MEDITERRANEAN MONK SEAL
(*Monachus monachus*)

GREEK POPULATION

POPULATION AND HABITAT VIABILITY ASSESSMENT

Athens, Greece
4-7 April 1994

WORKSHOP REPORT

A Collaborative Workshop

Elliniki Etairia
The Hellenic Society for the Protection of the Environment
and the Cultural Heritage

IUCN/SSC Seal Specialist Group
IUCN/SSC Captive Breeding Specialist Group

Hosted by

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1 September 1994

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SECTION 1

EXECUTIVE SUMMARY

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The Mediterranean monk seal is the world's most endangered phocid seal. No reliable estimates of total population size exist, but this is probably less than 500. There are two widely separated but potentially viable populations: one on the Atlantic coast of North Africa and the other in Greece (Aegean and Ionian Seas). There have been no major changes in the size and distribution of the North African population, nor in the broad distribution of the eastern Mediterranean population over the past 20 years. However, populations in other parts of the Mediterranean have declined or disappeared altogether.

Greek scientists, conservation organizations and wildlife authorities have developed a collaborative Greek National Program for the Protection of the Monk Seal under the coordination of Elliniki Etairia. The goal is to eliminate human-caused mortality of seals in the Greek population and to restore and maintain a genetically-viable, self-sustaining, free-living monk seal population. To achieve the recovery goal, it is necessary to understand the risk factors affecting survival of the monk seal and to reduce the risk of extinction to an acceptable level. Software tools to assist simulation and quantitative evaluation of risk of extinction are available and were used as part of Population and Habitat Viability Assessment Workshop. This technique identifies and ranks risks and assists in assessment of management options.

Forty-five biologists, managers and decision-makers attended a Population and Habitat Viability Assessment (PHVA) Workshop in Athens, Greece at the Elliniki Etairia premises on April 4-7, 1994 to apply these recently developed procedures to the Greek population of Mediterranean monk seals. The Captive Breeding Specialist Group and the Seal Specialist Group of the IUCN/Species Survival Commission were invited by Elliniki Etairia to collaborate and facilitate the discussion and decision-making process. The purpose was to review data on the wild population as a basis for developing stochastic population simulation models. These models estimate risk of extinction and rates of genetic loss from the interactions of demographic, genetic, and environmental factors. Other goals included determining habitat requirements, the role of direct threats (including killing by fishermen) as factors in species decline, the potential role of indirect threats (such as disease) and prioritized research needs.

The first morning and afternoon consisted of a series of presentations by the Greek organizations summarizing data known about the wild population. A brief presentation on population biology, the PHVA process and the use of VORTEX (the computer simulation model used) was made. The participants formed four working groups (wild population, direct threats, health issues and current programs) to: 1) review in detail current information; 2) develop values for use in the simulation models; and 3) formulate management scenarios and recommendations. Stochastic population simulation models were initialized with ranges of values for the key variables to estimate the viability of the wild population using the VORTEX software modelling package.

Based upon a consensus of the participants, the following life history values were selected for the modelling process. All adult males were assumed to be available for breeding. Age of

maturity for females was set at either 5 or 6 years based upon comparisons with the Hawaiian monk seal and limited data for the Mediterranean monk seal. The interbirth interval value used was 2 years (50% of females produce a pup each year). The risk of disease events was included in some of the models. The initial population in 1993 was set at 90, 180, or 360 (reflecting an agreed range of numbers). Carrying capacity was set at 500. An equal sex ratio at birth was assumed. All simulations started with a stable age distribution. Inbreeding depression was not included in the scenarios. A range of values for mean juvenile mortality (20, 40 and 60% for the interval between birth and 1 year), and mean adult mortality (either 2, 4 or 6% from age of maturity until death) was used to determine the sensitivity of the intrinsic rate of increase and probability of extinction to these parameters. Projections were run for 200 years and each scenario was run 200 times.

This report includes a set of recommendations for reducing of human-caused mortality, needed research and management of wild populations as well as sections on population history, population biology and simulation modelling.

RECOMMENDATIONS

Recommendations for Wild Populations

1. Provided that deliberate killing is drastically reduced or eliminated the probability of survival of the Greek Monk seal population is very high. Therefore, the highest priority must be given to reducing deliberate killings of seals. Actions should reduce the antagonism that fishermen feel towards monk seals. Existing public awareness and sensitization programs in Greece already have had some success. However, more immediate action also is required including increased enforcement and legislation forbidding the carrying of firearms on boats and the killing of seals. Since guards have been present in the Northern Sporades National Park and fishermen using traditional methods have been given exclusive access to certain areas, no deliberately killed seals have been found. These management actions should be continued and they can be used as a model to reduce deliberate killing elsewhere. Such efforts should be concentrated in areas where killing is particularly frequent.

2. Even if reducing deliberate killing is effective, it will not eliminate the probability of extinction unless the potential rate of population growth is relatively high. Presently the actions necessary to ensure this are not known. Therefore, there is an urgent need to develop a multi-disciplinary integrated program to study the factors affecting reproductive success, survival, feeding success and migration in the Greek monk seal population. An early evaluation of results will make it possible to determine priorities for additional management actions.

3. Care is necessary in interpreting fishermen's reports on the status of wild populations because they are likely to classify any sighting of two seals that differ substantially in size as a mother and pup even if the two individuals actually are a large adult and a smaller, sub-adult. Further work is needed to assess the comparability of the different approaches used to interpret

seal sightings by fishermen. (The problem with the interpretation and accuracy of the reports given by the fisherman is general, i.e. colour, age, action, etc.).

4. The composition of field teams and their continued presence in particular areas should be maintained as much as possible and descriptions of individual animals should be recorded in a standard format that makes it possible for newly-recruited observers to accurately identify individuals.

5. Further analysis of the available data on the characteristics of shelters used by monk seals for resting and breeding is needed to allow of potential additional habitat.

Recommendations Concerning Direct Threats

Habitat degradation and disturbance

1. Analysis and assessment of the projected land use developments and the threats they may pose must be made in relation to the size and location of important monk seal habitats.

2. Priorities must be set for protecting those areas known to contain important breeding caves, although other peripheral caves must not be excluded. Habitat carrying capacity must not be further reduced by land use developments.

3. Where surveys indicate high levels of pollutant in seals and their foods, the source of the pollutants must be identified and the problem corrected.

4. There must be more emphasis on cooperation and collaboration of the various working teams with governmental bodies in directing conservation activities on the species and its respective habitats.

5. In the execution of present and future research activities high priority must be placed on minimum disturbance to the seals.

6. Contingency plans must be prepared with the cooperation of all teams available to deal with potential crises especially an oil spill close to or in monk seal habitat as well as a broad range of potential threats.

Interaction with fisheries

1. The highest priority be placed on reducing deliberate killings by fishermen. Public awareness, sensitization of the fishermen and environmental education are considered important long-term actions. The latter, in particular, may be considered a general recommendation applying to both habitat and fishery aspects, however, such efforts do not suffice as conflicts of interest are simply too strong. The continuous presence of a team in the area is considered important to

maximize awareness and sensitization though in some cases, in absence of acceptance by fishermen, it might stimulate conflicts.

2. At the policy level, fisheries must be considered an integral part of work carried out on the Mediterranean monk seal. The specific characteristics of the fishery in each area (fleet structure, fishing gear, exploited species) must be carefully studied in relation to community policy and the interactions between seal and fisheries monitored.

3. On the basis of monitoring activities, those areas where greatest damages to nets are caused by seals must be identified and designated as high priorities on which to concentrate on reducing fishermen's antagonism. Areas where killing is occurring frequently should have the highest priority for action to reduce kills.

4. Protected zones with exclusive fishing rights for local coastal fisheries, and other protection measures are strongly recommended. An important working example in Sporades was mentioned where the establishment of the marine park has been considered as a positive measure by the fishermen and no killed seals have been found in the last 5 years.

5. The effective control of protected areas is crucial. Port police must be provided with all necessary equipment and manpower to be successful. The possibility must be explored of NGOs working together directly or indirectly with competent authorities on effective patrolling of protected areas. Further, continuous and adequate funding must be secured through national and international sources, for safeguarding and surveillance against illegal activities within the National Marine Park of the Sporades and other such protected regions in the future.

6. Direct compensation measures for fishermen (i.e., nets, money) appear to be associated with many problems (difficulty of accurately assessing gear damage and escalating demands by fishermen). These issues must be handled very carefully on a case by case basis.

7. Efforts are needed to reduce other sources of income loss to the fishermen (eg. illegal fishing, amateur fishermen). Licensing system for the amateur fisheries must be re-evaluated (individual license, vessel license, fishing gear) and regulations must be made to decrease overall fishing effort. Strong lobbying action is needed to restrict illegal use of scuba diving equipment for spearfishing concentrating first on areas representing important monk seal habitats.

8. Provide improvements in the technical infrastructure of the fishery such as ice making facilities, and VHF radio as important supportive measures which will continuously remind the fishermen of a positive intervention associated with the presence of the seal. Such actions should be considered as part of an incentive program to reduce killing.

9. Reorientation programs to other fishing activities not in direct antagonism with the monk seal should be examined as a possible way to reduce local conflict with seals.

Recommendations Concerning Indirect Threats

1. Adherence to appended guidelines for collecting, handling and shipping biological samples from the Mediterranean monk seal for evaluating the presence of infectious diseases and pollutants, as well as assessing genetic diversity, is essential for all individuals working with these animals as sampling is only done when animals are handled for other reasons.

2. Vaccination of free-ranging Mediterranean monk seals as a preventative measure should not be performed. However, a contingency plan to deal with the implications of a disease outbreak in an isolated sub-population should be developed and made available if a vaccine is demonstrated to be of significant value in a model seal species.

3. Concerted efforts should be made to integrate information from opportunistic sampling of Mediterranean monk seals for environmental contaminants with information collected on the distribution of these contaminants in the seals' ecosystems.

4. Opportunistic sampling of material from Mediterranean monk seals should continue for the purpose of evaluating population genetics.

5. Communication and collaboration among field biologists and basic scientists are essential if decisions are to be made and insight obtained on how to manage Mediterranean monk seals. An active effort should be made to encourage veterinarians, immunobiologists and others with relevant expertise to participate in this effort.

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SECTION 2

WILD POPULATION BIOLOGY AND MODELLING

WILD POPULATIONS

Information on the population biology of the Mediterranean monk seal is available from three sources: detailed studies by teams resident in areas which are known to be important for seals; surveys of monk seal habitat; and discussions with fishermen and other local groups. These data can provide information on:

1. the current and historical distribution of the monk seal in Greece,

2. an index of population size,

3. trends in local abundance, and

4. the distribution and use of suitable habitat for resting and pupping.

The group recognized that there was a wide variation in the reliability of the information from these sources. It discussed the best way to interpret the data which were currently available and considered ways in which the different methodologies could be improved.

1. Current and historical distribution

The monk seal in Greece

Although there are problems in interpreting the estimates of population size which can be derived from reports of seals received from fishermen, port police, sailors, naturalists and tourists (see Section 2), the Group agreed that these data could provide reliable information on distribution and the relative importance of different geographical areas for monk seals. Fishermen using traditional methods and operating relatively close to the shore were the principal source of this information. It was recognized that there could be a problem in interpreting apparent changes in distribution with time if the activities of fishermen had also changed. However, the Group agreed that, although there had been a general increase in the size of the boats and the amount of gear used by these fishermen, any changes in fishing techniques had not affected the amount of time that fishermen spent at sea.

Data on the distribution of monk seals in the mid-1970s were available from Sergeant et al. (1978) and Vamvakas (1979). Data on current distribution were available in an number of sources, for example Cebrian and Vlachoutsikou (1992). Maps from these reports are incorporated in Figure 1. There has been little change in the broad distribution of the monk seal in Greece over the last 20 years, but local distribution has sometimes changed markedly.

1.2 Importance of an area for breeding

Fishermen sometimes provide information on the presence of pups born in particular areas. Most reports are of pups seen with their mothers at sea. The Group concluded that such reports could provide reliable information on the importance of that area for breeding. It is

difficult to determine the size of a seal in the water and, therefore, to identify a lone seal as a pup. However, relative size is easier to determine. It is known that monk seal pups do swim outside caves or move between them, so mothers and pups could be seen together by fishermen.

Reports of sightings of pups in the past are also likely to be more reliable than reports of sightings of seals on their own, because a sighting of a pup is likely to be a memorable event. ***The Group recommends that care is necessary in the interpretation of these reports, however, because fishermen are likely to classify any sighting of two seals which differ substantially in size as "a mother and her pup", even if the two individuals are actually a large adult and a smaller, sub-adult.***

2. Estimates of local population size and trends in abundance.

2.1 Sightings of individually-recognizable seals

For areas, such as the Ionian and the Northern Sporades, which have been the subject of intensive studies for a some time, the number of seals which can be recognized individually provides a downward biased estimate of the number of animals using the area. However, changes from year to year in the number of animals which can be recognized may reflect changes in the skill and experience of the teams, and in the effort made to collect sightings as well as changes in actual numbers. ***The Group, therefore, recommended that the composition of teams and their continued presence in particular areas should be maintained as much as possible, and that the descriptions of individuals should be recorded in a standard format that made it possible for newly-recruited observers to identify them.***

If sightings of animals which can and cannot be recognized are collected and recorded in a systematic way, it is possible to use capture-recapture analysis to provide estimates of abundance, survival and recruitment and of the error associated with these estimates. Such statistics can provide a better indication of changes in abundance.

2.2 Information from fishermen

The Working Group considered that fishermen's estimates of the total numbers of seals in a particular area are not reliable. However, the Group recognized that fishermen's reports of sightings of monk seals in the area where they fish could provide some indication of the number of seals in that area. A number of teams in Greece have conducted surveys of fishermen for this purpose. Extreme care is necessary in interpreting of these reports because judgement of the size and color of an individual can be strongly influenced by lighting and weather conditions, distance from the observer, whether the seal is wet or dry and by the observer's perception of color. In addition, careful judgement is necessary in deciding whether reports of seals at different points on the coast could be sightings of the same individual. Each team has developed its own protocol for making these judgements; this has contributed to the variability in results referred to in Section 1.

The Working Group recommended that further work was required to assess the comparability of the different approaches used to interpret sightings of seals by fishermen. Two possible approaches were suggested: 1) an exchange of sightings information among teams working in different areas to determine the sensitivity of the estimate of the number of seals in a particular area to the protocol used to interpret the sightings; and 2) the calibration of this approach in an area where an independent estimate of abundance based on individual recognition is also available.

3. Distribution of suitable habitat

Most teams are also carrying out surveys of sites likely to be used for resting and pupping by monk seals. These are usually referred to as "shelters". In most cases, these are caves, but in exceptional cases deserted beaches and rocks are still used for resting. The suitability of a potential shelter was usually assessed from the size and location of the beach, its vulnerability to storms, the number of access points and the presence of evidence that the shelter was being used by seals. Data sets have now been collected on the characteristics of shelters which were known to be used by seals and those which were not. In some cases, the characteristics of the beach in a shelter had changed markedly with time due to the effects of storms. Any changes in the use of a shelter following this could provide a good indication of the characteristics which were most important to seals. ***The Working Group recommended further analysis of the available data on the characteristics of shelters used by monk seals for resting and breeding.***

4. Input information for VORTEX

The simulation program VORTEX requires estimating a number of population parameters and current population size. Direct estimates of the values of these variables are not available for the Mediterranean monk seal in Greece. ***The Working Group chose the following values for illustrative purposes:***

4.1 Demographic parameters

DEMOGRAPHIC PARAMETER	VALUE CHOSEN	REASONS
Female age at first pupping	5 or 6 years	Age at maturity of one female autopsied in Zakynthos. Data from Hawaiian monk seal.
Male age at first successful mating	7 years	
Maximum age	40 or 25 years	Age of dead male seal found in Sporades. Maximum age recorded in Hawaii.
Primary sex ratio	0.5	
% females breeding	50	Hawaiian monk seals.
Standard deviation in % females breeding	12.5%age units	Observations of individual females in Northern Sporades.
Age-specific mortality	age 0: 20, 40, 60% age 1 10% age 2 10% age 3 8% age 4 6% age>=5 2, 4 or 6%	Hawaiian monk seals. Atlantic population of *Monachus monachus.*
Standard deviation in mortality	age 1 10-20%age units age 2 5%age units age 3 3%age units age 4 3%age units age 5 1-2%age units	Atlantic population of *Monachus monachus.*

4.2 Initial population size

To provide a range of values for the initial population size, estimates of the number of seals from individual recognition studies and estimates based on the interpretation of reports from fishermen were used. In all cases, records of pups were excluded from the totals. ***It should be recognized that these numbers do not provide an agreed upon estimate of the number of seals in Greece. They merely form the basis for the choice of the initial population sizes used in the simulations.***

AREA	NUMBER	SOURCE
Kefallonia	10	Individual recognition studies
Zakynthos	9	Individual recognition studies
Myrtoon Sea	15	Interpretation of reports from scientists & fishermen
Cyclades	43	Interpretation of reports from fishermen
Northern Sporades	27	Individual recognition studies
Halkidiki	9	Interpretation of reports from fishermen
Eastern Aegean	62	Interpretation of reports from fishermen
Samothraki & Limnos	5	Interpretation of reports from fishermen
TOTAL	180	

The Working Group carried out simulations with an initial population size of 180 and values one half and two times this number: i.e. 90, 180 and 360. All combinations of demographic parameters and initial population sizes that were used in simulations of basic scenarios are provided in the appendix.

4.3 Metapopulation structure

The Working Group had no information on the metapopulation structure of monk seals in Greece. It chose to use the following illustrative examples:

i. A single population of 180 animals;

ii. Two population units of 20 and 160 individuals with the following annual migration rates: 0%, 1%, 10%. This can be considered as reflecting the situation of discrete populations west and east of Peloponnisos, or of a discrete population in the Northern Sporades National Park which has limited interchange with the rest of the Greek population.

iii. Three population units of 20 (A), 60 (B) and 100 (C) individuals where migration is only possible between neighboring units (i.e., between A and B, and between B and C, but not directly between A and C). The annual migration rates are shown in Appendix 3.

If there are discrete sub-populations in the northern and eastern Aegean, the southern Aegean and the Ionian, they might be expected to have this metapopulation structure.

The migration rate is the probability that an individual will move from one population unit to another and remain there for 1 year.

All input for basic metapopulation scenarios is listed in Appendix 3.

5. Results of VORTEX simulations

5.1 Effects of variation in demographic parameters on population rate of increase and choice of parameter values for additional simulations

Figures 2 and 3 illustrate the sensitive of r (the intrinsic rate of increase of the population) to variations in maximum age, age at first breeding, adult mortality and first-year mortality. In general, r is more sensitive to variations in first-year mortality than to variations in adult mortality.

The Group recognized that the combination of demographic parameters used to generate a particular r value was unlikely to affect the vulnerability of the population to extinction. There was a general belief that the value for first year mortality was more likely to vary than any of the other demographic parameters. Therefore, the Group decided to investigate the effects of population size and r on the probability of extinction by varying the value for first-year mortality in a population with an adult mortality rate of 6%, a maximum age of 40 years and an age of first breeding of 5 years. This rate of adult mortality is consistent with the rate estimated for a number of other seal species.

5.2 Effects of r and population size on the probability of extinction

Figure 4 illustrates the relationship between r, initial population size and probability of extinction within 200 years for the simulated population. Population size had little effect over the range of values chosen. There was a finite, but small, risk of extinction even for populations where r was greater than 0; this probability rose rapidly as the value of r was reduced to less than 0. All results from the basic scenarios are listed in Appendix 2.

5.3 Effect of metapopulation structure on the probability of extinction

Figure 5 shows the effect of r and migration rate on the probability of extinction for a population divided into two units, one of 20 and the other of 160 individuals. If there was no migration, there was a finite probability of extinction for the small population even if r was 0.04. The probability of extinction rose rapidly to 50% as r decreased to 0. However, if there was any migration (although population units may go extinct), recolonization occurs so that the metapopulation behaved as a single population. The risks of extinction for the entire system were similar to those for a single population of 180 individuals.

Figure 6 illustrates the results for a population divided into three units of 20, 60 and 100 individuals. If there was no migration, all population units were at risk of extinction for values of r less than 0.03, with the highest risks for the smallest population. If migration was introduced, the results were virtually identical to those for a single population of 180 individuals. This result was unaffected by the nature of the migration process ("propagule rain" or "stepping stone" - see Appendix 3).

All results from the basic metapopulation scenarios are listed in the appendix.

5.4 Effects of epizootics

Effects of epizootics on the probability of extinction were investigated with a population of 180 individuals. Each epizootic was assumed to cause 50% mortality in all age classes. Epizootics effects at an average interval of 40 and 20 years also were investigated.

Epizootic every 40 years:

First Year Mortality	Theoretical rate of increase - r determ (without epizootic)	Actual rate of increase - r stochastic	Probability of extinction within 200 years	Average time to extinction
60	0.003	-0.022	0.61	166
55	0.010	-0.009	0.17	132
40	0.029	0.009	0.00	-
20	0.051	0.033	0.00	-

Epizootic every 20 years:

First Year Mortality	Theoretical rate of increase - r determ (without epizootic)	Actual rate of increase - r stochastic	Probability of extinction within 200 years	Average time to extinction
60	0.003	-0.039	0.97	108
55	0.010	-0.032	0.85	119
40	0.029	-0.007	0.30	157
20	0.051	0.014	0.00	-

The occurrence of epizootics significantly reduced the actual rate of increase of the population and therefore, increased the probability of extinction (Fig. 7). For populations with an r value of greater than 0.04 in the absence of epizootics, the probability of extinction was near 0. However, the probability of extinction rose rapidly as r decreased. This means that management actions aimed at increasing population productivity are more likely to be effective in reducing extinction risks from epizootics than vaccination as a preventative measure.

6. The Effects of "Harvesting"

6.1 Simulations to assess the effects of deliberate killing by fishermen were performed using the 'harvest' option of VORTEX. The following basic demographic values were used:

Female age at first pupping	5 years
Male age at first breeding	7 years
Maximum age	40 years
Adult mortality rate	6%

The intrinsic rate of increase of the model population was varied by changing the value for first year of life mortality.

The basic annual 'harvest' was the upper limit of the range of reported deaths due to deliberate killing over the last 30 years, (i.e., 2 pups and 4 adults), with deaths divided equally between the sexes. These deaths were divided up as follows:

AGE	1	2	3	4	>=5	>=6
Male	1	1	0	0	0	1
Female	1	1	0	0	1	

The results with a population of 180 animals were:

First Year Mortality	Theoretical rate of increase - r determ (without harvest)	Actual rate of increase - r stochastic	Probability of extinction within 200 years	Average time to extinction
60	0.003	-0.098	1.00	40
55	0.010	-0.089	1.00	47
40	0.029	-0.009	0.58	127
20	0.051	0.039	0.00	-

Simulations with a harvest twice the basic value (i.e., 12 animals per year) also were run. Extinction occurred in all simulations with an r of less than 0.03 and in 77% when r was 0.051.

The results with a population of 360 animals were:

First Year Mortality	Theoretical rate of increase - r determ (without harvest)	Actual rate of increase - r stochastic	Probability of extinction within 200 years	Average time to extinction
60	0.003	-0.059	1.00	76
55	0.010	-0.036	0.86	100
50	0.019	-0.009	0.47	114
40	0.029	0.018	0.00	-

If the harvest was reduced by 50%, the results with a population of 180 animals were:

First Year Mortality	Theoretical rate of increase - r determ (without harvest)	Actual rate of increase - r stochastic	Probability of extinction within 200 years	Average time to extinction
60	0.003	-0.115	1.000	73
55	0.010	-0.081	0.910	90
50	0.019	-0.039	0.560	151
40	0.029	0.009	0.035	110

These results are summarized in Figure 8. 'Harvesting' had a dramatic effect on the probability of extinction. Even populations with an r of 0.06 in the absence of harvesting had a finite probability of extinction in the next 200 years, and extinction was certain if r was less than 0.03.

If the level of 'harvesting' was reduced by 50%, the probability of extinction was substantially reduced for all populations where r was greater than 0.02 (although it was still high for population's where r was even less).

The Group investigated the effects of metapopulation structure for a population where r = 0.03. The population was divided into three units of 20, 60 and 80 individuals with migration possible among all units. The harvest was allocated so that one animal per year was removed from the unit with 20 individuals, three animals from the unit with 60 and two from the unit of 80 individuals. The effect of reducing the harvest by 50% in all units, and of reducing it to 0 in the unit with 60 individuals was investigated. The results for the latter two scenarios were virtually identical. Thus the impact of deliberate killing was not affected by metapopulation structure as long as there was some migration among population units. Similarly, the effects of reducing such killing was the same if it was applied to a single population unit or across the range of the species, provided there was some migration.

