THE EVOLUTION OF THE COASTLINE AT PENICHE AND THE BERLENGAS ISLANDS (PORTUGAL) - STATE OF THE ART

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Abstract
The Peniche peninsula, corresponded before the twelfth century to a coastal island, separated from the continent by a wide erosive navigable channel. The gradual silting up of the mouth of the São Domingos River built the present sandy isthmus leading to the human occupation of the island and its huge development as a harbour. Its geology and lithology, mainly Jurassic limestones showing spectacular cliffs and carved forms such as lapis, attract thousands of tourists nowadays. Several archaeological sites are identified in the area, such as, shipwrecks, port structures, salt marshes, nurseries, burial deposits, anchorages and an amphorae production complex.

16km West of Peniche is the Berlengas Archipelago; a group of small islands and islets. Their geology is quite different from that of Peniche and the continent. They correspond to Precambrian emerged submarine mountain tops, having their main ones made up of coarse grained red granite, the “Berlengas Granite”. As such, they testify to the ancient bounding of the Gondwana continent before the separation of Europe and America, and represent the limit of a large tectonic trough in the east (Lusitanian Basin).

This paper aims to present the origins of both sites in order to contribute to our understanding of the reasons behind their particularly different histories and evolutions.

Key words: Portuguese coast, islands, geomorphology, human occupation

I. Introduction
The origins and human occupation of the Peniche Peninsula on the Portuguese shore, and the Archipelago located close in front of it - “Berlengas Archipelago” - are somewhat two peculiar features in the Portuguese coastline (fig. 1). Even though several papers have been published about each of them, there is no one that points out their differences although they are only 16km away from each other. This paper aims to contribute to our understanding of the reasons behind their particularly different histories and evolutions.

II. The Lusitanian basin
The Portuguese coastline extends from N to S, about 30 to 50km wide by 200km long. Since the beginning of the Jurassic and over the Cretaceous periods, there formed an extensive sedimentary basin,, the Lusitanian Basin. This is a internal intracratonic basin, separated from an exterior zone by a structural relief, the Berlengas Horst – where materials coming from both its W and E margins accumulated (fig. 2). In the lower Cretaceous, four distinct paleogeographic domains (Rey, 1972) made up the landscape of the studied region: (1) Paleozoic bedrock to the East; (2) Western and Eastern Margins; (3) Mid sedimentary Basin and finally (4) Western Paleozoic Ridge.

In the Western ridge, granitic-gneissic reliefs bordered a small longitudinal horst rising circa 10km W of the present coastline, in the continuance of the Berlengas and Farilhões islands which still emerge.

During the Liassic and Upper Jurassic it was already an elevated area and all over the Mesozoic it was alternately emerged and submerged. The frequent local drainage to the East is related with its emersion.

Fig. 1 – Location of the area in the study (in PO-RNB, 2007)

Fig. 2 – Schematic interpretive profile of the pale geographic domains; (1) Paleozoic bedrock; (2) E margin; (3) Mid sedimentary Basin; (4) W margin; (5) W Paleozoic Ridge (Rey et al., 2006)
III. The Peniche Area

III.1. Geology and lithology

The geology and lithology of Peniche, refer to a composition of mainly Jurassic limestones showing spectacular cliffs and carved forms such as lapis, attracting thousands of tourists nowadays. The limestone cliffs that border the entire Peniche Peninsula, tell a continuous story, of more than 20 million years of geologic evolution of the lower Jurassic in Portugal. The Ponta do Trovão area is unanimously considered by the international scientific community as having the world’s best transition record of the Pliensbachian-Toarcian time intervals (Venâncio et al., 2007).

In 2008, the proposal for its inscription to the World Heritage Committee was presented to the ICS (UNESCO) as being the area on the Planet where the geological record, of this sequence, is the most complete (about 183 Ma; Fig. 3). The Peniche geology has been the theme of numerous articles and communications presented in speciality conferences and meetings held all over the world.

