are spotted every season.

C) Safety potential: Gyaros Island by default becomes inaccessible with winds above 5 beaufort. The trail is somewhat sheltered from North winds and completely sheltered from South winds. Currents are weak if present. Unexploded ordinance was discovered (2) and GPS located in order for its safe removal by the appropriate military unit.

D) Access potential: Gyaros is only visited by boat from any Island, depending on the vessel used. Eco friendly moorings will be provided close to the reef for the safe anchoring while visiting.

E) Fragility potential: The site has a low fragility index as it is composed mostly of rock reefs, Posidonia and sand.



Picture 28. *Aerial view of the Prison Reef Trail, with the "Gioura" (7,5m vessel) anchored on top. Image donated by George Stefanou.*

6.2 Easter Island

A) Land potential: The jagged coastline is extremely interesting above the site of the UWT with indentations that permit both snorkelers and divers to explore them. Opposite the site of the UWT,a view of an elevated rock formation that looks somewhat like the Easter Island Moais lays opposite a sandy beach. Above the jagged rock cliffs, the not so common plant *Euphorbia dendroides* forms large clusters, providing for amazing colors especially in spring to beginning of summer. In the middle of the route, the rock capsizes vertically forming a small indent flooded with water. (**Picture 29**)

B) Marine potential: Rock reef with stepped plateaus until the max depth of 55m. Sand patches and posidonia tufts interchange within the reef. Surface wall has 1 indentation resulting in a small cavity with some photophobic species. Shallow boulders (5m) towards the end of the dive provide a perfect safety stop. Interesting geomorphology accompanied by a rich variety of Eastern Mediterranean fauna and flora. Protected species of *Pinna nobilis, Charonia variegata, Tonna galea, Centrostephanus longispinus* and grouper species are spotted every season.

C) Safety potential: Gyaros Island by default becomes inaccessible with winds above 5 beaufort. The trail is completely sheltered from North winds but not sheltered from South winds. Currents are weak if present.

D) Access potential: Gyaros is only visited by boat from any Island, depending on the vessel used. Eco friendly moorings will be provided close to the wall reef for the safe anchoring while visiting.

E) Fragility potential: The site has a low fragility index as it is composed mostly of rock reefs, Posidonia and sand.

Picture 29. *Euphorbia dendroides,* blooming over the vertical indent in the wall and surrounding cliffs. Photographs by WWF Greece/E.Samara.

6.3 Alatonisi Islet-Syros

A) Land potential: The jagged rocky outcrop that makes up Alatonisi has many crevices for exploration and a beautiful view to Kokkina beach, on South Syros. Marine birds have been spotted in the area. (**Picture 30**)

B) Marine potential: Two peaked, rock reef with gentle slope alternating between sand patches and tufts of Posidonia. Interesting geomorphology accompanied by a rich variety of Eastern Mediterranean fauna and flora. At 5m a very interesting maze of rock canyons and cavities can be explored. Protected species of *Pinna nobilis, Charonia variegata* and grouper species are spotted every season.

C) Safety potential: Alatonisi UWT is completely protected from North winds but exposed to South winds. As the area is a conspicuous reef, motorboats do not approach at a close distance. Currents are weak if present.

D) Access potential: Syros Island is very frequently served by ferries from Athens and other Aegean Islands, as it boast to be the Capital of the Cyclades. Planes from Athens and Thessaloniki serve the Island but not daily. From the port Hermoupolis, Posidonia lays 20 min to the south by car, taxi or community bus. From there, visitors head West for Kokkina Beach, where the trail lays 80m South (10 min swim), by Alatonisi Islet. Optionally, from Posidonia the site is less than a nautical mile west, outside the marina by boat.

E) Fragility potential: The site has a low fragility index as it is composed mostly of rock reefs, Posidonia and sand.