Figure Legends

Introduction: The growth rate of a population is affected by the interaction of many factors. The growth rate, represented by 'r' is a measure of the result of these interactions. If the value of 'r' is negative, then losses are greater than gains and the population will decline and eventually become extinct. A value of 0 indicates a stable population. A positive value indicates a growing population. In stochastic simulations, as in VORTEX, these values are means calculated over the duration of the simulated projections (200 years in these analyses).

1. Past and recent distribution in Greece of the Mediterranean monk seal. Data from (A) Sergeant et al., 1978; (B) Vamvakas, 1979; and (C) Cebrian & Viachoutskiou, 1992.

2. Sensitivity of the intrinsic rate of increase of a population 'r' value to variations in adult mortality. Trajectories are presented for different combinations of maximum age (MAX), age at first breeding (BREED) and first-year mortality (JUV. MORT.). The values used for the plots were: #1: 40 years, 5 years, & 20%; #2: 40, 6, & 20; #3: 25, 6, & 25; #4: 40, 6, & 60; #5: 25, 5, & 60; and #6: 25, 6, & 60%. Thus population growth rates increased with: increasing maximum age, lower age of first reproduction, decreases in juvenile mortality, and decreases in adult mortality.

3. Sensitivity of the intrinsic rate of increase of a population ('r') to variations in first-year mortality. Trajectories are presented for different combinations of maximum age (MAX), age at first breeding (BREED) and adult mortality (AD MORT). The values used for the plots were: #1: 40 years, 6 years, 2%; #2 25, 6, & 2; #3: 40, 6, & 6; #4: 25, 6, & 6. Again population growth rates increased with: increasing maximum age, lower age of first reproduction, decreases in adult mortality, and decreases in juvenile mortality.

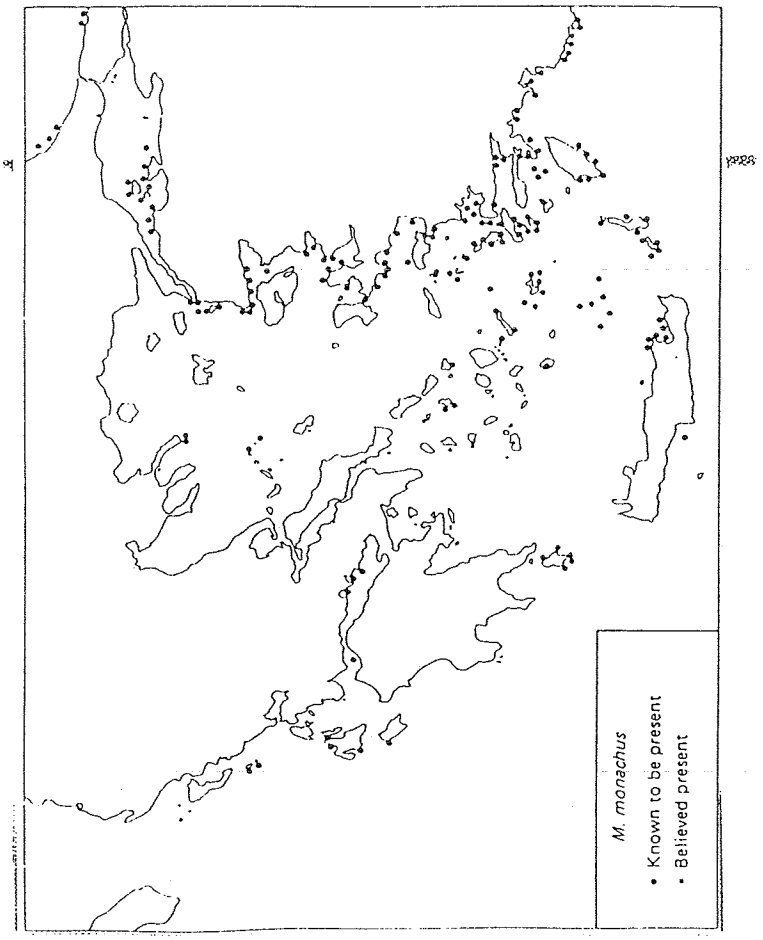
4. Effect of intrinsic rate of increase of a population ('r') on probability of extinction (PE). Data included represent all combinations of values of adult and first-year mortality, age at first breeding and maximum age. Symbols represent three different initial population sizes (N). Negative growth rates are associated with a rapidly rising probability of extinction which occurs more rapidly and at earlier times in smaller populations.

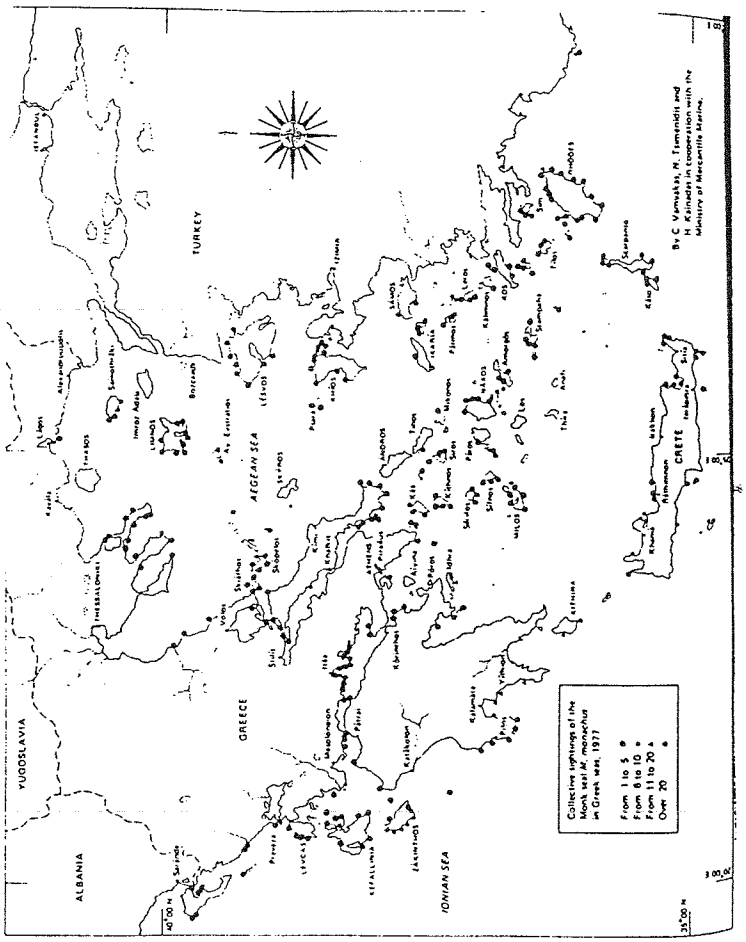
5. Probability of extinction (PE) for a metapopulation with two subpopulations, as an effect of varying the intrinsic rate of increase ('r'). Initial population sizes were 20 and 160. Data included represent simulations with adult mortality = 6%, maximum age = 40 years and age of first breeding for females = 5 years. Results for the large population with the migration rate set at 0.01 (1% per year), as well as for the total metapopulation with no migration, were identical to those for the large subpopulation with no migration. The results for the small subpopulation, as well as for the total metapopulation, with migration rate = 0.01 were identical to those for the single population.

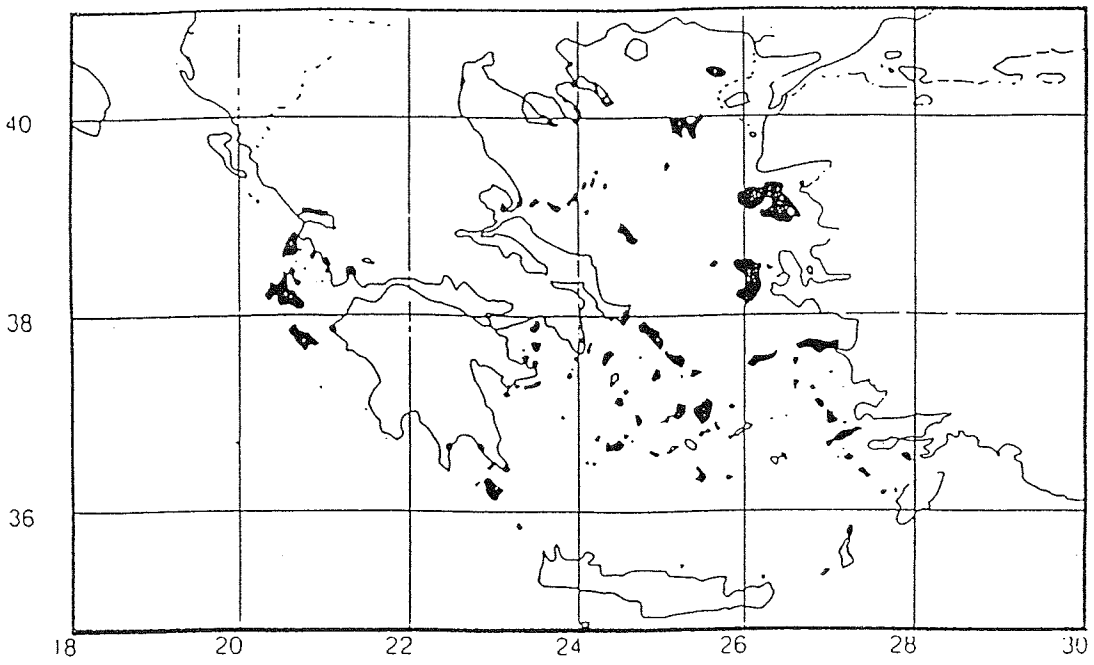
6. Probability of extinction (PE) for a metapopulation with three subpopulations, as an effect of varying the intrinsic rate of increase ('r'). Initial population sizes were 20, 60, and 100. Data included represent simulations with adult mortality = 6%, maximum age = 40 years, and age of first breeding of females = 5 years. The propagule rain model of migration was applied in these simulations. The results for all three subpopulations separately, with migration rate = 0.01 (0.005 in each direction), as well as for the total metapopulation, were identical or very close to those for one single population.

7. Effect of catastrophes on probability of extinction (PE). The probability of a catastrophe (PC) was set at 2.5% or 5% per year resulting in a catastrophe every 40 or 25 years on average. Results with PC = 0 are entered for comparison. Data included represent simulations with adult mortality = 6%, maximum age = 40 years, first age of breeding of females = 5 years for PC = 2.5% and 5% and all combinations of values for PC = 0. Initial population size was maintained constant at 180 individuals.

8. Effect of harvesting on probability of extinction (PE). Three different harvesting scenarios were simulated. (A) six seals killed annually in an initial population of 180; (B) six seals killed annually in an initial population of 360; and (C) three seals killed annually in an initial population of 180. Results with no harvesting are shown for comparison. Data included represent simulations with adult mortality = 6%, maximum age = 40 years and first age of breeding for females = 5 years for the harvesting scenario and all combinations of values for simulations without harvesting.


M. monachus
• Known to be present
▪ Believed present


TURKEY
AEGEAN SEA
GREECE
YUGOSLAVIA
ALBANIA
IONIAN SEA
CRETE
By C Vlamakis, M Tsimenidis and H Kalinderis in cooperation with the Ministry of Mercantile Marine
Collective sightings of the Monk seal M. monachus in Greek seas, 1977
From 1 to 5 •
From 6 to 10 ▪
From 11 to 20 ▲
Over 20 ▲


40
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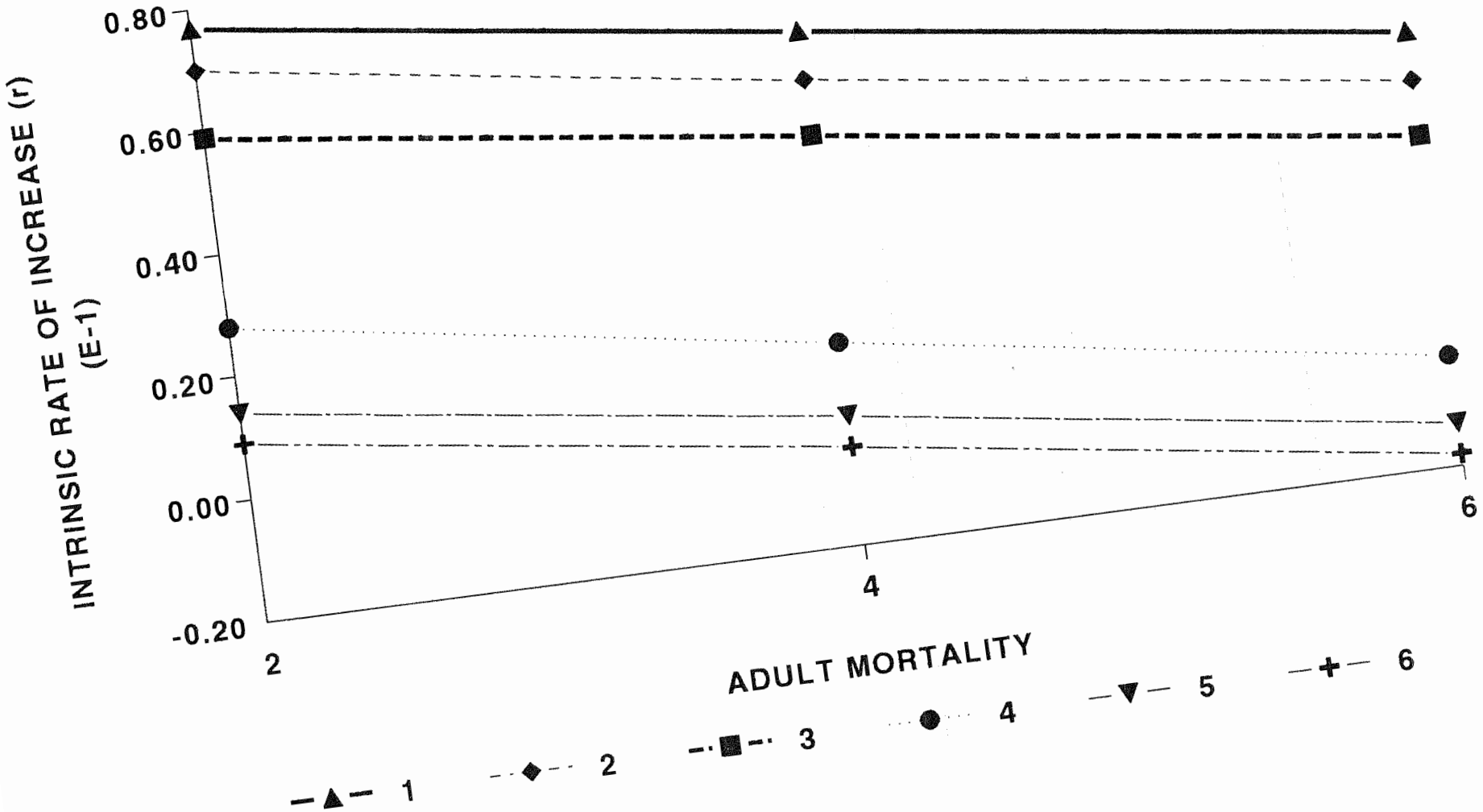
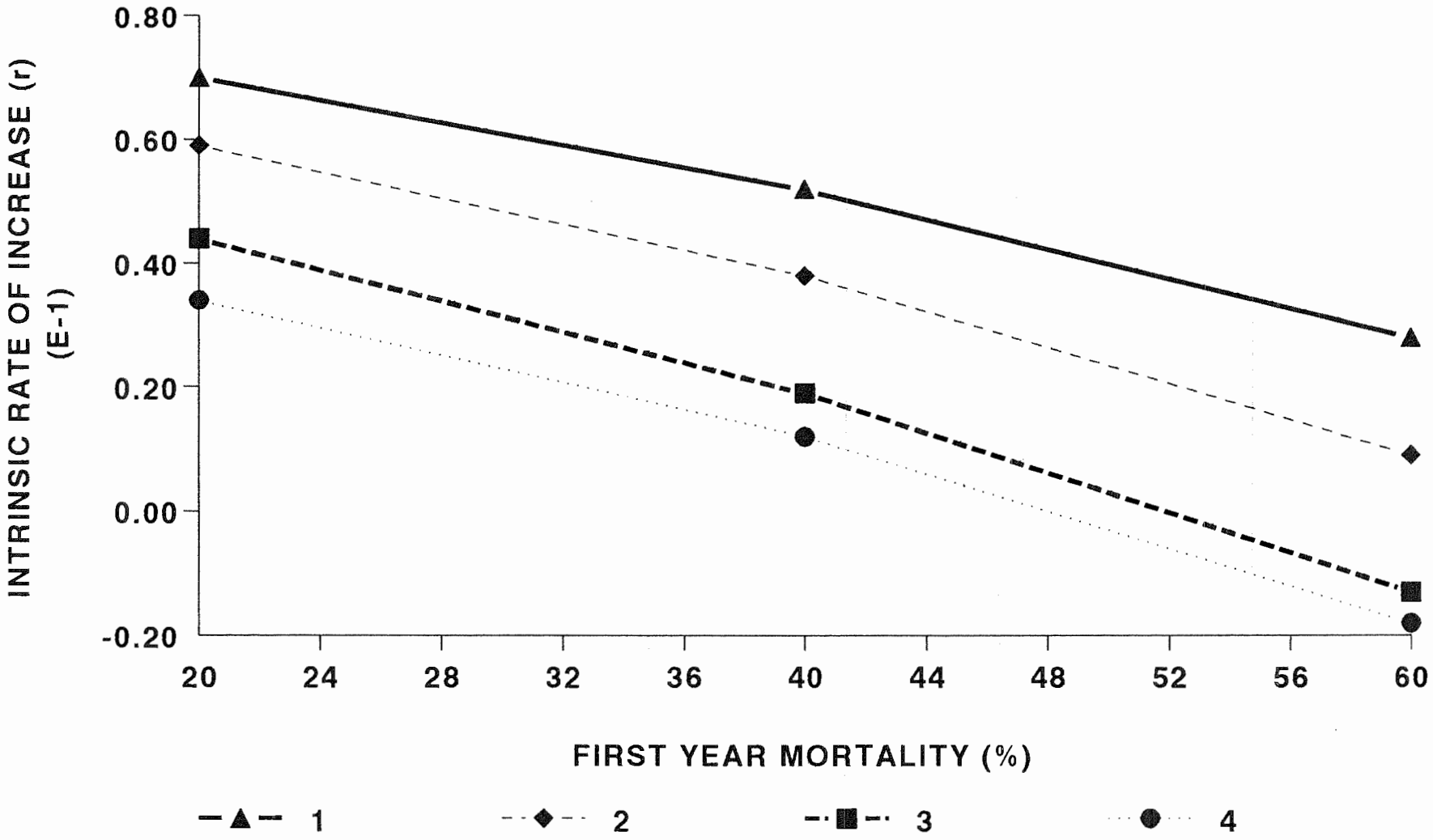
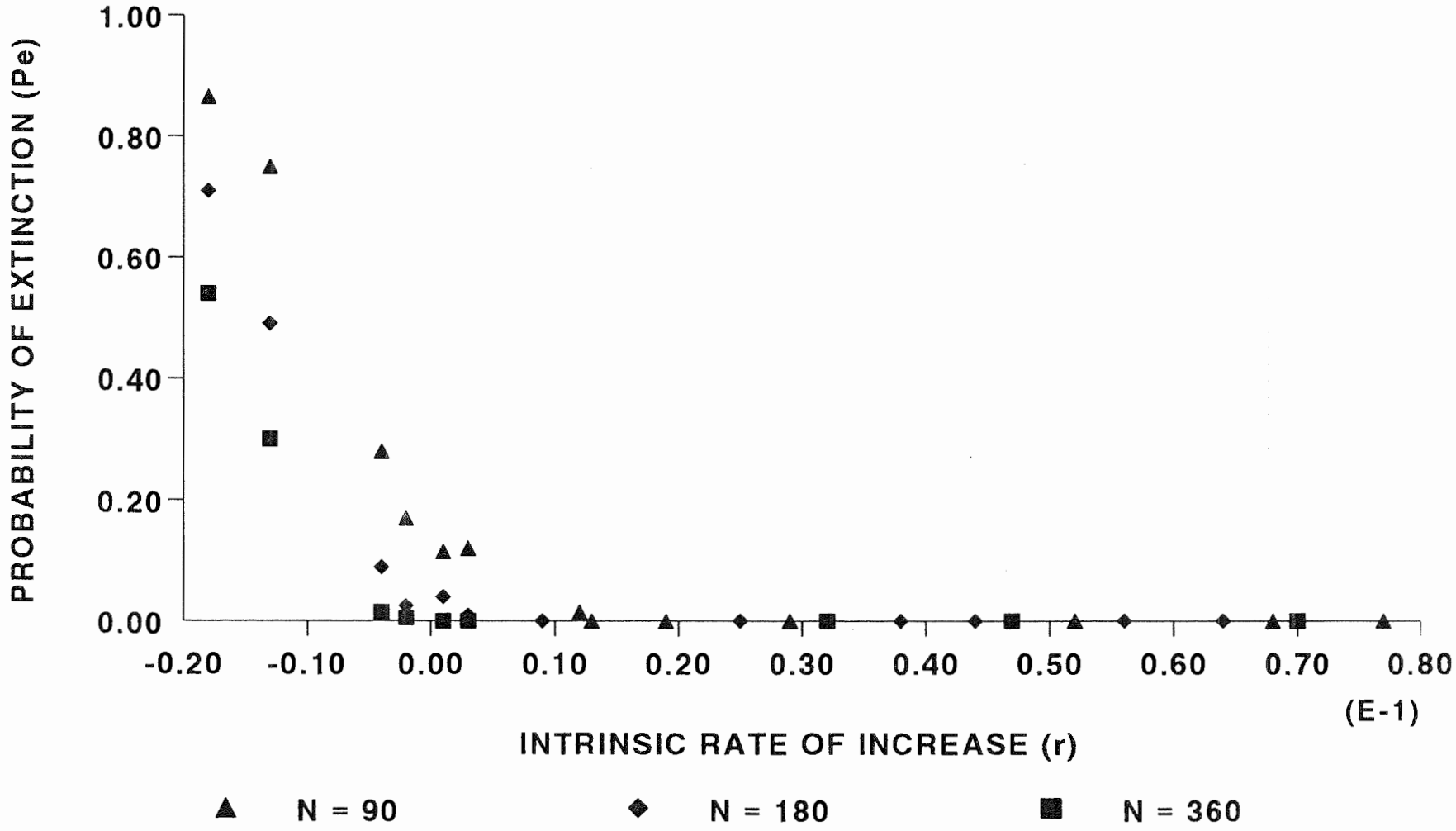
Sensitivity of intrinsic rate of increase (r) to adult mortality

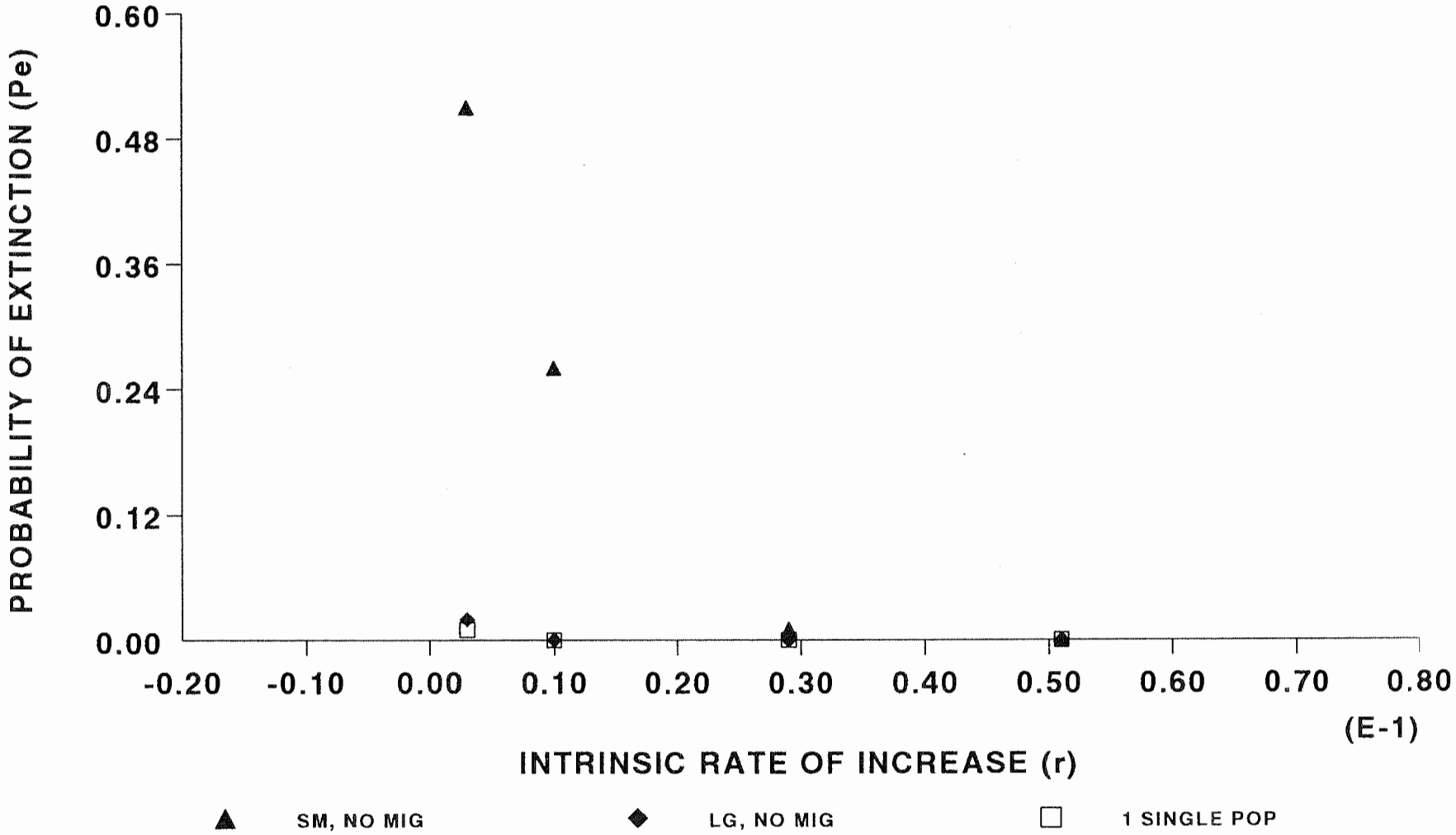



Sensitivity of intrinsic rate of increase (r) to adult mortality
INTRINSIC RATE OF INCREASE (r)
(E-1)
0.80
0.60
0.40
0.20
0.00
-0.20
20
24
28
32
36
40
44
48
52
56
60
FIRST YEAR MORTALITY (%)
1
2
3
4