III.2. Building of the Peniche Isthmus

Fig. 4 – Evolution of the Peniche Isthmus and silting of Atouguia da Baleia Port (Dias, 2004)

The Peniche Peninsula, called “Phenícies” by navigators during the Middle Ages’, corresponded before the twelfth century to a coastal island, separated from the continent by a wide, erosive, navigable channel. The gradual silting up of the mouth of the S. Domingos River (fig. 4) built the present-day sandy isthmus. Therefore, after the 16 century, a perfect peninsula was developed leading to the human occupation of the island and its huge development as a harbour (Dias, 2004).

The stabilization of the mean sea level about 5000 years ago made stable the physical frontier between land and water. However, the morphology of the coastal territory, which has been changing continuously, does not only depend on eustatic movements. The vegetation cover on the mountain slopes was destroyed by the action of man, leaving behind extensions of soil, which constitute the materials leading to the silting of the fluvial navigable areas. For these reasons, the vertical oscillations of sea level have been combined with a horizontal development (silting), particularly strong in estuaries.

The role of the anthropic action in soil erosion over the last 6000 years in the Portuguese territory have shown that: “The first signs of intense Holocene erosion [in the central-north western mountains] date back some 6000 years BP, when Man, through fires, sought the conquest of grazing areas”, with a growing erosion reflecting “a regressive evolution of the vegetation, until the period of reforestation of the last century” (Cordeiro, 1992).

Just before the beginning of our Era rivers exported to the coast great quantities of coarse sediments allowing the progressive straightening of the coast line. The protuberances were eroded while the indented parts were filled with sands (Dias, 2004). A huge infilling and silting of the valleys and of the river mouths occurred mainly in the Middle Neolithic and during the Romanization when an intensification of the erosion
occurred (Dias et al, 2000). There are also references to episodes of fires, recorded in peat, corresponding to deforestations to get agricultural areas (presence of pollens from cereals, olive trees, vineyards, and others), back in the times of Christian re-conquests, with an important erosive period preceding the fifteenth century that intensified sedimentation (Cordeiro, 1992).

The navigability of the lower areas of rivers, estuaries, their bars, and the access to the ocean, became impossible, drying out and driving away from the sea’s previously navigable areas: the interior river courses and estuaries of the Northwest rivers, the mouth of the Pederneira lagoon, the Alfeizerão area, Óbidos lagoon and the mouth of the S. Domingos River (Atouguia da Baleia). There was indeed a period in which the impacts of anthropogenic activities on sediment genesis became very sensitive, especially in estuarine bodies: “the last great constructive period of the Portuguese coast seems to have taken place between the sixteenth and nineteenth centuries”. The entrance of river bars was also damaged due to shedding of vessels that arrived to ship goods and unloaded the stone ballasts they brought. A severely ban punished it in 1775 (Dias et al., 2000).

The influences of Neotectonics at the time are irrelevant: “In the Portuguese coastline (...) inferred average speeds of uplifting in the Upper Pliocene and Quaternary that reached maximum values between about 0.1 and 0.2 mm/year, corresponding to usually high rates of uplift compared with those commonly observed in passive continental margins (...)” (Cabral, 1993).

III.3. Cartography of the Peniche Island/Peninsula

Details of the Peniche coast can be seen in several Maps of the Portuguese coast such as the map of Alvaro Secco (1561; Fig. 5). In the seventeenth century, a map in the Atlas of João Teixeira (1630) shows a detail of a creek, a reminiscent of the sea arm that isolated Peniche in the past, as well as, two clusters of population corresponding to the present urban areas: (Fig. 6; Blot, 2003).

