HELLENIC SOCIETY FOR THE STUDY AND PROTECTION OF THE MONK SEAL

MEDITERRANEAN MONK SEAL REHABILITATION IN GREECE 1990-2004: 15 years of action

Athens 2005

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Operation – Coordination:

MOm/ The Hellenic Society for the Study and Protection of the Monk Seal

Cooperating Organizations:

- **Seal Rehabilitation and Research Centre (SRRC), Pieterburen, the Netherlands**
- **Department of Virology, Erasmus University Rotterdam**
- **Veterinary Faculty of Aristotle University of Thessalonica**

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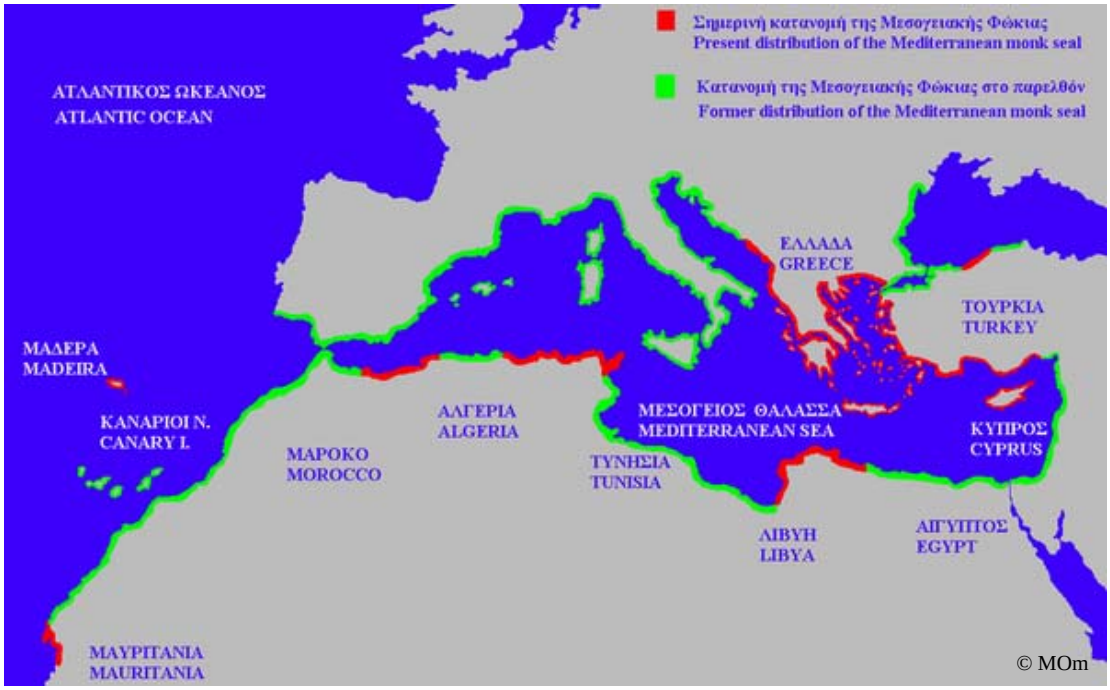
SUMMARY

The Mediterranean Monk Seal *Monachus monachus* is one of the most endangered species in the world. The species was distributed in the past in the entire Mediterranean Sea and the West Coast of Africa. Nowadays its population of ca. 500 individuals has been restricted in the E. Mediterranean, N. Africa, and the coasts of Mauritania, Morocco and Madeira. The main surviving population is in Greece and it is widely distributed along the Greek coasts. The main reason for the species decline is habitat destruction, while direct threats for its survival are considered to be deliberate killing of animals and accidental capture in fishing gear. Pollution, fisheries overexploitation, infectious diseases, or natural catastrophes are inadequately researched, but they may be also important for the population decrease. The rehabilitation of wounded, sick and orphaned animals constitutes a seminal tool when confronting species mortality.



Map of the distribution of the species in the Mediterranean and the coasts of Africa

The first orphan monk seal pups in Greece were rescued and transported to Holland for treatment, by the team of Seal Rescue and Rehabilitation Centre (SRRC) in 1987. In 1990 the same organization donated to MOm (which was recently established as a national NGO) a mobile rehabilitation unit, which was established in Alonnissos and since then it has been the base of the Monk Seal Rehabilitation program. MOm established the monk seal rehabilitation program in Greece with the cooperation of SRRC, Erasmus University Rotterdam and the Veterinary Faculty of Thessaloniki. The parallel establishment of a Rescue and Information Network (RINT) in 1991 by MOm, and its development so as to cover all insular and coastal Greece, ensures the timely receipt of information on stranded animals and the effective response of the rescue team.

The Monk Seal Rehabilitation Centre in Alonissos has been used exclusively for monk seal pups, whereas adults are usually treated on site, in order to avoid transportation stress. Overall 24 animals, out of which 17 pups and 7 adults, have been treated by the rescue team since 1987; 7 pups were released healthy to the wild in the protected area of the National Marine Park of Alonnissos N.Sporades, while 7 adult seals were released in the area of their stranding and treatment.

A view of the National Marine Park of Alonnissos, Northern Sporades

There were also numerous cases where intervention was not necessary and the rehabilitation coordinator instructed the observers/members of the RINT, how to follow the animal for as long as it stayed on the beach. Most of the pups treated were orphaned due to stormy weather conditions occurring at the lactation period. At the time of finding, most of them had very low weight, a condition that minimized the chances of survival despite treatment. The main problems these animals faced in the Centre were gastrointestinal, while at the time of preparation for release, the team in some cases had to solve behavioural problems such as denial of free feeding in the pool, familiarization with humans, etc. In the case of adult seals, the team treated injuries and various infections, stemming from injuries, disease or parasites, and behavioural problems. All animals, especially the adults, were handled with caution to avoid excessive stress. The intervention of the rescue team was decided in all cases, only when the responsible veterinarian evaluated that the problem was threatening the life of an individual. The methodology used in all cases followed specific protocols specially adapted to the needs of the Mediterranean monk seals, and the field conditions encountered in coastal Greece.

Through the RINT, the rescue team has also been notified for strandings of dead seals. In the case of a fresh or a moderate carcass, the team performed full necropsies and collected all necessary samples for the diagnosis of the death cause and other research purposes. The analysis of the samples was carried out in collaboration with national and international institutes. Based on the results of the necropsies performed over the past 15 years (80 in total), it appears that the most important direct threats for the species are related to human activities, namely deliberately killing and accidental entanglement in fishing gear. The samples are stored and registered at MOm's sample bank and they are available for further research.

Key priorities for the future development of the program are: improvement of the facilities, securing of funding, modification of the protocols in order to improve the survival rate of the treated pups, and application of new techniques, in the treatment and post release monitoring of the animals.

