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## THE COASTAL ZONE MANAGEMENT PLAN OF SANTA MARIA AS A CHANCE FOR FOSSILIFEROUS OUTCROPS MANAGEMENT

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### INTRODUCTION

The Azores Environment and Sea Agency through its Regional Department of Land Management and Water Resources, together with the Agency of Land Management of the Autonomous Government of The Canary Islands and the Regional Cabinet of Transport and Social Equipment of the Autonomous Government of Madeira carry on the project "Sustainable Management of the Social, Economic and Ecological Development of the coastal areas of Macaronesia within the community initiative INTERREG III B 2000-2006, Açores-Madeira-Canary Islands, which has been designated as LITOSOST.

The LITOSOST project aims at achieving land management of a coastal area which focuses on reducing the urban and infra-structural pressure and regenerating, recovering and converting it for public fruition (UNESCO, 1997; Mota *et al.*,

2004; DROTRH/SRAM, 2006; MAOTDR, 2006).

The general goal of the project consists on stimulating practices to the sustainable management of the coastal areas of the Azores, Madeira and Canary Islands. As specific objectives, the following stand out:

to strengthen the cooperation between the Macaronesia authorities; to identify the problems and the common potential of the coastal areas of the islands;

to train human resources: Management and Preservation of Resources;

to contribute for the improvement of the state of the coastal ecosystems of the EU islands.

The intervention area of this project in the Autonomous Region of the Azores, are the islands Santa Maria, Graciosa, Flores and Corvo, the main goal consists in the elaboration of the Coastal Zone Management Plans.

### MATERIALS AND METHODS

**Definition of Coastal Zone Management Plan**

The Coastal Zone Management Plans (CZMP) are considered as Special Land Management Plans, as mentioned in the Law-Decree nr 380/99 dated from September, 22<sup>nd</sup>, altered and re-published by the Law-Decree 310/2003, dated from December, 10<sup>th</sup>, which establishes the juridical regime of the Land Management Instruments/Tools. It has been adapted to the Azores Region through the Regional Legislative Decree nr 14/2004, dated from May, 23<sup>rd</sup>, altered and re-published by the Regional Legislative Decree nr 24/2003/A, dated from May, 12<sup>th</sup>. These plans constitute a Governmental extra means of inter-

vention and aim at achieving objectives of national interest with spatial repercussions, establishing safeguard regimes for resources and natural values, ensuring the permanence of systems which are fundamental to the sustainable land use.

**Intervention Area**

The definition of the intervention area for the CZMP is presented in the areas defined in Fig. 1. When the beach stretches beyond the established width, the bank will be extended according to the limits defined in the CZMP. In the process of designing this area, some practical aspects must be pointed out:

- a) the sea limit representing the Protection Sea Zone of Santa

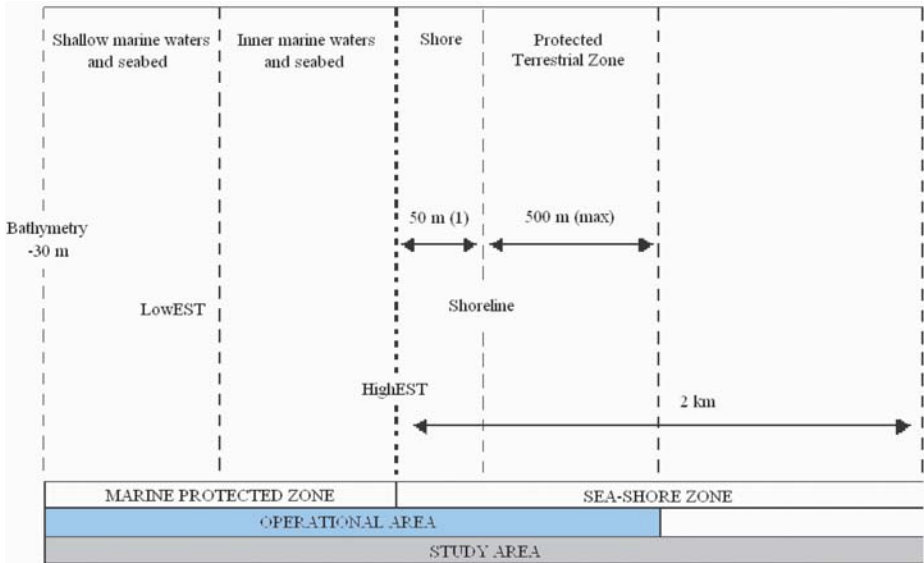


FIGURE 1. Intervention (operational) and Study Area of the CZMP. LowEST – Lowest level of equinox spring tide. HighEST – highest level of equinox spring tide.

Maria Island has been found by interpolating the bathymetric of the -50m and - 20 m;

- b) the island's limit, which equals the sea level, as been taken as the land limit of the Protection Sea Zone of Santa Maria Island, due to lack of information concerning the highest level of high tide of the equinox spring tide;
- c) coastline has been assumed to meet the sea level, as shown in the vectorial information, of the Geographic Institute.

In order to simplify the graphic representation, the AI is shown in two distinctive units as in Fig. 2:

- a) Protection Sea Zone, between the bathymetric of -30m and the coastline;
- b) The coastal strip 500 metres

wide, measured from the coastline inland.

### Coastal Zone Management Plan main Goals

The CZMP aims at integrating the socio-economic development with environmental protection and improvement, urban planning and management, besides protecting the coast, promoting the communication between institutions and public participation. The environmental planning is based on a set of guidelines, in order to achieve a holistic management of all resources, regardless their nature – economic, social, cultural or natural – ensuring, thus, a sustainable development (Beller *et al.*, 1990).

According to the Law-Decree nr 309/93, dated from September, 2<sup>nd</sup>, changed by the Law-Decree nr

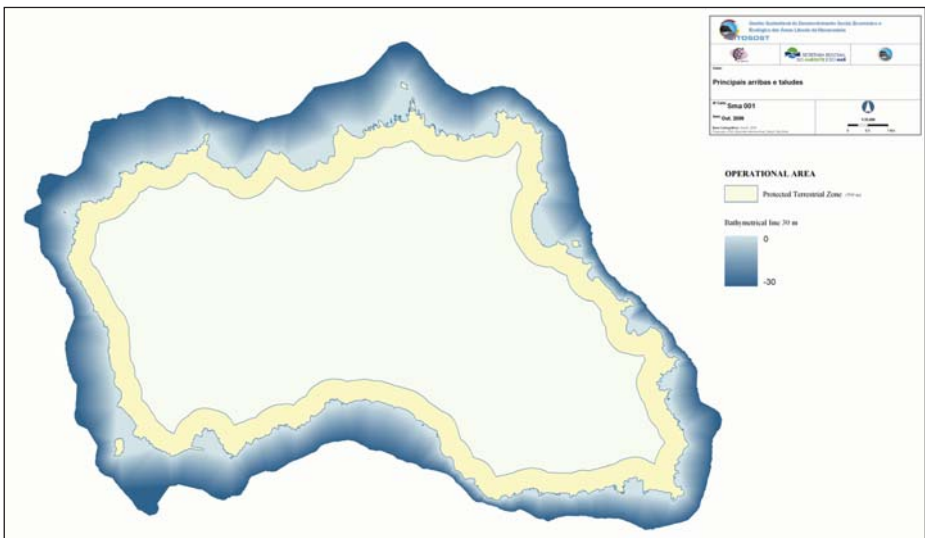


FIGURE 2. Limits of the intervention area of Santa Maria Island. At yellow, the protected terrestrial zone; at blue, the bathymetry of 30m depth.