The 1634 map (Fig. 7), in the El Atlas Del Rey Planeta (Teixeira, 1634), deserves special attention as it shows the first buildings in the ancient island, a still large creek and, the Atouguia lagoon already far away from the coast.
III.4. Human occupation of the Peniche Peninsula

The first occupations of the Peniche region are recorded to have been in caves, the most important of which is the Furninha Cave, and are located by the sea occupying a region that extends from the Middle Paleolithic until the end of the Calcolithic. It is the site of an extensive archaeological spoil: hominid bone remnants of Homo Sapiens; remains of quaternary fauna (fish and mammals) enriched with the bone remnants of the *Pinguinus impennis* (Pimenta, et al, 2008), lithic artefacts (bifaces, arrowheads and polished stone axes), bone utensils and several fragments of Neolithic ceramics known as "suspension cups".

During the Roman occupation, people cultivated the fertile alluviums of the S. Domingos and Ferrel rivers and exploited estuarine and marine resources. The importance of this activity is attested by the founding of a pottery complex dated from the first century and by the identification and recovery of about twenty lead anchor stocks and several Roman amphorae.

In the Middle Ages, documents refer to an island belonging to the administration of an important estate which later became the village of Atouguia da Baleia. From the sixteenth century on, with the settling of the isthmus, the population began to grow in an important way. During the sixteenth and seventeenth centuries prosperity continued with the building of an important defence system protecting the population from pirate attacks. The population’s economic and social structure consolidated during the nineteenth and twentieth centuries due to a growing wealth that originated from agriculture. In the twentieth century fish production increases due to the introduction of a new technique, the seine fishing allowing a varied fishing-related industry such as canning and shipbuilding factories, amongst others, to develop.

The port of Peniche is one of the main Portuguese fishing ports. Presently the population of Peniche found a major boost to the local economy through tourism.

IV. The BERLENGAS ARCHIPELAGO

IV.1. Geographic framework of the Berlengas Archipelago

16km Northwest off the Peniche Peninsula is the Berlengas Archipelago (Figs. 1 and 9), a group of three small islands and islets: Berlenga Grande, the most important, Estelas (18 small rocks) and Farilhões where the highest point occurs – 94m (Forcadas).

The Berlengas Archipelago rests on the Portuguese coast’s continental platform, on bottoms under 40m deep up to 70m, as is the case of Berlenga. But just North of Farilhões, 15 miles from the coast, they surpass quickly 2000m, as the Portuguese continental shelf has oceanic characteristics not common in Europe, reaching great depths close to the coastline. It is inset in the Portuguese Territorial Sea, near an important...
IV.2. Geology and Geomorphology

The Berlengas Archipelago is a fragment of the “Iberian Massif” (highly deformed and metamorphosed rocks of Precambrian and Palaeozoic age that intruded by granitic batholiths), part of the Variscan Fold Belt formed during the Devonian and Carboniferous, resulting from the collision of the two, then existing, great continents - Gondwana and Laurasia.

Therefore, the Berlengas islands are pieces of the ancient super continent Pangea left behind the Americas with the opening of the Atlantic Ocean (220 and 140 Ma ago; Fig. 2). They represent the emerged witness of the ancient bounding of the Gondwana continent before the separation between Europe and America, limiting the big tectonic trough (Lusitanian Basin) in the east and contributing as a sediment source in the Upper Jurassic (Bernardes et al., 1992), as well as in Cretaceous times.

The lithology of the several islands is completely different from the Jurassic limestones of the continent. Some of them composed by Palaeozoic and Proterozoic rocks being the biggest system formed by special coarse granite, with pink feldspar, called the Berlengas Granite (about 280 Ma old). The islets of Farilhões and Forcados have a different constitution known as the “Farilhões migmatic-shale Complex”. The most recent deposits, only identified on the Berlenga Island, are of Pleistocene age, and corresponded to two different beach levels. Caves and few deposits of rounded rocks represent them (França et al., 1960).