A. INTRODUCTION

The Mediterranean Monk Seal *Monachus monachus* (Hermann 1779) is one of the most endangered species in the world (IUCN, 2004). It is included in different international conventions and E.U. Directives for the protection of endangered species and their habitat, and since 1981 it has been designated as a strictly protected species by the Greek legislation. The Mediterranean Monk Seal was distributed in the past in the entire Mediterranean Sea and the West Coast of Africa. Nowadays its population of ca. 500 individuals has been restricted in the E. Mediterranean, N. Africa, and on the coasts of Mauritania, Morocco and Madeira (Reijnders et al., 1997). The main surviving population (representing approximately the 2/3 of the world population) lives in Greece and it is widely distributed along the Greek coasts (Adamantopoulou et al., 1998, 1999).

Over the last three decades, on several international meetings, which focused on the measures necessary for the protection of the Mediterranean Monk Seal, the rehabilitation of sick, wounded and orphan animals has been considered as an important and effective tool for the conservation of the species. Even though, self-evident, it should be noted that the successful reintroduction of the rehabilitated animals in their natural environment is the final goal of such an effort and this should be achieved along with the conservation of the species habitat.

From 1987-1989 three orphan monk seal pups were rescued and transported to Holland for treatment, by the team of Seal Rescue and Rehabilitation Centre (SRRC). In 1990, MOm established the Monk Seal Rehabilitation Centre at Steni Vala in Alonnissos, utilising the kind donation of a mobile Unit by SRRC. MOm has been operating the Centre in collaboration with the SRRC, the University of Rotterdam and the Veterinary Faculty of Thessaloniki. ***The main objective of the rehabilitation programme is to increase the survival possibilities of animals needing aid and to release them healthy and able to survive into their natural environment.***

The Monk Seal Rehabilitation Centre, at Steni Vala

For the effective operation of this program, the Rescue and Information Network plays a key role, since it provides all necessary information for animals in distress, to MOm's staff (see Methodology). During the period of rehabilitation the seals are under intensive veterinary care and follow a specific dietary program, and few months later, when healthy, they are prepared for their reintroduction to the wild. All rescue, treatment and release procedures are carried out according to specific protocols, which ensure the effective operation of the Rehabilitation Centre.

The rehabilitation of monk seals contributes significantly to the collection of scientific data, concerning growth (Androukaki et al., 1999), physiology, immunology, virology, microbiology, genetics and ethology of the species, along with the development of a species-specific sample bank.

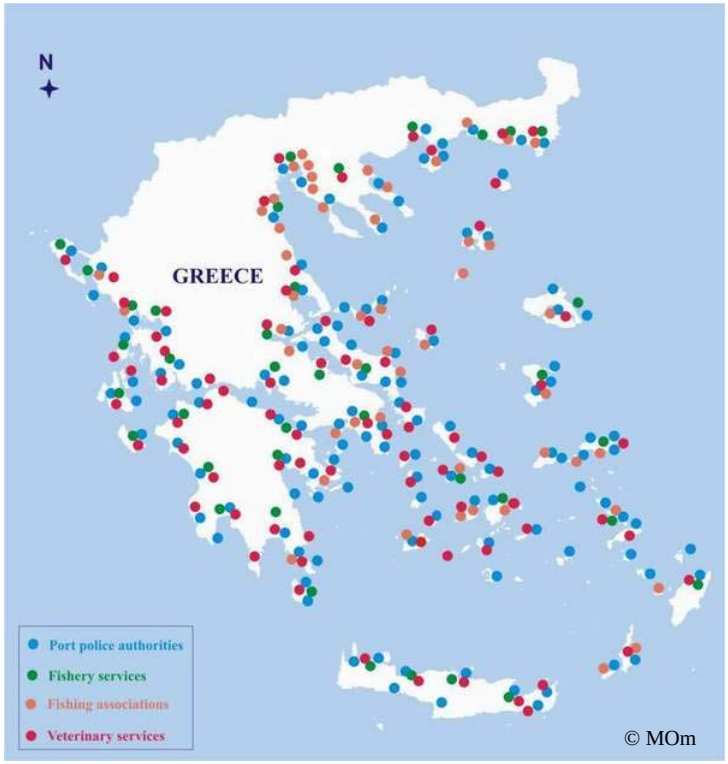
The data collected from animals in captivity is of great importance for advancing the knowledge of the species, since it is relatively difficult to obtain such information from animals in the wild. Furthermore, collecting such information and gaining experience on the rescue and treatment of monk seals will be valuable when confronting emergency cases (epidemics, catastrophes, possible breeding in captivity). In addition, the presentation of the results of the rehabilitation program to the general public raises awareness that is necessary to the overall conservation efforts for the species.

B. METHODOLOGY

MOm started to operate the Rehabilitation Centre in 1990, in co-operation with SRRC, which had already great experience on seal treatment. The Centre has been operating with the official permission of the Ministry of Agriculture, in co-operation with the Ministries of Environment and Mercantile Marine. Since 1996, the Veterinary Faculty of Thessaloniki has the responsibility for the veterinary treatment of the patients, while MOm is responsible for the co-ordination and operation of the Rehabilitation Centre, as well as, for all scientific research carried out in the Centre.

B.1. RESCUE & INFORMATION NETWORK

The collection of information regarding animals needing aid is achieved through the Rescue and Information Network (RINT) of MOm. RINT has been operating since 1991 and it involves today 1500 "contact members", including local authorities (port police, local municipalities, local fisheries and veterinary services), fishermen's co-operatives, nautical clubs, environmental associations, as well as, sensitised citizens from all coastal Greece, who report to MOm any encounter with a monk seal. The information collected through RINT concerns seal sightings, seals-fisheries interactions and seal strandings. In the case of an animal in distress or a seal stranded dead, the reporters are requested to report immediately the information in order for MOm's personnel to be able to respond appropriately and on time. The information is reported to MOm through a 24-hour operating telephone line.



Distribution of RINT members in Greece

When a seal is stranded alive, the reporters are requested to observe the animal from a distance, for as long as it stays in the area, and report to MOm's staff its condition, until the arrival of the rescue team. If a dead animal is found stranded, the reporters are asked to make observations of its external condition, take photos and measurements of the carcass, in order for MOm's staff to be able to evaluate whether a full necropsy should be performed. In fresh carcasses MOm's team conducts a full necropsy in order to identify the death cause and collect samples for research use. In case of a dead seal observed in advanced decomposition, MOm's staff asks from the observers to collect key samples (such as bones, hair and skin), since a necropsy would not result in the evaluation of the death cause. It should be mentioned that all wildlife hospitals in Greece are in close cooperation and assist each other in reporting of any wild animal needing aid.

On an international basis, MOm and SAD/AFAG (a Turkish NGO, involved in the protection of the monk seal in Turkey) are in close contact so as to respond in case of an incident, near the borders of the two countries. Any case of a dead or a sick seal occurring in one country is reported to the other, in order to monitor the area for unusual events. In addition, after a series of actions for the exchange of expertise, the two groups are currently using similar methodologies to commonly face emergencies.