Picture 30. *Aerial views of Alatonisi Islet, opposite Kokkina Beach. Images donated by George Stefanou.*

7. Monitoring of the Underwater Trails.

MPAs provide goods and services (i.e. attractive underwater flora and fauna, reef structures and seascapes) that attract tourists and often represent the reason for which scuba divers choose to visit an area. Diving tourism is one of the major forms of commercial use of MPAs throughout the world (Parsons & Thur, 2008). Owing to increased recreational use of coastal areas, there is a general consensus about the potential impacts of these activities on the marine environment (Milazzo *et al*, 2002). Most studies on biological impacts have concentrated in the tropics, where the coral structures are far more sensitive to trampling compared to Mediterranean rock reefs (Dalias *et al* 2007). However, since potential visitors are expected to increase in the area and their numbers are to be diverted on the suggested UWtrails, some damage on the sessile flora and fauna by trampling, contact with their fins or via rising of sediments is expected either intentionally or unintentionally (Claudet *et al*, 2010). Monitoring and evaluation systems are needed to ensure that the goals and objectives of MPAs are achieved, and therefore must be carefully designed and implemented (MMMPA, 2016).

7.1 Qualitative preliminary assessment of proposed trails

During the extensive field surveys, preliminary, qualitative data on species presence were collected and are presented below in **Table 1**. Species are separated within Family groups for fish and by Taxa for invertebrates. The species list is not complete, but reveals the most abundant and representative species present in each area regarding all major groups of plants and animals found in the Aegean. All selected trails shelter large marine gastropods and bivalve shells protected by, the Bern and Barcelona Convention (*Tritonis variegata, Tonna galea, Pinna nobilis*), as well as the Habitats Directive 92/43/EEC (*Pina nobilis*).

Table 1. Preliminary species list of the three proposed Underwater Trails in Gyaros and Syros, along with their protection status. Species are separated within Family groups for fish and by Taxa for invertebrates.