The Berlengas Archipelago’s relief is quite abrupt and jagged, with a relatively flattened central zone. This plateau, at an elevation of 90m, formed more recently, during the last Ice Age, due to the global variations of the sea level. In the biggest islands (Berlenga and Farilhões) this relatively flat central zone is limited by scarped cliffs that go into the sea, and, in some cases, are practically vertical (Fig. 10, 11 and 12). The shaping of the cliff and the particular form of the present islands with caves of different sizes, tunnels and small bays is strongly conditioned by the intense fracturing and the intensified chemical alteration of the granites along the old faults, allowing the accumulation of sands that form small entrenched beaches. The several islets and skerries which surround the archipelago show heights varying between 6.4m and 50m. The main islets, Estela Grande (between 40 and 45 m high) with very abrupt cliffs and a tunnel that crosses it in the E-W direction and Estelão, are about 80 m distant from each other and form the central nucleus. Farilhões (6 main islets) and Forcadas (2 islets), with steep cliffs, are two small groups of islets close to one another, situated about 10.9km (6.8 miles) NE of Berlenga.

Fig. 10 - Map of Berlenga Island and Estelas Islands (Sêmur, 2007)

Fig. 11 - A view of the Berlenga’s cliffs (Photo: T. Azevêdo, 2008)
The fauna and flora species

The fauna and flora of the island present unique characteristics despite the fact that they are located near the Continent. The first colonizers arrived about 15000 years ago, when the valleys (nowadays submarine valleys) were solid ground. They evolved very differently to its “continental siblings” due to other types of pressures, giving rise to different life forms. The Berlengas host the only populations of Madeiran Storm-Petrel (*Oceanodroma castro*) and Cory’s Shearwater (*Calonectris diomedea*) of continental Europe, the residual population of Common Guillemot (*Uria aalge*), the largest national population of Shags (*Phalacrocorax aristotelis*), the only couples of Lesser Black-backed Gulls (*Larus fuscus*), which reproduce in Portugal, and the largest colony in the country of Yellow-legged gull (*Larus michahellis*) with more than 25000 birds (2009 Sensus). Within the limits of ecological balance, the size of the population of seagulls on the island is beyond its supporting capacity, therefore this species can be classified as a plague and all the reachable clutches must be destroyed every year (fig. 13). Concerning the land fauna, the presence of an endemic subspecies (*Carbonell’s wall lizard or Podarcis carbonelli berlengensis*) is pointed out, which presents particular characteristics derived from the insularity that surrounds it, giving it a high intrinsic value. Historically associated with the beginnings of navigation, the black rat (*Rattus rattus*) must have accidentally been introduced to the Island of Berlenga. As to the marine fauna (*Sardina pilchardus, Scomber scombrus, Scomber japonicus, Trachurus trachurus, Conger conger, Raja spp.*) there is an abundance of species, of which the sardine is the most important. One conservational problem in this area regards the existence of the Dusky grouper (*Epinephelus marginatus*), considered “Endangered” by the IUCN (CBR; 2008). The islands are virtually devoid of trees, except for some small fig and olive trees. The vegetation is mainly dominated by annual or perennial herbs (*Tauleigne Gomes et al, 2004*). Their particular geography and climate, led to the speciation of three endemic floras amongst the 135 botanical taxa present. They have extremely high conservation value as they do not exist anywhere else in the world: the *Armeria berlengensis* (thrift or sea pinks), the *Herniaria berlangiana* (rupturewort) and the *Pulicaria microcephala* (bleabane or horseweed). By using the trails and the accesses to the fishing grounds, as well as moving away from the allowed places, tourists and visitors are responsible for the main impacts of anthropogenic origin, accentuating the erosion process. The archipelago is now only inhabited by the lighthouse keepers and monitors protecting the flora and monitoring the different animal species, mainly the thousands of seagulls which proliferation causes huge disturbances in other species of the island. The Berlengas Islands are classified as a Natural Reserve since 1981 and were included in the Natura Network 2000 (Special Protection Areas (SPAs) of European Community Directive). The Peniche municipality presented the Berlengas Archipelago’s Biosphere Reserve nomination to the UNESCO in 2008.