In order to respond to unusual mass mortality events of monk seals in the Eastern Mediterranean, an organized and immediate reaction is essential. Therefore, MOm is in contact with the relevant national authorities (Ministries of Agriculture, Mercantile Marine, Environment) and also with other environmental organizations (especially the wildlife hospitals in Greece and abroad). Most of the time, this kind of events involve more than one species and require numerous experienced personnel and organized volunteers that must act immediately. MOm has also established cooperation with the Sea Alarm Network and the International Fund for Animal Welfare (organizations that have in the past confronted such events) and both have agreed to provide their consultancy and help in the case of a mass mortality incident in Greece. Furthermore, MOm participates in the plan of the Ministry of Mercantile Marine for the confrontation of emergency cases of marine pollution, and has recently prepared a Master Contingency Plan in cooperation with SAD-AFAG (Turkey), for mass mortality events in the Eastern Mediterranean.

B.2. PROTOCOLS (STANDARD OPERATION PROCEDURES) OF REHABILITATION

The complete operation of rescue, treatment and rehabilitation of seals, till their reintroduction in their natural environment, is carried out according to specific protocols, based on relevant international protocols that have been modified for specific requirements of the Mediterranean Monk Seal. These protocols have been reviewed by the coordinator of the centre, in collaboration with the responsible veterinarian, based on the current specifications for wildlife centres provided by the Hellenic Ministry of Agriculture. They are also frequently updated, based on the scientific knowledge gained, through the study of the biology and ecology of the species. All staff members involved in the treatment and rehabilitation of seals are trained to follow strictly the existing protocols. These protocols include:

- **Emergency call**. The response to emergency calls, including the guidelines provided to the observers and the co-ordination of the rescue activities.
- **First examination on site and subsequent actions**. The first examination and the decision making process for the transportation, the on-site treatment or monitoring of the animal, are described step by step. Instructions are also included for the provision of information to the public and press and the protection of the animal from human disturbance and stress.
- **Transportation** of a seal to the Rehabilitation Centre, ensuring the safest and quickest possible way of transportation.
- **Admission of a new patient in the Centre,** including the first actions upon admission.
- **Veterinary treatment,** including the necessary veterinary examinations, the most common health problems encountered and the appropriate treatment.
- **Nutrition,** including the feeding methodology and the main principles of the nutrition program, decided individually for each case.
- **Management of the Centre,** including all organizational issues, research and public awareness ensuring the minimum disturbance of the animal.
- **Release,** including the criteria and the subsequent decisions, the preparation and the tagging of the animal, prior to its release, and the post monitoring of the seal in its new environment.
- **Necropsies,** including the reaction to a dead seal report, the necropsy methodology, the hygienic precautions, and the tissue sampling, analysis and banking.
- **Reaction to unusual mortality events,** including the risks of mass mortalities in Mediterranean monk seals, the level of readiness, the collaboration with the relevant authorities and wildlife organizations to be involved in such events, as well as, the coordination of all activities.

Transportation of a pup to the Centre

Fish feeding of a pup

Seal tagging in the Rehabilitation Centre

B.3.SEAL TREATMENT AND REHABILITATION CENTRE FACILITIES IN ALONNISSOS

The first mobile unit of the Monk Seal Rehabilitation Centre was established in 1990 at Steni Vala, Alonnissos. In 1999, new permanent facilities were built, near the Research Station of Gerakas, Alonnissos by the Prefecture of Magnesia, through EU funding, following the specifications of treatment facilities provided by MOm. However, these facilities have not been operational, due to management and bureaucracy obstacles encountered by the Greek State that is responsible for the Research Station.

B.3.1. Facility structure

The current utilised facility at Steni Vala consists of:

- An entrance hall used by the staff for changing clothing.
- The area for the preparation of food, the storage of the veterinary supplies and the basic laboratory tools.
- The seal's compartment consists of a pool, with dimensions 3 x 2 x 1.35m, and a platform where the animals rest, with dimensions 1.7 x 2m.

Within the facility, the temperature and the humidity are regularly controlled.

B.3.2. Equipment

The following equipment is available in the Centre:

- Room hygrometer & thermometer
- Fan heaters/ infrared light heat sources.
- Air steamer
- Washing machine
- Refrigerators and deep-freezers (-20^{0}C) for separate storage of food, medicines and samples
- Centrifuge
- Light microscope
- Food preparation utensils
- Balances for weighing the food and the animal
- Stretcher, carrying basket and cages
- Special uniforms for the personnel and towels used for handling the seal
- Consumables used in rehabilitation: gloves, masks, syringes, caps, shoes, etc.
- Medical supplies including medicines and tools
- First-aid and necropsy kits
- Vessel and vehicle available for animal and supplies transportation
- Office equipment/ Mobile phone
- Photo camera
- Equipment for tagging and post-release monitoring
- Information boards for visitors and informative material

Food preparation inside the facility

All the equipment is regularly maintained in order to be fully operational year round. Medicine and other consumables are renewed appropriately.

B.4. DEAD SEAL STRANDINGS AND NECROPSIES

Through the operation of the Rescue and Information Network, MOm receives reports related to dead seals, from all around Greece. The identification of the cause of death for all cases, through the detail examination of the carcasses and the analysis of the samples collected, is a necessary tool to consistently monitor the threats the Mediterranean monk seal faces, related either to interactions with fisheries (deliberate killing, entanglement in fishing nets, etc.), or to natural factors (disease, accidents, etc.). Therefore, in the case of a dead monk seal being reported to MOm, the Rehabilitation Coordinator, following the appropriate protocol, decides on the exact necropsy procedure.

All necropsies are conducted either *in situ* or in the necropsy room in Alonissos in collaboration with the Erasmus University of Rotterdam, that contributes in the necropsy of specialised cases and conducts the laboratory analysis of specific diagnostic samples, and the Veterinary School of Thessaloniki, that provides veterinary supervision. Additional laboratories in Greece and abroad may also be involved in sample analysis, when necessary. All the data collected from the macroscopic and microscopic examination of the animals, along with the diagnosis of the cause of death, are recorded in necropsy reports.

Samples that are not used for diagnostic purposes, but may be useful for future research, are deep-frozen and stored at MOm's sample bank in Athens; meanwhile all relevant information are archived in a relevant database. The sample bank is unique for the species and it can be used to increase our knowledge on its biology, providing important information for its conservation.

B.5. PUBLIC AWARENESS

Apart from its main objective, the rehabilitation program is an effective tool in the efforts of public environmental awareness. This is achieved in the following ways:

- During the hospitalisation of a seal in the rehabilitation centre, MOm's personnel inform visitors about the seal's condition. The public's visit to the animal is limited so as to secure the minimum disturbance.
- On a regular basis, press releases, accompanied by photos and informative material, are distributed to the local, national and international media describing the progress of the animals hosted in the rehabilitation facilities.
- At a local level, public sensitisation is achieved not only through the visits of local inhabitants, but also with their active involvement in the rehabilitation program, assisting and volunteering in various activities.
- During summer, when it is unlikely for the Centre to host patients, it serves as an information centre for the Mediterranean monk seal, its habitat and conservation. Volunteers guide the visitors inside the Centre facilities and present the seal treatment and rehabilitation program.

