
WORLD HERITAGE NOMINATION – IUCN TECHNICAL EVALUATION

MONTE SAN GIORGIO (SWITZERLAND) ID N°1090

1. DOCUMENTATION

- i) **IUCN/WCMC Data Sheet:** 8 references
- ii) **Additional Literature Consulted:** Hauschke, N. & Wilde, V. (ed.) 1999. **Trias - Eine ganz andere Welt. Mitteleuropa im frühen Erdmittelalter.** Verlag Dr.F.Pfeil, München, 636pp; IUCN (2002). **A global strategy for geological world heritage.** Gland, 51 pp; Sill, W. 2000. **Comparison of the world's Triassic vertebrate localities - a synopsis.** Unpublished Ms., 2pp; Felber M., Tintori A., Lombardo C., Furrer H., and Rieppel O. (2002) **Comparative Analysis** (Unpublished); Weidert, W.K.(ed.) 1995. **Klassische Fundstellen der Paläontologie - Band III.** Goldschneck Verlag, Korb, 70-75pp; Wells, R.T. (1996). **Earth's geological history - A contextual framework for assessment of world heritage fossil site nominations .** IUCN, Gland, 43 pp; Etter, W. 2001. **Monte San Giorgio: Remarkable Triassic Marine Vertebrates,** in Bottjer *et al.* (ed.) 2001 **Exceptional Fossil Preservations,** Columbia University press.
- iii) **Consultations:** 9 external reviewers. The mission also met with specialists from the Paläontologisches Institut der Universität Zürich, Università degli Studi di Milano/Dipartimento di Scienze della Terra, Museo naturale del Cantone di Ticino, and local and national authorities.
- iv) **Field Visit:** Tim Badman and Gerhard Heiss. July 2002.

2. SUMMARY OF NATURAL VALUES

Monte San Giorgio (MSG) is a pyramid-shaped, wooded mountain (peak 1,096 metres above sea level), which lies to the south of Lake Lugano in Canton Ticino, Switzerland. The natural values proposed for inscription on the World Heritage List arise because of its internationally important fossil remains from the Mid Triassic Period (245-230 million years ago). The nominated Site lies within an area identified as a Landscape Protection Zone (LPZ) under Swiss law, and comprises the part of this protected Zone that contains the main fossiliferous deposits. The total area of the nominated Site is 849 ha, lying within the Communes (or communities) of Meride, Riva San Vitale and Brusino Arsizio. The remaining parts of the LPZ are identified as the buffer zone for the nominated Site, comprising a further 1,389 ha of land, and territory within a further six communities

The Mid Triassic rock succession proposed for inscription rests unconformably on older, Permian volcanic rocks exposed on the north face of MSG, and is overlain by Upper Triassic, and Lower Jurassic rocks. The Mid Triassic sequence consists of approximately 1,000 metres of reef limestones, dolomites and bituminous shales which formed in marine conditions on the margins of the Triassic 'Tethys' Ocean. The exceptional fossil interest within the sequence arises because of the presence of five distinct, fossiliferous formations, the 'Grenzbitumenzone', the Cava Inferiore, Cava Superiore, Cassina Beds and the 'Kalkschieferzone'. The sequence records life in a tropical lagoon environment, sheltered and partially separated from the open sea by an offshore reef. Diverse marine life flourished

within this lagoon, including reptiles, fish, bivalves, ammonites, echinoderms and crustaceans. A stagnant and undisturbed seabed provided the conditions necessary for the preservation of these animals, when they died and fell to the sea-floor, to accumulate as abundant and exceptionally detailed fossils. Because the lagoon was near to land, the fossil remains also include some land-based fossils including reptiles, insects and plants. The fossiliferous rock succession is exposed in Switzerland on MSG, and also in the immediately adjacent area of Italy, in the area around Besano.