218/94, dated from August, 20<sup>th</sup>, and by the Law-Decree nr 113/97, dated from May, 10<sup>th</sup>, and still in accordance with the adaptation done concerning the Autonomous Region of the Azores, in the Regional legislative Decree nr 18/98/A, dated from November, 9<sup>th</sup>, the objectives of the CZMP are as follow:

- a) to rank the different uses and practices;
- b) to classify the beaches and regulate the bathing use;
- c) to value the beaches considered as strategic, due to environmental or tourist reasons;
- d) to lead the development of specific activities of the coastal area;
- e) to preserve nature.

The fulfilment of the guidelines regarding the interventions on the coastal area implies that a set of principles is observed during the elaboration of the CZMP. The principles established by law, to be observed during the elaboration of the plan are the following:

- a) protection of the biophysical integrity of the space;
- b) valuation of the coastal resources;
- c) preservation of landscape and environmental values.

Taking into consideration the pressures which exist along the coastal area and being the ecosystems of an immense natural, landscape and environmental importance, but, very sensitive, a proper land use management of this place must be

observed. The guidelines concerning the coastal interventions are defined in the Resolution nr 138/2000, dated from August, 17<sup>th</sup>, which sets the guidelines regarding the interventions on the coastal areas:

- a) environmental protection and valuation of the natural and landscape resources;
- b) integration of the water resources in the comprehensive coastal planning, aiming at its sustainable development;
- c) promotion of the socio-economic development;
- d) transport and communications as regional cohesion factors;
- e) improvement of the population's life standard;
- f) preservation of the coastal area;
- g) preservation of the sea environment adjacent to the coast.

The general objectives underlying the elaboration of the CZMP reflect different concerns and support the issues which are intended to be prevented and will be presented accordingly with specific goals for the coastal area of each island. The goals include simultaneously the specificities (urban and legal) of this Land Management Plan tool, the coastal planning on islands and the specific features of the coastal areas of the islands. According to the Resolution nr 138/2000, dated from August, 17<sup>th</sup>, the general objectives underlying the elaboration of the CZMP concern:

- a) respect for the soil conditions, preservation of the resource water and delimitation of risk areas;

