

**PRELIMINARY FINDINGS ON THE FEEDING BEHAVIOUR AND
GENERAL ECOLOGY OF THE MEDITERRANEAN MONK SEAL
MONACHUS MONACHUS - (PINNIPEDIA: MONACHINAE) ON THE
DESERTAS ISLANDS**

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With 2 figures, 2 tables and 1 annex

ABSTRACT

The mediterranean monk seal (*Monachus monachus*) faced a gradual decrease on the Desertas islands, mainly due to the competition with fishermen resulting in deliberate killings, and accidental killings by entanglement in gillnets. Also the lack of fish as a consequence of overfishing on the Desertas shore, contributed to the decrease of the seal population.

By August 1988, the seal population of the Desertas islands, estimated at 6 to 8 individuals, was in the verge of extinction, and benefiting of the support of the Commission of the European Communities, a field project was initiated on the Desertas by the Parque Natural da Madeira, aiming to implement urgent measures for the conservation of the monk seal. Since then, similar conservation projects have taken place, resulting in a certain recovery of the seal population and its habitat. An account of the evolution of these projects, the monk seal's improvement status and also biological information is given on this paper.

According data obtained from 1990 to 1995, and regarding the monk seal feeding behaviour on the Desertas islands, two situations can be clearly distinguished: Spot feeding, when adult seals spend several hours around the same shoals in search of food, diving for up to twelve minutes. The other way, transit feeding, seals dive for periods no longer than seven minutes while covering considerable distances of the shore line. Immature seals has been recorded only on transit feeding. An evident correlation between the tide and monk seals feeding activity has been tested, coinciding the higher feeding activity with high tide, followed by mid tide.

On the sheldom occasions that monk seals were spotted holding a fish out of the water, some taxa was identified such us *Specia officinalis* and *Liza aurata*, among other. Subadult seals were also recorded feeding on limpets and crabs.

A nature reserve was legally set on the Desertas in May 1990, with the aim of the protection of the monk seal and its habitat. The monk seal population is at present estimated at 14 to 18 individuals.

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INTRODUCTION

The Desertas are made up of a group of three volcanic islands, separated by narrow channels, twelve nautical miles south of the eastern tip of Madeira between 32°.24' and 32°.25' latitude north and 16°.35' longitude west.

The northernmost and smallest of the islands is Ilhéu Chão, 1.6 km in length and rising to a plateau 100m above sea level. The central and largest island is Deserta Grande which is 11.7 km long with an altitude of 480m above sea level. The southernmost island of Bugio is 7.5 km long, rising to 348m above sea level and both Bugio and Deserta Grande have very rugged terrain (Press, J.R; Short, M.J., 1994).

The continuous erosion of the sea along the coasts of the islands has carved many caves out of the basalt structure, particularly where it alternates with compressed pyroclastic material.

The prevailing wind on the Desertas is the north and north east trades which blow, on average, 59.5% of the year. The direction and intensity of the wind changes with the seasons and is also affected by the high pressure centre of the Azores anticyclone, which reaches its maximum pressure during the summer months, when it moves north, resulting in strong and sometimes violent wind from the north. In winter it reaches minimum pressure and moves south, resulting in a decrease in the north wind and in frequent south winds. The annual average frequency of south and southwest wind on the Desertas is 11.9% (Instituto Hidrográfico; 1979).

The islands are affected by the prevailing Canaries cold current, a branch of the descendent gulf stream.

The sea temperature rises to a maximum of 23°C in September and falls to a minimum of 17° in March.

The Desertas are owned by the state and are uninhabited, with the exception of the observation station at the Doca on the western side of Deserta Grande, where teams of three wardens from the Parque Natural de Madeira stay for two week periods.

Apart from Ponta São Lourenço on the remote easternmost tip of Madeira, the Desertas are the last refuge for the mediterranean monk seal (*Monachus monachus* Hermann, 1779) in the archipelago of Madeira. In 1984, Reiner and Santos estimated the population on the Desertas at six to eight individuals. In 1989 Marchessaux made the same estimate. At that time the monk seal population was on the verge of extinction due to overfishing and indiscriminate use of gill-nets. Human disturbance and persecution also led to their decline. The situation for the mediterranean monk seal in general is very critical as described in Reijnders et al. (1993). Therefore the protection of the colony existing in the Madeira archipelago is of high importance for the species.