The result is a fossil resource of great richness. Fossils from MSG have been known to science for over 150 years. The resource is finite, and stable, so that excavation is necessary to produce fossil finds. Historically many finds were brought to light through commercial extraction of the carbon-rich layers to produce oil; however there is also a long history of scientific excavations dating from 1863 on the Italian deposits, and 1924 on the Swiss side. In summary, the current extent of discoveries includes more than 10,000 fossil specimens, representing 30 species of reptiles, 80 species of fish, c.100 macro-invertebrates, and 3 plant species, in addition to microfossil material which includes spores, pollen and marine micro-organisms.

The distribution and abundance of different fossil groups in the five different levels is variable, with the greatest diversity of material having been found within the Grenzbitumenzone. The vertebrate material includes particularly spectacular specimens, including large, articulated skeletons up to 6 metres in length. Complete skeletons include ichthyosaurs, nothosaurs, placodonts, and the remarkable 'giraffe necked' saurian, *Tanystropheus*. The land-based fauna is more restricted, but includes a significant and unique complete skeleton of the archosaur, *Ticinosuchus*, the first complete skeleton from this group to be discovered in the northern hemisphere.

There are a number of additional features that render exceptional importance to the fossil resource of MSG. First, there is the exceptional quality of preservation of material, including both complete skeletons of marine and land reptiles, and the display of minute detail including internal features such as stomach contents and embryos. Second, there are a number of unique and 'first' discoveries of species that have been made at the Site. A third feature is the presence of five superimposed fossil layers, allowing evolutionary and comparative studies, and a number of features within the sedimentary sequence that allow precise dating. Finally, it is significant that the area has been the subject of detailed study for over 75 years (150 years in Italy), resulting in a rich scientific literature of over 800 papers reviewing the fossils and many aspects of the detailed geology of the deposits. During that time the research and collection activity has been conducted by the universities of Zürich and Milan and the Milan Museum of Natural History. As a result, the fossils that have been found form a unique, consolidated, well-preserved and catalogued resource.

Although it is the geological significance of MSG that is the basis for its nomination as a World Heritage Site, it also displays significant other natural values, as well as cultural links between the geology and the life of the local community. These include quarrying of building stones, past production of mineral oils, and the establishment of a local fossil museum in Meride. Noteworthy local features include dry meadows on limestone sub-soils which are home to plant populations not found elsewhere in Switzerland or in the entire southern-Alpine zone of Italy. The site is rich in fungi (554 species), including 30% of known European species of *Boletus*. 37 of the modern vertebrate species found within the nominated Site are on the national red list, and 21 are protected under the Berne Convention. Three spider and one fungus species, previously unknown to science, have also been found here.

3. COMPARISONS WITH OTHER AREAS

The nomination document contains only a superficial comparative analysis, which claims a 'unique' status for the nominated site. As a result, IUCN:

- 1) undertook a review of the comparative values of the nomination itself through a number of leading international experts, and
- 2) requested the State Party to provide a more detailed comparative analysis, which was received in February 2003.

These analyses record that two sites are already inscribed on the World Heritage list which contain notable aspects representative of the Triassic period: Ischigualasto-Talampaya (Argentina), and the Dorset and East Devon Coast (UK). Ischigualasto-Talampaya is inscribed expressly for its Triassic fossil values, and is regarded as the best fossil record of terrestrial life in Triassic times, displaying a complete Triassic section. However, the values of this Site do not provide any insight into the marine fauna of this period, and are therefore clearly differentiated from MSG, where the fossil record is primarily marine. Thus the two sites may be said to complement each other. The Dorset and East Devon Coast includes a Triassic succession as part of a full exposure of the Mesozoic period, and within a site with diverse geological and geomorphological values. Whilst the Triassic succession in this Site is more complete than Monte San Giorgio, the fossil record in terms of both quantity and quality is much lower and primarily restricted to terrestrial aspects.

Other significant Triassic fossil sites that are well known and studied world-wide are also primarily representative of terrestrial interests. Such sites include localities in Australia, the USA, the Karoo of South Africa, Russia, East and North Africa and Brazil. Elsewhere in the Alps, Spain and Central Europe there are important marine fossil deposits of the Triassic period, but it appears that the most significant Triassic marine fossil material, apart from that at MSG, is now being discovered in Guizhou, China. Whilst the total extent and quality of this new material is not yet known, it is apparent that the composition of fossils differs a great deal from the contemporary collection at MSG. Moreover, it is clear that MSG has a pre-eminent importance given its long history of study and exceptional, rich and diverse remains.