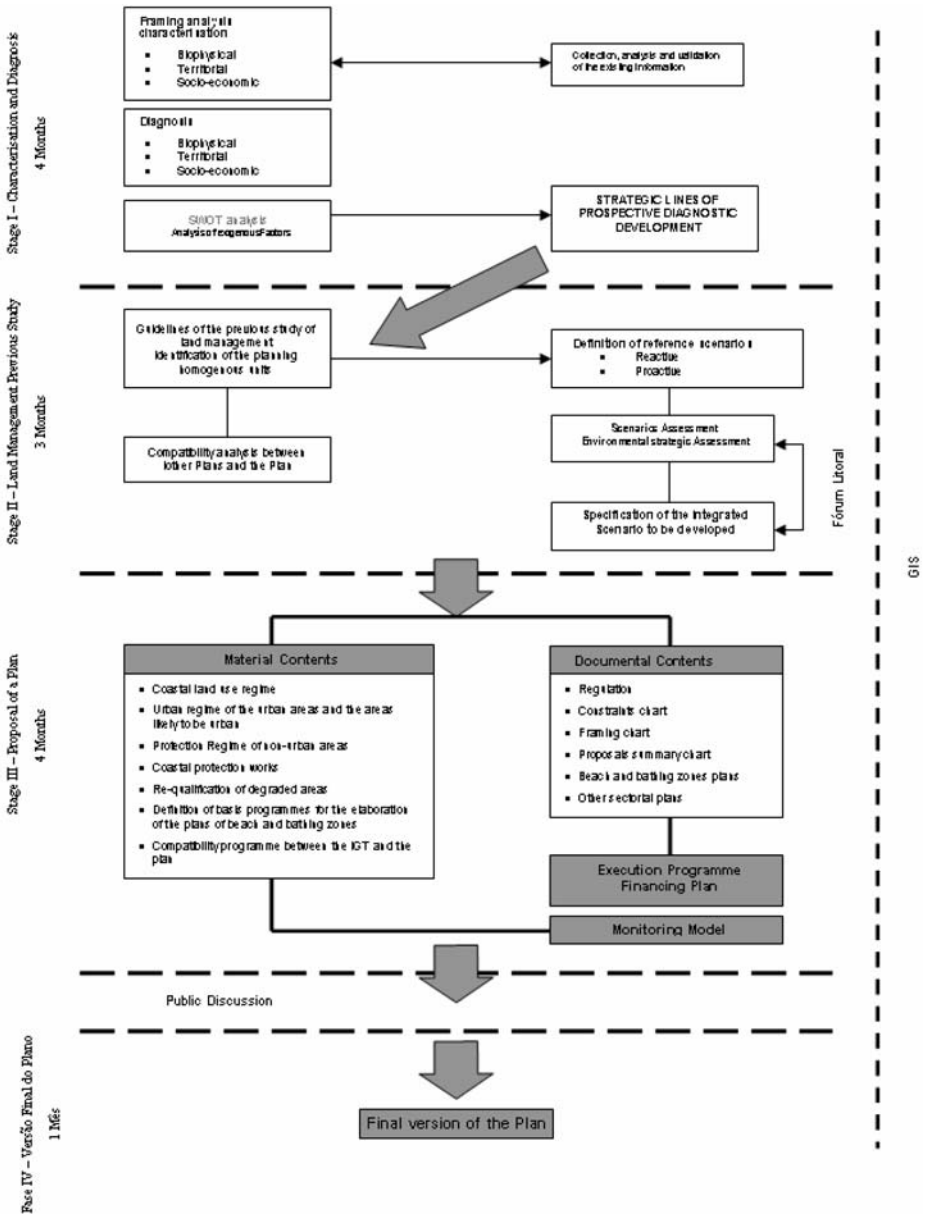


FIGURE 3. Methodology of the different stages of the CZMP of Santa Maria Island (Azores).

- b) urbanization (limits, constraints, uses of the urban soil, etc.);
- c) building (construction stability, construction typology per soil, use and building area);
- d) cultural trend and dimension of each island;
- e) institutional communication and plan management.

part of the CZMP proposals and will be one of the conditions defined to achieve the sustainable use of resources and coastal development.

The island of Santa Maria is the only one in the Azores archipelago to have visible fossiliferous outcrops. These are often characterised by their value and good state of preservation. Most of these outcrops are Late-Miocene Early-Pliocene of age (*e.g.*, Figueiral, "Pedra-que-Pica", Ponta Negra, Ponta da Malbusca, Ponta do Norte and Cré) (Zbyszewsky *et al.*, 1961; Zbyszewsky & Ferreira, 1962; Estevens & Ávila, 2007; Kirby *et al.*, 2007), although there are also evidence of Pleistocene outcrops (Prainha, Lagoinhas and possibly "Pedra-que-Pica") (Zbyszewsky & Ferreira, 1961; García-Talavera, 1990; Callapez & Soares, 2000; Ávila *et al.*, 2002; Ávila, 2005). For a complete list of references see Madeira *et al.* (2007) and consult Fig. 4 for the location of the fossiliferous outcrops.

Since the 16<sup>th</sup> century that these deposits have been source of interest (*e.g.*, Gaspar Frutuoso (1978) in "*As Saudades da Terra*") when limestone was extracted to be used in construction. Nevertheless, the industry was not very significant outside the internal market due to the bad quality of the stone and because of the difficult access to the deposits and it came to an end when limestone from the mainland became more easily available (Mitchell-Thomé, 1976).

In the second half of 19<sup>th</sup> century the first scientific studies began with the arrival of German scholars to the island (*e.g.*, Brönn, 1860; Reiss, 1862;

## DISCUSSION

### The CZMP of Santa Maria Island (Azores)

The CZMP of Santa Maria Island is due to be elaborated in about 12 months and taking into consideration the last period due to public participation. Thus, the different stages of the plan will be:

- a) Stage I – Characterisation and Diagnosis;
- b) Stage II – Land Management Previous Study;
- c) Stage III – Proposal of a plan;
- d) Stage IV – Final version of the plan.