Pisces	PRISON REEF	NTP	ALATONISI	Algae/Plants (cntd.)	PRISON REEF	NTP	ALATONISI
Muraenidae				*Jania rubens*	+	+	+
Muraena helena	+	+	+	*Lithothamnium sp.*			
Atherinidae				*Cystoseira sp.*	+	+	+
Atherina spp.	+	+	+	*Colpomenia sp.*	+		
Scorpaenidae				*Acetabularia acetabulum*	+	+	+
Scorpaena porcus	+		+	**Mollusca**			
Scorpaena notata	+	+	+	*Serpulobris arenarius*	+	+	+
Serranidae				*Heraplex trunculus*			
Epinephelus marginatus [2]	+	+	+	*Plalium granulatum*	+	+	
Epinephelus caninus		+		*Flabellina affinis*	+	+	+
Epinephelus costae	+	+	+	*Janolus cristatus*	+		
Serranus cabrilla	+	+	+	*Arca noae*	+	+	
Serranus scriba	+	+	+	*Discodoris atromaculata*		+	
Anthias anthias		+		*Cratena peregrina*	+	+	+
Apogonidae				*Bolma rugosa*	+	+	+
Apogon imberbis	+	+	+	*Patella sp.*	+	+	+
Centracanthidae				*Cerithium sp.*	+	+	+
Spicara maena	+			*Tonna galea* [1,2]	+	+	
Sparidae				*Tritonia variegata*	+		+
Diplodus sargus		+		*Pinna nobilis* [1/II;2/II;5/IV;6;7;8]	+	+	+
Diplodus annularis	+	+	+	*Spondylus gaederopus* [7,8]	+	+	+
Diplodus puntazzo	+	+		*Octopus vulgaris*	+	+	+
Spondyliosoma cantharus	+			*Sepia officinalis*	+		
Diplodus vulgaris	+	+	+	**Crustacea**			
Diplodus puntazzo		+		*Balanus sp.*	+	+	+
Oblada melanura	+	+	+	*Dardanus calidus*	+	+	+
Sarpa salpa	+	+	+	*Scyllarides latus*	+		
Sciaenidae				*Palinurus elephas*		+	
Sciaena umbra	+			*Lepas anatifera*	+		
Mullidae				**Echinodermata**			
Mullus barbatus	+	+	+	*Arbacia lixula*	+	+	+
Pomacentridae				*Paracentrotus lividus* [2,5]	+	+	+
Chromis chromis	+	+	+	*Centrostephanus longispinus* [5 IV]	+		
Labridae				*Sphaerechinus grannularis*	+	+	+
Coris jullis	+	+	+	*Antedon mediterranea*		+	
Thalassoma pavo	+	+	+	*Echinaster sepositus*	+		
Symphodus tinca	+	+	+	*Hlothuria sanctori*		+	
Symphodus mediterraneus	+	+	+	*Holothuria forskali*	+	+	+
Symphodus roissali	+	+	+	**Porifera**			
Symphodus rostratus	+			*Chondrosia reniformis*	+	+	+
Symphodus ocellatus	+	+	+	*Crambe crambe*	+	+	+
Symphodus melanocercus	+	+	+	*Sarcotragus spinolusus*	+	+	+
Labrus merula	+			*Axinella polypoides* [1/II; 2/II]		+	
Scaridae				*Aplysina aerophoba*	+		+
Sparisoma cretense	+	+	+	*Chrondrilla nucula*	+	+	+
Tripterygiidae				*Agelas oroides*	+	+	+
Tripterygion delaisi	+	+	+	*Cliona sp*	+	+	+
Blennidae				*Spirastrella cunctatrix*	+	+	+
Parablenius rouxi	+	+	+	**Hydrozoa**			
Gobiidae				*Eudendrium racemosum*	+	+	+
Gobius bucchichii	+	+	+	*Balanophyllia europea* [3/II;4/DD]	+	+	+
Siganidae				*Leptopsammia pruvati* [3]		+	+
Siganus luridus [9]	+	+	+	*Caryophyllia smithii*		+	+
Siganus rivulatus [9]	+	+	+	**Polychaeta**			
Monacanthidae				*Hermodice carunculata*	+	+	+
Stephanolepis diaspros [9]	+			*Sabella pavonina*	+	+	+
Algae/Plants	+	+	+	*Sabella spallanzanii*	+	+	+
Posidonia oceanica [5]	+	+	+	*Protula tubularia*	+	+	+
Lithophyllum bysoides		+		*Serpula vermicularis*	+	+	+
Codium bursa	+	+	+	**Bryozoa**			
Dictyota dichotoma	+	+	+	*Reptadeonella violacea*	+	+	+
Udotea petiolata	+			*Schizoporella dunkeri*	+	+	+
Peyssonelia squamaria	+	+	+	**Ascidia**			
Amphiroa rigida	+	+	+	*Halocynthia papilosa*	+	+	+
				Microcosmus sp	+	+	+

1. Bern Convention *- Convention on the conservation of European wildlife and natural habitats, Council of Europe 1979;* ***2. Barcelona Convention*** *- Protocol concerning Specially Protected Areas and*

Biological Diversity in the Mediterranean, 1995; ***3. CITES*** *- Convention on International Trade in Endangered Species of Wild fauna and flora, 1973;* ***4. Red List of IUCN*** *- the International Union of Conservation of Nature;* ***5. Habitats Directive 92/43/EEC****;* ***6.*** *Presidential Decree 67/1981;* ***7.*** *Presidential Decree 109/2002;* ***8.*** *Presidential Decree 227/200;* ***9.*** *Alien (non indigenous) species;* ***I, II, III, IV.*** *Appendix/Annex I,II, III, IV,* ***DD.*** *Data deficient;* ***LC.*** *Least Concern.*

7.2 Proposed scheme for minimizing effects by visitors

Diver frequentation to the suggested UWTs is a necessary follow up activity, in order to understand where and when measures of management must be applied. Various tools have been used in Mediterranean MPAs in order to monitor diver numbers, ranging from questionnaires to a specific diving license for the MPA (Dalias *et al*., 2007). For the Gyaros MPA, we suggest a combination of methods in order to assess frequentation numbers by divers and snorkelers while generating sustainable finances for the MPA management.