Students visiting the Rehabilitation Centre

C. RESCUE OF MONK SEALS

C.1. RESCUE CASES

During the period 1990-2004, human intervention was necessary in 24 cases of stranded animals. The main incidents encountered can be grouped in two categories:

- Orphaned pups, always dehydrated, mostly malnourished, often with infections and injuries. These animals may result orphans due to:
  - weather conditions - in case of sudden storms during autumn/ winter, when most births occur
  - killing of the mother, due to interaction with fisheries
  - neglecting of the pup by the mother due to sickness (of the mother or the pup), maternal milk deficiency, inexperienced mother, food shortage.

These animals may be hit by the waves inside their caves, drowned or killed on the rocks, or die from starvation, since they are still in lactation. In some cases, monk seal pups are drifted and carried away on an open beach. If fishermen or others observe a pup on the beach, they notify MOm either directly or via the nearest port police station. In the case of a pup found without maternal care for several days, it is underweight and has very few chances for survival, since this condition may not be reversible. Due to the fact that these animals need prolonged treatment they are immediately transferred to the Monk Seal Rehabilitation Centre, to monitor their health and growth.

The first weeks of treatment are quite critical, because the health status of a young animal is unstable. If the problems are treated, and the pup's growth progresses well, the animal is prepared for its release to its natural habitat. Prior to its release, the seal is tagged for future monitoring. Out of the 17 pups treated up to date, 7 survived and were released healthy into their natural environment. Up till now there are no reports of dead seals, which have been released after rehabilitation.

Treatment of a pup at the Centre

All released seals were followed for a period of 1 week and up to 5,5 months, by using different methods of tagging (temple tags, paint stain, injected microchip, VHF and satellite transmitters). The last case of a rehabilitated seal "Dimitris" (released in May 2004), tagged with a satellite transmitter, was monitored for 5,5 months, during which important evidence were collected on its survival and gradual adjustment to its natural environment.

Tube feeding and force feeding of seals in the Rehabilitation Centre

- Adult / sub-adults with injuries, infections, unusual behavior (7 cases, percentage of survival 86%).

In such cases, based on the first aid protocol, the rescue team intervenes 24 hours after the animal is found stranded on a beach, unless it exhibits other critical symptoms such as passive behavior, severe injuries on the body or disease symptoms. In general, the short treatment and release of adult or sub-adult animals is carried out on-site, in order to avoid unnecessary stress. The therapy may also include restraining of the animal, protection from its surrounding, and other measures, when the problem is considered serious. In the case where a health problem is not considered serious, the animal is monitored from a distance for as long as it stays in the area. As soon as the seal leaves the area, the RINT members of the surrounding area are alerted about the event and requested to report immediately if the animal is stranded again. Concerning behavioral problems, the rescue team had to respond once to a case of an adult male reported "trapped" in a water pipeline for a week. The seal eventually left the pipe shortly after being isolated and prevented from moving higher inside the pipe, and returned to the sea with safety.

An adult female exhibiting health and behavioral problems

The following tables present all cases of monk seals treated.

MONK SEALS TREATED

CODE NAME	AREA	AGE	SEX	ADMITTED	INITIAL DIAGNOSIS	PROBLEMS ENCOUNTERED IN THE PROCESS	RELEASE	DEATH CAUSE
Teo *	Corfu	pup	Male	15/10/87	Weakness, dehydration, hypothermia		NMPANS 22/4/88	
Dimitris *	Tilos	pup	Male	15/10/87	Weakness, dehydration, hypothermia	Maldigestion, constipation	NMPANS 22/4/88	
Ikaria *	Ikaria	pup	Female	19/10/89	Weakness, dehydration, hypothermia	Maldigestion, constipation		14/12/89 Torsio mesenterialis
Thodoris	Skopelos	pup	Male	24/10/90	Weakness, dehydration, hypothermia	Maldigestion, severe constipation	NMPANS 16/4/91	
	Alonissos	Weaned pup	Male	29/4/91	Serious injuries at head and flippers	Familiarization to humans	NMPANS 9/6/91	
Stelios	Skopelos	pup	Male	15/8/91	Weakness, dehydration, hypothermia		NMPANS 9/11/91	
Efstratia	Ag. Efstratios	pup	Female	6/10/91	Weakness, dehydration, hypothermia	Difficulty in learning free feeding from the pool	NMPANS 10/3/92	
Elpida	Coast of Pelion	pup	Female	10/10/94	Weakness, dehydration, hypothermia, respiratory problems	Severe respiratory problem, gastrointestinal problems		20/10/94 Severe respiratory and gastrointestinal infection
Dimitra	Evia	pup	Female	11/11/94	Weakness, dehydration, hypothermia, respiratory problems, trauma, strong anemia	Insisting strong anemia, emphysema, gastrointestinal problems		25/11/94 Severe respiratory and gastrointestinal infection internal hemorrhage
Kostantina	Evia	pup	Female	2/10/95	Weakness, dehydration, hypothermia	Gastrointestinal problems, aerophagia, difficulty in force feeding		3/12/95 Gastrointestinal problems, acute pneumonia
Katerina	Evia	pup	Female	25/11/95	Weakness, severe dehydration, hypothermia, hemorrhagic gastritis, anemia, low weight	Extreme weakness, hypoglycemia, intestinal parasitosis, infections, gastrointestinal problems.	NMPANS 20/4/96	
Petroula**	Loudias river Delta, N.Greece	adult	Female	17/2/97	Eye injury, dehydration, unusual behavior, molting		Delta of Loudias 23/2/97	

MONK SEALS TREATED

CODE NAME	AREA	AGE	SEX	ADMITTED	INITIAL DIAGNOSIS	PROBLEMS ENCOUNTERED IN THE PROCESS	RELEASE	DEATH CAUSE
Pahi**	Attiki	adult	Female	15/6/97	Low weight, weakness, eye infection, photophobia, passive behavior	No improvement		20/6/97 Extended systemic infection, septicemia
Ikaros	Ikaria	pup	Female	20/12/97	Weakness, severe dehydration, hypothermia, parasitic infection, anemia, very low weight	Gastrointestinal problems, sudden failure		26/12/97 Acute gastrointestinal infection
Akritas	Ikaria	pup	Male	3/11/99	Weakness, severe dehydration, hypothermia, parasitic infection, anemia, very low weight	Gastrointestinal problems, sudden failure		10/11/99 Starvation
Tony **	Evia	adult	Male	1/12/99	Old injuries in head and flippers		Evia 3/12/99	
Sfougaras**	Attiki	Sub-adult	Male	29/9/00	Unusual behavior		Attiki 29/9/00	
Koursaros**	Evia	adult	Male	6/11/00	Serious injury at the right eye		Evia 7/11/00	
Varvara	Piperi	pup	Female	4/12/00	Very low weight, hypothermia, passive, severe dehydration	Passive, respiratory problem		4/12/00 Starvation, aspiration pneumonia
Alexandros**	Skiathos	adult	Male	7/12/00	Trapped in water pipe	Stress	Skiathos 12/12/00	
Stella **	Attiki	adult	Female	26/11-12/12/01	Molting process	Molting stress	Attiki 26/11-12/12/01	
Andreas	Lipsi	pup	Male	6/12/01	Dehydration, hypothermia, infection.	Stress?		7/12/2001 Embolization, myocardial pause
Hionati	Evia	pup	Female	31/10/02	Low weight, dehydration, very young age.	Gastrointestinal problems, sudden failure		8/11/02 Starvation
Dimitris	Karpathos	pup	Male	31/12/03	Weakness, dehydration, strong anemia, superficial trauma	Respiratory problem, sporadic indigestion, hypoglycaemia, immobility of the back part of the body	NMPANS 22/5/04	
Hippokrates	Kos	pup	Male	8/10/04	Weakness, dehydration, temperature, superficial wounds, conjunctivitis	Maldigestion, severe constipation, aerophagy		22/10/04 catarroic enteritis leading to cardiac failure and pulmonary oedema