The plan will be developed according to the methodology present in Fig. 3.

### A chance for Fossil Deposits management

Within stage I – Characterisation and Diagnosis of the CZMP of the Santa Maria Island, an item has been included specially to enable the fulfilment of a specific goal: "Preservation and Promotion of the Fossil Deposits of the Island Santa Maria". Therefore, the fossil deposits management is a

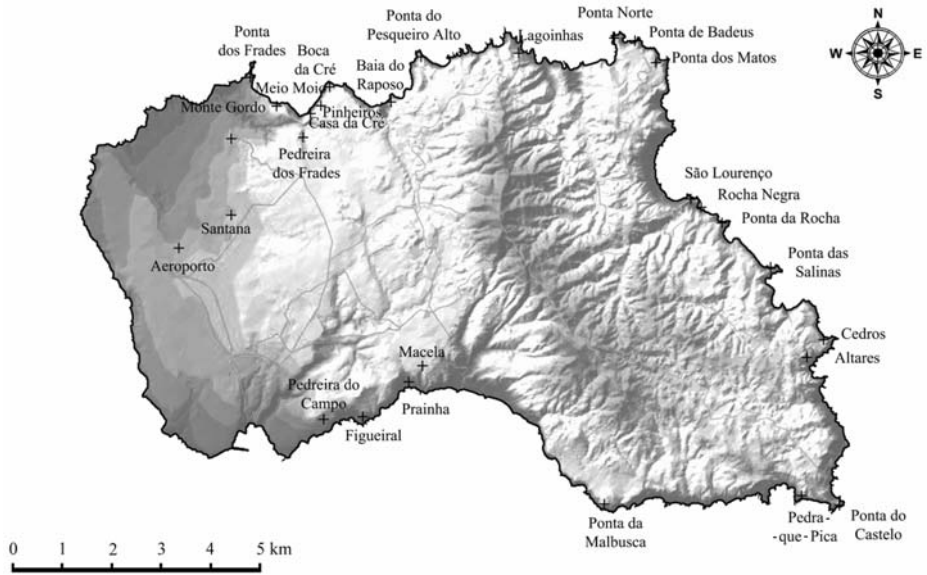


FIGURE 4 – Location of the fossil deposits of Santa Maria Island and environmental areas in which they are included (adapted from DRA/SRAM, 2005). 1) Pedreira do Campo, Figueiral, and Gruta Velha (Marvão) outcrops, are included in the protected area of “Monumento Natural Regional da Pedreira do Campo” (Regional Natural Monument of Pedreira do Campo) and in the “Reserva Natural Regional do Figueiral-Prainha” (Regional Natural Monument of Figueiral-Prainha); 2) Macela, Prainha, and Praia do Calhau (Praia Formosa) deposits, are included in the “Reserva Natural Regional do Figueiral-Prainha” (Regional Natural Reserve of Figueiral-Prainha), and in the “Reserva Natural da Baía da Praia” (Natural Reserve of the Baía da Praia); 3) Ponta da Malbusca (Piedade), “Pedra-que-Pica” (Baixa do Sul), and Ponta do Castelo (Maia) deposits, are included in the areas “Sítio de Interesse Comunitário da Ponta do Castelo” (Spot of Community Interest of Ponta do Castelo); 4) Ponta das Salinas (Figueiras), and Ponta Negra (Baía de São Lourenço), are included in the “Reserva Natural da Baía de São Lourenço” (Natural Reserve of São Lourenço Bay); 5) Ponta do Norte, Baía do Tagarete (Lagoinhas), and Ilhéu das Lagoinhas, are included in the area of “Paisagem Protegida do Barreiro da Faneca e Costa Norte”(Protected Landscape of Barreiro da Faneca and North Coast); 6) Cré deposits, are included in the area of “Reserva Natural da Baía dos Anjos” (Natural Reserve of the Anjos Bay).