A) As a preventative measure and in order to ensure the protection of the diving sites, a code of good practices will be in place and the sites within the MPA will be equipped with permanent, posidonia friendly mooring buoys, placed nearby. The code is listed below, and will be given out to potential visitors, along with the ID cards and maps.

CODE OF GOOD PRACTICE FOR THE GYAROS MPA AND SYROS UNDERWATER TRAILS

- Control your buoyancy and breathing.
- Don’t dive alone, it’s more fun with company.
- Don't touch the sea floor, rest on it or kick it.
- Avoid kicking up sand.
- Do not touch the reef animals, and never feed them.
- Be extra careful with your buoyancy when taking photographs.
- Take all of your litter home.
- Enjoy your visit and ensure those who follow enjoy theirs too.

B) Diver and snorkeler numbers should be monitored in order to understand where and when measures of management must apply (site rotation, new sites, maximum numbers of divers per day etc.), as each site has a certain capacity to support the diver’s presence (Dalias *et al*., 2007). In order to keep track of visitors on the UWTs, the use of a diving license is suggested. By applying a symbolic fee for each diver or snorkeler, numbers of visitors can be monitored and at the same time sustainable financing can be generated for MPA management. An example of a dive badge for annual permition to dive in the famous Namena Marine Reserve, Fiji is depicted in **Picture 31**. Approximately 1,200 guests visit and pay for dive tags every year. Since 2003, and in consultation with tourism operators, the price of dive tags has risen to FJ$30 (14 euro) from an initial fee of FJ$2. Funds collected from the sale of dive tags have been used to set up a tertiary scholarship fund for students from the local communities, along with community development projects, maintenance, and general management of the MPA (Coral Reef Alliance, 2014).

Picture 31. Dive tags from Namena Marine Reserve, Fiji. The tags can be bought from collaborating dive centers and tourist offices. Each year, a photo competition is organized and the winning photograph is used for the tags, making them a collectible item.

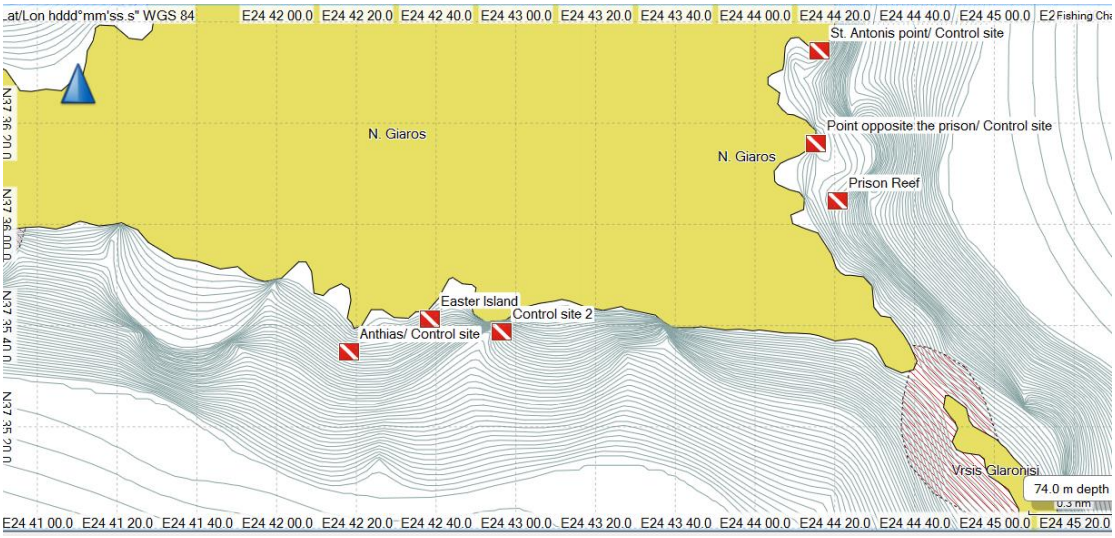
Research shows that tourists generally and divers in particular are prepared to pay reasonable entrance fees provided they have evidence that their outlay is used to improve conservation. In their comparative analysis in willingness to pay for access to marine parks, Peters & Hawkins (2009) demonstrate that people would be prepared to pay higher user fees for access to marine protected areas, revealing considerable untapped resources.