**IV.4. The Berlengas human occupation**

The bathymetry of the channel, that isolates the island from the continent, indicates that in the Upper Paleolithic, due to the Flandrian Regression caused by the Würm Glaciation. The island could be reached directly by foot, as during the Last Maximum Glacier, circa 18.000 BP (Bell and Walker, 1992), the eustatic level was about 120-130m above the present level (Jelgersma and Tooley, 1995). The major part of the present submarine territory should be then emerged and potentially occupied or visited. For some authors, the island was reached by the Mesolithic navigation. These factors together with the occurrence of several natural cavities used as shelters could potentiate its occupation as it happens in the Peniche Peninsula with the Gruta da Furninha (Furninha Cave) archaeological site. At the time it was located just up the extensive coastal plain connecting this peninsula to the granitic block that is presently the Berlengas Archipelago. In spite of this,
several excavations have not yet shown evidence of a prehistoric occupation. Through classic literature, Berlenga Grande was occupied since Antiquity, being then called Londobris, a toponym of Celtic origin, which indicates a pre-Roman occupation. This was confirmed by the poem of Rúfio Festo Aviño in the fourth century AC., which mentioned an island, located on the West Iberian coast, where the navigation was quite dangerous and consecrated to Saturn. It has been mentioned as lying in the legendary route of the Cassiterides; a tradition that comes from the Bronze Age. Some centuries later, the island was occupied by Phoenicians, Punic and later by Romans, Vikings, Muslims, also French and English pirates. Some historians think that a Phoenician sanctuary, dedicated to a Baal-Melkart, (a rain and fertility God of the northern Semites), was built on the island.

Due to its strategic location, recent excavations showed marks of occupation starting from the first century, to the beginning of the Atlantic navigation era. The island seems to have acted as a mandatory stopping point for Roman merchant ships crossing the existing Portuguese coast that commercially linked the Mediterranean and Northern Europe (Blot, 2002). This long distance trading network is suggested by the earliest records known to Western Europe which point to the presence of Rattus rattus from Asia, in the Mediterranean at the beginning of the first millennium A.C. The Berlenga Island, situated along this route, received these species, in particular, from the end of the first century B.C., the period for which the archaeological remains of Roman navigation are more evident. The occupation during this period stands out with particular relevance (CBRB, 2008). Abundant diversified archaeological materials suggest a continuous, or very frequent, occupation of the island since those times. In the Fishermen Quarters, built in 1941 (CBRB, 2008) to lodge local fishermen, an establishment of a seasonal nature was found, with the presence of a small industrial unit linked to fish production and preparations (preserves, sauces) similar to that of the island of Peniche at that time. Human occupation continued since the medieval period as seems to be attested by the identification of archaeological materials of an Islamic horizon. The Arabic presence is testified by the English crusade Ranulfo de Granville in 1147, which in a letter to the clergyman Osberto of Baldreseia, when he passed in front of the Peniche Island wrote: “[…] Near it there are two other islands that I think they call Berlengas, corruption of Baleares and in one of them a splendid architectural palace exists, with many rooms and lodgings… of a certain king […]”.

In 1513, the monks of the St. Jeronimus Order built on the island, on the present Fishing Quarter, the Berlengas Monastery, to aid the numerous sailors that often landed on the island. This was not only to give them the sacraments, but to allow them to listen to the divine offices as well. But they lived there for a short time due to lack of food. The island didn't produce, and the sea was too wild to be depended upon, to add to the fact that the island was often also invaded by pirates. Besides that, the monks often died “with illnesses as they had nobody to treat them and often fell from the cliffs”, which was confirmed by found remains of human bones (Bugalhão and Lourenço, 2001; Santos, 1994). The Monastery seems to have been abandoned in 1545, when the 12 surviving monks moved to Vale Benfeito, in the continent. It fell into ruins, and its stones were later used to build the S. João Baptista fortress (Fig. 14; Bugalhão and Lourenço, 2001; Santos, 1994).