Mayer, 1864). Throughout the 20<sup>th</sup> century, although prolific, the scientific publishing decreased until it became almost forgotten from 1980 onwards. At the turning of the millennium the Santa Maria fossil

deposits gained a new importance when they restarted to be systematically studied by one of the authors (Ávila), in 1998. As a consequence of his work, three international expeditions were organised by him and

other members of the “Marine Palaeobiogeography Working Group of the University of the Azores (MPB, Department of Biology of the University of the Azores) between 2002 and 2006. These were characterised by their scientific nature, as well as by the fact that the participants in the expedition spread their findings of a natural and unique heritage urging to be preserved to the population, during a series of talks given in every expedition at the local yacht club, Clube Naval de Santa Maria. As a result, scientific articles were published (*e.g.*, Cachão *et al.*, 2003; several papers on this volume) and the most complete reference collection (DBUA-F) about the Fossils of Santa Maria Island was done. This collection is housed at the Department of Biology of the University of the Azores (São Miguel Island).

The Pedreira do Campo was the first site in the Azores to be classified as a “Regional Natural Monument”. This protection zone possesses diverse geological, biological and historical characteristics, with an ancient exploitation front where a sequence of volcanic eruptions and sediment deposits can clearly be seen (Cachão *et al.*, 2003). It includes, still, an artificial cave (an old lime extraction cave), which makes this reserve into a place of the highest importance to understand not only the natural, but also the social history of the Azores archipelago. These characteristics can be found in many other deposits on Santa Maria (*e.g.*, Ponta da Malbusca and Ponta das Salinas). Nevertheless,

Pedreira do Campo is the only one to have an easy access, allowing it to be used for tourism exploration and enabling the possibility of didactic-pedagogical activities to take place there.

The growing interest of the scientific community on the fossil deposits of Santa Maria has shown that these are threatened or even at risk when certain natural and anthropogenic factors are taken into account. Most deposits are located on the coast, exposed to the sea erosion. As for the effects of Man upon these deposits, it can be observed that, even though the exploitation of this non-renewable resource has stopped due to its economic unviability, the tourist sector, fast expanding on the island, together with the low interest of the local population, seems to be the major risk factor. From all the deposits, those of Prainha and of Praia do Calhau are elucidating examples of the risks that the deposits are exposed to nowadays. Both are located in the bathing zone of Praia Formosa, they are exposed not only to the sea erosion but also to the increasing pressure created by tourism since other places such as Baía dos Anjos, Maia and São Lourenço cannot respond to the growing tourism pressure, even though it is only during the Summer. The threats come from the possible increase of buildings on the coast, summer-houses, hotels and a large number of supporting structures, such as parking lots and paths. The accessibility, which turns a deposit into a possible study and leisure place, without proper control struc-



tures can become a risk factor, particularly when the good state of preservation that the fossils show in many of the deposits is taken into consideration. These become easy targets for “irresponsible collection”. This risk can only be minimised by isolating the deposits and making campaigns to raise the population’s awareness for the fact that a fossil out of its environment is worthless (Beatley, 1991; Comissão Europeia, 1999).

The focus on the potentialities and risks of the fossiliferous outcrops of Santa Maria Island is a consequence of a renewed scientific interest which is at the very beginning. Besides the need to continue to study the geological heritage of Santa Maria, efforts must be done in order to sensitise the population not only for their protection, but also for the potentialities of their non-destructive exploration, being them an added value, instead of a negative contribution, for the local economy.