The fossil values of the Site are at least comparable with other fossil sites of different era on the World Heritage list in terms of the global representivity of the fossil remains, and the range of time represented. Indeed MSG is more globally representative and covers a longer period of time than the exceptional Eocene lagoon deposits at Messel in Germany. The nominated Site can be regarded as a Triassic equivalent of the Devonian fish site at Miguasha, Canada, in representing life in the marine realm, and complements the exceptional records of the Jurassic marine environments represented on the Dorset and East Devon Coast.

In summary, IUCN considers that MSG can be accepted as unique in the world as the best single fossil record of Triassic marine life. The strict, systematic and continuous scientific research that has been carried out for over 75 years in Switzerland, almost exclusively by the Universities of Zürich and Milan, have resulted in a remarkably complete and co-ordinated record of the Site. Despite the fact that the comparative analysis submitted by the State Party in February 2003 at the request of IUCN contains some gaps on information, it is considered by the majority of the independent experts that MSG has a clear and fully substantiated claim as the principal global reference site for marine palaeontological sciences of the Triassic period.

4. INTEGRITY

4.1 Boundaries

The nominated Site and its buffer zone together correspond to the area of the MSG Landscape Protection Zone, defined under Swiss Law and identified in the Cantonal Development Plan. The nomination document is ambiguous about the precise area to be nominated with contradictory statements in sections 1e and 1f. However, it was confirmed during the field inspection that the area to be nominated for inscription is solely that of the outcrop of the Mid Triassic rock formations, with the remainder of the Landscape Protection Zone forming the buffer zone for the Site. The buffer zone adjoins the Site on three sides; the fourth side of the Site is marked by the Swiss-Italian border.

This approach to definition of the Site boundary is supported in principle, and is appropriate in relation to the integrity criterion in the operational guidelines. In practice on the mountainous and wooded terrain of MSG, and given the discontinuous nature of the rock exposures, the boundary cannot be traced in the field, and the precise extent of the nominated Site is therefore not clearly defined at present. It should at least be clearly marked upon paths etc., and the overall boundary should correspond to identifiable landscape features that conform most closely to the limits of the Mid Triassic exposures.

The nomination document describes the Swiss and Italian deposits as a single entity, although only the Swiss exposures are proposed for inscription. Important elements of the 'story' of the discovery and study of fossil resource of MSG relate to the Italian exposures. The first scientific excavations were carried out in Italy, resulting in the first discoveries and descriptions of several species. However, the fossil material recovered from these early Italian studies was almost all destroyed when the Milan Museum of Natural History was bombed in 1943. Systematic fossil excavations began in Switzerland in 1924, and have continued to the present day with 17 sites having been excavated, in over 50 different campaigns. Most of the spectacular finds within the Mid Triassic rocks of the area have been made in Switzerland, although significant finds have also been made in Italy since excavations (involving a total of three sites) recommenced from the 1950s, including two spectacular skeletons of marine reptiles that are only known from Italy. A further Italian discovery of a partial Jurassic dinosaur at Saltrio, only 200m from the border and on the mountain adjacent to MSG is also noteworthy. The fossil remains in Italy have a high public profile, with a significant local museum at Besano, and a small museum at Induno Olona. Finally, there are equivalent scientific excavations underway in both Switzerland and Italy, and there has been considerable cross-border co-operation between research institutes. The prospects for further finds being made in either Switzerland or Italy depend on the future levels of excavation and study.