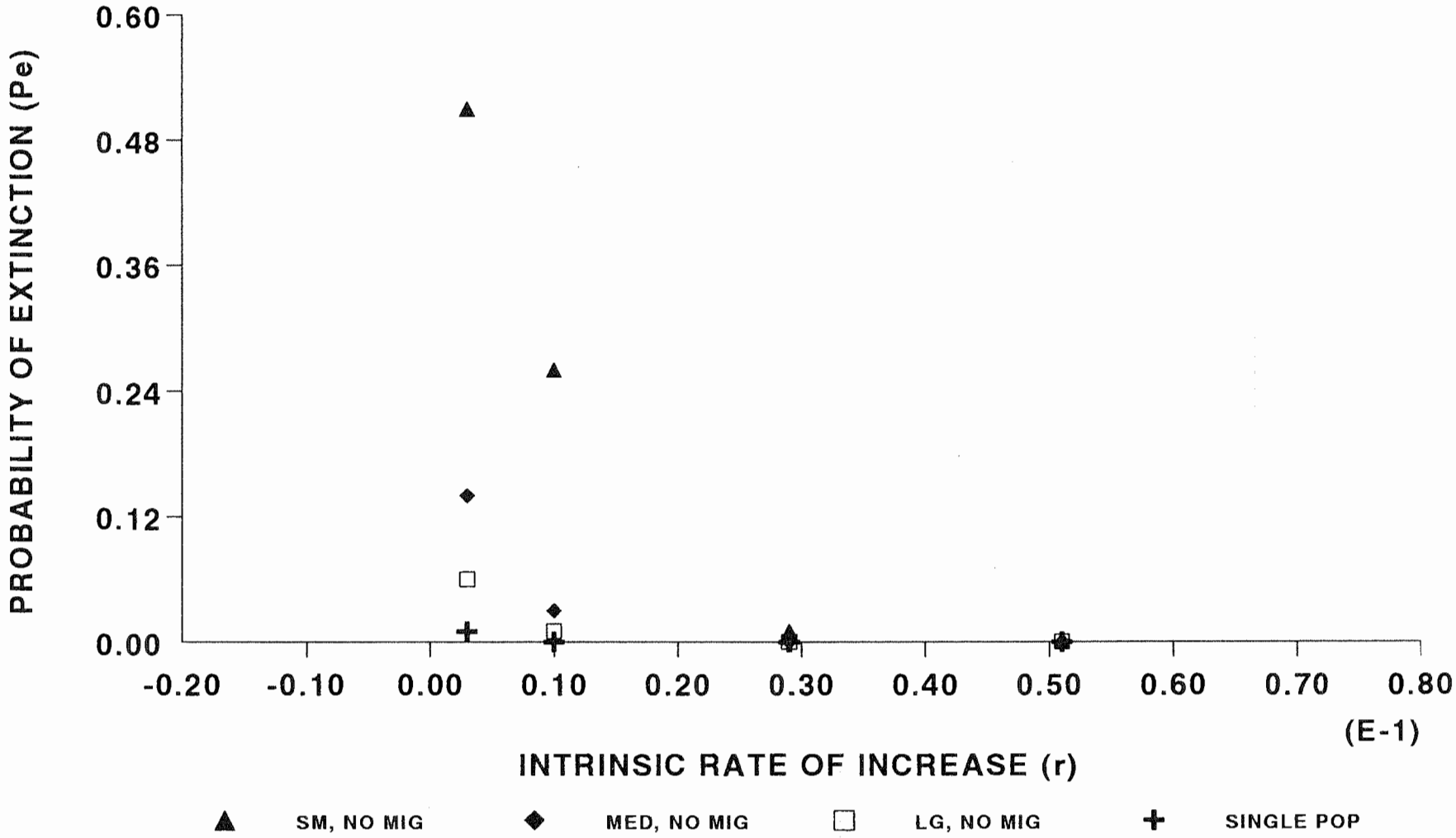
Effect of intrinsic rate of increase (r) on probability of extinction (Pe)



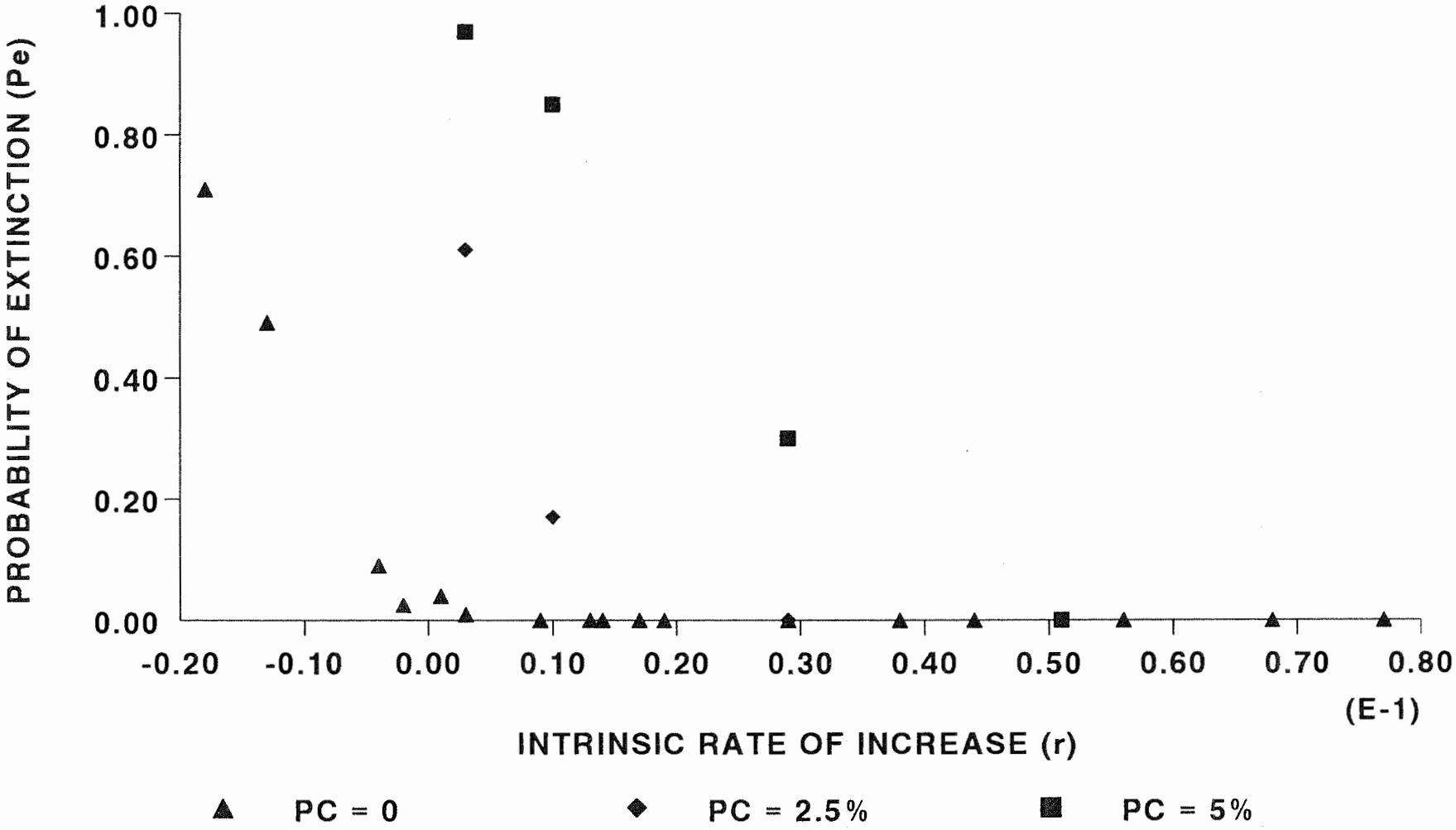
Probability of extinction for a metapopulation with two subpopulations



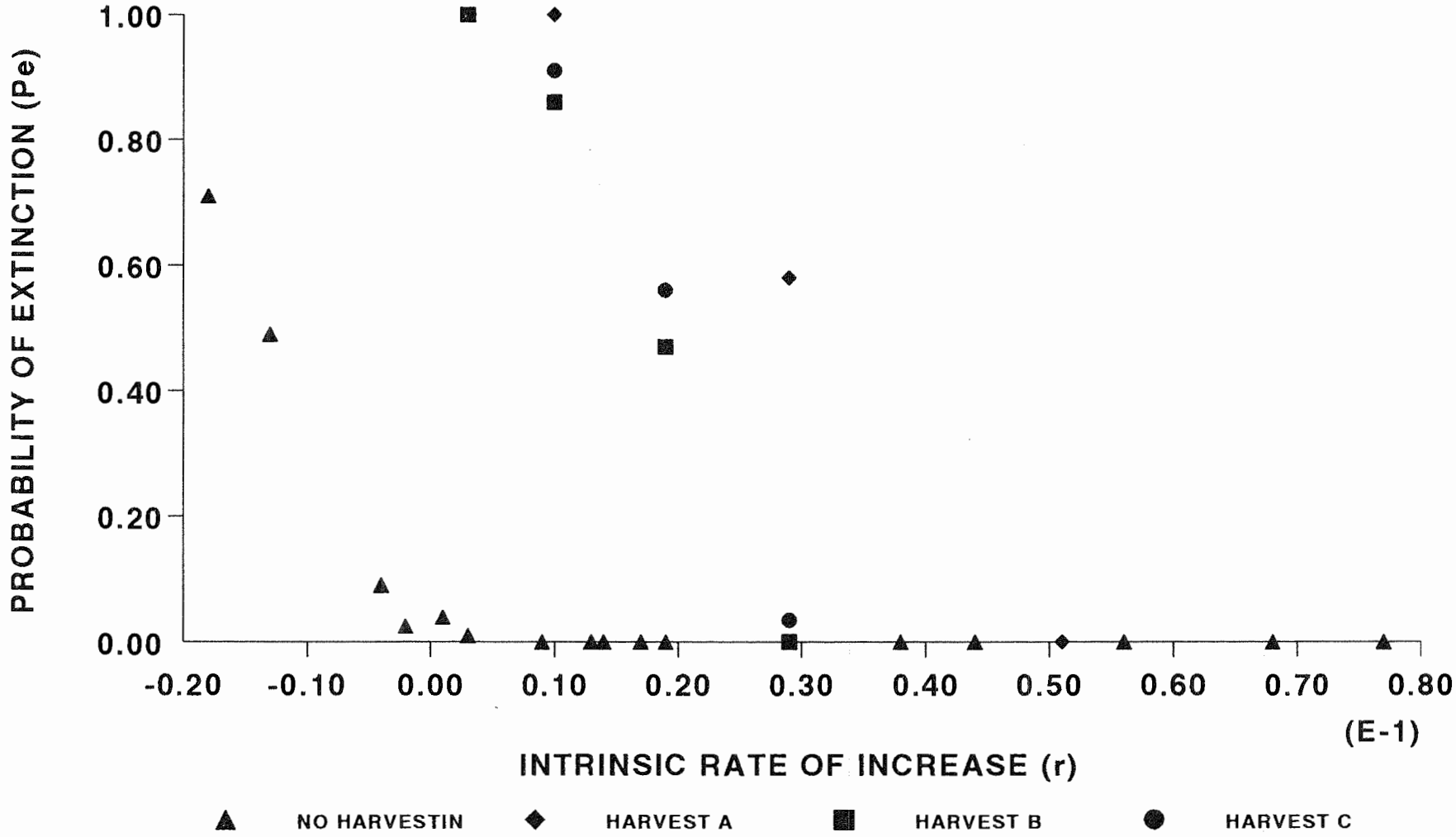
Probability of extinction for a metapopulation with three subpopulations



Effect of catastrophes on probability of extinction (Pe)



Effect of harvesting on probability of extinction (Pe)



MEDITERRANEAN MONK SEAL
(*Monachus monachus*)

GREEK POPULATION

POPULATION AND HABITAT VIABILITY ASSESSMENT

Athens, Greece
4-7 April 1994

Report

SECTION 3

DIRECT THREATS

Direct Threats To The Survival Of The Mediterranean Monk Seal

Discussions were divided into two main issues: 1), the identification and evaluation of direct threats to the survival of the Mediterranean monk seal; and 2) the formulation of recommendations aimed at overcoming or minimizing threat impacts.

1. Identification and evaluation of direct threats

The group considered habitat degradation and interaction with fisheries to constitute the main threats to species survival. Both are the highest priority concerns for the Mediterranean monk seal.

1.1 Habitat degradation and disturbance

The Group discussed the expansion and diversification of anthropogenic influences and their effect on seal habitat use, distribution and behavior. It was noted that, although Mediterranean monk seals were known to haul out on open beaches in the past, this behavior is very rarely exhibited now in the Mediterranean. This may represent changes in the species behavior due to human presence and an associated reduction in the size of the monk seal habitat. Seals appear to have retreated to caves which, in turn, are being threatened by human activities.

The physical destruction or disturbance to seal habitats is being affected through land and sea access with the development of tourism, associated construction operations (roads, hotels, harbors) and increased boat activity. The impact on the species may be more serious when breeding caves are threatened. In areas where important seal habitats are generally located in less developed regions such as the Sporades, disturbance threats due to tourism or boat activity appear to be less of a problem, although this may change in the near future. This contrasts with the situation in the Ionian sea where the development of tourism and associated activities is threatening monk seal habitat.

The presence of industrial installations and coastal development not only in Greece but also in neighboring countries was considered as a potential threat. Within Greece, the negative impact of quarries on the monk seal habitat of Milos was presented. The group discussed how seal distribution within each study area may be changing in response to human presence, and correlations were suggested between increased boat activity and movement of seals away from the area. Such changes may, however, also be associated with reproductive patterns, about which little is known. People working in the field noted seasonal differences in behavior with increased restlessness of seals inside caves during the summer.

Research activities may be a potential disturbance threat and should be taken into consideration when planning specific projects.

Although the topic of pollution was considered by another group, the issue of increased shipping activity and associated habitat destruction was discussed. Recent political changes in the Balkans may result in heavier use of shipping routes with a potential influence on monk seal

habitats. The recent oil spill in the Pylos area is an example. Volatile products of oil pollution and the use of foam also may be problems in the event of a spill. In addition to any direct effects of pollutants on the species, the group also considered the more subtle effects of pollution (e.g., on reproductive fitness and efficiency) none of which are clearly understood.

Taking into account the limestone composition of caves, the Group also noted the alteration and/or physical destruction of caves due to natural causes (e.g., earthquakes, wave action etc.). As a naturally-occurring event, this may not in itself have created a problem but in combination with negative anthropogenic influences, should be considered as a variable.

1.2 Interaction with fisheries

Relative to the interaction with fisheries, the Group considered two different causes of monk seal mortality: 1) accidental entanglement in fishing gear; and 2) deliberate killing. The potential effect of decreased food availability also was considered. It was noted that fish stocks appear to have decreased since more effort is needed to catch the same quantity of fish and the size of the fish caught has decreased. However, it is difficult to determine if this factor qualifies as a direct threat since the monk seals appear to spend a relatively small fraction of their time for feeding.

Based on all available evidence, it was agreed that the major observed cause of mortality was deliberate killing. The most commonly-used method of deliberate killing is by gunshot although other methods have also been reported (e.g., clubbing, dynamite).

It must be stressed that (due to the inconclusive estimates of Mediterranean monk seal populations in Greece), the following table cannot provide accurate mortality rates. Furthermore, it is important to emphasize that there is a definite underestimation of the real number of deaths occurring due to the non-reporting of killing incidents for fear of severe legal consequences. Therefore, the death rates shown represent a minimum estimate.

Data on known deaths collected from 1988-1993 by the Greek teams.*

YEAR	Number	Age Class	Cause of Death
1988	2	Pups	Killed by fisherman
	1	Unknown size	Drowned in net
1989	1	Adult/Juvenile	Unknown
	1	Adult/Juvenile	Killed by fisherman
	1	Juvenile	Drowned in net
	1	Juvenile	Unknown
	1	Unknown size	Killed by fisherman
1990	2	Pups	Killed by fisherman
	1	Adult/Juvenile	Killed by Fisherman
	1	Adult/Juvenile	Unknown
	1	Adult	Drowned in net
	2	Unknown	Killed by fisherman
1991	1	Unknown size	Killed by fisherman
	1	Unknown size	Unknown
	1	Pup	Killed by fisherman
1992	8	Unknown size	Killed by fisherman
	1	Adult	Killed by fisherman
	1	Adult/Juvenile	Unknown
1993	1	Adult	Drowned in net
	1	Unknown size	Killed by fisherman
	1	Unknown size	Accidental - dynamite
	1	Adult/Juvenile	Killed by fisherman
	1	Adult/Juvenile	Unknown

*Figures presented above are based on information provided by the Greek teams; for the Sporades area, no fishery-related killings have been found in the last 5 years.

The deliberate killing of monk seals in Greece by fishermen was a common practice in the past as seals have been regarded traditionally as competitors with fishing activities. Group members shared experiences of fishermen confessing to having repeatedly killed seals 20 or 30 years ago. Attitudes may differ according to the dependence on fisheries in the area, and the history of fisheries. The case of Zakynthos, where fisheries have only recently developed and only a very small part of the population is entirely dependent on fisheries, was contrasted with islands of the Aegean with a traditional history and dependence on fisheries.

The structure and evolution of Greek fisheries was briefly considered in relation to national and European Community policy, and problems for the coastal fisheries sector were outlined:

-Serious gaps in fisheries knowledge and regulatory policy

-Irrational exploitation of resources with probable depletion of fish stocks

-Illegal fishing activities (dynamite, spearfishing at night and with scuba gear, amateurs using professional gear, encroachment of coastal zone by trawlers and purse seiners)

-Increased market and resource competition from medium fisheries sector (i.e., trawlers and purse seiners).

-Large and increasing number of amateur fishermen with strong lobbying power

-Lack of professional organization of coastal fisheries sector

-Poorly developed technical infrastructure (e.g., fishing harbors and preservation facilities).

2. Recommended actions

Having identified the major threats, the group proceeded with the difficult task of proposing recommendations.

2.1 Habitat degradation and disturbance

-Analysis and assessment of the developmental trends in the areas must be made, in relation to the size and location of important monk seal habitats and the threat that they may pose.

-Priorities must be set for areas with important breeding caves although other peripheral caves must not be excluded. Overall habitat carrying capacity must not be reduced.

-Where surveys of pollutant levels in seals and their food reveal high values, efforts must be made to detect the source of the pollutants.

-Collaboration of the working teams with governmental bodies in directing conservation efforts of the species and its respective habitats.

-In the execution of present research activities and the formulation of future research technique and methodology, high priority must be placed on minimum disturbance to the seals.

-A contingency plan must be devised with the cooperation of all teams to deal with a crisis situation (eg. oil spill close to or in monk seal habitat) both promptly and effectively. Such a plan should cover a broad range of potential threats.

2.2 Interaction with fisheries

-From the discussions of this group, the data presented and the application of VORTEX by the wild populations working group, it is recommended that the highest priority be placed on reducing deliberate killings by fishermen.

-At the policy level, fisheries must be considered an integral part of work carried out on the Mediterranean monk seal. The specific characteristics of the fishery in each area (fleet structure, fishing gear, exploited species), must be carefully studied in relation to Community policy and the interactions between seal and fisheries monitored.

-Public awareness, sensitization of the fishermen and environmental education are considered important long term actions. The latter in particular, may be considered a general recommendation applying to both habitat and fishery aspects. However, such efforts do not suffice as conflicts of interest are simply too strong. The continuous presence of a team in the area is considered an important point in relation to awareness and sensitization efforts.

-On the basis of monitoring activities, isolate those areas where greatest damages to nets are being caused by seals and designate these as high priority areas on which to concentrate efforts at reducing feelings of antagonism. In areas where killing is occurring frequently, more immediate action should be considered in order to reduce kills.

-Strong recommendation for protected zones with exclusive fishing rights for local coastal fisheries, and other protection measures. Important working example of Sporades was mentioned where the establishment of the marine park has been considered as a positive measure by the fishermen and no seal killings have been found in the last five years.

-The effective control of such areas is a key issue. Port police must be provided with all the necessary equipment and manpower in order to succeed in their task. Possibility of NGOs working together either directly or indirectly with competent authorities on the effective patrolling of protected areas. A recommendation is made to secure continuous and adequate funding, through national and international sources, for safeguarding and surveillance against illegal activities within the area of the National Marine Park of the Sporades. Where a protected status is designated to other regions in the future, the same recommendation also applies to these.

-Direct compensation measures for the fishermen (i.e., nets, money) seems to have a number of associated problems (difficulty of accurate assessment of gear damage and escalating demands on the part of the fishermen which may not be met in the future). Issues must be handled very carefully on a case to case basis.

-Direct efforts at other sources of income loss to the fishermen (eg. illegal fishing, amateur fishermen). Licensing system for the amateur fisheries must be re-evaluated (individual license, vessel license, fishing gear) and regulations must be made to decrease overall fishing effort. As regards the illegal use of scuba diving equipment for spearfishing, strong lobbying action must be taken to restrict this, concentrating firstly on areas representing important monk seal habitats.

-Improvements in the technical infrastructure of the fishery (eg. ice making facilities, VHF etc). These are considered important supportive measures which will continuously remind the fishermen of a positive intervention associated with the presence of the seal. Such actions should be considered as part of an incentive program to reduce killing.

-Reorientation operations to other fishing activities not in direct antagonism with the monk seal should be examined as a possibility.

MEDITERRANEAN MONK SEAL
(*Monachus monachus*)

GREEK POPULATION

POPULATION AND HABITAT VIABILITY ASSESSMENT

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Report

SECTION 4

INDIRECT THREATS

Indirect Threats to the Survival of the Mediterranean Monk Seal

Potential threats facing the Mediterranean monk seal, other than deliberate killing and habitat degradation, include infectious diseases, pollution, and lack of genetic diversity. To evaluate these possible threats, it is beneficial to accumulate data on the existing population, realizing that systematic sampling is not feasible due to practical considerations.

Currently, there a document exists that has been distributed to all Greek marine mammal research groups, detailing the biological samples to be taken from **living** and **dead** animals for generating the appropriate data bases. This document is continuously updated to ensure present and future requirements such as collection of feces, hair and placentas. An updated version is appended and includes appropriate handling and shipping of samples. Specimens are shipped to the Erasmus University Rotterdam in The Netherlands for evaluating infectious diseases, to the Institute for Forestry and Nature research at Texel (Netherlands) for pollutant studies and to the Institute of Zoology in London for genetic and pollution studies. As sampling of the Mediterranean monk seal is only opportunistic, it is of the utmost importance that every group involved in the recovery of the Mediterranean monk seal adheres to the guidelines if enough useful information is to be obtained for evaluating evidence of infectious agents, levels of environmental contaminants and inbreeding depression.

Since the late 1980's, morbilliviruses have caused extensive mortalities in seals in the North Atlantic and cetaceans in the Mediterranean. The absence of antibodies to these viruses in the Mediterranean monk seal, based on limited samples, suggests that this population has not been exposed yet. The risk of exposure is currently not known, although recent studies have indicated *in vitro* susceptibility of Mediterranean monk seal cells to different morbilliviruses. The seal species involved in the ongoing North Atlantic epizootic do not range down into the Mediterranean Sea. However, the potential danger of introducing morbilliviruses from terrestrial sources, such as free-ranging canids and mustelids, should not be discounted. Although morbilliviruses are presently considered the major infectious disease risk to the Mediterranean monk seal, the possible introduction of other pathogens, not yet identified, must be considered.