7.3 Proposed scheme for monitoring potential impacts on the marine life .

Gyaros UWTs were selected in a way as to divert expected visitors on less vulnerable areas, i.e rocks reefs instead of caves. When some activities are prohibited in specific areas, it does not prevent allowed uses to impact the ecosystem, even if some areas may sustain heavy levels of recreational uses without apparent degradation. Claudet *et al* (2010) have used an Underwater Visual Census (UVC) protocol for assessing snorkeler impacts on the structure of fish and macroalgae assemblages on the UWT of the Cerbere-Banyuls Nature Marine Reserve. UVC monitoring techniques provide qualitative and quantitative survey with a limited impact on the ecosystem, and are particularly suited for marine reserves. By adapting the Claudet *et al* (2010) protocol for divers and snorkelers we aim to assess the impacts visitors may cause on the fish and macroalgae assemblages of the Gyaros UWTs.

The design of this monitoring protocol is based on a before-after-control-impact (BACI) approach. Surveys will be conducted three times per year: before, during and after the opening of the UWTs (June, August and October respectively). For each period, 6 locations will be surveyed: the two UWTs and two control locations for each trail. Control locations (**Picture 32**) chosen are in non-frequented but close by areas with the same type of habitats and range of depths, similar to the UWTs. One random 30m transect will be laid out at two depths: two to four meters and twelve to fifteen meters. A team of two divers will perform the deepest transect first continuing then to the shallower transect. While swimming along each transect one diver will identify and count each non-cryptic fish species (fish families of Gobiidae, Bleniidae, Tripterygiidae will be excluded from the list) observed within a distance of 2m on each side of the transect. All data will be written on an

underwater sheet pad and transferred on excel sheets on land. The second diver will monitor the macroalgae by using photoquadrats (**Picture 33**). Three types of macroalgae will be chosen as indicators of potential impact: *Acetabularia acetabulum*, *Padina pavonica* and a third category with all other raised algae (mainly *Dyctiota dichotoma* and *Cystoseira* sp.). Within each location, 15 random quadrats (20cmX20cm) will be photographed. Photographs will be processed on land using GIS software (MapInfo 7.5) in order to estimate species coverage. By maintaining the monitoring surveys of the UWTs each year, the data collected may be analyzed in order to assess potential impacts on the marine life. Once managers are aware of any potential impacts, site rotation should be implemented.



Picture 32. *Map of Gyaros UWTs and their nearby control sites suggested, for monitoring purposes.*

Picture 33. *Two different types of quadrats used for macroalgae (left) and sea urchin (right) monitoring, by the HCMR team for the Natura monitoring protocols on Gyaros Island. Photos by E.Samara/WWF Greece.*

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9. APPENDIX

Assessment of surveyed sites

St. Antonios Cape

A) Land potential: St. Antonios Cape borders the first prison bay. The bay has remnants from the first exile settlements, lying above a sandy beach. Just above the cape, lays an old cemetery.

B) Marine potential: Below the cape a rock reef extends to a depth of 25-30m. The rock reef interchanges with posidonia tufts and sandy patches. Very interesting geomorphology accompanied by a rich variety of Eastern Mediterranean fauna and flora. Protected species of *Pinna nobilis* and grouper species are present. The site was not chosen due to the plentiful remains of shattered amphora shells and the high sedimentation, which limits the visibility. One unexploided missile was also present. **(Picture 34).**

C) Safety potential: Gyaros Island by default becomes inaccessible with winds above 5 beaufort. The site is slightly sheltered from North winds and completely sheltered from South winds. Currents are weak if present.