Ideally, then, the boundary for MSG should encompass the deposits in both Italy and Switzerland. It is accepted, however, that at present there is not the same level of public and community commitment to a nomination for Italian territory. It is also the case that the Swiss portion of the fossil resource provides an adequate representative sample of the fossil resource of MSG, and that activity in Switzerland has produced most of the discoveries. IUCN, therefore, considers that the nominated Site fulfils adequately, but not optimally, the condition of integrity for site boundaries. Nonetheless, there should be strong encouragement for future extension of the Site to cover the interests that lie in Italy. It is welcome that a Protocol on a possible extension of the Site to include the Italian part has recently been signed (5 February 2003) by representatives of local authorities and communes in Italy, declaring their intent to collaborate for the purposes of extending the boundaries of the Site across the border.

4.2. Legal Status

Although the nominated Site does not have a distinct legal status in its own right at present, both it and the buffer zone are treated as a single site under Swiss law, and receive identical protection. Thus at the federal level, MSG is defined and mapped in the 'Federal Inventory of Landscapes, Sites and Natural Monuments', declared and ratified in 1977. The protected area is in essence the same as the combined area of the nominated Site and buffer zone (the one minor exception is a proposal for an additional area of buffer zone at its extreme southern point). The inventory binds all federal authorities to respect the values for which the site is listed, and also applies to bodies to whom cantonal powers are delegated.

The Cantonal Development Plan (CDP) identifies this same area of land as a Landscape Protection Zone (LPZ). In such zones, the protection of natural landscape features has the highest priority amongst different human uses. The CDP sets out six general objectives for protection, promotion of research and preparation of management plans. The protected area is also translated into the Local Development Plans of the Communes, which include plans providing for different land uses. Within these plans, the significant natural areas within the LPZ are identified as nature reserves, although the detailed policies for protection in both the cantonal and local plans are not recorded in the nomination documentation.

All fossil remains in Canton Ticino are protected through the 'Cantonal Regulations for the Protection of Flora and Fauna' which were passed in 2002. These regulations include sections which replace a legislative decree passed in 1974, which protects fossil remains. Under the regulations, important fossil material throughout the Canton is identified as the property of the State. A cantonal permit is required for all fossil excavation and collection activities, providing a very strict regulatory system which has been applied to fossil excavations on MSG for many years – with permits only having been granted to universities with a proven research record (principally Zürich and Milan). It is difficult to conceive of a stricter regime of fossil protection, which is clearly challenging to implement on a widespread basis throughout the Canton. In relation to the very special and finite resources of MSG, which require excavation if they are to be realised, this level of protection provides an appropriate and workable legal solution to the protection of the resource.

4.3. Ownership

The nominated Site is in the ownership of three different local Communes. Around 10% is cultivated, privately-owned land, mostly near Meride and Riva San Vitale. Some private dwellings lie within the Site along the narrow road that connects Meride with Serpiano. The ownership position is not optimal; however the legislative umbrella of the Canton provides sufficient support for necessary management and protection of the fossil interests of the Site if required.

4.4. Management

Management responsibilities for the nominated Site are divided between the federal, canton and commune levels, with no single management authority. However management of the fossil resource is exclusively the task of the Canton Ticino, within the legal framework described in 4.2.

The site does not currently have a management plan, but a draft management plan was submitted subsequent to the submission of the nomination document. At this stage the draft plan sets out broad statements of intent, and details of current programmes that are being developed by the Canton, in some cases with the support of the Federal and local authorities, and partners in Italy. The plan is not yet at a sufficiently advanced stage to be able to identify the specific management requirements of the nominated Site, as distinct from the wider buffer

zone, nor to make links between management and the land use and regulatory aspects of the commune plans in particular.

As noted, the management of the fossil resource is based on a system of strict legal protection, with regulation of scientific excavation through permits, and strict conditions on the protection, preparation and curation of specimens found. Canton Ticino has shown determination in its management of excavations in the past, as is evident in the exceptional collection of fossils held principally in only three institutions. However, the nature of this management, and the future plans, are not set down in a clear written statement, and thus the expectations of the World Heritage Convention in relation to the conditions of integrity are not fully met on this point. IUCN recommends that the Canton, as the responsible management authority, should prepare a binding written statement to identify clearly to the World Heritage Committee the approach that will be taken to the management of palaeontological material and excavations from MSG. The State Party is requested to give particular attention to ensuring that this aspect continues to be fully supported in the future. These statements would form the first stage to the development of a wider management plan for the Site and the surrounding area. The State Party has indicated that the MSG management plan will include information on research campaigns, the conservation of fossil remains and their presentation.