In view of this situation, in August 1988, the Parque Natural da Madeira launched an urgent monk seal conservation programme with financial support from the European Commission. A research station was built at the Doca, Deserta Grande, and full time wardens were provided. Close contacts were established with the fishermen visiting the

Desertas and a programme to try and educate them to the needs of conservation was initiated.

At that time, very little was known about the habitat of the monk seals on the Desertas and in the summer of 1989 an extensive survey was carried out. The whole of the coastline of the Desertas was surveyed, visiting all the caves. Potentially good caves and those in use were mapped as were areas frequented by the seals. Since this survey the caves have not been visited.

In May 1990, the Regional Parliament of Madeira approved a law creating a Nature Reserve on the Desertas, an area of 8.249 ha with a total of 37.7 kms of shoreline, comprising the three islands and the surrounding sea area to a depth of 100 metres. (See annex I). In the most important area for the monk seals, all human presence and fishing activities have been banned, while in the remaining area which is a partial reserve, fishing is strictly controlled and the use of nets is not permitted. Thus the monk seal habitat in Madeira is legally protected.

METHODS

Apart from implementing practical measures to protect the monk seal and its habitat, observation of the colony was initiated. Since the situation of the seals was critical, a non-invasive study was adopted to create the least possible disturbance for them (Neves, H Costa; 1991).

In January 1991, twelve observation points were set up around the coast of the Desertas, strategically close to the caves and areas that the seals frequented. All monitoring was carried out from these points from 1991 to 1995 allowing us to observe the seals for long periods without disturbing them.

The observer normally spends six to eight hours at the observation point and seals can be frequently seen as close as eight meters. In order to obtain a more solid and comprehensive data the observations were, depending on weather conditions, equally spread over high, medium and low tide. The observer always wears rock-coloured clothing which is the best camouflage in his surrounding environment. During the observation periods, the surrounding sea area is watched for occurrence of seals and the times at which they occur are noted. Whenever possible, the seals are identified and when close enough, photographed. Special attention is given to the seal's diving periods, their interaction with each other, their feeding activity and their general behaviour. The state of the tide is also noted at the time of sighting (Neves, H Costa; 1994).

The use of 10X42 Binoculars, a 300mm zoom lens on a camera and a video cam-corder, enables us to identify the different seals and to observe them at close quarters. Special attention is paid to the feeding behaviour and food preferences of the seals.

Table I shows the number of hours spent at the observation points during several years and the number of seal sightings.

In this five year period, the average time spent on the observatories was 404.2 hours per year, with an average of 109 sightings per year. The time of observations were more or less equally distributed over the whole year. In this first attempt at understanding the preferences and feeding activities of the monk seals on the Desertas we used the method of direct observation. During this seven year study period we never found a dead seal

and therefore never had the opportunity to do a post mortem examination which might have given us more insight into their diet. We have observed the seals defecating in the water several times, though without visiting the caves, we were unable to collect the seal's faeces, which would have enabled us to analyse the remains of their prey.

RESULTS AND DISCUSSION

Feeding behaviour and ecology of the monk seals

The natural resources of the Desertas have made a marked recovery since the implementation of the law making them a natural reserve, effectively protecting the area. The diversity and balance of the fish stock has almost regained its natural levels, so that the seals now have enough food while the fishermen fishing in the vicinity of the reserve are also benefitting from this recovery (Neves, H Costa; 1991). When our recovery programme started, we noticed that the seals had to cover large areas of the coast, probably to find sufficient food due to the depleted stocks of fish, although we have no data from that time. With the improvement of food resources, we notice that the seals are gradually showing a more sedentary behaviour. From 1995, a more accurate collecting data was established. In fact they are now feeding very close to shore and prefer shallow reefs where the currents and productive sea bed provide a considerable variety and quantity of fish.

Over this period, we were seldom able to observe seals holding fish out of the water, which leads us to presume that the majority of feeding takes place underwater. We have observed, at the surface, seals eating *Liza aurata* (Risso), *Bodianus scrofa* (Valenciennes), and on several occasions, *Sepia officinalis* (Linnaeus), and expelling the cuttlebone.

Subadult seals have also been observed feeding on crabs, (*Pachygrapsus sp*) and limpets (*Patella sp*). On one occasion, while snorkelling, it was possible to observe an adult seal catching a *Sarpa salpa* (L.) and later a *Sparisoma cretense* (Linnaeus).