The question arises whether a vaccination program should be initiated as a preventative measure. This is a controversial issue. Live, attenuated vaccines should not be used in wildlife species. If non-replicating vaccines are to be used, preference should be given to vaccines that are efficacious after single dose administration. For free-ranging populations, the benefit of vaccination (presumed protection) versus the risk (disturbance of animals to deliver the vaccine) must be assessed. We do not recommend vaccination of free-ranging Mediterranean monk seals as a preventative measure. However, a contingency plan (not including vaccination) to deal with the implications of an outbreak in an isolated sub-population needs to be developed.

There is good evidence that pollutants can have a serious impact on the reproductive and immune systems of marine mammals. Ongoing studies are occurring to evaluate levels of pollutants in the eastern Mediterranean Sea. To assess the actual risk of pollution on Mediterranean monk seals, apart from opportunistic sampling to determine levels of contaminants, studies should be encouraged addressing the distribution of certain pollutants in the Mediterranean monk seal ecosystems. In this respect, special attention also should be given

to the study of the animals' feeding habits.

Currently, studies are in progress to evaluate genetic diversity in Mediterranean monk seals. The opportunistic collection of appropriate samples for genetic analysis should be encouraged just as occurs for monitoring infectious diseases and pollutants. Furthermore, results from these studies should be integrated with future studies on immunology and reproduction to determine if the degree of genetic diversity present in the Mediterranean monk seal population either affects the ability to respond appropriately to infectious diseases or reproduce efficiently.

The free flow of information and materials collected by field researchers and laboratory investigators is essential for assessing the impact of infectious diseases, pollution and lack of genetic diversity on the Mediterranean monk seal. An active effort should be made to encourage veterinarians, immunobiologists and others with relevant expertise to become involved in the study of factors threatening the Mediterranean monk seal at present. Many factors undoubtedly interact to jeopardize the populations, and only by working together to evaluate available information can rational decisions be made and insight obtained on how to manage these populations.

Summary of recommendations

1. Adherence of appended guidelines for the collection, handling and shipment of biological samples from the Mediterranean monk seal for evaluating the presence of infectious diseases and pollutants, as well as assessing genetic diversity, is essential for all individuals working with these animals as sampling is only done opportunistically.

2. Vaccination of free-ranging Mediterranean monk seals as a preventative measure should not be done. However, a contingency plan (not including vaccination) to deal with the implications of an outbreak in an isolated sub-population should be developed.

3. A concerted effort should be made to integrate information obtained from opportunistic sampling of Mediterranean monk seals for environmental contaminants with information collected on the distribution of these contaminants in the seals' ecosystems.

4. Opportunistic sampling of material from Mediterranean monk seals should continue for the purpose of evaluating population genetics.

5. Communication and collaboration amongst field biologists and basic scientists are essential if decisions are to be made and insight obtained on how to manage the Mediterranean monk seals. An active effort should be made to encourage veterinarians, immunobiologists, and others with relevant expertise to participate in this effort.

MEDITERRANEAN MONK SEAL
(*Monachus monachus*)

GREEK POPULATION

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SECTION 5

CURRENT CONSERVATION PROGRAMS

Current Conservation Programs

Current conservation programs for the Mediterranean monk seal in Greece are collaboratively organized within the Greek National Program for the Protection of the Monk Seal. The National Program started in 1991 and in which nine organizations participate is coordinated by the Elliniki Etairia and supervised by the Ministry of the Environment. The names of these organizations, the areas in which they work and the type of work undertaken by each is presented in Table 1. The programs of these organizations are summarized below and, the description presented is contributed by each group and therefore is their own responsibility. Full reports concerning each group's activities are presented in the Presentations, Sections 6 - 13.

The main objectives of the Greek National Program for the Protection of the Monk Seal as agreed upon at the first national meeting in Athens (11/2/191) and presented in the meeting of the Group of Experts for the Protection of the Mediterranean Monk Seal, in Brussels (15/2/1991), and also in the International Seminar for the Protection of the Monk Seal, organised by the Council of Europe in Antalya, Turkey (14/5/1991) are:

1. Active protection by legal and practical means (e.g., guarding) of the monk seal populations in the two areas currently identified as most important:

   a. in the northern Sporades (Aegean Sea)
      -continuation of monitoring,
      -operation of the Biological Station in Gerakas,
      -continuation of the Rescue Center functioning with a provision to expand it to cover not only the Greek region but also the entire Eastern Mediterranean,
      -possibility of future establishment of a captive breeding center.
   b. in the Ionian Islands
      - continuation of monitoring,
      - designation of areas for legal protection.

2. Promotion of the awareness of fishermen and the general public throughout Greece regarding the importance of the monk seal and the various measures for protection. Study of the interaction between fisheries and the monk seal, as well as the promotion of incentives for fishermen (e.g., exclusive fishing rights) with respect to their potential in active protection of the species.

3. Expansion of monitoring surveys to include the entire Greek region and to study in-depth the monk seal populations found there.

4. Increase of the critical mass of people, both within and outside of universities, involved in monk seal research and protection, to increase the scientific potential of the different teams working in the field.

5. Establishment of facilities to keep dead animals (dolphins or monk seals), and a bank of biological samples. Supply of the working teams with field kits for obtaining samples *in situ.*

Table 1. Participants in the Greek National Program for the Protection of the Monk Seal and areas and topics in which each specializes.

NAME	AREA	WORK
1. Hellenic Society for the Study and the Protection of the Monk Seal	A. N. Sporades B. Greece	A. Scientific Research Monitoring Safeguarding Rehabilitation Public Awareness c) Inf. Rescue Network Public Awareness
2. Environmental Research Bureau	Cyclades Islands	A. Scientific Research B. Public Awareness
3. Scientific Group from the University of Aegean	N. Aegean Islands	A. Scientific Research B. Public Awareness
4. Scientific Group from the University of Thessaloniki	Skyros Island	A. Monitoring B. Public Awareness
5. Ecological Society of Hydra "Hydraisa Fhokia"	Myrtoon Area	A. Monitoring B. Public Awareness
6. European Nature Heritage Fund		Public Awareness
7. Hellenic Society for the Protection of Nature		Public Awareness
8. Elliniki Etairia The Hellenic Society for the Protection of the Environment and the Cultural Heritage		A. Coordination B. Running of the Biological Station in Gerakas Alonnisos C. Book-directory D. Register
9. WWF - Greece *	Ionian Sea	A. Scientific Research B. Public Awareness

* Funded under another budget line from the European Union through WWF-International and therefore, not supervised by the Ministry.

Alonnisos Fishermen Cooperative	Alonnisos Island	Active Participation in the Protection of the Animals

6. Continuation of the work of centralization and treatment of data, including historical information.

7. Further studies of interaction among populations of monk seals with other variables (e.g., pollution).

The collaborating organizations of the Greek National Programme for the Protection of the Monk Seal are:

Hellenic Society for the Protection of Nature
Nikis 24, 10557 Athens Tel 322-4944 Fax 322-5285
Focus: Public Awareness

The Hellenic Society for the Protection of Nature has 1750 members, 1000 of who are actively participating, and is the oldest national organization. It was founded in 1951 by members of the Hellenic Climbing Association, which was interested in protecting Greek nature even before the war. The Hellenic Society for the Protection of Nature contributed to establishing the National Park of Olympus and Panassos in 1938. The Society has particularly stressed sensitizing the public to the plight of the Mediterranean monk seal. Since 1952, the society has worked closely with the Ministry of Education with particular focus on developing and distributing informative material to elementary schools.

In the scientific research field, the Society assists Greek and foreign scientists with biological studies and also with publication of reports. The Society operates a biological station in the Evros Delta, which is fully equipped for ornithological and other observations. The Society cooperates with international environmental organizations. In cooperation with the Ministry of the Environment, it has the coordination, in Greece, of the European Union Program "Blue Flags of Europe" that focuses on public awareness with respect to the quality of coastal waters of the European Union, awarding "quality flags" in recognized stretches of coast.

The Society also has focused on educating fishermen, recognizing early the importance of good relationships between the society and local people. To facilitate their work, the Society has also offered incentives (e.g., refrigerators to cooperatively used by a local community) to fishermen for not killing monk seals. This group has $\pm$ 160 focal points for the aforementioned "Blue Flag" program on the various coasts to which information concerning the Mediterranena monk seal is passed and received with respect to problems in and near the areas.

Scientific Group from the University of Aegean
Karantoni 17, 81000 Mytilini Tel 0251-29579, 61005, 21286 Fax 0251-23783
Area: Northern Aegean islands
Focus: Monitoring and public awareness

Areti Kontogianni, a Ph.D. student of the University of Aegean, in 1993, created the Monk Seal Research Group at the Department of Environmental Studies. Since then, this

rapidly developing group has increased its activities, separated into the following groups:

A monitoring group	A conservation-education/public awareness group
An economics and policy group	A population biology group

The Mediterranean monk seal Research team consists of three professors, five postgraduate students and 20 undergraduate students and is based permanently in Lesvos. A team for environmental education also has been organized in Rhodos at the Department for Primary and Secondary Education of the University.

Participating in the National Programme, the team has undertaken research in the greater area of the Northeast Aegean, specifically Lesvos, Samos, Fourni, Chios, Psara and Rhodos islands. The Group's program focuses on identifying important habitats that are needed to secure the existence of the monk seal population in the NE Aegean area. The most recent studies seriously support the idea that there is interchange between the islands populations and Turkish opposite coast.

University of Thessaloniki
PO Box 134, 54006 Thessaloniki Tel 031-911426
Area: Skyros Island
Focus: Monitoring

The scientific team from the University of Thessaloniki consists of seven members that have a permanent (academic) or temporary (Ph.D. students) relation with the zoology section of the biology department.

The Programs activities consist primarily of qualitative study of the benthic organisms (hard and soft substrate) and the demography of fish populations. The scientific team has surveyed the monk seal population in the northern Aegean and now is working on monitoring the population in the area of Skyros Island. Geographically, this group works within the smallest area.

The University of Thessaloniki group also collects informal information from fishermen and is carrying out studies of fisheries catch and its relation to the monk seal. Frequent cave surveys are conducted; there have been sightings in a few caves. Although the presence of animals has been confirmed, it is not yet know if they reproduce at Skyros. There also have been anecdotal reports of animals on secluded beaches.

Hellenic Society for the Study and the Protection of the Monk Seal
Solomon 53, 104 32 Athens Tel. 3644164, 5222888 Fax. 5222450
Focus: Monitoring, safeguarding, public awareness, and a rescue center

The Hellenic Society for the Study and Protection of the Monk Seal (HSSPMS) is a non-profit, non-governmental environmental organization established in 1988 by a group of biologists and researchers from the ecology and zoology departments of the University of Athens. They were

joined by sensitized students, who were concerned about the state and the protection of the marine environment. It currently has 2000 members, with a full time staff of 14 scientists and field researchers, four part-time staff, and as many as 40 volunteers. The goal of the Society is the study of the Mediterranean monk seal aiming to understand its biology, ecology and behavior and its protection with all legal means, including the raising of the public awareness.
Within these 5 years of efforts, the HSSPMS has managed to operate continuously with specific projects, based on the main directives and plans of action that have been set from the international community for the protection of this species.

To expand its activities and increase the effectiveness of its research, the HHSPMS established an International Advisory Committee consisting of experts on different aspects of Marine and Seal Biology.

The main activities of the HSSPMS are:

-Surveillance and guarding of the National Marine Park with the HSSPMS high speed boat "Alonnissos" and with two professional guards, in cooperation with an officer of the Port-Police station of Alonnisos.

-Operation of the Seal Treatment and Rehabilitation Centre, always in collaboration with the Seal Rehabilitation and Research Centre, Pieterburen, the Netherlands. In the intensive care unit, which is located at Steni Vala Alonnisos, HSSMPS has treated three orphaned monk seal pups.

-Establishment and operation of an Information and Rescue Network throughout Greece through monthly expeditions to selected areas of coastal Greece. In the HSSPMS offices, a 24 hour telephone line is always operating for emergency cases. The network collects information on the monk seal population and its distribution as well as the immediate reports of cases that monk seals needing treatment are found.

-Informing and sensitizing of local fishermen on the status of the monk seal. In collaboration with fishing cooperatives and fishery services, promote joint proposals for the protection of the monk seal and the local fish stocks.

-Promotion for establishment of protected areas in collaboration with the relevant government authorities.

-Environmental education with emphasis on the monk seal in the schools of major cities and of coastal Greece. The project (started in 1990) is operating on a daily basis throughout the school year and includes slide shows, discussions with the children and distribution of specially designed relevant material.

-Operation of four information kiosks in the islands of Skiathos, Skopelos and Alonnisos by experienced personnel and volunteers.

-Informing and sensitizing the public by the mass media through television and radio interviews with articles in newspapers and magazines of the national and local press.

-Organizing presentations, lectures and exhibitions on the protection of the monk seal and its habitats.

All these activities are realized by the effective work of a devoted team of scientists, environmentalists, technicians, volunteers and society members.

World Wide Fund for Nature
Asklepiou 14, 10680 Athens Tel/Fax 362-3342
Area: Ionian Sea
Focus: Monitoring and public awareness

WWF, the World Wide Fund for Nature is an international non-governmental, non-profit environmental organization with more than five million supporters world-wide. It has institutional presences in 49 countries, including Greece. Its mission is to achieve the conservation of nature and ecological processes.

One of the priorities in WWF's programme to the Year 2000 is the marine environment, including coasts. Coastal regions are very productive ecosystems, but are very threatened by human activity which is increasingly concentrated in the coastal edge. At the same time, many of the inhabitants of the open sea, such as whales, dolphins, sea turtles, seals, pelagic fish and birds are also threatened by human actions. WWF promotes marine conservation efforts through a variety of strategies.

In October 1993, WWF-Greece completed the first of a 3-year conservation programme in the Ionian sea especially Zakynthos, Kephalonia and Ithaka islands, concerning habitats of species threatened by extinction. The goal of the programme is to achieve progress in an integrated approach towards conservation of these species and their habitats. The species of special concern are the loggerhead turtle Caretta caretta and the Mediterranean monk seal.

The WWF monk seal project consists of regular monitoring of the seal habitats, visit to caves, collection of evidence, recording of seal sightings, boat counts, recording of weather conditions, public awareness campaigns and other activities. Two different groups from the WWF are working on each island, monitoring the populations and carrying out public awareness campaigns. The WWF has established a protected area in the Strofades Islets and is now carrying out an extensive study on the interaction between monk seals and fisheries as well as on economic incentives with respect to monk seal preservation.

Ecological Society of Hydra "Hydraisa Fhokia"
Periandrou 12, 15126 Marousi Tel 362-7341 Fax 360-5531
Area: Myrtoon
Focus: Monitoring and public awareness

The Ecological Society of Hydra (ESH) was founded in 1989 by a group of 40 people; the organization now has 200 actively participating members. The activities of ESH span activities ranging from scientific research to public awareness, including environmental education concerning the greater part of Saronic and Argolic Gulf, as well as the Myrtoon Sea. There has been particular emphasis toward approaching fishermen and working with local information from that source. The Society has established a program of incentive with local fishermen whereby new engine oil is exchanged without cost for used engine oil.

Activities of the Ecological Society of Hydra include:

-presentation of speeches in schools and professional unions
-meeting with local people, hotel owners and fishermen
-distribution of informative material
-mapping of the sighting areas for the monk seal
-coordination of the network for collecting information in their area
-field observations
-annual free distribution of engine oil to the fishermen of the area, in quantities matching the used oil delivered by them

The ESH has reported finding seals on secluded beaches, which is not common in other areas. Observational studies have been carried out since 1990. The ESH has suggested that there appears to be sufficient potential breeding/nesting sites and that the major problem concerns nutrition (e.g., adequate food supply) - as is indicated by increased attacks by monk seals on fishing nets. Monk seals have turned to eating fish that they normally would not eat (e.g., smaller fish or species that normally are not consumed), which indicates that there is a definite downward trend in the food supply.

Environmental Research Bureau
PO Box 8470, 10010 Athens Tel 360-3143
Area: Cyclades islands
Focus: Monitoring and public awareness

The Environmental Research Bureau (ERB) was founded in 1991 and is a non-profit organization consisting of a small group of specialized scientists with significant experience in research and management of the environment. It is oriented toward operating programs related to the direct protection and study of endangered species and their habitats, as well as in promoting the idea of the sustainable management of the environment and natural resources.

The ERB participates in the Greek National Programme for the Protection of the Monk Seal, specifically working on monitoring of the monk seal population in the area of Cyclades Islands. Other emphases include the sensitization of the local people to monk seal conservation

issues and the analysis of the parameters affecting the decline of the monk seal population in the area. The ERB also has worked in other areas of Greece (Chalkidiki and Zakythos).

ERB members have worked in different research programs funded by the European Union, the Greek government, environmental organizations and private sponsors. The scope of the projects mainly are related to the biology and ecology of marine and terrestrial species, with an aim toward effective protection.

European Nature Heritage Fund - Euronature
Patitiri, 37003 Alonissos Tel/Fax 0424-65789
Focus: Public awareness

The European Nature Heritage Fund (ENHF now called EURONATURE) was founded in 1987 and is concerned with conservating the monk seal and its Mediterranean habitat, in particular, the Northern Sporades National Marine Park, the island of Zakynthos, the coasts of Greece, Turkey, Algeria, Morocco as well as other parts of the Mediterranean. Primary emphases include the preparation of an educational package for Greek schools and teachers, as well as lobbying outside Greece over issues pertaining to the monk seal.

Since June 1992 Euronature has been closely cooperating with the Ecological and Cultural Movement of Alonnisos, an organization founded in 1989, with main objectives not only protecting the Mediterranean monk seal, but also protecting the natural and cultural environment in the National Marine Park of Alonnisos-N.Sporades.

Since 1992 the two organizations have run an information centre in Patitiri, the capital of Alonnisos, to promote the National Marine Park among the local people and tourists. Both organizations work to promote ecotourism on the island as an alternative tourist model. They conduct public awareness projects aimed especially to sensitize children towards environmental friendly behavior. Each year campaigns are organized with local people to clean the island's beaches and forests.

Elliniki Etairia - The Hellenic Society for the Protection of the Environment and the Cultural Heritage
Tripodon 28, 10558 Athens Tel 322-5245 Fax 322-5240
Focus: Coordination, operation of the biological station in Gerakas - Alonissos, preparation of a book summarizing efforts of the various organizations focusing on monk seal conservation within Greece and coordinating the Greek part of the International Monk Seal Register started by the European Union in collaboration with the I.R.Sc.N.B and the Sea Mammal Reasearch Unit, study of the legal and economic framework, conduct research in collaboration with universities and research groups.

The Elliniki Etairia (EE), the Hellenic Society for the Protection of the Environment and the Cultural Heritage was founded in 1972 and is a registered non-governmental, charitable organization. Its aims are to enhance the interest of the Greeks in the value of their natural and

and participating actively in protecting the environment.

The activities of the EE are divided into several areas: actions and pilot projects for protecting the Greek natural and cultural heritage; contribution to research for the protection of the natural environment; campaigns; increasing the awareness of the authorities and the public on crucial environmental issues; and environmental education. The EE also undertakes interaction with the state, national, regional and local authorities and political parties for the formulation and application of effective environmental policies, international environmental non-governmental organization work (e.g., EEB, Europa Nostra, IUCN), with particular emphasis in the Mediterranean.

Since 1991, the EE has coordinated the National Programme for the Protection of the Monk Seal, under the supervision of the Ministry for the Environment and has the responsibility of presenting all the packaged proposals for funding to the European Community. The Greek government co-signs for the funding with Elliniki Etairia and both share responsibility for funded projects and provide indirect and in-kind support. The funding for the Ionian project which integrates monk seal and sea turtle research and is operated by WWF is not funded in this way, although the WWF Ionian Sea project is also coordinated by the Elliniki Etairia, as it respects data collection, participation in the meetings of the Greek National Programme and other activities.

The EE also has organized several national meetings. Much work has focused on preparing presidential decrees covering the area of the Sporades National Park. Apart from the coordination of the National Programme, the EE is responsible for the Greek central register on monk seal data, which is part of the International Monk Seal Register run by the I.R.Sc.N.B and the S.M.R.U. and is preparing a book where all the principal players in monk seal conservation are presented.

The EE runs the field station at Alonnisos (Gerakas). This station hosts groups from Greece, from universities and also foreign groups interested in carrying out research at Alonnisos. The EE has worked extensively to develop good relations with the fishermen's cooperative in Alonnisos, possibly via incentives as an investment (e.g., the purchase of ice-making machinery and offering to build a boat for ecotourism) and it has managed to secure funds for these actions from the European Union through the National Programme. Because of the change in political climate from year to year, the structure of managing body of park is somewhat uncertain at present. When this body is appointed, this effort with local fishermen will be less tenuous. If this effort is to succeed, the contribution of the local fishermen to the program will need to be recognized and lauded, both by the scientists and the political bodies.

EE has prepared and will install the system of signs as well as the eco-tourist guide of the National Park of Sporades.

The EE also is working on pollution issues in the northern Sporades area, and the Greek seas in general, although these activities are not specially funded by same sources. Information concerning these issues (e.g., water quality) is offered to the monk seal conservation programs through the programs of Professor Scoullos at the University of Athens.

Additional activities by other organizations:

Hellenic Zoological Society
P.O. Box 3249, 102 10 Athens, Tel. 7231007, Fax. 7284604

The Hellenic Zoological Society has established a Greek Fauna Documentation Centre that collects all the literature on the fauna of Greece including the monk seal. The Centre is preparing a data base for Greek fauna that includes distribution data and mapping. The Society has also published a Red Data Book on the vertebrates of Greece which is now being transformed to a computerized form to facilitate updating. Taking into account the data known so far, the monk seal has been assigned an endangered species status according to the IUCN categories.

REEK NATIONAL PROGRAMME FOR THE PROTECTION OF THE MONK SEAL

Ecological Society of Hydra
"Hydraisa Phokia"

Periandrou 12, 15126 Marousi
Tel: 3627341, Fax: 3605531

Working area:
MYRTOON SEA

Contact person: M. Tsakiris

W.W.F. - GREECE
World Wide Fund for Nature

Asklepiou 14, 10680 Athens
Tel-Fax: 3623342

Working area:
IONIAN

Zakynthos: A. Vlachoutsikou
Kephalonia: A. Panou

Hellenic Society for the Study
& the Protection of the Monk Seal

Solomou 35, 10682 Athens
Tel: 3644164, Fax: 3628211

Working area:
NORTHERN SPORADES
DODECANESA

Contact person: V. Zavras

University of Thessaloniki
Biology Dept. - Zoology Div.

P.O. Box 134, 54006 Thes/niki
Tel: 031-991426

Working Area:
SKYROS

Contact person: A. Koukouras

Environmental Research Bureau

P.O. Box. 8470, 10010 Athens
Tel: 3603143

Working area:
CYCLADES

Contact person: D. Cebrian

University of Aegean
Environmental Studies Dept.

Karantoni 17, 81100 Mytilini
Tel: 0251-21286, Fax: 23783

Working area:
NORTHERN AEGEAN

Contact person: N. Margaris
A. Kontogianni

European Nature Heritage
Fund (ENHF)

Patitiri, 37003 Alonnisos
Tel-Fax: 0424-65789

PUBLIC AWARENESS

Contact person: G. Hau

ELLINIKI ETAIRIA
The Hellenic Society for the
Protection of the Environment
and the Cultural Heritage

Tripodon 28, 10558 Athens
Tel: 3225245, Fax: 3225240

Co-ORDINATION
Book-Directory
Data Register

Hellenic Society for the
Protection of Nature

Nikis 24, 10557 Athens
Tel: 3224944, Fax: 3225285

PUBLIC AWARENESS

Contact person: G. Sfikas

MEDITERRANEAN MONK SEAL
(*Monachus monachus*)

GREEK POPULATION

POPULATION AND HABITAT VIABILITY ASSESSMENT

Athens, Greece
4-7 April 1994

Report

PRESENTATIONS

SECTIONS 6 - 14

MEDITERRANEAN MONK SEAL
(*Monachus monachus*)

GREEK POPULATION

POPULATION AND HABITAT VIABILITY ASSESSMENT

Athens, Greece
4-7 April 1994

Report

SECTION 6

ELLINIKI ETAIRIA

GREEK NATIONAL PROGRAMME FOR THE PROTECTION OF THE MEDITERRANEAN MONK SEAL (*Monachus monachus*) - FIRST RESULTS

Scoullos, M., Mantzara, B., and Constantianos, V.