Interpretation and presentation of the fossil material is particularly important to communicate the special interests to a widespread audience. There are currently good off-site displays of material from MSG at Zürich and Lugano (as well as at Besano and Induno Olona in Italy). Within the buffer zone, a small local museum has been established in Meride, and there are plans to restructure and increase this facility in view of the international interest in the area. A decision on funding for this project is awaited, and IUCN considers that this would be an important development in providing for the needs of visitors to the Site. It is noted in particular that there are no dedicated staff identified for managing MSG at present, and provision of permanent staff based at the museum would be of great benefit, in order to supervise the property, and relate to visitors. The State Party has since confirmed that the staff assigned to the museum at Meride will have a role in guiding visitors on-site.

A project to promote an integrated development plan for the MSG area has recently been agreed through the INTERREG IIIA programme (jointly funded by the EU and Swiss Government), which includes as partners not only the Swiss Communes and Canton partners, but also the equivalent bodies in Italy. The preparation of a management plan is one of the tasks of this project. CHF 100,000 has been identified for this work within Switzerland, with a matching amount in Italy. The plan should be completed by 2005. This is a welcome initiative, especially the cross-border nature of the partnership. It is hoped that this will encourage a common approach to the fossil resources of the Swiss and Italian parts of MSG. The recently-signed protocol amongst the Italian local authorities and communes suggests that progress is taking place.

4.5. Human Impact

At present there do not appear to be significant threats to the Site's natural values in general, and strict protection and regulation of the fossil resource is in place. In contrast to other forms of conservation, palaeontology is by its nature invasive, and in the case of MSG requires active programmes of excavation. These are well regulated at present, and have been so for many years. Extraction of fossil material for oil production has ceased, and whilst it presumably resulted in some losses, it was also the reason that the fossil remains were first recognised.

5. APPLICATION OF CRITERIA/STATEMENT OF SIGNIFICANCE

Monte San Giorgio is nominated for inscription under natural criterion (i).

Criterion (i): Earth's history and geological features

MSG is the single best known record of marine life in the Triassic period, and records important remains of life on land as well. The Site has produced diverse and numerous fossils, many of which show exceptional completeness and detailed preservation. The long history of study of the Site, and the disciplined management of the resource have created a well documented and catalogued body of specimens of exceptional quality, and are the basis for a rich associated geological literature. As a result MSG provides the principal point of reference, relevant to future discoveries of marine Triassic remains throughout the world. Based on its own analysis and a supplementary comparative analysis by the State Party regarding the exceptional comparative value of the site, IUCN considers that the nominated site meets this criterion.

6. RECOMMENDATION

IUCN recommends that the Committee **inscribe** Monte San Giorgio on the World Heritage List under natural criterion (i).

In addition IUCN suggests that the State Party should be requested by the Committee to:

- continue its efforts to include the Italian part as an extension, to be added once satisfactory levels of political commitment have been attained and it is clear that the conditions of integrity can be met;
- ensure that the boundaries of the Site are marked clearly on the ground;
- develop on-site interpretation, so that visitors to the site can readily appreciate its significance, linking this interpretation to the development of the Meride museum.

IUCN would also like the Committee to remind and emphasise to State Parties that all sites nominated for inclusion on the World Heritage List on geological grounds should be accompanied by a thorough global comparative analysis.

APPENDIX 1: IUCN FOSSIL SITE EVALUATION CHECKLIST

Coverage of an extended time period

The site provides fossils of Mid Triassic age, from within a complete Mid Triassic succession covering a period of 15 million years. The presence of five distinct fossiliferous levels provides the opportunity for comparative and evolutionary studies through time.