D) Access potential: Gyaros is only approached by boat, depending on the weather and the vessel used. Eco friendly moorings will be placed within the bay. For this reason St. Antonis Cape may be used as a rotation site for the Prison Trail, if needed.

E) Fragility potential: The site has a low fragility index as it is composed mostly of rock reefs, Posidonia and sand.

Picture 34. *Epinephelus caninus and Pina nobilis from St. Antoniso cave. The high level of sedimentation is evident. Photos by WWF Greece/E.Samara.*

Glaronisi

A) Land potential: This small island is the most south eastern part of Gyaros, and is the home of a large seagull colony, hence the mane (Glaros = seagull). The coastline is completely jagged and since it was the main bombing site used by the Navy, unexploded ordinance is scattered all around.

B) Marine potential: Rock reef with stepped plateaus until the max depth of 55m on the most southern side. Pebble patches and posidonia tufts interchange within the reef on the east and west sides. Protected species of *Pinna nobilis* and grouper species were spotted. Unexploided ordinance is found all around the marine area of Glaronisi. **(Picture 35)**

C) Safety potential: Gyaros Island by default becomes inaccessible with winds above 5 beaufort. Glaronisi provides shelter depending on the wind direction, however currents are unpredictable and extremely strong when encountered.

D) Access potential: Gyaros is only approached by boat, depending on the weather and the vessel used.

E) Fragility potential: The site has a low fragility index as it is composed mostly of rock reefs, Posidonia and sand.

Picture 35 *Some of the unexploided ordinance surrounding Glaronisi islet. Photos by WWF Greece/E.Samara.*

Craters

A) Land potential: The rocky slope above the water is composed of "softer" rock appearing like it has been melted by the wave erosion, providing for very interesting geomorphology.

B) Marine potential: The "softer" rock surface has been eroded below the water by rocks and wave action, creating the bare crater appearance until the depth of 7m. Below that Posidonia medows interchange with sandy patches. As the "craters" are next to Glaronisi, two missiles were found with probably more scattered within the posidonia. Finally, large cave at 9m is very interesting but has a high fragility factor. Protected species of *Pinna nobilis* are present. **(Picture 36)**

C) Safety potential: Gyaros Island by default becomes inaccessible with winds above 5 beaufort. The craters are completely protected from North winds but exposed to South winds. Currents are weak if present.

D) Access potential: Gyaros is only approached by boat, depending on the weather and the vessel used.

E) Fragility potential: The site has a high fragility index due to the cave and the fragile marine life inhabiting its walls

Picture 36. *Unexploded ordinance (left) and inactive missile (right) found on the site. Photos by WWF/E.Samara.*

Anthias

A) Land potential: The jagged coastline is interesting above the site Anthias. Above the jagged rock cliffs, the not so common plant *Euphorbia dendroides* forms large clusters, providing for amazing colors especially in spring to beginning of summer. Indentations within the rock cliff provide for interesting geomorphology.
B) Marine potential: Rock reef with stepped plateaus until the max depth of 55m. Sand patches and posidonia tufts interchange within the reef. Surface wall has many indentations resulting in a small cavities with some photophobic species. Interesting geomorphology accompanied by a rich variety of Eastern Mediterranean fauna and flora. Protected species of *Pinna nobilis, Charonia variegate* and grouper species are spotted every season. Anthias fish are present from 12m depth, hence the name of the site. This site could be used as a rotation site for Easter Island Trail, if required. **(Picture 37)**
C) Safety potential: Gyaros Island by default becomes inaccessible with winds above 5 beaufort. The trail is completely sheltered from North winds but not sheltered from South winds. Currents are strong if present.
D) Access potential: Gyaros is only visited by boat from any Island, depending on the vessel used. Eco friendly moorings will not be placed close by. The area is on the border with the seal territory.
E) Fragility potential: The site has a low fragility index as it is composed mostly of rock reefs, Posidonia and sand.