ELLINIKI ETAIRIA
Hellenic Society for the Protection of the Environment and the Cultural Heritage

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ABSTRACT

Since January 1991, Elliniki Etairia (The Hellenic Society for the Protection of the Environment and the Cultural Heritage) has the co-ordination of the Greek National Programme for the Protection of the Mediterranean Monk Seal, which aims to organize all the groups carrying out fieldwork and research in sensitive areas and important Monk Seal habitats and/or run public awareness campaign, and to create a central data base of all surveys carried out in the Greek space and their results.

The project "Monitoring Surveys of Monk seal in Greece except in N.Sporades" was the first "pilot project" carried out in this framework between 7.11.91 - 30.6.92 by five different groups. Its main objective was to assess the status of the population and habitat of the Monk Seal in the Aegean Sea.

The main principal of a harmonized National coordination is not to implement common uniform practices and ready made solutions in each one of the areas were Monk Seal habitats exists but to secure a coordination in institutional approaches (as it concerns e.g. fishing or incentives-disincentives etc.), to facilitate exchange of information and expertise, to promote a balanced coverage of the Greek space and to encourage the development of a "Greek School" of Management of Monk Seal habitats.

Key Words: monk seal, endangered species, habitat assessment, wildlife conservation, National programme

INTRODUCTION

The Mediterranean Monk Seal (*Monachus monachus*) is the No 1 endangered species in the E.C. and the 10th most endangered species in the world. It was once found along all shores of the Mediterranean, the Black Sea, the coasts of Northwest Africa, around Madeira and the Canary Islands.

The main reasons for its extinction are overfishing, uncontrolled tourism, the pollution of coastal and marine environment and the hostile attitude of the local fishermen including also, particularly in the past, deliberate killing. Recent development of coastal infrastructures has destroyed many areas that females once used for pupping, forcing them to more remote spots. The last surviving population live mainly in Greece, although small populations also exists in other parts of the Mediterranean coast.

1. THE NATIONAL PROGRAMME

1.1 LAUNCHING OF THE NATIONAL PROGRAMME - PARTICIPATING GROUPS - COMPETENT AUTHORITIES

In order to protect this animal at a National level, Elliniki Etairia was called to undertake the coordination of a consorted effort of the Greek Government, the European Community and the environmental groups active on various aspects of protection of the animal in the entire Greek space and in this way the National Programme for the Protection of the Monk Seal was launched.

The groups working for the Monk Seal carrying out fieldwork in sensitive areas and important Monk Seal habitats and/or running public awareness campaign, participating in the Project (No:4-3010(92)7829-E.C. contract) supported financially (75%) by the Commission of the European Communities are listed Table 1.

Apart from these groups, some other local initiatives exist and their representatives are often invited in the relevant meetings.

The PUBLIC AUTHORITIES involved are:

- THE MINISTRY OF THE ENVIRONMENT AND PUBLIC WORKS
- THE MINISTRY OF AGRICULTURE
- THE MINISTRY OF MERCANTILE MARINE
- THE PREFECTURE OF MAGNESIA
- THE MUNICIPALITY OF ALONNISOS.

1.2 AIMS - GUIDELINES

One of the first aims of the Coordination was to define a number of realistic goals and guidelines for the protection of the Monk Seal in Greece which would provide a workable common ground to be taken into account by all groups for the development of their own projects.

For this purpose Elliniki Etairia organized in 1991, 3 National Meetings with the relevant groups and the competent authorities, the output of which formed the guidelines of the Greek National Programme. These guidelines are:

1. Active protection by legal and practical means, guarding etc. of the Monk Seal populations in the two most important areas identified until now:
(a) In N. Sporades (Aegean sea): Continuation of the monitoring - Operation of the Biological Station in Gerakas - Continuation of the Rescue Centre functioning and provision to expand it to cover the Greek space and the entire Eastern Mediterranean - Future establishment of a captivity breeding centre.
(b) In the Ionian islands: Continuation of the monitoring - Designation of the area under a legal form of protection.

2. Promotion of the awareness of fishermen, and the general public throughout Greece, on the importance of the Monk Seal and of the various protection measures. Study of the interaction between fisheries and Monk Seal and promotion of incentives such as exclusive fishing rights for the active protection of the species.

3. Expansion of monitoring surveys to cover the entire Greek space, and in depth study of the Monk Seal populations.

4. Increase of the critical mass of people (inside and outside universities) involved in Monk seal research and protection and of the scientific potential of the different teams working in the field.

5. Establishment of facilities to keep dead animals (dolphins or monk seals), and a bank of samples. Supply of the working teams with mobile kit for taking samples in situ.

6. Continuation of the work of centralization and treatment of data, including some historical ones.

7. Further studies of interaction among populations of Monk Seals and other parameters, such as pollution etc.

1.3 ACTIVITIES

The area of N.Sporades has been declared a National Marine Park and it is protected under the Greek Low by a Presidential Decree issued on 28th of May 1992 after persistent pressure and a lot of continuous efforts by everyone involved in the Monk Seal Protection and a lot of preparatory work provided by Elliniki Etairia and others.

A Rescue network covers the entire Greek space supported by all groups. Furthermore a rescue and rehabilitation station is operating in Alonnisos island (N.Sporades), under the responsibility of the Hellenic Society for the Study and the Protection of the Monk Seal, which is the group working in that area.

The Coordinator has managed to secure the largest proportion of funds contributed by the Commission of the European Communities for the period '92-'94 for the protection of the Monk Seal, by presenting a thoroughly prepared and harmonized project covering in a relatively balanced way the entire Greek Space. We must point out the fact that this was the first time that a central coordination and management of funds took place, through which a large number of groups were supported to work in this field while few years ago only one or two groups had the possibility to secure funds from the E.C.

2. FIRST RESULTS

During 7/11/91 - 30/6/92 the first pilot project "Monitoring Surveys in Greece except in N.Sporades" was completed with main objective to assess the status of the population and the habitats of the Monk Seal in the Aegean Sea.

Five teams undertook the field work (monitoring and research surveys), covering the following regions of the Aegean Sea, respectively:

A. The Hellenic Society for the Study and the Protection of the Monk Seal (HSSPMS), in the Dodecanese islands, namely Nissiros, Yiali, Strogylo, Tilos, Halki, Alimnia, Symi, Rodhos, Karpathos, Saria and Kasos,

B. The Environmental Research Bureau, in the Cyclades islands, namely Milos, Antimilos, Kimolos, Poliaigos, Sikinos, Folegandros, Santorini, Anafi, Paros and Andiparos,

C. The Ecological Society of Hydra "Hydraisa Phokia", in the island of Hydra and the Myrtoon Sea, and more specially the coast of Peloponnisos from Monemvasia to the island of Spetses,

D. A research team under the supervision of Prof. A.Koukouras of the University of Thessaloniki in the Northern Aegean, except Samothraki island. This team worked

surveyed the islands of Limnos, Ayios Evstratios, Lesvos, Chios, Euvia and also the peninsula of Sithonia and Athos, in Chalkidiki,

E. A research team under the supervision of Prof. T.Alifakiotis of the University of Thessaly surveyed the Samothraki island.

The teams worked independently but in close contact with the Elliniki Etairia. Several meetings were organized with the groups during the study period.

2.1 METHODS OF COLLECTING DATA

The teams worked using both indirect and direct methods to collect data about the Monk Seals in the area they examined with relatively small differences in their methodologies and processes followed.

The indirect method is based on interviews with the local fishermen, concerning the area, the number of seals, their mortality and natality and also the damages they cause to nets. All groups were well aware of the problems of this method and therefore great care was taken in order to secure that the assessment reflects the minimum number of individuals in the examined area. Information was double checked and cross-checked with the descriptions provided by various fishermen, on specific seals.

The direct methods included examination of all the hollows, rock openings and caves of the surveyed area by snorkeling, by boat and by using diving equipment when available. All, or at least most of the caves considered as suitable shelters for mating and resting for the seals, were recorded and photographed and every evidence of seal presence in the examined area was recorded. Two teams (HSSPMS and ERB) presented, also, sketch diagrams of the caves which they considered as very important.

2.2 PUBLIC AWARENESS

In the framework of the project, important work has been done by all teams in the sector of environmental education and public awareness, concerning the monk seal. The latter was used as a symbol through which the protection of the entire marine environment was promoted. In that direction rescue networks for the monk seal were organized in most of the areas, based on volunteers.

2.3 MAIN CONCLUSIONS OF THE SURVEYS

In broad lines we should mention that the number of suitable shelters identified (about 100 so far) in proportion to the length of the coastline examined and the total number of caves recorded, was not impressive. It should be stressed, however, that

caves with submarine entrances have not been identified during this phase

Concerning the Monk Seal population, we can conclude that, a considerable number of Monk Seals still live in the part of the Aegean studied and also pupping occurs in several areas. A moderate assessment gives 80-100 adult Monk Seals without counting the Sporades islands and many other large areas, such as Crete and the small islands of S. Aegean, where monk seal populations occur but they remain virtually unstudied, so far. The present results are comparable with those published by the Royal Institute of Natural Science of Belgium.

Illegal fishing, destruction of the habitats mainly due to tourist development and marine pollution, together with still going on deliberate killing by fishermen present acute pressures responsible for the shrinking of the original Monk Seal population of the Aegean.

EPILOGUE

The main principal of a harmonized National coordination is not to implement common uniform practices and ready made solutions in each one of the areas were Monk Seal habitats exists but to secure a coordination in institutional approaches (as it concerns e.g. fishing or incentives-disincentives etc.), to facilitate exchange of information and expertise, to promote a balanced coverage of the Greek space and to encourage the development of a "Greek School" of Management of Monk Seal habitats.

Given that the vast majority of the animals live in the Greek waters the aforementioned activities and the Greek Coordination is hoped to contribute substantially to the protection and safe survival of this species, which has become a symbol of the vulnerability of our Environment in the entire Mediterranean.

TABLE 1

NAME	AREA	WORK
1. HELLENIC SOCIETY FOR THE STUDY AND THE PROTECTION OF THE MONK SEAL	N.SPORADES	a. MONITORING b. SAFEGUARDING c. PUBLIC AWARENESS d. RESCUE CENTRE
2. ENVIRONMENTAL RESEARCH BUREAU	CYCLADES ISLANDS	a. MONITORING b. PUBLIC AWARENESS
3.SCIENTIFIC GROUP FROM THE UNIVERSITY OF AEGEAN	N. AEGEAN ISLANDS	a. MONITORING b. PUBLIC AWARENESS
4.SCIENTIFIC GROUP FROM THE UNIVERSITY OF THESSALONIKI	SKYROS ISLAND	a. MONITORING b. PUBLIC AWARENESS
5.ECOLOGICAL SOCIETY OF HYDRA "HYDRAISA FHOKIA"	MYRTOON AREA	a. MONITORING b. PUBLIC AWARENESS
6.EUROPEAN NATURE HERITAGE FUND		PUBLIC AWARENESS
7. HELLENIC SOCIETY FOR THE PROTECTION OF NATURE		PUBLIC AWARENESS
8. FISHERMEN COOPERATION OF ALONNISOS	ALONNISOS ISLAND	ACTIVE PARTICIPATION IN THE PROTECTION OF THE ANIMALS
9.ELLINIKI ETAIRIA THE HELLENIC SOCIETY FOR THE PROTECTION OF THE ENVIRONMENT AND THE CULTURAL HERITAGE		a. COORDINATION b. RUNNING OF THE BIOLOGICAL STATION IN GERAKAS ALONNISOS c. BOOK-DIRECTORY d. REGISTER
WWF-GREECE *	IONIAN SEA	a. MONITORING b. PUBLIC AWARENESS

* Funded under another budget line from the E.C. through WWF-International

SUBPROJECT 1
Title : BIOLOGICAL STATION IN GERAKAS BAY

In the North side of Alonnisos island, situated in a place with panoramic view over the Gulf of Gerakas the Biological Station of the National Marine Park of Alonnisos N.Sporades has been built. The Elliniki Etairia is responsible for the maintenance and running of the Station for the period 92-94, under the supervision of the Ministry for the Environment.

The Station is able to host at least 12 scientists and serve as a scientific and research post for people who want to work in the area of the Park. It has a laboratory room for biological scientific research and a deep freezer for preserving samples. There are 3 fully furnished bedrooms in the building an operational kitchen with all the necessary facilities for cooking and a dinning-living room. The central heating installation allows the functioning of the Station even during winter months.

Since 1.4.1992 a resident keeper has been hired by the Elliniki Etairia for the Biological Station in Gerakas bay. He is staying at the premises of the Station with his wife, and he is responsible for the maintenance of the building and for doing small repairs where and when it is needed, where his wife is responsible for cleaning the place.

In order to promote the parallel use of wind energy in the Marine Park, a survey is carried out by the Elliniki Etairia, on the possibility of installing a wind generator in the area of the Biological Station.

Our aim is to make the Station a Centre for the protection of the Monk Seal in the area of the National Marine Park, and able to host National and international meetings on subjects relevant to coastal management and protection of endangered species. Also to serve as a Scientific and research post for people who want to work in the area of the Marine Park.

The first International training course took place at the Biological Station in Gerakas Alonnisos during the first week of September 1993. The meeting was jointly organized by the UNEP/SPA, Elliniki Etairia, the Ministry of the Environment and the H.S.S.P.M.S.

SUBPROJECT 2: Title : PREPARATION OF A BOOK-DIRECTORY FOR THE PROTECTION OF THE MONK SEAL IN GREECE

The aim of this project is to present in a comprehensive way all the research and conservation work carried out and currently being done on the Monk Seal in Greece by all relevant groups, Universities and Institutions that are active on this subject in the Greek space.

The first step to this direction is the review of all the work completed and the gathering of the existing material.

Several personal contacts have been made with the groups and a considerable amount of material has been collected. A beautiful collection of old gravures depicting various seals has been identified and purchased in order to be used for the publication. The layout has been made. The next step will be the classification of all the information collected and the detailed designing of the publication in order to be printed before the end of the year.

A pamphlet has been published, in order to promote the National Programme for the Protection of the Monk Seal, and to present it in a short and easily understandable way, giving brief information about each one of the participating groups, contact persons, tel., fax etc. This

pamphlet is going to be distributed to all public services and other administrations and the coastal Greek municipalities, especially those important for the Monk Seal.

SUBPROJECT 3: Title: FUNCTIONING OF A DOCUMENTATION CENTRE

Upon the approval of this project the Elliniki Etairia became also responsible for the functioning of the Documentation Centre, which was until recently located at the University of Volos under a joint programme with the I.R.S.N.B. Due to this commitment the Elliniki Etairia organized two National meetings (July'92 - March'93) with all the concerned groups, to discuss in length all the issues regarding the Documentation Centre and our cooperation with the I.R.S.N.B. The meaning of the intervention of the E.E. is to collect nationally all the available relevant information which is needed for the assessment of the activities undertaken, the management introduced and the design of future policies.

The E.E. worked closely with the Royal Institute to formulate a protocol for the Register, acceptable by every one participating to it, and also to arrange all the relevant details for the transfer of all the documentation facilities.

All the existing information and data on the monk seal surveys in Greece have been inserted in the Greek Register and their available to all working groups and they are continually updating.

RUNNING - COORDINATION OF THE PROJECT

In the framework of the Coordination of the National Programme for the Protection of the Monk Seal, the Elliniki Etairia has organized or took active part in the following activities:

- Organization of 3 National meetings with all the participating groups and the competent authorities to discuss, organize and decide upon the priorities of the Programme and every other relevant issue. Several meetings have been also organized before the official beginning of the project in order to prepare it thoroughly and harmonize the various views.

- The President of the Elliniki Etairia made several trips to Brussels, to participate in the Experts meetings, to present and support the Programme and follow closely the issues.

- A lot of preparatory work had been done by the Elliniki Etairia and others participating in the Programme, for the drafting, finalization and issuing of the Presidential Decree for the Establishment of the Marine Park which was finally issued on 28 May 1992 (ΦΕΚ 519).

- A lot of work has been invested by the Elliniki Etairia for the preparation of the new supplementary Presidential Decree needed, concerning the Management Body of the Park and a number of technical issues.

- A small project of the Hellenic Society for the Protection of Nature concerning the production of public awareness material was funded.

- Participation in the events of the release of the monk seals "Thodoris" and "Efstratia", in Alonnisos. These events were of great importance and there were attended by the Minister of the Environment and the Prince Satur din Aga Han.

-Participation in Seminars: 25/27.9.92, in island Ustica N. Sicily : "Management of Marine Protected areas- Touristic Development". The National Programme and the Marine Park of Alonnisos N.Sporades were presented. 5/7.11.92, the 3rd annual meeting of MEDPAN network was held in Alicante-Spain. The National Marine Park of Alonnisos N.Sporades was presented.

- A visit to the Seal Rehabilitation and Research Centre in Pieterburen and in ecoMare in Texel -Netherlands was made in order to have a closer look on the different activities and on the organization of these Centres.

- Visit to the Port Cross Marine Park.

-A Seminar on the "Morbillivirus in Dolphins" has been organized due to the significance of this incident to the marine environment and to the Mediterranean Monk seal itself. Experts on autopsy procedure and sampling from dead animals were invited to give lecture together with the groups that have field experience. Representatives from the Ministries of Environment and Agriculture were also present. Participation on a Seminar on the same subject organized by the Society of Oceanographers in the Athens University.

- Several press conference an interviews had been given by Prof. M. Scoullos on the subject of the protection of the Monk Seal and the National Programme in Greek and foreign radio stations and newspapers. A presentation was also made in the Super Channel-UK on the Mediterranean including the Monk Seal.

-Gathering of material relevant to the issues of Monk Seal Protection, and management of endangered species, their ecosystems and protected areas.

- A chapter on protection of endangered species is drafted to be included in the Greek National Strategy for the Protection of Nature, now under preparation.

- A stand presenting the National Programme was exhibited in the International Exhibition and Conference HELECO'93, which was held in Athens between 1-4 April 1993.

- The National Programme for the Protection of the Monk Seal was presented to the participants of the two Residential workshops organized by the Mediterranean Information Office in Athens with NGO delegates from different European and non-European Mediterranean countries.

- The concept of the National Programme and the status of the Mediterranean Monk Seal in Greece was briefly presented by Prof. M. Scoullos in several occasions in international meetings and conferences.

MEDITERRANEAN MONK SEAL
(*Monachus monachus*)

GREEK POPULATION

POPULATION AND HABITAT VIABILITY ASSESSMENT

Athens, Greece
4-7 April 1994

Report

SECTION 7

HELLENIC SOCIETY FOR THE STUDY AND PROTECTION OF THE MONK SEAL

HELLENIC SOCIETY FOR THE STUDY AND THE PROTECTION OF THE MONK SEAL

Thank you,

I am Vrassidas Zavras, chairman of the Hellenic Society for the Study and Protection of the Monk Seal. Since it's a long name, it's better to remember it as Hellenic Society or HSSPMS which is not easy either but shorter.

On behalf of the HSSPMS I would like also to welcome you here and I hope that it will be a fruitful meeting.

In the late eighties the status of the monk seal protection in Greece was far from ideal. The reasons of its decline continued uncontrollably and protection proposals were not implemented. It was becoming obvious that an organization with sole aim the protection of the No 1 endangered species in Europe, was necessary. Thus the HSSPMS was established in 1988, as a non-profit and non-governmental organization, by a group of biologists and researchers. Today all Society's efforts are supported by 2.000 members in Greece and abroad.

The goals of the Society are the study of the Mediterranean Monk Seal aiming to understand the biology, ecology and behavior of this species, and its protection with all legal means, including the raising of the public's awareness.

In order to achieve the above, the Society is governed by a flexible 7 member board of directors which is elected by the General Assembly. Further, more, the continuously increasing members, provide to the Society strength on a political and social level.

In addition, recently, the HSSPMS, in its effort to expand its activities and increase the effectiveness of its research work, established an International Scientific Advisory Committee consisting of experts on different aspects of Marine and Seal Biology. The members of the committee are :

Prof. A.D.M.E. Osterhaus, from the Seal Rehabilitation and Research Center, The Netherlands.
Prof. P. van Bree, from Institute of Taxonomic Zoology, University of Amsterdam, The Netherlands.
Dr. J. Harwood, from Sea Mammal Research Unit, Cambridge,
United Kingdom.
Prof. D. Lavigne, from International Marine Mammal Association, Canada.
Prof. A. Legakis, from Zoological Museum, Department of Biology, University of Athens, Greece.
Dr. P. Reijnders, from Institute of Forestry and Natural Management, Texel, The Netherlands.
Prof E. Trillmich, from Department of Behavioural Ecology, University of Bielefeld, Germany.

The task of this Committee is to :
- advise on the scientific research priorities related to the goals of the HSSPMS
- advise on the development and implementation of an active scientific research plan, according to research priorities
- play an active role in the establishment of a national and international collaborative network with organizations relevant research groups for the benefit of the study and protection of the monk seal.

The International Scientific Community, due to the highly endangered status of the Monk Seal has, several times during the last two decades, addressed the main threats to this species and proposed plans of action for its conservation.

Throughout these plans there are several common points that make up a complete strategy for the conservation of the monk seal and its habitat. These are :

- The establishment and enforcement of legislation aiming at the prevention of the Killing and for the full protection of the species.
- The establishment of a network of monk seal reserves.
- The effective protection of the existing conservation areas.
- The Operation of facilities for the survival of orphans or wounded seals.
- The raising of public's awareness through campaigns targeting all levels of society, governments, public, children etc. - The involvement of fishermen in the protection of the species, aiming at changing their attitude towards seals and thus eliminating deliberate Killing.
- The determination of the distribution, current status, level of interchange between populations as well as study of the factors affecting the ecology of the species.

The HSSPMS since its creation considered that the only possibility for the success of this strategy is the continuous and simultaneous implementation of all the above points.

In this spirit we have continuously tried to operate on all these levels with direct actions at national and local levels through specific activities which are :

- Study of the biology and ecology of the species.
- Contribution on the establishment and operation of the National Marine Park of Alonnisos - N. Sporades.
- Establishment and operation of an information and rescue network, throughout coastal Greece.
- Establishment and operation of the Seal, Treatment and Rehabilitation center, in collaboration with the Seal Rehabilitation and Research Center of Pieterburen, the Netherlands.
- Public awareness at a national and local level.
- Environmental education in schools of Athens and coastal Greece.

Please allow me, at the point, to briefly describe the rational methodology and some of the up till now results of these activities hoping that they will be useful for this workshop.

PUBLIC AWARENESS

Few years ago only a handful of people were aware of even the existence of the monk seal in Greece. When we first started our campaigns. The common reaction from the public was to ask "Are there seals in Greece ?" This is part of the past. During the last years a huge effort has been carried out by the HSSPMS to inform the public through the mass-media as well as through presentations lectures, exhibitions and slides-shows, documentaries productions and informative printed material.

It is difficult to have an exact measure of the effectiveness of such a campaign, however some indicative figures may show the response by the mass-media and by the public :

- Over 500 articles have been published in local, national and international newspapers and magazines in the last four years.
- More than 100 radio interviews have been given by society members addressing the threats of the Mediterranean Monk Seal in Greece.
- 50 television appearances have been made in several local, all national, and some international television stations.
- In the last two years 40 lectures and presentations with slides shows have been given throughout Greece.
- 20 times the HSSPMS exhibition on the monk seal consisting of photographic and informative material panels, was presented in various cities of Greece. It is worthwhile to mention that in Thessaloniki and Athens, more than 10.000 people attended these exhibitions.
- More than 200.000 people have visited the HSSPMS informative Kiosks which are operating in the National Marine Park of Alonnisos - N. Sporades for the last 4 summers.

The above efforts have contributed to the fact that today the name "Monachus - monachus" is widely Known in the public.

Lastly a major part of the HSSPMS campaign has concentrated on sensitizing the Greek children.

ENVIRONMENTAL EDUCATION

Considering that Environmental Education is a new educational system aiming at the formation of conscious citizens equipped with knowledge, sensitivities, imagination and awareness of their links with the natural environment, ready to propose solutions and participate in making and applying decisions, the HSSPMS decided to invest considerable energy in this field.

For four consecutive years the Society is applying programs of environmental education systematically and throughout the school year on students of all educational levels with daily presentations in Athens and in coastal Greece.

These programmes even though they deal mainly with the monk seal they were designed to be vivid and interesting to the children but also to address other environmental issues like sea pollution-over-fishing, recycling and environmental protection in general.

More specifically, the EE team, consisting of one biologist, one educator, and one psychologist, run three environmental education programs. Each program explores the children's questions and tries to show them that we are all responsible for what is happening to the environment today.

A. The first program consists of presentations in the schools of Attiki (greater Athens and surrounding areas). These presentations have been held daily since 1990 and we always try to improve them by adding new elements. In these presentations the number of children is always kept very low. The presentation starts by slide projection and then discussion with the pupils takes place. At the end of the presentation, leaflets and booklets about the Monk Seal are

distributed.

What we try to demonstrate is that man, sea, and the Monk Seal are all interdependent. We avoid dramatizing the situation and we let children reach their own conclusions.