Richness of species diversity

MSG is the richest known site for marine Triassic vertebrate fossils in the world, providing fossils of reptiles, fish, bivalves, ammonites, echinoderms and crustaceans. Around 110 species of marine reptiles and fish are known from the site, together with c.100 macro-invertebrates. Terrestrial vertebrate, insect and plant species are also known from the site, although in smaller quantities, but include a spectacular complete skeleton of an archosaur. There is an important microfossil fauna.

Uniquely representative of a geological time period

Amongst numerous Triassic fossil sites world wide, MSG has yielded a uniquely rich fauna of marine fossils, and is considered a pre-eminent 'type locality'. Other significant Triassic fossil sites of equivalent international importance provide evidence of terrestrial, rather than marine life.

Existence of other comparable sites

No sites of greater importance are known. Recent finds of marine Triassic fossils have been made in China but are yet to be properly studied, and MSG provides the major reference point for comparative assessment of the significant and interpretation of these and other sites. The nominated Site includes only the Swiss parts of MSG, whilst the deposits extend over the border into Italy. The majority of discoveries have been made within the Swiss area, although significant parts of the 'story' of MSG relate to the Italian part. The Swiss exposures therefore provide an adequate, but not optimal, sample of the scientific interests of MSG, and it is recommended that a future extension of the nominated Site into Italy should be sought.

Ischigualasto-Talampaya (Argentina) is inscribed on the World Heritage List and provides an exceptional record of terrestrial Triassic environments and fossils; MSG provides a complementary record of marine environments.

Contribution to the understanding of life on earth

MSG is the only site where Triassic marine deposits have been studied through continuous disciplined scientific excavation over a period of more than 75 years, and can be considered the main location where a complete, well-preserved record of Triassic marine life has been made. The quantity and quality of fossil biota enables interpretation of species evolution, palaeoenvironments and landforming processes that existed 200 million years ago. The site provides a record of marine life during a critical period in vertebrate evolution on earth, and has an importance that extends beyond representation of life in the Triassic 'Tethys' Ocean, to provide a global reference point for comparative studies of evolution.

Prospects for ongoing discoveries

More than 10,000 fossil specimens have been recovered from the nominated Site to date, and recent excavation campaigns have shown a continued pattern of new discoveries of fossil

material. Much material that has been collected awaits study. Prospects of new discoveries of spectacular reptiles appear to be greatest in the Grenzbitumenzone, but studies at all of the main levels are capable of producing new information. The depth of study of the deposits is capable of providing an increasingly precise and well understood document of Mid Triassic marine life. Recent discoveries of stratigraphic markers such as microfossils and datable volcanic clays are important in establishing the overall precision of the information being gathered from the Site.

International level of interest

MSG is of global importance for geology in general, and palaeontology and evolutionary biology in particular. Its geological interests are documented in over 800 scientific and popular publications. It is internationally renowned to geological science as a uniquely important occurrence of fossiliferous marine Triassic deposits, which has been the subject of focussed and disciplined scientific study and management.

Associated features of natural value

There are other features of natural value (e.g. the contemporary flora and fauna) associated with the nominated Site, which include three spider and one fungus species first discovered there. The nominated Site is an area of attractive landscape, with a range of natural, archaeological and historic features - particularly in the buffer zone. The landscape features and modern processes in an Alpine mountain setting do not relate to the marine environments recorded in the Triassic fossil record.

State of preservation of specimens

The specimens found in the nominated Site include many examples that are complete and fully articulated, ranging from large marine reptiles to insects. Generally the state of preservation of the specimens is outstanding.

Curation, study and display of fossils

Excavations of the nominated Site are carried out exclusively under the regulation of Canton Ticino, and all excavations have been made under the supervision of the University of Zürich, in cooperation with the Cantonal Museum of Natural History, Lugano and the University of Milan. Fossil finds are curated, catalogued and displayed in both Zürich and Lugano, to excellent standards. An additional exhibition is available immediately adjacent to the Site in Meride (within the buffer zone), which forms the main starting point for visitor excursions to MSG. This facility provides only for interpretation and has no permanent staff at present; however there are plans to develop it further in the future.

Local museums at Induno Olona and Besano in Italy also display finds and information about the fossils of the Monte San Giorgio area.