## CONCLUSIONS

The CZMP of Santa Maria Island is now entering the last phase. On this phase a Land Use map is produced and it has bindery power to all private and public agents. Also an operational and financial program is presented. These programs do not have the same power to oblige the agents and institutions, but they act as guidance for the agency responsible for Coastal Management. Therefore the fossil deposits were included on the final phase in two parts:

Land Use Map - the fossil deposits of Santa Maria are included in a land use class defined as “Coastal Buffer”. In those areas only conservation and protection measures will be allowed. They will be *non aedificandi* and even the buildings and structures already existing are not allowed to expand. On the opposite, the structures needed to promote and protect nature and natural values are incentivated;

Operational and Financial program – a specific project for fossil deposits management was included with the indication of the amounts needed and the institution that will promote the project. The project includes the existence of a “Fossils interpretation and museum house”.

The success or not of these proposals can only be measured in a few years, when the CZMP of Santa Maria Island be assessed. However successful it will be, the scientific research and knowledge need to be improved. This is a task that the CZMP can not achieve, and at ultimate sense, the researchers will be the most important agents in the overall process of the fossils deposits conservation and management.

## REFERENCES

- ÁVILA, S.P., R. AMEN, J.M.N. AZEVEDO, M. CACHÃO & F. GARCÍA-TALAVERA, 2002. Checklist of the Pleistocene marine molluscs of Praínha and Lagoínhas (Santa Maria Island, Azores). *Açoreana*, 9(4): 343-370.

- ÁVILA, S. P., 2005. *Processos e Padrões de Dispersão e Colonização nos Rissoidae (Mollusca: Gastropoda) dos Açores*, x+329 pp. PhD Thesis, Universidade dos Açores, Ponta Delgada.
- BEATLEY, T., 1991. Protecting biodiversity in coastal environments: introduction and overview. *Coastal Management*, 19: 1-19.
- BELLER, W, P. D'AYALA & P. HEIN, 1990. Sustainable Development and Environmental Management of Small Islands; *Man and the biosphere series – volume 5*; J.N.R Jeffers Series Editor; United Kingdom.
- BRÖNN, H. G., 1860. Die fossilen Reste von Santa Maria, der südlichsten der Azorischen Inseln. In: HARTUNG, G., 1860. *Die Azoren in ihrer äusseren erscheinung und nach ihrer geognostischen nature*. Verlag von Wilhelm Engelmann, Leipzig.
- CACHÃO, M., J. MADEIRA, C. MARQUES DA SILVA, J. M. N. AZEVEDO, A. P. CRUZ, C. GARCIA, F. SOUSA, J. MELO, M. AGUIAR, P. SILVA, R. MARTINS & S. P. ÁVILA, 2003. Pedreira do Campo (Santa Maria, Açores): monumento natural. Actas do VI Congresso Nacional de Geologia. *Ciências da Terra (UNL)*, Lisboa, n.º V: 120-123.
- CALLAPEZ, P. & A. F. SOARES, 2000. Late Quaternary marine mollusks from Santa Maria (Azores); paleoecologic and paleobiogeographic considerations. *Ciências da Terra (UNL)*, 14: 313-322.
- COMISSÃO EUROPEIA, 1999. *Para uma estratégia europeia de gestão integrada das zonas costeiras (GIZC): Princípios Gerais e Opções Políticas*. Serviço das Publicações Oficiais das Comunidades Europeias, Luxemburgo.
- DRA/SRAM, 2005. *CD Áreas Ambientais dos Açores*. Direcção Regional do Ambiente / Secretaria Regional do Ambiente e do Mar.
- DROTRH/SRAM, 2006. *Plano Regional de Ordenamento do Território dos Açores (PROTA)*. Direcção Regional do Ordenamento do Território e Recursos Hídricos / Secretaria Regional do Ambiente e do Mar.
- ESTEVENS, M. & S.P. ÁVILA, 2007. Fossil whales from the Azores. In ÁVILA, S.P. & A. M. de F. MARTINS, (Eds.), *Palaeontology in Atlantic Islands. Proceedings of the First Atlantic Islands Neogene International Congress. Açoreana*, Suplemento 5: 140-161.
- FRUTUOSO, G., 1978. *Livro Sexto das Saudades da Terra*; Instituto Cultural de Ponta Delgada; 2.<sup>a</sup> edição; Ponta Delgada.
- GARCÍA-TALAVERA, F., 1990. Fauna tropical en el Neotirreniense de Santa Maria (I. Azores). *Lavori S.I.M.*, 23: 439-443.
- KIRBY, M.X., D.S. JONES & S.P. ÁVILA. Neogene shallow-marine paleoenvironments and preliminary Strontium isotope chronostratigraphy of Santa Maria Island, Azores. In: ÁVILA, S. P. & A. M. DE FRIAS MARTINS (Eds.): *Proceedings of the 3rd Workshop "Palaeontology in Atlantic*