From observation points No. 4 (Ilhéu) and No. 7 (Garajaus), one can overlook a long coastline where fish is abundant, especially near some shoals favoured by the seals. From these observation points, we have, on several occasions, recorded and timed seals diving in search of food in a way that we have named "spot feeding". In these areas seals hunt in close proximity to the shoals, always following the same pattern: diving against the surface current and parallel to the coast, emerging at the same spot. Several times, seals have been observed diving like this for three hours continuously, and as if they were being timed, spending eight to nine minutes underwater and about one minute on the surface. On another occasion, an adult seal was recorded using this technique for seven hours continuously.

This time the seal made regular dives of ten minutes and one of twelve minutes. This behaviour is usually observed in solitary adults in these areas. In both areas the depth of water does not exceed six meters at high tide.

Similar behaviour has also been observed in a seal named "Amadeus" on the colony of Cap Blanc, Mauritânia (Marchessaux 1989).

During these long dives one can only suppose that the seals eat their prey underwater, only coming to the surface to breath when they are at their physiological limit.

In other areas of coastline visible from the observation points, seals do not show similar patterns of feeding behaviour, probably feeding while roaming, what we call “transit feeding”. In “transit feeding” the seals cover relatively large areas close to the shore, diving for shorter periods of five to seven minutes. This method of feeding is more often observed from observation point No. 3, (Areias), overlooking a wide open bay where the sea bed alternates between sand and a few isolated smooth rocks. This area is rich in fish, particularly cuttlefish (*Sepia officinalis*) which is a favourite with the seals.

Our data records also a significant behaviour of monk seals passing through the area, referred as transiting.

Immature seals have never been observed “spot feeding” on the Desertas. They prefer to hunt occasionally, moving very close to shore and diving for no longer than six minutes at a time.

Some interesting differences have been observed in the way seals swim and dive. For example, some immature seals prefer to dive gently submerging from the tail, while others swim with the whole head out of water in contrast to those seals that only keep the top of the head, eyes and nostrils above the surface. Adult seals always dive in the classical way, giving a strong thrust with the body and submerging head first.

From April to August with a peak in June (figure I), the behaviour associated to feeding is the most prominent type, compared with the rest of the year. This may be related to feeding needs of pregnant females since they will have to nourish the pups along six to eight weeks in the coming autumn/winter.

The social interactions are mostly observed on the Desertas, from March to June. By that time seals congregate very often in groups of five and sometimes seven individuals, and this normally occurs at the open bay named Calhau das Areias controlled by the observatories nº 3 - Areias and nº 4 - Ilhéu.

Influential factors on the feeding activity

During this study of the mediterranean monk seal on the Desertas, we tried to correlate the feeding activity with the tides. In Table II the average feeding activity according to the phase of the tide is presented. From the data we collected, it became evident that the intensity in feeding activity varied with the state of the tide.

Figure II demonstrates that during high tide the highest frequency of monk seal sightings occurs, corresponding to the observation of 51 seals.

At ebb tide and flood tide the frequency of monk seal sighting is not to be disdained contrasting with a low frequency at low tide, as we can see on figure II

One explanation could be that the seal’s feeding periods are related to the flooding of their resting and breeding caves at high tide. During 1995, the highest tide in Madeira was 2.6 meters. This figure can safely be used for the Desertas, given the close geographical position of the islands. However, the majority of the good breeding and resting caves on the Desertas are not always affected by the high tide. In fact in most of the caves used by the seals a significant area remains above the high water mark, meaning that the seals can

remain in the caves, even at high tide. This fact has been verified several times on the Desertas.

A more plausible explanation could be that there is a relationship between feeding periods and the cycles of the tide, caused by the movement of fish according to the tide. In general, our data show that the seals do not feed in very deep water, preferring to look for their prey between two and twenty five meters depth. The sea currents and level of the tide may affect the presence of fish near the shore, resulting in a higher monk seal feeding activity during high tide.

It is interesting to note that the majority of seals sighted at low tide are immature individuals.

Monk seals have been observed demonstrating similar behaviour at night several times, leading us to presume that they also feed during the night on the Desertas.