Picture 37. *A cryptic octopus and a juvenile Epinephelus marginatus from the site. Photos by WWF Greece/E.Samara.*

Point opposite prison reef

A) Land potential: The site borders the fourth prison bay. The point faces the prison buildings and above it lays an old cemetery.

B) Marine potential: Below water a rock reef extends to a depth of 25-30m. The rock reef interchanges between posidonia tufts and sandy patches. Interesting geomorphology accompanied by a rich variety of Eastern Mediterranean fauna and flora. Protected species of *Pinna nobilis* and grouper species are present. The site was not chosen because of the high sedimentation, which limits the visibility. **(Picture 38)**

C) Safety potential: Gyaros Island by default becomes inaccessible with winds above 5 beaufort. The site is slightly sheltered from North winds and completely sheltered from South winds. Currents are weak if present.

D) Access potential: Gyaros is only approached by boat, depending on the weather and the vessel used. Eco friendly moorings will be placed within the bay. This site may be used as a rotation site for the Prison Trail, if needed.

E) Fragility potential: The site has a low fragility index as it is composed mostly of rock reefs, Posidonia and sand.

Picture 38. *The picture on the left shows the high sedimentation of the site, covering a sponge and on the right the exotic species Stephanolepis diaspros. Photos by WWF Greece/ E.Samara.*

Garden of Eden - Syros

A) Land potential: The area is next to the most southwestern part of Syros Island. The jagged rocks provide for interesting geomorphology. Marine birds have been spotted in the area.

B) Marine potential: Rock reef extends until the depth of 40m, interchanging between sand and posidonia patches. In between the rocks at 10m depth there is an entrance to a funnel that reaches up to 3m depth. The funnel shaped cave is inhabited by typical sciophilous communities that are very colorful, hence the name "Garden of Eden". Protected species of *Pinna nobilis* and grouper species were spotted. The site was not selected due to the high fragility of the cave. **(Picture 39)**

C) Safety potential: Garden of Eden is completely protected from North winds but exposed to South winds. Currents can be strong, if present.

D) Access potential: Syros Island is very frequently served by ferries from Athens and other Aegean Islands, as it boasts to be the Capital of the Cyclades. Planes from Athens and Thessaloniki serve the Island but not daily. From the port Hermoupolis, Posidonia lays 20 min to the south by car, taxi or community bus. The site lays 2 nm West of Foinikas and is only approached by boat.

E) Fragility potential: The site has a high fragility index due to the cave and the sensitive marine life inhabiting its walls.

Picture 39. *The fragile marine life within the cave shoul not be exposed to high diving pressure. Photos WWF Greece/ C.Papadas*

Psathonisi Islet

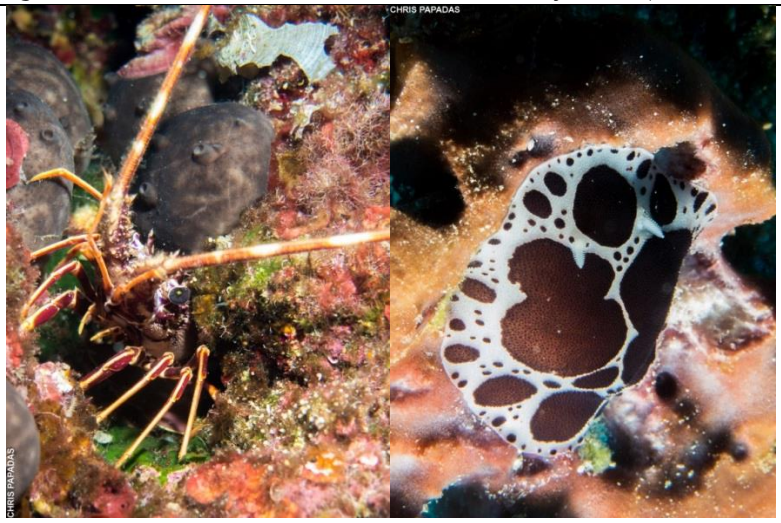
A) Land potential: The Islet is south of Atsiganokastro in South Syros. A small navigation light is placed on it, in order to be visible at night. Marine birds have been spotted in the area.