Note: * Treated in SRRC, Pieterburen, the Netherlands
** Treated on site

Distribution map of all rescue cases from 1987 to 2004

The release of "Efstratia" in March 1992

The release of "Katerina" in April 1996

The release of "Dimitris" in May 2004

C.2. NOTIFICATIONS FOR ANIMALS THAT NEEDED NO HUMAN INTERVENTION

Until1996 the Rescue and Information Network had not received any notifications of stranded adult or sub-adult seals, possibly due to inadequate public awareness. Since 1997 the reports of wounded or sick animals became frequent and the reports increased significantly. From that year and on (till 2004), MOm received 40 notifications of live animals that seemed to be in danger, according to the RINT members. Although in some occasions the observers reported that a stranded seal was facing health problems, the rescue team upon evaluation of the animal's behavior and/ or condition judged that there was no need for human intervention. The notifications concerned mainly adults and few sub-adults from all over coastal Greece. Most of the reports concerned animals that were swimming in the ports or near other human settlements, whereas in other cases animals were lying on the beach sleeping or resting for several hours. In 4 cases the seals had superficial wounds on their body, while in 3 other cases the animals were in the process of molting and therefore they spent a long time ashore. According to the descriptions received from the observers involving the morphology/ behavior/ swimming and diving abilities of the seals, it was concluded that these animals did not exhibit any severe health problems and human intervention would only stress them out. In all the above-mentioned reports the seals left the area within the first 24 hours of their observation. The reporters were asked to observe the animals carefully and give as many information as possible to the rescue team of MOm, in order to obtain a good estimation of the seal's condition. In some cases, the observers who followed the seal for as long as it appeared in their area provided interesting behavioral observations.

Adult seal in the process of molting

Adult seal resting in a fish farm

D. NECROPSIES

During the period 1990-2004, 80 necropsies have been performed on animals that were stranded dead. Most dead animals were reported through the Rescue and Information Network, but in some cases, the research team of MOm found the carcasses during research surveys. When a carcass was in advanced decomposition and its thorough examination would hardly provide any data for the identification of the death cause, the observers were asked to take photos, basic measurements and, when possible, certain samples, valuable and easy to collect by inexperienced staff (e.g. bones and teeth). If the carcass is available and in a good condition, a full necropsy of the animal is performed by MOm's specialized staff, following specified protocols (see Methodology). Tissue samples are collected not only for the diagnosis of the death cause, but also for research purposes.

Necropsy procedures of animals stranded in coastal Greece

D.1. DEATH CAUSES

The most important goal of the necropsy process is the identification of the death cause, and therefore the evaluation of the relative importance of the direct factors affecting the survival of monk seal population in the Eastern Mediterranean. Death causes, diagnosed after macroscopic examination or/and laboratory analysis, are classified in the following categories:

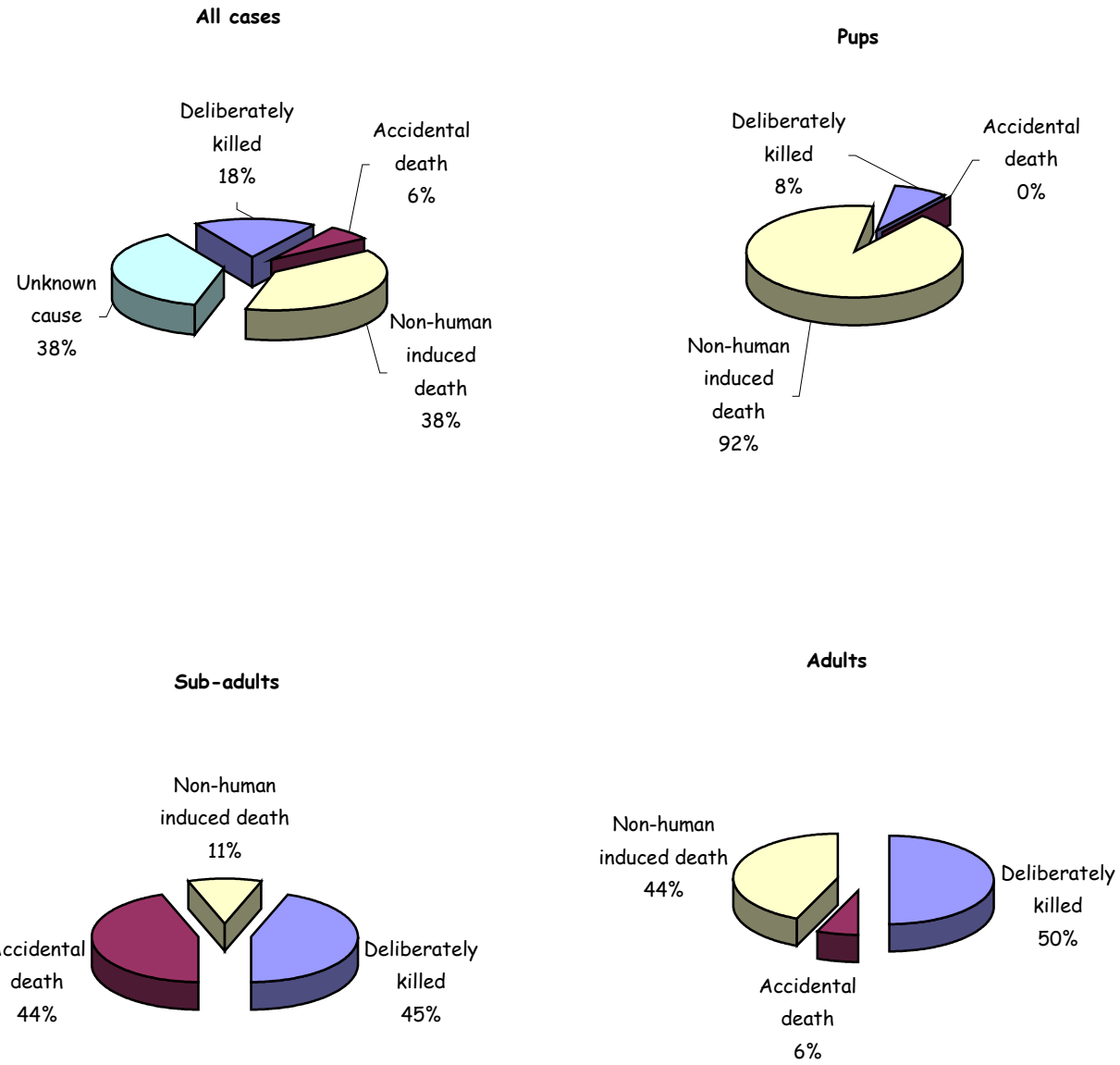
- Deliberate killing (DK): Includes all incidents, where it is clear that the cause of death came from human deliberate action (lethal trauma from shooting gun, harpoon, spear gun, knife, dynamite, etc.)
- Accidental death (AD): All incidents, where death is caused by non-deliberate human action: entanglement in fishing gear, propeller trauma, etc.
- Natural death (ND): Any non-human induced cause (disease, non-human induced trauma, drowning of pups, etc.)
- Unknown (U): All cases, where the cause of death cannot be diagnosed.