- Islands”, Ponta Delgada, 12-14 June 2006. *Açoreana*, suplemento 5: 112-125.
- MADEIRA, P., S.P. ÁVILA & A. M. DE FRIAS MARTINS. The marine fossils from Santa Maria Island (Azores, Portugal): an historical overview. *In*: ÁVILA, S. P. & A. M. DE FRIAS MARTINS (Eds.): Proceedings of the 3rd Workshop “Palaeontology in Atlantic Islands”, Ponta Delgada, 12-14 June 2006. *Açoreana*, suplemento 5: 59-73.
- MAOTDR, 2006. *Programa Nacional da Política de Ordenamento do Território* (PNPOT). Discussão Pública. DGOTDU, Ministério do Ambiente, do Ordenamento do Território e do Desenvolvimento Regional. <http://www.territorioportugal.pt/>. (last Access October, 2006).
- MAYER, K., 1864. *Die Tertiär-Fauna der Azoren und Madeiren. Systematisches Verzeichniss der fossilen Reste von Madeira, Porto Santo und Santa Maria nebst Beschreibung der neuen Arten*, VI+107pp. Zürich.
- MOTA, I. A., PINTO, M., SÁ J. V., MARQUES, V. S., RIBEIRO, J. F., 2004. *Estratégia Nacional para o Desenvolvimento Sustentável* (ENDS) - 2005-2015. Ministério das Cidades, Ordenamento do Território e Ambiente. [http://www.portugal.gov.pt/NR/rdonlyres/2D23430D-3202-4C C 8 - 8 D A C - 30E508633158/0/ENDS\\_2004.pdf](http://www.portugal.gov.pt/NR/rdonlyres/2D23430D-3202-4C C 8 - 8 D A C - 30E508633158/0/ENDS_2004.pdf) (last access October, 2006).
- REISS, W., 1862. Mitteilung uber die tertiaren Schichten von Santa Maria, der sudlichsten der Azoren, und ihre organischen Einschlusse. *Neues Jarhrb. f. Miner., Geogn., Geol. und Petrefactenkund*: 1-22.
- UNESCO, 1997. *Guide méthodologique d'aide à la gestion intégrée de la zone côtière*, contributions de Denis J. et de Hénocque Y., Manuels et guides n.º 36. Organização das Nações Unidas para a Educação, Ciência e Cultura.
- ZBYSZEWSKY, G. & O. da V. FERREIRA, 1961. La faune marine des basses plages quaternaires de Praia et Prainha dans l'île de Santa Maria (Açores). *Comunicações dos Serviços Geológicos de Portugal*, 45: 467-478.
- ZBYSZEWSKY, G. & O. da V. FERREIRA, 1962. Étude géologique de l'île de Santa Maria (Açores). *Comunicações dos Serviços Geológicos de Portugal*, 46: 209-245.
- ZBYSZEWSKY, G., O. da V. FERREIRA & C. T. de ASSUNÇÃO, 1961. *Carta Geológica de Portugal na escala 1/50 000. Notícia explicativa da folha de Ilha de Santa Maria (Açores)*. Serviços Geológicos de Portugal, Lisboa, 28 p.