B. The second EE program, called "Play and Environmental Sensitization", started on November 1992. In this program, we meet the same group of children for three consecutive days. The first day includes theatrical games (improvisation, exercises, movement and expression), all of which refer to the sea environment. On the second day, slide-projection, discussion with the children and some role-playing take place.

The children use their imagination to play the role of the fisherman, the seal, the mayor, the minister, etc. On the third day, a drawing workshop allows children both to express their feelings about the things they saw the two previous days and to make suggestions about these problems. Children are encouraged to "experience" what is being presented and learning becomes something more than a simple transfer of information.

The games help children assimilate the information about the Monk Seal in a very pleasant and educational way. The children' drawings (drawings of polluted seas, of the food chain, etc.) are an indication of our success in making children become more aware of different environmental problems.

C. The third program aims at schools of coastal areas and islands and started in February 1993. It has been presented in 20 different coastal area. Each visit lasts for about one week. The presentations were the same with the ones in Attiki. However, sometimes we have allowed more pupils per presentation, since it is really important to reach as many children as possible. Reaching children that have a more direct contact with the sea environment was interesting but not easy. The children had the opportunity to hear an opinion slightly different than the one they were used to hear from their family and friends. Children in the country are very well informed and very sensitive to environmental issues.

During the 92-93 school year more than 17.000 children have participated in the above programs. Overall throughout the operation of the environmental education campaign 60.000 pupils have attended our presentations. Based on this work it has become obvious that there is a need to educate the teachers themselves on matters of environmental protection and this is a direction that the society, together with the children's presentations, foresees for the future.

INFORMATION AND RESCUE NETWORK FOR COASTAL GREECE

A realistic strategy for the protection of the monk seal in Greece, has to take under consideration the distribution of the species and the unique morphology of the country. Within its 3.000 islands and 15.000 kilometres of coastline, lives and breeds the last population within a European Community country and the largest population of the species in the Mediterranean (Reijnders et al., 1993). Past estimates of the size of the monk seal population in Greek waters give results between 200 to 500 individuals (Marchessaux and Duguy, 1979; Vamvakas et al., 1979), while more recently the population has been estimated to be between 200 to 250

(Reijnders et al., 1993). This population is distributed throughout the coasts of Greece in small populations.

Furthermore, it is necessary to mention that one of the most important causes of decline is still the deliberate killing of individuals, mainly by fishermen (HSSPMS, unpubl. results; Panou et al., 1993).

For the above reasons it is imperative to involve the local people, fishermen and authorities within the species range in the conservation strategy and to build a continuous good working relationship with them.

This project which started in 1991, establishes promotes and maintains a working relationship with locals, local communities, fishermen, fishing cooperatives, local environmental organizations and port police authorities by directly contacting them. This relationship serves a dual purpose :

- Sensitize the local public on the endangered status of the species, the reasons for its decline and the uniqueness of the existence of the monk seal in their area, in order to alter their attitude and involve them in the effort to conserve it.

- Continuously receive information valuable for the conservation of the species, from throughout its range, in order to :

- determine the monk seal distribution in Greece
- estimate the size of the Greek population
- monitor changes in the status of the population
- record fishing activities relevant to the monk seal
- act immediately when needed :

- in cases of dead animals by performing autopsies collect information on causes of mortality, feeding biology, and aspects of taxonomy, genetics, virology, biology and parasitology of the monk seal
- in cases of alive animals needing treatment, rescue, provide veterinary care and when necessary rehabilitate them.
- identify and propose potential areas for protection

The team responsible for the implementation of this campaign, consists of two biologists and an assistant.
They made contact with all Greek port police departments, coastal communities and municipalities, fishery services, as well as fishing cooperatives by sending the campaigns information package which included:
- a letter of introduction
- a poster or a sticker giving illustration instruction in case that a monk seal needing help is found.
- a questionnaire asking general information about the area regarding to the seals, the fishery and the locals.

- a form to be fulfilled in case of a monk seal observation in the wild.
- a form in case of a dead sea-mammal (monk seal, cetacean) finding.

In total move than 700 local authorities have been contacted through out coastal Greece.

In addition the same packages were mailed to the Minister of Merchant Marine, the Chief of Port Police, the Ministry of International Affairs, the Panhellenic Union of fishing Cooperatives, and the Ministry of Agriculture asking for their assistance.

Furthermore, the campaign continued by directly visiting selected coastal areas of Greece. The selection of the areas was based mainly on past and present information on the distribution of the monk seal.

The duration of each visit was between one and two weeks depending on the size of the area visited.

During each visit, the team travels within the area with the HSSPMS van and contacts the locals on a general and personal way. Apart from exhibitions and presentations that aim to attract the majority of the local population, interview contacts are conducted with the fishermen and the port police officers in order to build a sense of trust and to collect past and present information on monk seal habitats in the area, the status of the local monk seal population and the local fishery.

Up to date 50 different islands and coastal areas have been visited and move than 70 public lectures and presentations have been given.

In addition to the results from the direct visits to the areas, the response of the people to the "monk seal sighting" questionnaire indicates the effectiveness of this relationship. Since 1990, apart from the N. Sporades and Kefalonia and Zakynthos in the Ionian, 133 reports were received by the HSSPMS regarding specific and recent sightings of alive monk seals and 34 times dead animals were found and reported by locals, fishermen and port police authorities.

The significance of these reports in the determination of the distribution of the species is obvious, when one considers that the estimated size of the Greek monk seal population is between 200-250 individuals (Reijnders et al, 1993).

The map shows clearly that the monk seal is still distributed throughout Greece.

A study using the above data and older reports of the dead animals, out of which 14 times autopsies were performed and samples were taken for analyses, suggests that deliberate and accidental killing still remains the major threat to the monk sea.

Apart from the results related to the monk sea, the team has received more than two hundred and thirty five reports of stranded cetaceans. The above reports and the autopsies that were performed in some of these individuals gave important evidence for the spread of the dolphin morbillivirus epidemic in the Mediterranean (Van Bressem, et al. 19930).

Possibly the most important result of this campaign is that we have managed to initiate a productive working relationship with the locals of coastal Greece.
It was almost a unanimous consensus of the fishermen of all areas visited, that the do not consider the damages caused by the monk seal as the major problem but the decrease in the fish-stock by illegal and industrial fishing (dynamite, chemicals, night speargun fishing, trawlers, purse-seine boats).

The experience gained, made clear to us that the fishermen should and can play one of the most important roles in the conservation strategy. Thus, any conservation measure for the monk seal must also ensure the conservation of the fish stock of the areas of interest.

RESCUE - TREATMENT - AND REHABILITATION

One of the reasons contributing to the decrease of the monk seal is infant mortality due to the mother's death or the loss of the pup due to bad weather conditions.

Bearing in mind the law population numbers the rescue and rehabilitation of orphan and wounded animals is considered to be important. The HSSPMS facing this problem in collaboration with the Seal Rehabilitation and Research Centre of Pieterburen, the Netherlands (SRRC), installed a mobile intensive cave unit on Alonnisos, N. Sporades in the fall of 1990. The unit contains a swimming pool with a large platform that can be heated with an infra-red light, a fully equipped kitchen for the preparation of food and storage of veterinary supplies and a small washing compartment. The climatological condition are carefully controlled and a stringent regimen of hygienic measures is strictly implemented.

The team working in the Centre has been specially trained in handling and treating seals in the Netherlands.

Since its establishment three orphan monk seals have been rescued, and treated in the centre.

The first pup treated in the centre was a mail, 4 weeks of age, which stayed in the centre for seven months due to an injury after his first release.

The animal after some initial problems of human conditioning adapted to its natural habitat.

The next two pups, a mail and a female treated in the centre were released in three and five month period respectively, and appeared to adopt quickly to their natural habitat.

During their stay valuable experience and information has been gained on the rates of development and behavior of pups in captivity.

Additionally blood samples of these animals were used for virological analyses.

A study using these samples provided evidence which suggest that the monk seal may be less susceptible to the DMV epidemic as was originally feared (Osterhaus et al. , 1992).

The area of release of the pups was chosen taking into consideration :

- the state of the environment
- the existence of a breeding population
- and the protection status of the area.

the above requirements exist only in the National Marine Park of Alonnisos - N. Sporades, the area chosen.

NATIONAL MARINE PARK OF ALONNISOS -N. SPORADES

The National Marine Park of Alonissos Northern Sporades is located in the North Aegean sea and includes seven island and several smaller islets. Of the seven islands within the park,

one is inhabited while the others are deserted. The geological bedrock of the island consists mainly of limestone, except in the island of Psathoura which is of volcanic origin (Christou, 1987). The climate of the area is Mediterranean, with wet winters and dry summers.

The flora of the island is considerable, but variable between island. The larger island of Alonnisos is covered to a considerable degree by pine forest.

The herpetofauna and ornithofauna of the islands are of great interest. More than 80 resident and migratory bird species have been identified. These islands are within the migratory route from Africa to Norther Europe.

Apart form the variety of species, the park contains important habitats for several endangered species like Falco eleonorae, Larus audouinii, Calonectris diometea, and Phalacrocorax aristoteles (Christou, 1987). Note worthy is also the presence in the island of Gioura of the wildgoat Capra hircus aegagrus.

In terms of the marine environment, the overall quality of the water is considered to be good (Mimikos, 19850. It is important, however, to note that the evidence that exists comes only form a single limited study. The marine flora and fauna in the area of the National Park has not been studied extensively.

The Northern Sporades are considered to be one of the most important habitats for the Mediterranean Monk seal. Apart from the importance of the area for the survival of this species, there are reports of sightings of several species of dolphins (Delphinus delphis, Stenella coerulesalba, and other) and whales (Physeter catodon, Ziphius cavirostris, and Orcinus ozca).

PROTECTION STATUS OF THE MARINE PARK

The National Marine Park of Alonissos North Sporades is the first marine park in Greece. Fishing regulations for the area existed since 1986 by a Prefecture decision and temporary Ministerial decisions. After long term lobbying in which HSSPMS played an active role it was declared as such on the 28th of May 1992 by a Presidential Decree. Since 1992 the area is protected by the restrictions included within the Presidential Decree, and the park will be governed and operated by an administrative body that is long overdue.

The area of the park is divided into two zones of protection (A Zone and B Zone). Within Zone A, the core of the Park, the island of Piperi is located. The core is protected from all activities, since the approach close than a distance of 3 nautical miles is forbidden. In the rest of the A Zone a number of restrictions apply, such as, medium fisheries 9haul seine and purse seine trawlers) are not allowed in areas closer than 1.5 nautical miles from the islands coasts. Further rules determine and control the access to areas designated for visitors to the area. In Zone B, restrictions for fishing are similar with some allowances for low scale amateur fisheries. Access to this Zone is easier and controlled development is allowed.

Since it was obvious that the regulations of the NPMANS need to be implemented the HSSPMS since 1993, operates a project of surveillance and safeguarding of the area against violators.

Under the approval of the Ministry of Environment and Merchant Marine, the HSSPMS guarding crew consisting of two guards and assisted by a port police officer, using the society's patrol speed-boat "ALONNISOS" an IFAW donation, performed daily patrols throughout the NMPANS checking for any violations.

Apart from the daily patrols, the team was ready to respond to any report of a violation on a 24 hour bases. The daily pattern of the pattern of the patrols, in terms of time and place, were based on the needs of the season and the activities within the park.

On each patrol the team approached every boat within the park and informed its crew about the regulations of the NMPANS. In case that a violation was observed, depending on the violation, the port police officer took the necessary action (reduce, issue a summons, confiscation, arrest, or other). The above procedure was based on the rationale that the HSSPMS responsibility is to monitor the area and locate any violation. In case of a violation, to give the ability to the port police officer, who is the one responsible by law, to approach the violators and take the necessary action.

During the summer season, when the tourist activity is extremely high, the guarding team was reinforced by hiring a part time assistant. He continued to work in the team throughout the monk seal breeding period, a crucial time for the local seal
population.

From the first months of operation, it became evident that in order to effectively perform its task the guarding team needed to extend its activities in matters that were not originally anticipated. In particular, after a violator was found and the port police officer took the necessary action against him, the prosecuting procedure was greatly assisted, if the guards contributed in the legal procedure. Thus, members of the guarding team often signed sworn statements and testified against violators at the Alonnisos Port Police, and travelled to the court of the city of Volos during the trials of violators as prosecution witnesses. Finally, during the legal procedures, it was necessary for the HSSPMS to seek legal advise and to invest considerable effort to publicize these events through the mass media (newspapers, magazines, television stations).

From March until the end of December, the guarding team performed 127 patrols in the park area for a total of 524 patrolling hours. The guarding effort in the different zones of the Park was distributed as follows: 86% of the patrols covered the A and B zones and 14% covered only the zone B. The "ALONNISOS" covered more than 13.000 nautical miles throughout the protection zones of the NMPANS.

During the operation of the project, 55 incident were recorded at which the Port Police officer took some action. The action depended on the severity of the violation and on whether the violator was a repeated offender. At the same time, the guarding team, informed as many people as possible about the regulations of the NMPANS.

Forty (72.7%) of the incidents recorded, during the first year of operation of the project, were located within the A zone of the NMPANS. In terms of the violators, 49% of them were professional fishermen while 51% were tourists or visitors. We should mention that out of all incidents, the vast majority (89,1%) were related to some form of fishing activity (professional, amateur or speargun).

Possibly the most important conclusion of this activity is that effectiveness of such an operation depended on the interaction of a multitude of factors:
- the approval and cooperation of the relevant ministries provided the necessary authorization and state support
- the cooperation of the local fishermen and their cooperative gave the ability to create a network of observers throughout the area that assisted and supported the guarding team
- the participation of the Port Police authority through the Port Police officer on board the HSSPMS patrol-boat gave the ability to act against the violators.
- the sensitization of the public through the HSSPMS information kiosks in the Northern Sporades which operate every summer through a network of 40 volunteers, and through the mass media on a national level was of extreme importance for publicizing the NMPANS and its regulations.

The results show that we managed to a large extend to control illegal activities not only during the summer season, but throughout the year as well. The public awareness efforts as well as the fines, confiscations and prosecution of the violators, contributed greatly not only to the present, but also to the future protection of the NMPANS.

The results of the project during the first year of operation show clearly that after ensuring the above factors it is possible to conduct such a project and it can be effectively performed within the Greek reality.

STUDY OF THE BIOLOGY AND ECOLOGY OF THE SPECIES

The fact that within the NMPANS the seal population is of considerable size and breeds regularly provides a unique opportunity to study in detail the biology-ecology and behavior in the wild.

Apart from several survey expeditions in other Greek areas (Ag. Efsrtatios, Cyclades, Dodecanese, SW Peloponese), the society in the last few years has concentrated its research work in the NMPANS and the neighboring areas.

The study is performed by the research team of HSSPMS. The team consisting of 3 biologists and a technical assistant is also the crew of the HSSPMS research boat "IFAW-ODYSSIA". The 13 meter motor-sailing boat fully equipped with necessary navigational instruments for day and night monitoring is also used for accommodation of the crew. This boat gives to the team the ability to be independent of port for several days at a time. A 3.5 meters inflatable with a 25hp outboard engine tendered to "IFAW- ODYSSIA" is used for approaching the cave areas.

Initially all caves of the area were examined and the possible sea; shelters were determined and mapped. The methodology used for monitoring the seal population consists of a combination of direct and indirect observations. The bulk of the work is performed by directly visiting the already known seal shelters. Apart from when weather conditions are not permitting, the team tries to have a continuous presence throughout the year. The procedure and frequency of the visits is determined by considering the minimum disturbance to the animals. During these visits all evidence of animal presence are recorded and when possible, photographs of the animals encountered are taken. In addition, in certain cases programmed cave camera equipment is used (built and supplied as part of Contract No ACE 6611/28 between the European Commission and the Institute Royal des Sciences Naturelles de Belgique).

The aim of the above activities is multiple:
- to monitor the status of the individuals of the local population, record any deaths, births, injuries etc. In case of emergency to be able to inform the HSSPMS rescue team to take the necessary actions.
- to identify and estimate accurately the individuals and the size of the current local seal population.
- to identify and monitor the importance of different sites (caves, beaches, islands) as important seal shelters.

Most of the results obtained are from 32 different shelters which have been identified and regularly visited. the team has conducted close to 900 visits to the above caves which have been performed throughout the day and night period. During these visits 300 times animals have been sighted and recorded by members of the team. At these sightings the team has managed to photograph with hand cameras more then 300 times pups and adult monk seals. In addition more than 50 films from the pre-programmed cameras have been collected (representing approx. 4.500 hours of cave coverage).

The research team, using the information from the direct observations, sketches ..... and photographs has managed up to date from a preliminary analysis to identify 27 adults and juveniles as distinct individuals. In addition 8 newborn pups were recorded and identified during the last breeding season. You may note that 25 more animals have been observed. However, the evidence collected for these are not sufficient for an exact identification. The collection of further data as well as the incorporation in the analysis of data from previous years will give us a more complete picture of the status of the N. Sporades seal population.

Possibly the most important and encouraging observation, is the birth of 8 new pups during the last breeding season. This is the forth year in a row that births are recorded within the area of N. Sporades (see Figure 1). The team monitored closely the first weeks of development of all the newborn pups until it became apparent that they were beyond this critical period in their life. The above fact becomes even more important when we consider that only two animals were found dead in the area during the last 4 years. Apart from the data collected on the identification of the local population, information has been gathered related to preference in habitat choice, daily and seasonal activity patterns as well as movements of individuals in the wider area.

Ladies and gentlemen, I am aware that it was a dense, long and tiring presentation. However, I can assure you that it was the briefest way to describe the efforts of HSSPMS team over the last five years. I hope that we showed you how the HSSPMS tried to translate designed conservation plans into actions. I will repeat our belief that only implementation of integrated complete conservation strategies may ensure the viability of the Med. Monk Seal and its habitat. Thank you very much for your attention.

MEDITERRANEAN MONK SEAL
(*Monachus monachus*)

GREEK POPULATION

POPULATION AND HABITAT VIABILITY ASSESSMENT

Athens, Greece
4-7 April 1994

Report

SECTION 8

WWF - GREECE

WWF INTEGRATED IONIAN PROJECT FOR THE STUDY AND CONSERVATION OF THE MEDITERRANEAN MONK SEAL IN ZAKYNTHOS

INTRODUCTION

- Background of WWF Ionian Integrated Programme launched in 1992 as a continuation of previous monk seal and sea turtle projects in the area. Monk seal projects in the Ionian are of three years duration and have been divided into two areas:

a. Zakynthos
b. Kefalonia and Ithaki

- Presentation will be based on the project undertaken in Zakynthos; in the brief time period allowed, emphasis will be placed on research activities carried out.

- Work on Zakynthos initiated as early as 1988 by Ada Vlachoutsikou and later joined by Daniel Cebrian; important experience on which to draw upon.

RESEARCH ACTIVITIES

- Importance of research activities in substantiating our priorities for conservation efforts and directing these in an appropriate manner. May be divided into three main aspects:

1. Monitoring of caves and seal sightings

Based on previous work, a network of 61 caves has been established around the island. These are visited at ten day intervals (weather permitting) by a team, in order to confirm and extend information on:

- population size (explanation of capture-recapture method).

- seal distribution and habitat range (underwater survey being planned to investigate presence of underwater caves or entrances).

- various aspects of the biology and ecology of the species (scat, hair and tissue samples collected from caves are being analyzed in collaboration with scientists present in this workshop).

- behavior of the species.

- Minimizing disturbance to seals has been a high priority in previous research in the area and continues to be very seriously taken into account when considering future research methodologies.

2. Monitoring of seal/fishery interactions

- Regular monitoring of damages to fishing gear carried out in two ports (Keri, Agios Sostis). Less regular monitoring of Ag. Nikolas in North due to large distance away from team base in Keri. During these monitoring activities, efforts are made to record information on fish catches although this is practically not always very simple.

- Undertaking of study by WWF Greece on the state of fisheries in the Ionian Sea, with particular reference to the habitat of the Mediterranean monk seal. This short term study aimed to collect knowledge to date on fisheries in the area, identify gaps in important information and provide initial proposals aimed at rational exploitation of resources and overcoming the antagonism felt by fishermen towards seals. First draft ready and will be circulated shortly.

3. Assessment of other human activities affecting seals

- Assessment of habitat degradation through recording developmental trends on island (i.e., new building, road construction etc)

- Monitoring of boat traffic in the area; important index of disturbance.

RESULTS

- Population estimate:

Vlachoutsikou and Cebrian (1992) report a minimum of 18 individuals (9 adults, 1 juvenile or adult, four juveniles, one juvenile or pup and three pups).
Vlachoutsikou and Cebrian (1994) report a minimum of 9 individuals (4 adults, 1 juvenile or adult, 2 juveniles and 2 pups).

This does not by any means indicate that the population has dropped to half its size; it is merely a reflection of the fact that fewer precise sightings were made between the first and second period.

- Mortality:

Total of 8 deaths recorded since 1988 (2 pups, 2 adults, 2 adults or juveniles and 2 of unknown size). Out of these 8 animals, 6 killed by fishermen, 1 drowned in net and in 1 cause of death unknown.

- Natality:

Seems to be a trend of two pups being born every year.

- **Distribution:**

- Info. on distribution often related to frequency of sightings which are related to fishing activities and weather conditions.

- Distribution around island may be changing in response to increased disturbance and habitat destruction (eg. of road constructed in NE part of island).

- Sightings of seals inside caves are definitely changing between summer and winter, reflecting possible influence of disturbance.

- **Interaction with fisheries:**

- Frequency of damage to nets caused by seals roughly 5%. Interesting to note that very low frequency of damage over the last few weeks is coinciding with high fish catches (possible support of the hypothesis that seals moving towards nets as prey density begins to drop.

CONCLUSIONS

- It has become evident that Zakynthos hosts an important monk seal population.

- This population is nevertheless under threat from a considerable number of sources (deliberate killing by fishermen, habitat destruction and degradation, possibility of decreased food supply)

- Definite priority should be given to reducing direct killings by fishermen, a subject which should be addressed in the present workshop.

MEDITERRANEAN MONK SEAL
(*Monachus monachus*)

GREEK POPULATION

POPULATION AND HABITAT VIABILITY ASSESSMENT

Athens, Greece
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SECTION 9

NORTH EASTERN AEGEAN MONK SEAL RESEARCH TEAM

NORTH EASTERN AEGEAN MONK SEAL RESEARCH TEAM
DEPARTMENT OF ENVIRONMENTAL STUDIES
UNIVERSITY OF THE AEGEAN

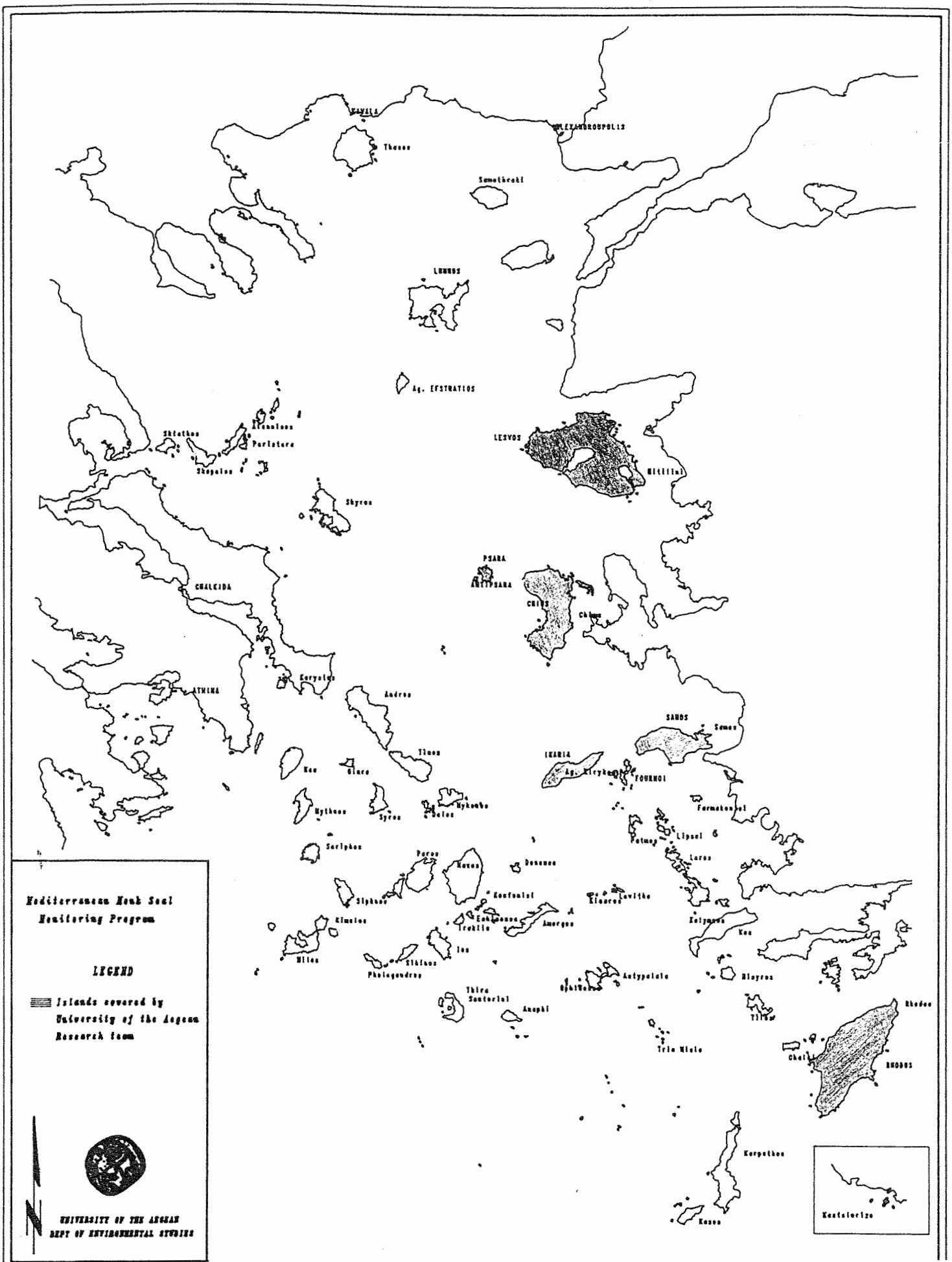
1. Area covered /time period /organisation of the research (maps 1 & 2)

This project running in the four biggest Greek islands Lesvos , Chios, Samos, Rhodes and several other smaller (Psara, Antipsara, Fourni, Agios Kirikos, Kastelorizo etc.) , was inaugurated in 1993 as part of the Greek National Program for the Protection of the Monk Seal (map 1) . All of the islands, lying across the East Aegean Sea, were monitored for the first time for this purpose, and considering the length of the shores it will take some more time and effort before our team finds itself in the position to give accurate numbers of individuals inhabiting /encountered on the researched area (map 2) . Thus, in order to get as soon as possible a first estimation of the seal population in the area, a combination of two methods is used :
- interviews with fishermen from an experienced team, resulting in a huge amount of information. This kind of information is then cross-checked according to spesifique scientific criteria in order to get a data of a greater reliability.
- direct survey of the whole coastline of the islands /identification and mapping of the suitable caves for breeding or resting according to prechosen criteria for the assessment of the habitats. Our monitoring team is working intensively -all year round- surveying the caves by sea and by land .