Based on the data obtained between 1990-2004, the conclusion drawn is that the percentage of deliberate killing remains an important threat for the monk seal population in Greece, especially for adults and sub-adults, where it accounts for up to 45-50%, of all such cases. In sub-adults the mortality from entanglement in fishing nets is a considerable threat, accounting for 44% where the death cause was identified. In adult seals this factor is not as important as it is in sub-adults since it is recorded in only 6% of such cases. In pups, which do not interact with fisheries till their weaning, natural mortality is the main cause of death (92%), namely: disease, starvation due to breaking away from the mother and finally drowning or killed on the rocks due to bad weather conditions.

Net entanglement of a sub-adult seal

The following figures present the percentages of death causes, recorded in the last 15 years.

Death causes of monk seals between 1990-2004



D.2.SAMPLE BANK

D.2.1. Structure and use

The main objective of establishing a sample bank for the Mediterranean Monk Seal is to store and record important samples for research purposes, collected either from live or dead seals. The samples are stored mainly in the headquarters of MOm in Athens; most are frozen at –20^{o}C, other in appropriate reagents or even cleaned and stored dry (bones, hair etc.). Some samples are also stored in collaborating institutes, for analysis or research (Erasmus University Rotterdam, Veterinary Faculty of Thessaloniki, etc.). The sample bank concerns exclusively the monk seal *Monachus monachus* and it is unique for this species. MOm's scientific personnel collected most of these samples, the staff of other organizations/institutes collected several others, and few other tissues were obtained from RINT members, with the guidance of the rescue team. Overall, this sample bank contains 1703 samples, from 872 tissues, obtained from 99 individuals, some of which have already been analyzed and others are stored for future research.

Since 2001, MOm has created a relevant database concerning the samples collected since 1987. The database is regularly updated upon every sampling or any change in the sample bank, due to use of samples for analysis or other reasons (i.e. transportation in different medium or different place for storage). Through this database it is quite easy to extract data on:

- the animal that the samples come from (age, sex, alive or dead, when dead the stage of decomposition) and the area of stranding,
- the samples: date of collection, number of samples obtained from the same tissue, the analysis they have been collected for, the storage medium and place; if they have been sent for analysis, which type of analysis they were used for (histology, pathology, genetics etc.), the name of the laboratory and the results (date and reference to the paper or the file are included).

The registration of the samples in the database assists in the easy access to the samples, collected for scientific purposes, for the follow up of their analysis and for planning future research. When samples are sent to other institutes for analysis, MOm makes of use the results obtained from the tests through publications, in order to contribute to the scientific knowledge on the species worldwide.

D.2.1. Up to date contribution of the sample bank to monk seal research

D.2.1.1.Pollutants (Heavy Metals)

In 2000, samples (blubber and skin) collected from 17 dead monk seals (stranded in coastal Greece) during 1994-1999, were analyzed for detecting the level of heavy metals. The analysis was conducted as part of a Master thesis at the University of Bangor (A. Dosi, 2000). Heavy metals detected in the samples were in average at low levels, in comparison to those found in other marine mammals. The tissue type and the stage of development accounted for a difference in the concentrations of all metals studied, with the highest concentrations observed in the skin of the pups. Significant differences were not identified in the metal concentrations over the years and the different locations, and the sex of the seals was not related to the concentration of metals.

D.2.1.2. Genetics

An analysis for the determination of the genetic diversity of the Eastern Mediterranean population of Mediterranean Monk seals and a comparison with the Atlantic population was made during the period of 1999-2000 in the University of Barcelona, as part of a PhD dissertation (Teresa Pastor, in preparation). In this study, skin samples collected from 25 different individuals over the years 1993-1999, were analyzed via microsatellite loci processing. The analysis showed that the genetic diversity of the population living in the Greek coasts has been reduced through the years and that

between the populations of the Atlantic and the Mediterranean there are genetic differences that may be the result of the long-lasting isolation of the two populations.

Another study on the genetic variability has been recently completed, in collaboration with the National Centre of Marine Fisheries and the University of San Diego. The purpose of this study was to determine the phylogenetic relationship between the three species of the monachine seals *(Monachus monachus, Monachus tropicalis* and *Monachus schauislandi)*, and their relationship with the rest of the Phociids (Fyler et al, 2005).

D.2.1.3. Morphometrics - Age determination.

In order to determine the age of individual monk seals encountered on the Greek coasts, and to gather important morphological information for the biology and physiology of the species, MOm has been regularly collecting bone and teeth samples, from dead animals. Until the summer of 2005, samples collected from 33 different individuals, were cleaned at the Research Station of Gerakas, recorded and stored dry at MOm's sample bank. Samples from another 15 individuals were buried and will be cleaned in the following years. In one case, from Skopelos island in 1991, the age of the animal was determined at 44 years old through the examination of its canine tooth (C. Lockyer, personal communication).

E. PUBLIC AWARENESS

The rehabilitation of sick, wounded and orphaned animals is a key tool for the sensitization of the public at the local, national and international level. The establishment and operation of the Monk Seal Rehabilitation Centre contributed considerably in the awareness of the public concerning the threats that the Mediterranean Monk seal is facing, as well as, the efforts for the protection of this endangered with extinction species. From 1990 till 2004 the following actions have been carried out for the awareness of the public:

- 150 articles were published in the local, national and international press, while in numerous occasions news from the rehabilitation program were presented on national and local T.V. and radio broadcasts.
- Interviews on local and national radio and TV channels concerning animals under treatment in the Centre.
- Information and news published on the quarterly MOm's magazine, which is sent to MOm’s members and RINT contacts.
- The facilities of the Centre are open for the public during the summer period when no animal is hospitalized. Volunteers assist in the guidance of the visitors inside the facilities and explain the actions undertaken for the protection of the Monk seal. During the years 1997-2004 approximately 16,000 people have visited the Rehabilitation Centre and have been informed about the Rehabilitation program and MOm’s conservation work.

ΚΩΣ Κάτοικοι του νησιού έσωσαν νεογέννητη φώκια

Ο ξεχωριστός... Ιπποκράτης

Η φώκια στα ελληνικά νησιά είναι είδος προς εξαφάνιση. Η ιστορία του **Ιπποκράτη** (όπως ονομάζεται η ελληνική φώκια), που εντοπίστηκε πριν από λίγες ημέρες στην Κω, δεν άφησε ασυγκίνητους τους κατοίκους του νησιού. Η ορφανή αρσενική φώκια ταξίδεψε αεροπορικώς στην Αθήνα για να καταλήξει στην ασφάλεια του Κέντρου Διάσωσης και Περίθαλψης Μεσογειακής Φώκιας στην Αλόννησο.