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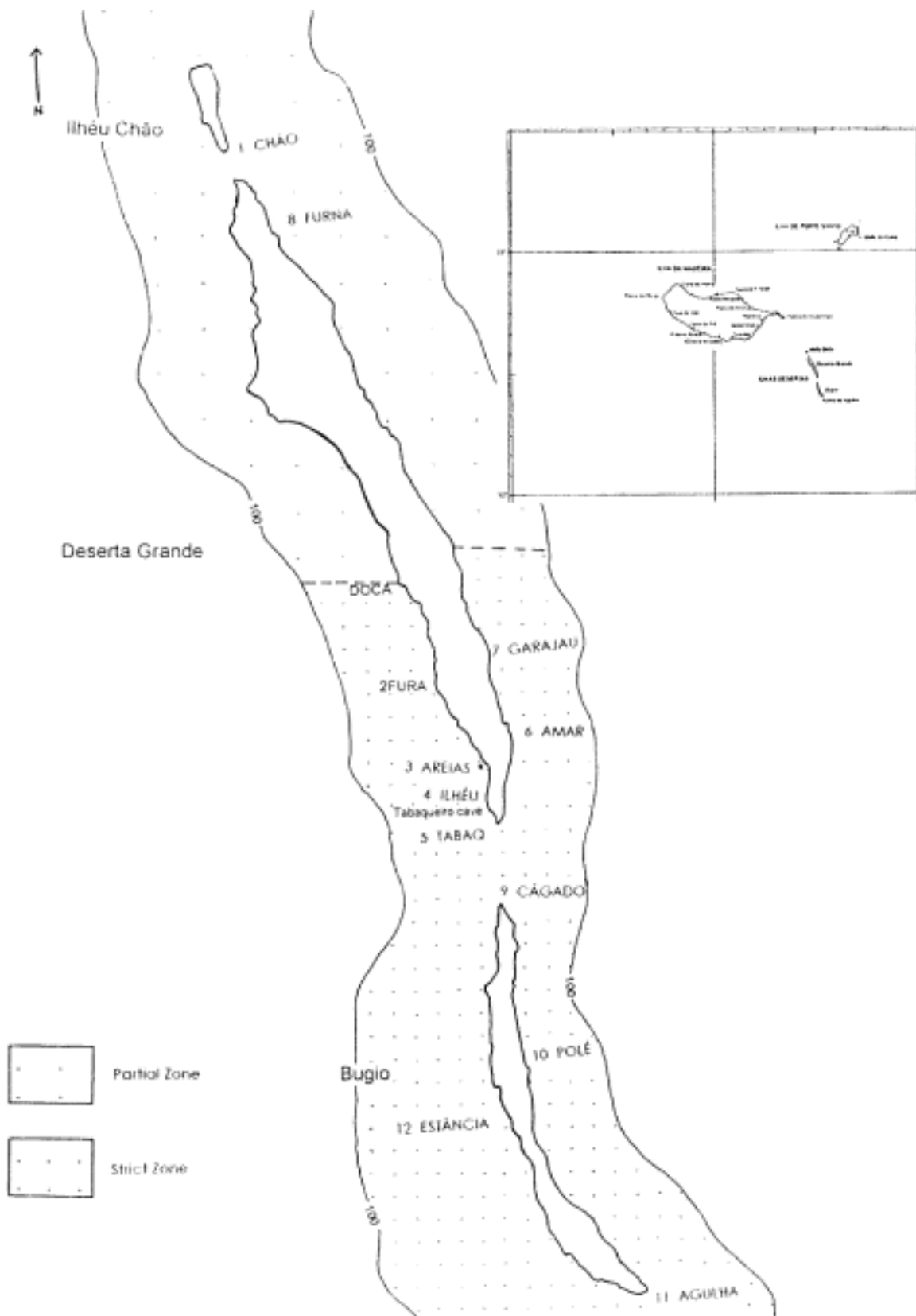
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ANNEX I



Years	Time of observations in hours	Number of seal sightings
1991	106	85
1992	449	124
1993	579	144
1994	383	97
1995	504	109

Table I: Number of hours spent per year on monk seal monitoring, and the monk seal sightings.

Years	High tide	Mid tide	Low tide
1990	50%	31%	19%
1992	42%	31%	25%
1993	57,7%	27%	15,5%
1994	69%	20%	11,2%
1995	47,7%	47,7%	4,5%

Table II: According data collected on the Desertas Islands from 1990 to 1995, the highest frequency of monk seal sightings occurs during high tide, followed by mide tide.