To get an idea of the extension of the surveyed area (and the time needed to reach accurate estimates), we use as measure the well known island of the Greek National Marine Park Alonissos and give to you the relative shore lengths of some of the islands under study and research:

Relative Shore Lengths

Lesvos	5.7	Samos	2.3
Chios	3.4	Psara	0.6
Rhodes	3.7	Furni	1.25
Ikaria	1.5	Alonissos	1

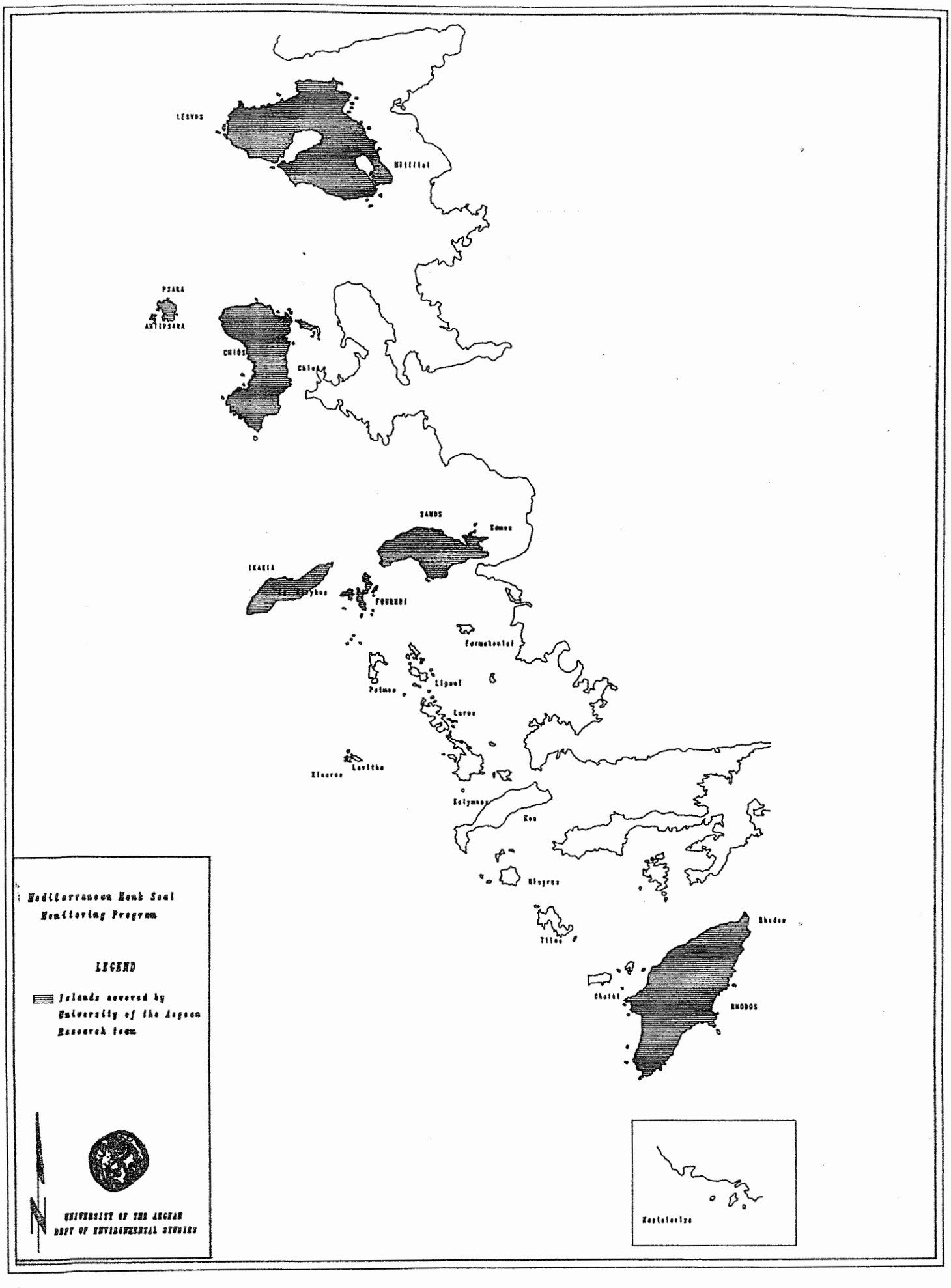


Mediterranean Monk Seal Monitoring Program

LEGEND

Islands covered by University of the Aegean Research team

UNIVERSITY OF THE AEGEAN
DEPT OF ENVIRONMENTAL STUDIES


LESVOS
PSARA
ANTIPSARA
CHIOS
SAMOS
IKARIA
FOURNOI
Fournoulat
Patmos
Lipsoi
Leros
Kalymnos
Kos
Nisyros
Tilos
Rhodos
Chalki
RHODOS
Kastelorizo
Mediterranean Monk Seal
Monitoring Program
LEGEND
Islands covered by
University of the Aegean
Research team
UNIVERSITY OF THE AEGEAN
DEPT OF ENVIRONMENTAL STUDIES

2. Criteria used for habitat assessment

The following criteria are used to assess the suitability of the surveyed caves as shelters for the monk seals. They are criteria chosen in such a scientific way as to fit to the so far known biology/ecology of the species :

- Orientation of the cave
- Exposure to light
- Exposure to winds/waves
- Sub-aquatic entrance
- Terrestrial entrance
- Cave terrestrial area
- Entrance visible from sea ?
- Cave interior visible from sea?
- Known to native people?
- Development level of neighbouring area
- Suitable for permanent shelter
- Suitable for temporary shelter

Source : North-Eastern Aegean Monk Seal Research group - University of the Aegean

3. Population estimate / distribution of the species in the area (table 1)

Trying to fill gaps in knowledge on the status of the monk seal in this area which is the 1/3 of the Aegean Sea we proceed to give our first estimation of the population in the area : 97 individuals (20 pups /youngs, 77 adults). From those animals 3 individuals were identified , the rest are relied on information provided by fishermen, which was assessed very carefully. The accumulation of more sufficient data is needed anyway to draw more reliable conclusions.

Table 1. Monk Seal Presence at the islands of North - Eastern Aegean Sea

ISLAND	Total number	Males	Females	Unknown	Dead	Pups Youngs	Year
Lesvos	20	-	4	12	1 (11/92)	4 youngs (age 1-2)	1992/93
Chios- Inusses- Ag. Stefanos **	16	4	4	3	1 (Sum/93)	2 pups +3 young (age 2-3)	1993/94
Psara- Antipsara	12	1	3	5	1 (Sum/93)	3	1994
Samos	14	-	3	6	1 (4/89)	5 youngs (age 1-2)	1992/93
Ikaria- Furni	15			15			
Rhodes*	16	1	4	9	6 (2/92) +1(4/93 Accidentally by dynamite)	1pup +1 young (age 2-3)	1992/93
Kastelorizo	4	1	1	1	0	1	1994

*The large number of monk seals present in Rhodes island includes also individuals living in nearby islets.

** 6 individuals live permanently in Chios, the rest are strongly considered to be immigrants from Psara

Source : North-Eastern Aegean Monk Seal Research group - University of the Aegean

4. Greek and opposite coast seal population (table 2)

Last year's observations strongly support the idea that there is an interchange of the sub-populations living in the area. There are in some cases distances smaller than one mile between the Greek and the Turkish coast and given the fact that an inividual's home range extends to 40 kilometers of coastline (Marchessaux 1987) , or that some individuals perform stochastic travels of more than a hundred kilometres (Marchessaux 1987) it is possible that we do have interchange of the local populations.
Berkes et al .(1979) states that fishermen from the turkish coast have reported fewer sightings during summer and thought that seals were leaving the area. On the other hand fishermen from the Greek islands of the East Aegean Sea report that sightings are more frequent in summer than in winter.The species is non-migratory (Marchessaux 1987) but detailed study in this area is clearly needed to assess the possibility of seasonal shifts in distribution .

Table 2 : Greek and opposite coast seal populations

Island	Total number*	Opposite coast seal population**
Samothraki	5-6	10
Lesvos	20	3-5
Chios- Inusses Ag. Stefanos	16	10
Psara- Antipsara	12	-
Samos	14	2
Ikaria- Furni	15	5
Rhodes	16	10
Kastelorizo	4	5

* Observations reported by the Aegean research group
** Observations reported by Marchessaux, (1987)

Source : North-Eastern Aegean Monk Seal Research group - University of the Aegean

5. Factors influencing the shift in the distribution (migration rate) of the population of the East Aegean

1. Weather (e.g. repeated sightings of an individual in Samos which mooves from turkish coast to Samos according to the weather)

2. Seasonality (winter /summer) (Aegean team report unpublished 1994, Marchessaux IUCN 1987)

3. Abundance of food (e.g. seasonal sea streams coming from Bosporus, carrying herd of fishes / Lesvos : 10 seals together, 1989)

4. Geomorphological shape of the coast

5. Tourism pressure /human disturbance

6. Existence of males /females for reproduction

7. Social factors within the population (e.g. competition between males resulting to the migration of the looser)

8. Number of individuals already living in this area (Law of the biogeography of islands -Mac Arthur & Wilson 1967)

9. Other stochastic factors

6. Table 3: Dead individuals per population**

Island	Total number	Deliberately killed individuals
Samothraki	5-6	
Lesvos	20	1 (11/92)
Chios-Inusses-Ag. Stefanos	14	1 (Summer/93)
Psara - Antipsara	12	1 (Summer/93)
Samos	14	1 (4/89)
Ikaria - Furni	15	*
Rhodes	16	6 (2/92) +1 (4/93 Accidentaly by dynamite
Kastelorizo	4	0

** An 80% reduction in this island seal population reported for the last 10 years . This island has been registered as having the biggest fishing fleet in the Greek seas*

*** Direct killing by fishermen remains the most frequent cause of death for the monk seals of the East Aegean*

Source : North-Eastern Aegean Monk Seal Research group --University of the Aegean

7. Reasons of decline /Potential threats for the monk seal population of the East Aegean Sea

1. Interaction with commercial fisheries

-hostility of coastal fishermen due to the damage to their fishing gear/capture of fish from their gear

- physiological pressure to coastal fishermen caused by the large trawlers : they believe that these by modern technology equipped vessels will definitely cause depletion of fish stocks, so their hostility is applied and bursts out to the weaker : seals and dolphins

2. Increasing tourist development in almost all the studied islands results to habitat degradation (e.g. Rhodes, or the new ferry -boat line Sigri-Rafina planned to begin this summer in Lesvos island)

3. Lack of implementation of restriction measures in the protected areas (e.g. Megalo Seitani , Samos or Lindos, Rhodes) . The dissemination of rumours from the part of the researchers themselves about potential protection measures causes disappointments and additional hostility to seals. Fishermen have the willingness to accept some measures but since those measures are discussed and negotiated with those people, there is an urgent need for quick and careful implementation .

Inbreeding depression does not represent a threat for the population of the East Aegean Sea since it is almost documented that there exists interchange with the neighbouring population

Incidental entanglement in fishing gear does not consist a threat for the population of this area since only one death was reported during the last five years (Samos)

Large scale mortality caused by virus infection and mortality caused by oil spills never occurred in this region but they do represent a stochastic environmental disturbance

ECONOMIC INCENTIVES FOR THE PROTECTION OF THE MEDITERRANEAN MONK SEAL. by M.S. Skourtos

University of the Aegean, Department of Environmental Studies

1. We start with a *factum*: The main threats to the preservation of the Mediterranean monk seal are 1) deliberate killing and 2) loss of habitat due to the expansion of human activities. To date, most efforts designed to protect the species from these treats have taken the form of legislative prohibitions. The pros and contras of direct regulative mechanisms, such as prohibitions concerning processing, use and disposal of materials. are well studied in other areas of environmental policy. In the field of the conservation of species the similar efforts do not seem to have worked well. The failure to safeguard habitats on which endangered species depend, lack of coordination of regulating agencies, conflicts of jurisdiction between central and local government, and above all, general willingness to sacrifice preservation of species for other goals have contributed to the ineffectiveness of the overall effort.

Direct regulation of endangered species such as the Mediterranean monk seal has thus proven to be relatively ineffective. There are many reasons why such a policy is bound to fail, mainly because of the existence of perverse incentives in over-exploiting or deliberately killing the animals. In comparison with direct regulation, economic incentive schemes are promising a better rate of compliance at a lower overall cost. therefore direct regulations are proved to be not only ecologically ineffective but they are also economically inefficient. Such negative approaches, however, can reach their target if they operate within a general climate in which the majority of those capable of affecting the existence of threatened species recognize them as having value. In other words, without discarding existing regulations , immediate incentives (economic and otherwise) to comply with preservation measures must be provided for those who can affect endangered species. Values that can be realized only in distant future, if ever, will not be sufficient.

2. At the beginning of every policy design we need to have a rough estimate of the amount of (monetary) value which people are willing to play in order to secure the conservation of the species. This amount does not represent a market price for monk seals(!) but it would approximately give to the regulator an idea of the direction and magnitude of human preferences involved. To this end, a pilot application of the contingent valuation methodology should be conducted. Complementary research is also needed on the institutional and socio-economic framework which conflict the practical failure of the policies for the preservation of the species designed so far results. The response of the local population and the equitable basis of the burden of the policy should also be taken into consideration.

The policy should be designed on a regional basis. Appropriate measures may include assigning at least some management responsibility to local institutions, strengthening community-based resource management systems (cooperatives, initiative groups, clubs etc.), designing pricing policies and tax benefits which will promote conservation attitudes, and introducing a variety of property rights and coastal land tenure arrangements.

To this end, the research should work out measures that will promote:
- Support from the central government for community-based incentives
- international support for the incentives (e.g. through tourism)
- funding for the establishment of a conservation policy

Practically the following steps should be taken, which correspond also to the successive phases of the research:
- An estimation of the size, composition and professional organization of the fishermen of the Aegean sea
- A consistency test of their attitudes towards the conservation of species
- Survey of existing counter-incentives and their institutional/legal setting

The design of the policy should explore the possibilities for choice among a range of possible instrument like:
- Differentiated taxes on fisheries equipment and tourism activities
- Soft loans for alternative tourism development
- User charges for specific areas
- Administrative charges for the financing of the project
- Design of the appropriate enforcement, monitoring and feedback mechanisms
- Choice of the pilot region for the application of the policy
- Promotion and dissemination of the policy among local population
- Feedback/Upgrading of the policy
- Final report and recommendations.

MEDITERRANEAN MONK SEAL
(*Monachus monachus*)

GREEK POPULATION

POPULATION AND HABITAT VIABILITY ASSESSMENT

Athens, Greece
4-7 April 1994

Report

SECTION 10

EUROPEAN NATIONAL HERITAGE FUND

Project: The Mediterranean Monk Seal

EUROPEAN
NATURAL HERITAGE FUND

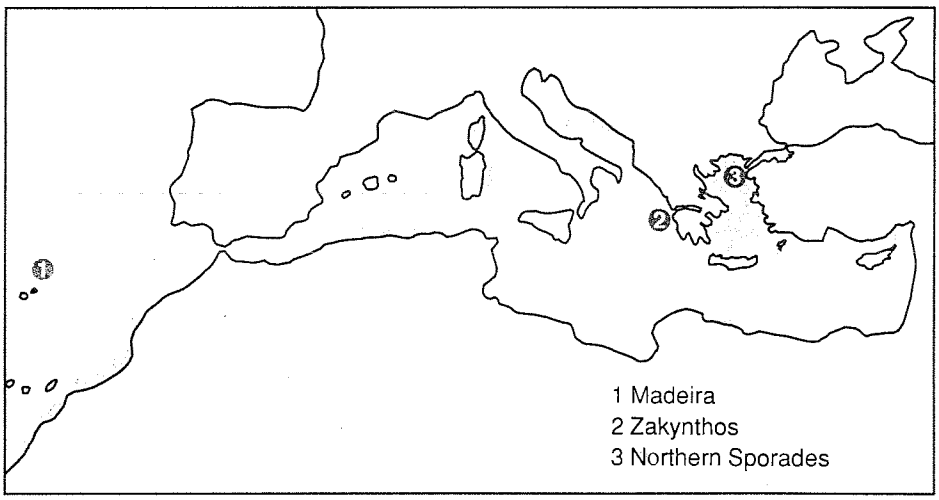
Stiftung Europäisches Naturerbe
Fondation Patrimoine Naturel en Europe
Fondo Patrimonio Natural Europeo

THE MEDITERRANEAN MONK SEAL

Project: Conservation of the monk seal *Monachus monachus* and its Mediterranean habitat. Protection measures are focussing particularly on the Northen Sporades National Marine Park, the Island of Zakynthos, the coasts of Greece, Turkey, Algeria, Morocco and other parts of the Mediterranean.

Project Management: The European Natural Heritage Fund, in collaboration with other national and international organizations; World Wide Fund for Nature (WWF), International Fund for Animal Welfare (IFAW - United Kingdom), Gesellschaft zum Schutz der Meeressäugetiere e.V. (Germany), Archipelago (Greece), Elliniki Etairia (Greece), Fondo para la Foca del Mediterráneo (FFM - Mallorca), the Hellenic Society for the Study and Protection of the Monk Seal (HSSPMS - Greece), the Bellrive Foundation (Switzerland), and the Ecological and Cultural Society of Alonnisos (Greece), local, regional and national government, and other state institutions.

The Mediterranean monk seal is the rarest mammal in Europe and is one of the most endangered species on Earth. Only about 500 live in the Mediterranean and on the Atlantic coast of North Africa. Most visitors to the Mediterranean are unaware of the existence of the monk seal, seals normally being associated with colder waters. In the Aegean and Ionian Seas off Greece, a few healthy monk seal colonies have survived. The Northern Sporades National Marine Park in the Aegean Sea (near the port of Volos and the island holiday resort of Skiathos), with its many uninhabited and undisturbed islands, is one of the seal's last refuges. The unique flora and fauna of the Northern Sporades, its rich fishing grounds and function as an important stopover for migratory birds make the Park a nature reserve of international importance.



The Mediterranean monk seal once occurred throughout the Mediterranean. Today, the seal is found in just a few undisturbed sites.

Ecological Importance

The Mediterranean region is the birthplace of Western culture. For centuries, it was the centre of great civilizations, cradle of the Phonecian, Greek, Byzantine and Roman cultures. Although human impact on Mediterranean ecosystems was considerable and included widespread deforestation, unique natural countryside survived, and fascinating cultural landscapes evolved.

The monk seal was named the siren of Antiquity, because of its poignant distant-sounding call. In Homer's time, monk seals were common on the beaches and in the caves along the coast, and the seal is mentioned his *Odyssey*. Today, the monk seal, which can reach up to 2-3 m and weigh up to 400 kg, is threatened with extinction. There are just a few colonies in the Mediterranean and the Atlantic. On the coasts of France and Spain, the monk seal has disappeared. Greece, Turkey and the coast of Western Sahara still support significant populations, and there are small populations in Morocco, Algeria, Tunisia, Italy and on Madeira, but on the whole there are few places where the shy monk seal can rear its young undisturbed in the secluded caves it requires. One of the remaining enclaves is the Northern Sporades National Marine Park, where there are about 25 individuals. Here, the members of the Alonnisos fishing cooperative have agreed to help protect the monk seal, on condition that the exploitative "gri-gri" ships, which are foreign to the area, and illegal fishing activities, such as dynamite and harpoon fishing in the rich fishing grounds around the Northern Sporades, are stopped. These are forcing fishermen to compete with the monk seal for what fish are left.

As well as supporting the world's rarest seal, the Northern Sporades provide a last retreat for Europe's rarest gull, Audouin's Gull *Larus audouinii*, which breeds on small rocky islands. Eleonora's Falcon *Falco eleonorae* lies in wait for the numerous migratory birds which rest on the Sporades, and, if food supplies suffice, starts breeding on steep cliffs in late summer. The flora is also varied, with a number of endemic species - i.e. species which occur only on the Northern Sporades. On the sea-floor, there are various species of sponge and the rare red coral *Corallium rubrum*. In short, the Northern Sporades are one of the most important marine ecosystems in the Mediterranean.

Threats

In Ancient mythology, the monk seal was protected by the sun god Phoebus Apollo and the god of the sea, Poseidon. Today, the monk seal is a poignant symbol of a dying Sea. In just a few decades, the Mediterranean will have become practically lifeless, if we do not take immediate and drastic steps to reduce water pollution and overfishing. Many large Mediterranean ci-

ties, such as Thessaloniki, still pour their sewage untreated into a sea already contaminated with oil and chemical waste. Widespread and uncontrolled drift net fishing are degrading fish resources throughout the Sea. One hundred milion tourists visit the Mediterranean every year, causing considerable degradation of coastal ecosystems. Coastal areas which have escaped development until today - wetland, dune and lagoon habitats, which are required as stop-offs by migratory birds, are being destroyed by unsystematic touristic development, in some cases with EC Structural Funds, and without prior environmental impact assessment.

Today, the monk seal can be found only in secluded, undisturbed coastal areas - and mass tourism continues to encroach on these last enclaves. Furthermore, the seals are directly threatened by fishermen, who see them as competition in seas which are already overfished, and kill them because they destroy nets while attempting to get at the fish trapped in them. Illegal fishing practices such as dynamite and harpoon fishing, which rob traditional fishermen of their catches, are contributing further to the decline of the seal.

Unfortunately, there are too few marine protected areas, and those which do exist are handicapped by poor infrastructure. The Northern Sporades National Marine Park, for instance, has not been managed effectively and as a result uncontrolled tourism and illegal fishing threaten the objectives of the Park. The aim of international efforts must be to find ways to establish effective, long-term protection, which could then serve as a model for marine protection areas elsewhere.

The aim of the ENHF's Monk Seal Project is to protect the seals from the very real danger of extinction, and thus to help save an important part of our Mediterranean wildlife heritage. In close cooperation with Greek conservation and cultural organizations, local administration and the community, and in agreement with the Greek government and the European Community, the Fund hopes first to ensure the protection and management of the National Park.

At a later stage, the project will identify and support other potential marine reserves.

The Monk Seal Project - Activities and initiatives to date

- Scientific study of monk seal distribution in Greece, in order to identify the most effective protection measures.
- Support of an environmental education programme run by the Hellenic Society for the Study and Protection of the Monk Seal (HSSPMS), in the form of a financial contribution and assistance with publicity work.
- Support of a documentary film about the monk seal and the Northern Sporades National Marine Park, to improve public awareness.
- Contact and consultation with the EC, international conservation organization (IUCN, WWF), the Greek government and universities on the implementation of monk seal protection.
- Public awareness campaigns in the Press, on radio and television dealing with threats to the Mediterranean. A series of radio features have been produced in Greece, covering the Mediterranean and its wildlife, targeted particularly at fishermen and the coastal community.
- Information campaigns to sensitize fishermen in Algeria and Morocco to the plight of the monk seal, in collaboration with the FFM.