Η φώκια εντοπίστηκε στην παραλία Κέφαλος από κάτοικο του νησιού. Το μικρό ζώο δεν επιθυμούσε να επιστρέψει στη θάλασσα και καθώς η μητέρα του δεν εμφανίστηκε αποφασίστηκε η άμεση παρέμβαση της Μοm για τη διάσωση και περίθαλψη της νεογέννητης φώκιας.

Το ζώο έφερε σημεία αφυδάτωσης και ελαφρά τραύματα στο πιγούνι και στα πτερύγια, ενώ είχε υψηλή θερμοκρασία. Η κατάστασή του κρίθηκε κρίσιμη και έτσι δρομολογήθηκαν όλες οι ενέργειες για τη μεταφορά του στο κατάλληλο μέρος. Η νεογέννητη φώκια ταΐζεται ανά τέσσερις ώρες με ορό και από το επόμενο εικοσιτετράωρο η τροφή της θα είναι ψαροπολτός καθώς δεν υπάρχει υποκατάστατο του μητρικού γάλακτος. Όσο για το όνομα Ιπποκράτης, της δόθηκε προς τιμήν των κατοίκων της Κω που την έσωσαν.

Ο Δημήτρης δυναμώνει

Ο ΜΙΚΡΟΣ «ΘΟΔΩΡΟΣ» ΖΗΤΑΕΙ ΒΟΗΘΕΙΑ.

Απελευθερώθηκε η «Κατερίνα»

ΥΣΤΕΡΑ από πέντε μήνες η νεαρή φώκια «Κατερίνα» βρέθηκε στο φυσικό της περιβάλλον. Τα μέλη της Εταιρείας Μελέτης και Προστασίας της Μεσογειακής Φώκιας, τα οποία την περιέθαλψαν, την άφησαν προχθές στην περιοχή Γέρακα της Αλοννήσου παρουσία των αρχών της περιοχής.

Η «Κατερίνα» είχε βρεθεί στις ακτές της Βόρειας Εύβοιας τον περασμένο Νοέμβριο από ντόπιους ψαράδες σε κακή κατάσταση. Από μέλη της οργάνωσης μεταφέρθηκε στο κέντρο προστασίας, όπου παρέμεινε μέχρι να αναρρώσει.

Ύστερα από προσπάθειες πέντε μηνών, η «Κατερίνα» έγινε απολύτως καλά και προχθές άρχισε το «νέο της ταξίδι στη θάλασσα». Όλοι πιστεύουν ότι θα πετύχει, και βέβαια δεν είναι λίγοι αυτοί που ενδιαφέρονται για την πορεία της. Εκτός των μελών της οργάνωσης, το ΥΠΕΧΩΔΕ, το υπουργείο Γεωργίας, το ΥΕΝ και η Κτηνιατρική Σχολή του Αριστοτελείου επί πέντε μήνες συμπαραστάθηκαν στις προσπάθειες για να ανακτήσει η «Κατερίνα τις δυνάμεις της».

Press clipping concerning the rehabilitation of monk seal pups, published on national newspapers

F. DISSEMINATION OF RESULTS

The rehabilitation team presents its results in national and international conferences and scientific journals, and publishes an annual activity report concerning the Monk Seal Rehabilitation actions, which is sent to relevant institutes and organizations in Greece. The presentation of the results of the rehabilitation program in the scientific community and to key stakeholders not only promotes the efforts of MOm's rehabilitation team, but it also contributes to the knowledge on this critically endangered species for which scientific knowledge, necessary for its conservation, is still limited. Furthermore, the rehabilitation team has the opportunity to discuss the methodologies and results of its work with other specialists in corresponding workshops in order to improve its methodology and consequently its effectiveness. The following presentations/ publications have been made during the period 1990-2004:

F.1. PRESENTATIONS IN CONFERENCES

- Androukaki E., Adamantopoulou S., Dendrinos P., Tounta E., Kotomatas S., 1998. Causes of death in the Mediterranean Monk seal in Greece. The World Marine Mammal Conference. Workshop on the Biology and Conservation of the World's Endangered Monk Seals. Monaco 19-20/1/1998.
- Bildt M.W.G. van de, Martina B., Vedder E.J., Androukaki E., Kotomatas S., Komninou A., Abou Sidi Ba, Bent Jiddou Azza, Mohamed Ely Ould Barham, Niesters H.G.M., Osterhaus A.D.M.E., 1998. Characterization of two Monk Seal Morbilliviruses. The World Marine Mammal Conference. Workshop on the Biology and Conservation of the World's Endangered Monk Seals. Monaco 19-20/1/1998.
- Vedder E.J., Androukaki E., Abou Sidi Ba, Mint Jiddou Azza, Kotomatas S., Osterhaus ADME. Rehabilitation program for Orphaned Mediterranean Monk Seal (*Monachus monachus*) pups. The World Marine Mammal Conference. Workshop on the Biology and Conservation of the World's Endangered Monk Seals. Monaco 19-20/1/1998.
- Kotomatas S., Adamantopoulou S., Anagnostopoulou K., Androukaki E., Dendrinos P., Fatsea E., Tounta E., Zavras V. Implementing the Conservation Strategy for the Mediterranean Monk Seal in Greece. (UNEP, Mediterranean Action Plan) 29-31/10/1998, Arta Greece.
- Androukaki E., Vedder E.J., Fatsea E., Tounta E., Kotomatas S., 1999. Data on the Growth and Development of monk Seal Pups During Rehabilitation. 8th Intrnational Congress of Zoogeography and Ecology. Kavala 17-22/5/99.
- Androukaki, E, Fatsea, E, 't Hart, L, Kuiken, T, Osterhaus, A.D.M.E., Tounta, E, N, Komnenou, 2002: "Treating Stranded Mediterranean Monk Seal Pups in Greece" Workshop: Rehabilitation in Theory and Practice: Protocols, Techniques, Cases in the 16th Annual Conference of the European Cetacean Society, 7 April 2002
- Androukaki E., E. Fatsea, L. 'T Hart, A.D.M.E. Osterhaus, E. Tounta, S. Kotomatas, 2002: "Growth And Development of Mediterranean Monk Seal Pups During Rehabilitation"16th Annual Conference of the European Cetacean Society, 8-11 April 2002
- Dosi, A, Adamantopoulou, S, Dendrinos, P, Kotomatas, S, Tounta, E, E Androukaki, 2002: " Analysis of Heavy Metals in Blubber and Skin of Mediterranean Monk Seal" 16th Annual Conference of the European Cetacean Society, 8-11 April 2002

F.2. SCIENTIFIC PAPERS

- Osterhaus ADME, Van der Bildt M., Vedder E., Martina B., Niesters H., Vos J., Van Egmond H., Liem D., Baumann R., Androukaki E., Kotomatas S., Komnenou A., abou Sidi Barham M.E.O., 1998. Monk seal mortality: virous or toxin? *Vaccine 16*, **No 9/10**: 979-981
- Androukaki E., Adamantopoulou S., Dendrinos P., Tounta E., Kotomatas S., 1999. Causes of mortality in the Mediterranean Monk seal (*Monachus monachus*) in Greece. *Contr. to the Zoogeogr. and Ecol. of the East. Med. Reg.*, **Vol I** (1999), pp. 405-411.