Pirates and corsairs navigated these waters since, at least, the beginning of the Middle Ages, from reports of attacks against fishing villages of the region by pirates from England, France, Holland, Morocco and Algiers, until the middle of the seventeenth century, when the Fortress of S. João Baptista was built. The fortress was later used as deportation ground and also as a secret hiding-place for the English saboteurs during the Napoleonic invasions. The French army found them and finally destroyed it (Bugalhão and Lourenço, 2001; Santos, 1994).

Fig. 14 – S. João Baptista fortress (Photo by T. Azevêdo, 2009)
IV.5. Sinkings and underwater Archaeology

The Berlenga Island presents, in addition to that, its invaluable natural heritage, a valuable geological and historical one. Several subaquatic archaeological sites are identified in the Peniche waters, such as, shipwrecks, port structures, salt marshes, nurseries, burial deposits, anchorages and an amphorae production complex. The irregularity of the ocean bottom made the navigation quite dangerous and caused numerous shipwrecks, dozens of ships, namely big ones of modern ages, lying in its sandy bottoms. The waters and the treacherous rocks of the Berlengas were the scene of numerous shipwrecks and casualties whose memory is lost in time. Of these, stand out by their monumentality and impact on the memory of people, a broad range of steam-era ships that sank there between the last quarter of the nineteenth century and mid twentieth century. These include the British steamers El Dorado (Farilhões Grande – 1885) and Highland Hope (Farilhões – 1930), whose memory in the community is still strong (Reiner and Santos, 2002, in Venâncio et al, 2007). A famous case is the shipwreck of the Sáo Pedro de Alcântara (Fig. 15) a Spanish war ship, in 1786, in the Peniche waters, as it was returning from Lima excessively loaded with a huge treasure of gold and silver. It sunk with a complex Peruvian and Spanish crew. Eight archaeological campaigns were carried out to study both the sinking place and the funerary deposit (Blot, 1994; Blot & Vivar Anaya, 2002).

The number of registered shipwrecks, from the 2nd Iron Age on (Figs. 16 and 17), seems to point to the Berlengas having been before today, a very busy stop-over sheltered zone (Blot, 2003). Because of these disasters, the local industry linked to the dismantling of ships developed. Due to the good conservational conditions of the sandy bottoms around these islands, the relative depths and navigable dangers of the waters surrounding them, archaeologists believe in the vast, almost incalculable, archaeological potential of their locations. The Berlengas Sea presents today the largest assemblage of amphorae from the Portuguese coastal environment. Complementing these findings, about 20 lead amphorae stumps were located and attributed to the Roman epoch. Presently, they are in fact considered as already generalized after the fourth century B.C. (Blot & Vivar Anaya, 2002).

V. Geotourism in the Berlengas and Peniche area

This coastal scenery, is monumental (Romão, 2008) and aesthetically beautiful. The spectacular landscape emerges from the huge variety of elements, environments and processes of geological formation - Geodiversity (Gray, 2004) - that are evidence of the Earth’s past history. Peniche is known internationally by its exceptional conditions suitable for sports-lovers such as surfing, body boarding or diving. The beach of Médão Grande or “Supertubos” (“Europe pipeline”) is the scene of numerous international events relating to these sports and an ex-libris for surfers from around the world. Its natural conditions create perfect waves for such sports,
irrespective of the direction of waves and strength of winds. Other beaches in the municipality are also excellent for lovers of these radical sports.

Along the Peniche coastline there are sites with high scientific, educational, cultural, scenic and geo touristic values, as objects and geological structures favoured by its location, content, quirkiness, or even rarity (ICN-RNB, 2000-2006). These important non-renewable geo resources, outcrops or landscapes, are known as Sites of Geological Interest (Duke et al., 1983; Elizaga, 1988). When they present a high degree of particularity, didactic interest or natural monumentality, they are considered Geo monuments (Galopim de Carvalho, 1998; Romão, 2008).