B) Marine potential: Rock reef extends until the depth of 50m, interchanging between sand and posidonia patches. All that remains from two ancient wrecks are shattered ampora shells. The site was not selected because of the amphoras and their fragility and historic importance. **(Picture 40).**

C) Safety potential: Psathonisi islet is exposed to all winds and currents can be strong, if present.

D) Access potential: Syros Island is very frequently served by ferries from Athens and other Aegean Islands, as it boasts to be the Capital of the Cyclades. Planes from Athens and Thessaloniki serve the Island but not daily. From the port Hermoupolis, Posidonia lays 20 min to the south by car, taxi or community bus. The site lays 2.5 nm West of Foinikas and is only approached by boat.

E) Fragility potential: The site has a high fragility index due to the amphora shells.



Picture 40. *A small lobster (Palinurus elephas) and nudibranch (Peltodoris atromaculata) from the site. Photos by WWF Greece/C.Papadas.*

Stroggilo Islet

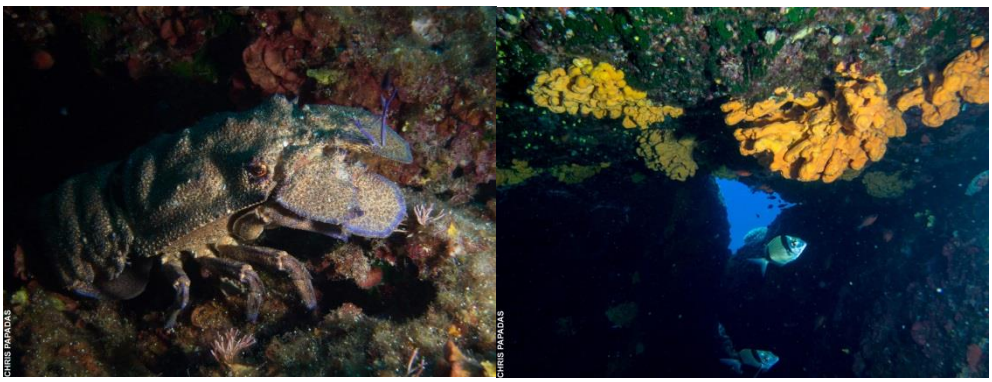
A) Land potential: The Islet lays 3 nm south of Foinikas bay, in South Syros. It is opposite the famous beach of Komito. Marine birds use this Islet as a nesting site, because of its jagged rocky surface.

B) Marine potential: Rock reef extends until the depth of 50m, interchanging between sand and posidonia patches. Large boulders and a cave at 25m make this an interesting site. It was not selected because the sciophyllic community inside the cave is very fragile. **(Picture 41).**

C) Safety potential: Psathonisi islet is exposed to mostly to south winds and less to north winds. Currents are weak, if present.

D) Access potential: Syros Island is very frequently served by ferries from Athens and other Aegean Islands, as it boasts to be the Capital of the Cyclades. Planes from Athens and Thessaloniki serve the Island but not daily. From the port Hermoupolis, Posidonia lays 20 min to the south by car, taxi or community bus. The site lays 3 nm south of Foinikas and can only be approached by boat.

E) Fragility potential: The site has a high fragility index due to the cave and the sensitive marine life inhabiting its walls.



Picture 41. *Slipper lobster (Scyllarides latus) and the fragile marine life within the cave. Photos by WWF Greece/ C. Papadas.*