- Bildt van de M.W.G., E.J. Vedder, B.E.E. Martina, Ba Abou Sidi, Azza Bent Jiddou, Mohamed Ely Ould Barham, E Androukaki, A. Komnenou, H.G.M. Niesters, A.D.M.E. Osterhaus, 1999. Morbilliviruses in Mediterranean Monk seals. *Veterinary Microbiology*. **69** (1999), pp. 19-21
- Fyler C.A., Reeder T.W., Berta A., Antonelis G., Aguilar A. and Androukaki E., 2005. Historical biogeography and phylogeny of monachine seals (Pinnipedia: Phocidae) based on mitochondrial and nuclear DNA data. *Journal of Biogeography*. **32**. 1267-1279.

F.3. REPORTS

- MOm/HSSPMS and SRRC, 1991. The rehabilitation of an orphaned Mediterranean monk seal (Monachus monachus) in the National Marine Park of the N.Sporades, Greece. Report. 31 p.
- MOm/HSSPMS, 1991. Action Plan 1991 - The Results - Protection, Public awareness, Research, Rescue Network, Rehabilitation. Athens, Greece.
- MOm/HSSPMS, 1992. The Seal Treatment and Rehabilitation Centre. pp. 1-7.
- MOm/HSSPMS, 1994. Continuation of Establishment of a Rescue Network for Orphan, Wounded and Sick Seals and Gathering of Seal Observations from the Whole of Greece-Function of the Seal Treatment and Rehabilitation Centre in Alonnissos. Final report for the European Commission Project 4-3010(92)7829, April 1992-March 1994.
- MOm/HSSPMS, 1995. The Seal Treatment and Rehabilitation Centre. Activities 1994. 12 p (in Greek).
- MOm/HSSPMS, 1996a: Monk Seal Conservation in Greece. Part 1. Coastal and Island Greece. Final Report for the European Commission Project B4-3040/95/009/AO/D2
- MOm/HSSPMS 1996b. The Seal Treatment and Rehabilitation Centre Activities Report. Autumn 1995 - Spring 1996 pp.1- 39 (in Greek).
- MOm 1998. The Seal Treatment and Rehabilitation Centre Activities Report 1997 pp.1- 34. (in Greek)
- MOm 1999. The Seal Treatment and Rehabilitation Centre Activities Report 1998 pp.1- 30. (in Greek)
- MOm 2000. The Seal Treatment and Rehabilitation Centre Activities Report 1999 pp.1- 34 + Appendices. (in Greek)
- MOm 2001. The Seal Treatment and Rehabilitation Centre Activities Report 2000 pp.1- 32. (in Greek)
- MOm 2002. The Seal Treatment and Rehabilitation Centre Activities Report 2001 pp.1- 37. (in Greek)
- MOm 2003. The Seal Treatment and Rehabilitation Centre Activities Report 2002 pp.1- 34 + Appendices. (in Greek)
- MOm 2004. The Seal Treatment and Rehabilitation Centre Activities Report 2003 pp.1- 34 + Appendices. (in Greek)
- MOm 2005. The Seal Treatment and Rehabilitation Centre Activities Report 2004 pp.1- 34 + Appendices. (in Greek)

G. CONCLUSIONS AND FUTURE PLANS

The Rehabilitation Program has been proved a significant tool for the conservation of *Monachus monachus*. Although, any rehabilitation program requires expensive equipment and consumables, specialized/ trained staff and thus a considerable cost and effort, the program carried out by MOm involves an endangered species; therefore the contribution of released, healthy animals to their natural environment (even if the actual number is small) is considered to be valuable to the total population. However, the prolonged shortage of financial resources does not allow access to new technology in diagnostic and therapeutical procedures, while the condition of the facilities is at present poor.

Despite the above difficulties, the success of the rehabilitation program in the survival of adult and sub-adult seals is quite high, up to 85%. The percentage of survival of the neonates, found orphan in the period of lactation, is reaching 45%. Orphan pups are usually admitted in a very bad condition since they are malnourished for several days, and they often suffer from bacterial, viral and parasitical infections. Most of the pups have difficulty to adapt to the nutritional program of rehabilitation, consisting either of mother milk substitute (a general milk for marine mammals) or fish slurry. The long lactation period of 3-4 months (unlike other seals that have a much shorter lactation period) means that their intestinal system is quite sensitive during this period. Due to the small number of patients hospitalized every year in the Centre there is limited experience worldwide on the rehabilitation of this species. Experience gained from other species although valuable, it does not apply directly to *Monachus monachus*. Thus it was necessary to develop species-specific protocols, which are regularly updated, based on new research findings.

After the completion of treatment, the survival of rehabilitated animals is quite high. No released animal has been found dead, while in one case where a satellite transmitter was used for 5,5 months, there was clear evidence of the gradual adaptation of the animal to the wild. The seal was observed to exhibit the behavior of a wild animal of its age.

Furthermore, the study of the captive animals, as well as, the information gathered from the necropsies of dead seals and the analysis of the samples collected, have contributed significantly to the knowledge of the species biology and ecology, the identification of its threats and the planning of effective measures for its conservation. In addition, the rehabilitation program serves as a key tool in raising awareness of the general and local public and especially through the environmental education activities of children, since it provides information on the problems seals are facing, as well as, a rich photographic archive.

The following steps need to be taken in order to continue the monk seal rehabilitation program in Greece, with success and to further improve its effectiveness:

- Construction of new facilities for the Centre and improvement of the available diagnostic and medical equipment. This is an imperative need and MOm is currently in search of funding.
- Continuous improvement of the protocols of the Centre in order to increase the survival rate of the neonate patients, in collaboration with other scientific institutes, having expertise on the issue.
- Provide continuous training to increase staff experience.
- Monitoring of post release survival and basic behavioural aspects of monk seals with modern techniques (treatment room camera, satellite tracking, etc.).
- Further improvement of the Rescue and Information Network for accelerating the receipt of information and the effectiveness of the response.

- Continue contributing to the public awareness campaign.
- Continue contributing in the research of the biology and ecology of *Monachus monachus*
- Secure stable funding for the activities of the rehabilitation program through European or state funds and private fundraising campaigns.

It should be stressed that MOm does not consider the rehabilitation program as an isolated conservation measure for the protection of the species, but as part of an integrated strategy aiming at the protection of *Monachus monachus,* including the conservation of its natural habitats. In addition, the necropsies performed to dead animals over the past 15 years provided evidence that the most important direct threats for the monk seals arise from their interactions with fisheries, resulting often to deliberate killing and drowning in nets. It is clear that in order to apply protection measures effectively, it is necessary to focus on the mitigation of the conflict between monk seals and fishermen.