Examples of Geo monuments, are: the Berlengas Horst; the Berlengas pink granite highland and Farilhões metamorphic peaks (Romão & Félix, 2005); the Ponta do Trovão Sedimentary Register, 183Ma old (Duarte, 2003); the Papoa’s Volcanic Eruption; the Baleal Monocline, Baleal Tombolo and the Furninha Cave. They potentiate great economic development to the region, mainly the Geo tourism, one of the newest touristy attractions.

The Berlenga Island is now a touristic site, visited by thousands of tourists. Canoeing and nautical sports are also areas of tourist development. Peniche is nowadays, nationally as well as internationally, a place of excellence for divers. People want, more and more, to enjoy the global subaqueous landscape: fauna, flora, geological formations and shipwreck remains.

There are four significant values regarding the historico-cultural and scientific Heritage of the Peniche region which, for their relevance and singularity, assume a national and international dimension (Venâncio et al, 2007): (1) Geological Heritage; (2) Constructed Historical Heritage; (3) Archaeological Subaqueous Heritage and; (4) A new strategy of development based on Geo-tourism.

Another important aspect of scientific tourism is the impact of “Jurassic of Peniche” offered for academic activities. Hundreds of field trips, teacher trainings and activities on various under – and post graduation levels are annually carried out, in addition to national and international conferences, workshops, public scientific lectures and the “Geology in Summer” programme.

The Gastronomic Tourism calls also thousands of tourists. The Peniche region is a territory where “people hug the sea and the sea hug them back”. The municipality has a rich and extensive gastronomy, mainly fish dishes, namely the caldeirada (fish stew, with origin in the food confection on board fishing boats. Salting and drying of fish were traditional processes of fish preservation (Venâncio et al, 2007).

VI. Conclusions

The Peniche Peninsula and the Berlengas Island are two uncommon features in the Portuguese coast. Their geological evolution is connected with the opening of the Atlantic Ocean. Their history comes from the most ancient of times, and their geological and archaeological sites have been studied by numerous national and international authors.

Although they are only 16km apart and facing each other they have evolved differently as the Berlengas is a block of the Iberian Massif and the ancient Peniche Island was a fragment of Jurassic limestones resulting from the erosion of the coastal cliffs. While Berlengas, due to the granite hardness, kept its morphology over time and has never been permanently occupied by man, the formation of an isthmus by progressive silting transformed the island of Peniche into a Peninsula leading to its growing importance as a fishing and touristic spot.

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BIBLIOGRAPHY


Blot, M.L.P. & Vivar Anaya, J. (2002) - “Arqueologia funerária de um naufrágio. Presenças humanas sul-americanas num depósito náutico da costa portuguesa (San Pedro de Alcântara, Peniche,
As to the marine fauna, the Berlengas Archipelago is pointed out, which presents a unique ecological balance, the size of the population of the most important. One conservational problem in this area is the accidental introduction of the black rat (Rattus norvegicus). Historically associated with the beginnings of maritime navigation, the black rat was accidentally introduced to the Island of Berlengas. This species, known for its adaptability to different environments, has successfully colonized the island, significantly altering the local ecosystems.

The fauna and flora of the island present unique characteristics despite the fact that they are located near the Continent. The first colonizers arrived by the IUCN (CBRB; 2008). The most important species include the trachurus (trachurus sp.), Conger conger, Raja, and the largest colony in the country of Yellow-legged gull (Larus michahellis). These species, along with the historic importance of the island, highlight its significance as a conservation area.

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IGC (1968) - Carta Corográfica de Portugal, 1:400,000, Instituto Geográfico e Cadastral, Lisboa.


Pimenta, C; Figueiredo, S; Garcia, M.M. (2008) - Novo registo de Pinguim (Pinguinus impennis) no Plistocênico de Portugal Revista Portuguesa de Arqueologia, volume 11. número 2., pp. 361–370


Romão, J.C. (2008) - Patrimônio geológico no litoral de Peniche: geomontomens a valorizar e divulgar. II Congresso Internacional de Turismo de Leiria e...
Oeste, Instituto Politécnico de Leiria, Leiria
Teixeira, P. (1634) - 