The fishermen on the island of Alonnisos support the National Marine Park and seal protection measures. A recent agreement has been made to protect them from the exploitative fishing practices of "gri-gri" ships and illegal dynamite and harpoon fishing which are destroying their livelihood.

This young monk seal, which was separated from its mother during a storm, was reared at a rescue and rehabilitation centre on the Northern Sporades by the Hellenic Society for the Study and Protection of the Monk Seal (HSSPMS) and was later released into the wild.

- Cooperation with Turkish conservation organizations concerned with monk seal protection.
- Support of HSSPMS public information information kiosk in the port of Patitiri, Alonnisos.
- Campaigns to counter illegal fishing activities in the Mediterranean and to inform tourists of the fishing regulations. The Fund is establishing a network of fishing cooperatives to coordinate the struggle against illegal and exploitative fishing activities.
- In June 1992, the ENHF opened a conservation information centre on the island of Alonnisos, together with the Ecological and Cultural Society of Alonnisos, in order to provide more effective support for conservation work on the Northern Sporades.

Further Priorities:

- Effective management of the Northern Sporades National Marine Park, in cooperation with the local fishing community, together with the Ecological and Cultural Society of Alonnisos and other groups.
- Conception and implementation of programmes to encourage ecologically sustainable tourism.
- Designation of further marine protection areas in the Mediterranean Sea.
- Public awareness measures to improve understanding of conservation issues in the coastal communities.
- Seminars for conservationists and supplementary training courses for multipliers (teachers etc.).
- Further environmental education programmes aimed at the protection of the Mediterranean region. The ENHF is currently preparing a monk seal educational package for schools.
- Guidebook on the wildlife of the Northern Sporades National Marine Park.
- Lobbying the EC to launch an effective programme for the preservation of marine resources in the Mediterranean.

Eleonora's falcon (Falco eleonorae) feeds mainly on migratory birds, and for this reason, does not start breeding until late summer.

The steep and inaccessible coastal cliffs and islands of the Northern Sporades offer European monk seal populations a last retreat.

Audouin's Gull (Larus audouinii) is Europe's rarest gull. In the Northern Sporades National Marine Park, it still breeds on small rocky islands.

The Mediterranean Monk Seal Project is part of the ENHF Mediterranean Conservation Programme and is sponsored by Daimler Benz AG.

Further Reading
Hutter, C.-P./Thielcke, G.: Natur ohne Grenzen
Edition Weitbrecht im K Thienemanns Verlag,
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Reference: Monk seal

MEDITERRANEAN MONK SEAL
(*Monachus monachus*)

GREEK POPULATION

POPULATION AND HABITAT VIABILITY ASSESSMENT

Athens, Greece
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SECTION 11

ENVIRONMENTAL RESEARCH BUREAU

ENVIRONMENTAL RESEARCH BUREAU

Introduction

The E.R.B. has undertaken the project "Status of the Mediterranean Monk seal in the Cyclades islands since February 1992, as part of the Greek National Programme for the Protection of the Monk seal. The goals of the project are the location of the breeding caves, the definition of the minimum population, the analysis of the parameters affecting the decline of the population during the last decades and the sensitization of the local community, especially fishermen to the Monk seal situation. The results will help to define a conservation strategy that will prevent the extinction of the species.

WORKING AREA

The Cyclades Archipelago is composed of 56 islands mainly mountainous, with very rocky coasts and an extremely sinuous coastline. To give you a picture, the 19 bigger islands of the Cyclades have a total perimeter of 1700km (which means 11% of the Greek coastline) providing a considerable habitat for the monk seals.

It is the most windy area of Greece. The northern winds are prevailing all year around with strong stability during the summer.

Only 22 of the islands are inhabited. The economy is based on the sea with navigation, fishery and tourism being the most important sources of income. A considerable part of the population is leaving the islands in winter and come to the mainland.

HABITAT ASSESSMENT - DIRECT METHODS

Since 1992 a survey by boat has been conducted to the islands shown black on fig.1. The coastline has been inspected from a distance of 50m maximum and all openings that could lead to caves were explored by snorkeling in order to cause minimal disturbance to the seals.

According the results of previous research made by Cebrian in Zakynthos and Chalkidiki, the caves mostly used by seals have more than one of the following characteristics:

- Depth of the beach greater than nine waters.
- Stable beaches that do not change significantly within the year.
- Moderate to null exposure to light.
- Beach opening proceeded by sea gallery.
- Beach protected from wave action.
- More than one entrances.

These characteristics were used as criteria to evaluate the suitability of caves where no seal evidence was found 57 caves were considered suitable and mapped. Their position was depicted on army maps (1:50.000).

POPULATION STATUS

The population was estimated from information coming from fishermen. Every port frequented by fishermen was visited and fishermen were interviewed personally. The interviews included questions on areas frequented by seals, location of caves, specific sightings, damages to nets, natality and mortality. The information was stored in individual files for every fisherman. The description of different seals were contrasted in order to estimate the minimum population frequenting an area.

This procedure is rather complicate. One difficulty is that the description of color is fully subjective and strongly depends on light and weather conditions or on weather the animal is wet or dry. Another problem is that since very little is known on the Monk seal range of territory, it is difficult to know whether two similar reports from different areas refer to the same animal. When similar individuals were reported and not sighted together the following acceptances have been made.

- Animals of similar size and different tints of the same color that are reported in one area are considered to be the same.
- Dark grey or dark brown seals are often reported as black. When a dark grey (or a dark brown) seal and a black one of similar size are reported in one area they are considered to be the same. This animal is most likely to be dark grey (or dark brown).
- The vague description of a seal is assigned to a more detailed one when its characteristics permit it.
- Similar seals described on the linked by the 50m isobath are considered the same.

One remark that can be made is that the population is relevant to the availability of caves. An island where only two caves were found suitable probably does not host a population of 10 seals. The areas with big concentration of caves host bigger groups of seals like the area of Milos, the straight of Tinos - Andros, the N. of Myconos and Paros - Antiparos.
Pups are not included in the estimate. Since 1990 pupping was reported in the areas of Milos, Antimilos, Polyegos, Sikinos, Anafi, Leros, Paros, Antiparos, Tinos, Mykonos, Syros.

THREATS

As elsewhere, deliberate killing by fishermen is the main cause of mortality and is enough to provoke the extinction of the species (table 2 and 3). The data from 3 different areas in Greece (Zakynthos, Cyclades, Chalkidiki) are very similar.
The pups are more vulnerable since many breeding caves are known to fishermen.

Most of the seals are killed by shotguns that are illegally carried on many vessels. Although this is something very easy to be checked, the very few inspections carried out by the port police have no effect since everybody seems to know when they are going to occur.

The number of seals drown in nets is considerably smaller. The change of nets to long line that was applied in the Desertas islands could be a solution to areas with special importance for seals, but is does not seem applicable to the whole area.

Other threats include the disturbance caused to the animal because of the increasing touristic activities and the coastal development. Usually the seal caves are found in the most rugged coasts that until some years ago where inaccessible to tourists. The boats used to belong only to fishermen and some privileged people. At present this is not the case since the purchase of an inflatable is equally accessible to that of a car. Tourist boats are available for rent or organize tourist trips around the island. Speargun fishermen enter the caves and scare away the seals. It is significant that very few sightings are reported during the summer.

The loss of habitat due to the coastal development is in fact directly connected with increasing tourism. Dirt road lead to the most remote beaches and houses may appear everywhere, sometimes just above the caves. In Milos the quarries have destroyed part of the coast. In Santorini and Milos some caves were converted to storehouses.

SUMMARY - CONCLUSION

Up to now 57 caves were found suitable and a population of 43 seals has been estimated. The main reason for the decline of the population is the deliberate killing of seals by fishermen. Since most seals are shot, one effective measure would be to insure systematically that no guns are carried on vessels. Direct compensation measures are not recommended but other incentives should be considered.

The next step should be the definition of protected areas based on the habitat directive. But unfortunately this will not change the situation dramatically. The biggest problem is how to patrol these areas and who is going to play that role.

It must be noticed that some of the islands lack completely of port authorities. Only in 4 islands, the port police maintain speed boats that seem to be used under special circumstances.

But anyway the conservation of the species could not be based only on legislation. The mentality of people towards nature is that need to be changed. Local people should be involved in conservation efforts. Through public awareness fishermen should be persuaded that they could benefit from the creation of protected areas since this will guarantee the regeneration of the fish resources.

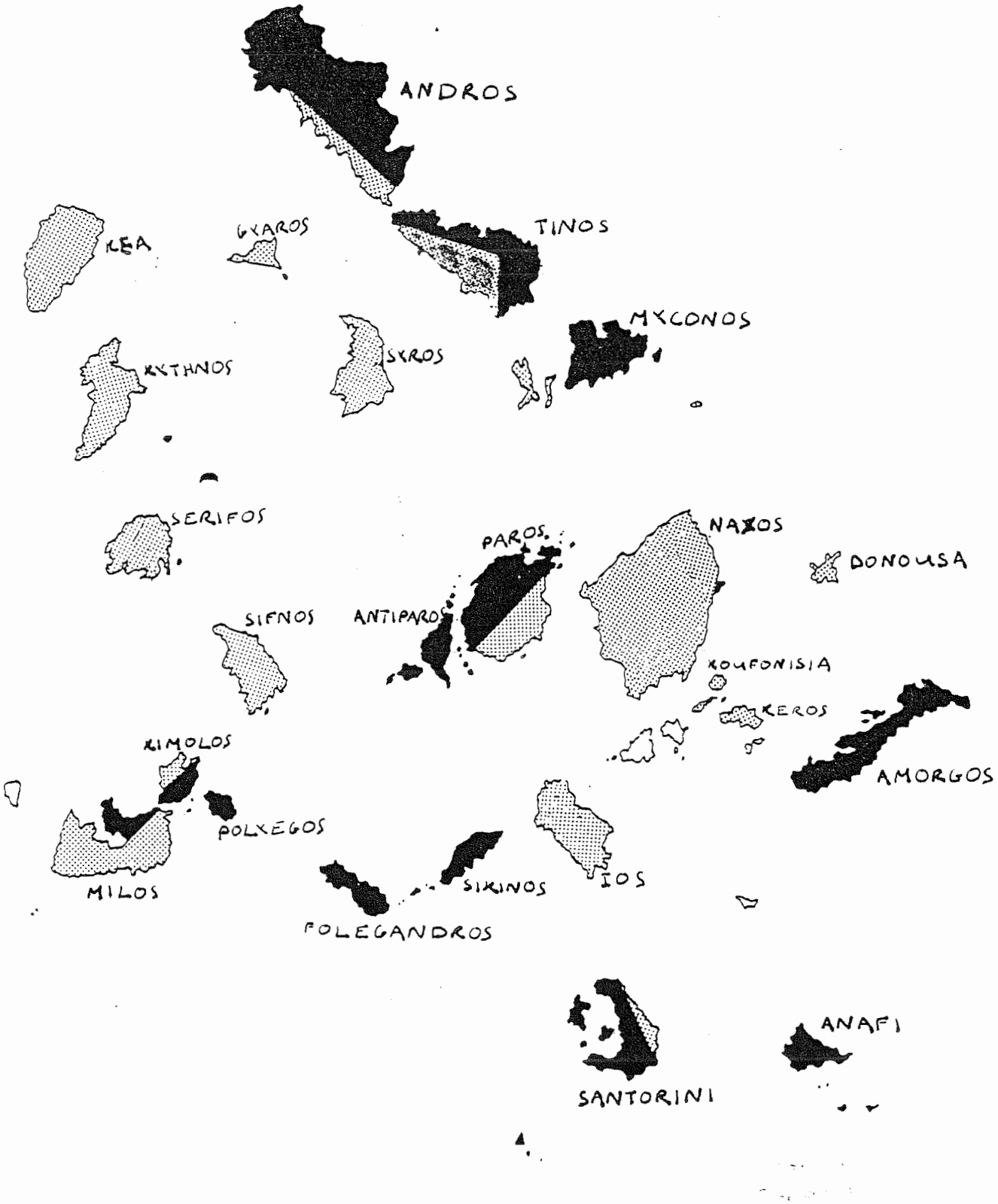

Fig.1.- Map of the Cyclades Islands. Shaded area indicates the coast surveyed by boat. Spotted area shows places where information was collected only by interviews

Table 1: Suitable caves and estimate of seal population in the Cyclades Islands

ISLAND	No of caves	No of seals
Milos (partial survey)	2	8
Kimolos (partial survey)	3	
Antimilos	?	
Polvegos	3	
Folegandros	4	3
Sikinos	3	
Kalogeros	1	
Christiana	?	1
Santorini	3	2
Anafi	2	3
Makra	1	
Amorgos	5	?
Schinousa	?	1
Keros	?	1
Makares	?	2
Naxos (partial survey)	2	4
Paros (partial survey)	1	
Antiparos	4	
Andros (partial survey)	9	4
Tinos (partial survey)	4	
Mykonos	6	4
Drakonisi	4	
Syros	?	4
Giaros	?	2
Kea	?	1
Serifos	?	1
Serifopoula	0	1
Sifnos	?	1

TABLE 2: Monk seals deaths recorded in Chalkidiki up to 1991

DATE	LOCATION	AGE CLASS	COLOUR	CAUSE	AUTHOR	PLACE
1955–1956	Porto Koufo. Sithonia	Adult	Dark brown	Shot	Prof. fisherman	Cave
1958	Kapsokalivia. Agion Oros	Pup	Black	?	?	Found on beach
Spring 1962	Paliouri. Kassandra	Adult male	Brown. White belly	Shot	Prof. fishermen	Sea
1968	Nea Skiti. Sithonia	Pup	?	Clubbed with anchore	Monk	Beach
Sixties	Nea Skiti. Sithonia	Pup	Black	Clubbed with sticks	Monks	Beach
1975–1980	Koultsou. Agion Oros	?	?	Killed	Monks	Cave
1975–1980	koultsou. Agion Oros	?	?	Killed	Monks	Cave
1983	Ormos Panagia	Adult	Grey	Drown in net	Prof. fisherman	Sea
1985	Koultsou. Agion Oros	Juv.	Dark brown	?	Fisherman	?
1985–1986	Nea Skiti. Agion Oros	Adult	?	Drown in net	Monk fisherman	Sea
Spring 1987	Kapsokalivia. Agion Oros	Pup	Black	Killed	?	?
Summer 1988	Kalamitsi. Sithonia	Pup	Black	Speargun	Austrian tourist	Sea
1989	Porto Koufo. Sithonia	No pup	Dark brown	Trident	Fisherman	Koufo Gulf
Winter 1989	Agias Anas. Agion Oros	Juv.	Brown. White belly	Drown in net	Prof. fisherman	Sea-shore
Winter 1989	Porto Koufo. Sithonia	Juv.	?	?	?	Beach
Winter 1991	Kaburotripes. Sithonia	?	?	?	Fisherman	Sea

Table 3.- Dead seals reported in the islands surveyed in the archipelago of Cyclades

PLACE	DATE	NUMBER, SEX, AGE CLASS,	CAUSE OF DEATH
PAROS (Ag.Nikolaos)	1962	1 Adult	Killed by fisherman
MILOS (Kleftiko) *	1965	7? Pups	Killed by fisherman
SERIFOS (Piperi)	1960s	Adult female	Shot by fisherman
SERIFOPOULA	1960s	Adult male	Shot by fisherman
MILOS (Kleftiko) *	1970	2 Pups	Killed by fisherman
SANTORINI (Focospilia)	1972	4 Pups	Killed by fisherman
SYROS #	Spring 1973	1	Drown in net
SYROS (Possidonia) #	1974	2 Pups	
MILOS (Kleftiko) *	1975-76	1 Adult 2 Pups	Killed by fisherman
NAXOS (Moutsouna)	1977	2	Drown in net
MYKONOS (Panormos)	1977	1 Adult	Killed by fisherman
SYROS (Agathopes)#	June 1984	1 Young	
MYKONOS (Dragonissi)	1985	1	Clubbed by fisherman
NAXOS	1988	1	Drown in net
MILOS (Kleftiko) *	13/3/90	2 Pups	Killed by fisherman
SANTORINI (Akrotiri)	13/3/90	1 Adult male	Drown in trammel net
TINOS (Kolybithres)	2/1992	1 No pup	Natural cause
KIMOLOS (Ag.Andreas)	May 1990	2	Killed by fisherman
SANTORINI	Summer 1990	1 No pup	
MILOS	May 1993	1 Young	Killed by fisherman
AMORGOS	1993	No pup	Unknown

MEDITERRANEAN MONK SEAL
(*Monachus monachus*)

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SECTION 12

ECOLOGICAL SOCIETY OF HYDRA "HYDRAIISA PHOKIA"

INTRODUCTION

The Society of 'Hydraiisa Phokia' has been working on the protection, monitoring and conservation of the population of seals that live in the area for which the society is responsible. Work is being carried out within the framework of the National Programme, coordinated by Elliniki Etairia and supported by the Ministry of the Environment and the European Community.

During the last two or three years the groups that are participating in the National Programme have achieved a very good level of collaboration, and today, they share significant experience, which is to the benefit of their common aim, the protection of the monk seal. An example of such interaction between individual teams, is the collaboration of the teams which is being planned for research projects in Crete and Albania.

Biologists, sailors and professional fishermen are members of our group which has Hydra and Spetses as its centre and is carrying out research in the Sea of Myrtoon, the east coast of Peloponnisos and the Saronic Gulf. Apart from the estimation and monitoring of the population of the monk seal, the biological and chemical quality of the waters is measured as well. We all know about the adverse effects of human activity on the marine ecosystems of Greece and the Mediterranean in general, ecosystems in which a significant number of monk seals still lives today.

The details of a preliminary study which was carried out with the aim of providing a first insight on the biological and chemical quality of the seawater in our area, will be avoided. It is encouraging that the quality of water is generally good. One exception to this are some areas in the Saronic Gulf and another in coastal areas of the Argolic Gulf the waters of which were yellow in appearance, at least in one occasion, something that may be due to pollution from land based agricultural activity.

RESULTS

We would like to present some of the results of our studies on the monk seal in our area the population of which appears to remain stable in recent years. Both the animals themselves and their tracks have been observed in caves but also in secluded sandy beaches. The interesting fact that seals may seek shelter on sandy beaches that are adequately protected and can secure their rapid escape in case of danger, is illustrated by the following two observations:

First, in the beach of Stavros on the island of Stavronisi of Hydra, in the sea of Myrtoon, both ourselves and fishermen have observed an old female seal spend its whole night on that beach. Second, in the beach of Saint Pierro in the vicinity of Hounta of Rigas on the island of Hydra, another seal has been observed to spend its night on the beach. It is interesting to note that this particular beach does not have any access from land, and allows the seal to see any boat that could be approaching the beach from a distance of at least 100 m.

Three individuals live in the desert island of Saint George, situated northwest of Cape Zourva of Hydra at the southernmost point of the Saronic Gulf, where it merges with the Aegean Sea, but judging by the number of suitable caves found there, the island could accommodate a larger number of seals.

At least three individuals live in another small desert island, Falconera, which fishermen call Gerakouli, situated in the middle of Myrtoon. Access to this island and the island of Saint George, is difficult because of the adverse weather that usually prevails and, as a result, these islands have not been investigated properly.

Two individuals live in Parapola, a desert island also situated in the middle of the Myrtoon.

It is worth mentioning here that the beacons of Zourva on Hydra, Parapola, and Kavo Malia in the southernmost tip of eastern Peloponnisos are particularly important for the navigation in the sea of Myrtoon.

A stable number of three to four individuals lives in the area of Gerakas of Lakonia in eastern Peloponnisos but no caves that are suitable for the shelter of these animals have been found so far. However, many small, secluded and secure sandy beaches have been identified. In fact it appears that on the coastline that stretches from the bay of Phokianos to Monemvasia, access by man is not possible from land to many of these beaches, whereas it is practically impossible from sea due to the bad weather conditions which are common in the area. One should also not rule out the possibility that underwater refuges may exist.

Three individuals have been observed in Spetses but fishermen believe that there are more. There is a particularly interesting refuge in this island, which is free from human activity between September and May and, therefore, suitable as a seal nesting place. This is the cave of Bekiri which is 45 metres deep and approximately the same in width and has a sandy beach inside it. Human access from land or sea is very difficult while at the same time it is possible for the seal to make a swift escape in the event of danger.

In Hydra, three to four individuals have been counted. Special care has been taken not to mix individuals from Spetses with those from Hydra and simultaneous sitings were carried out. However, the two islands are not far, from each other and they are connected by a series of small islands, so there is always the danger of having counted the same individuals twice. In any case, it is certain that five to eight individuals live in both islands.

It is known that in Hydra there are underwater caves which we have not yet discovered. The question here is how to investigate these perfectly secret and safe nesting places which may be particularly important for the survival of the seals. We would like the participants of this conference to consider this question. We wonder whether it would be more appropriate to keep away from these potential nesting sites and observe the activity of the seals from a distance in areas where the behaviour of seals has indicated that such underwater caves may in fact exist.

DISCUSSION

Threats to the monk seal

A major threat is off course pollution of the sea which threatens the marine ecosystem as a whole.

Lack of adequate food supply is probably the most important threat that the monk seal faces in the area of study. This makes seals nervous, reckless and more aggressive than normal towards the fishing nets. Over-fishing and illegal amateur fishing are damaging. Fishing with methods which are illegal and particularly destructive for the populations of fish such as drift-boats, dynamites, chemicals or extremely powerful lamps threatens all marine consumers, such as seals, whose nutrition depends strongly on fish. A threat which is specific to our area is fishing by Italian fishermen that use thousands of metres of drift nets and catch large numbers of individuals and species, even sharks and swordfish. The severity of such activities is illustrated by incidents such as the following, witnessed by Markou, a professional fisherman, who is a volunteer in our project. He described how he saw Italian fishermen near the island of Falkonera, cleaning their nets from dolphins that had been killed in their nets. At that time, the large number of dolphins found dead increased our confusion and worry about the magnitude of the dolphin virus disease because it was not possible to readily distinguish between those killed by the disease and those killled by the nets of the Italian fishermen.

What needs to be done?

There is urgent need for a National Policy coordinated by the State, in collaboration with the National Programme. In our opinion the Policy should enact the following:

- Protected areas in all regions covered by the National Programme.

- Measures for the sensitization of locals and tourists about the need to protect the monk seal and its habitats.

The Society publishes a newspaper on environmental issues, organizes talks in the unions of fishermen, schools and schools of naval studies, and has also published a small book for young children on the subject of the monk seal.

- Studies for the provision of incentives to professional fishermen who are a major source of information on the behaviour of the population of the seals as well as on the quality of the marine ecosystem as a whole. Such incentives should ideally be unified and reflect measures taken by all groups participating in the National Programme.

The Society has done a lot towards this direction. There is now mutual trust between the Society and the fishermen which enables us to make good use of their valuable experience. It is noteworthy that three chairmen of professional fishing unions are volunteers in our team. More specifically:

1. The Society has contributed many times in the solution of several professional problems of the fishermen.

2. For the past five years, the Society has been supplying fishermen, free of charge, with engine oil for their boats, in amounts equal to those of used oil

returned by the fishermen. Thus, two targets are met. First, our interest in the fishermen is materialized and second, pollution of the sea is reduced because used oils are returned and disposed of properly on the land, instead of being emptied in the sea.

3. The Society has instituted some small financial awards for the children of the fishermen that do well in school.

CONCLUSION

The survival of the monk seals in our country depends strongly on the availability of food and refuge for rest and reproduction. The caves and secluded beaches that are available in our area of study could accommodate at least double the numbers that live there today. We should not forget that in the past the numbers were much higher than today.

It appears that the existing populations of monk seals will be able to survive as long as a number of protective measures are taken. This could only be achieved by a consistent conservation plan in which the activity of the various research groups should be allowed to continue and expand. The success of the plan depends on the efficient monitoring and coordination by the State and the sensitization and active involvement of locals, tourists and fishermen.

MEDITERRANEAN MONK SEAL
(*Monachus monachus*)

GREEK POPULATION

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SECTION 13

CAPTIVE BREEDING OF PHOCIDS IN NORTH AMERICA

Figure Legends

Figure 1. Sources of the North American captive populations of *Phoca vitulina* in 1972 and 1992. The 1972 population of 109 seals was 49% wild caught and 2% captive born while the 1992 population of 310 animals was 9% wild caught, 48% captive born, and 43% stranded animals.

Figure 2. The age structure of the 1992 captive population of *Phoca vitulina* in North America. All but one of the wild caught animals are 17 years or older. The lack of animals in the 3 year and younger age class is a result of a deliberate decision to reduce captive breeding because the captive space is filled.

Figure 3. The age and sex specific mortality rates of the captive population of *Phoca vitulina* in North America. A total of 157 deaths are recorded with the oldest animal a female at 42 years.

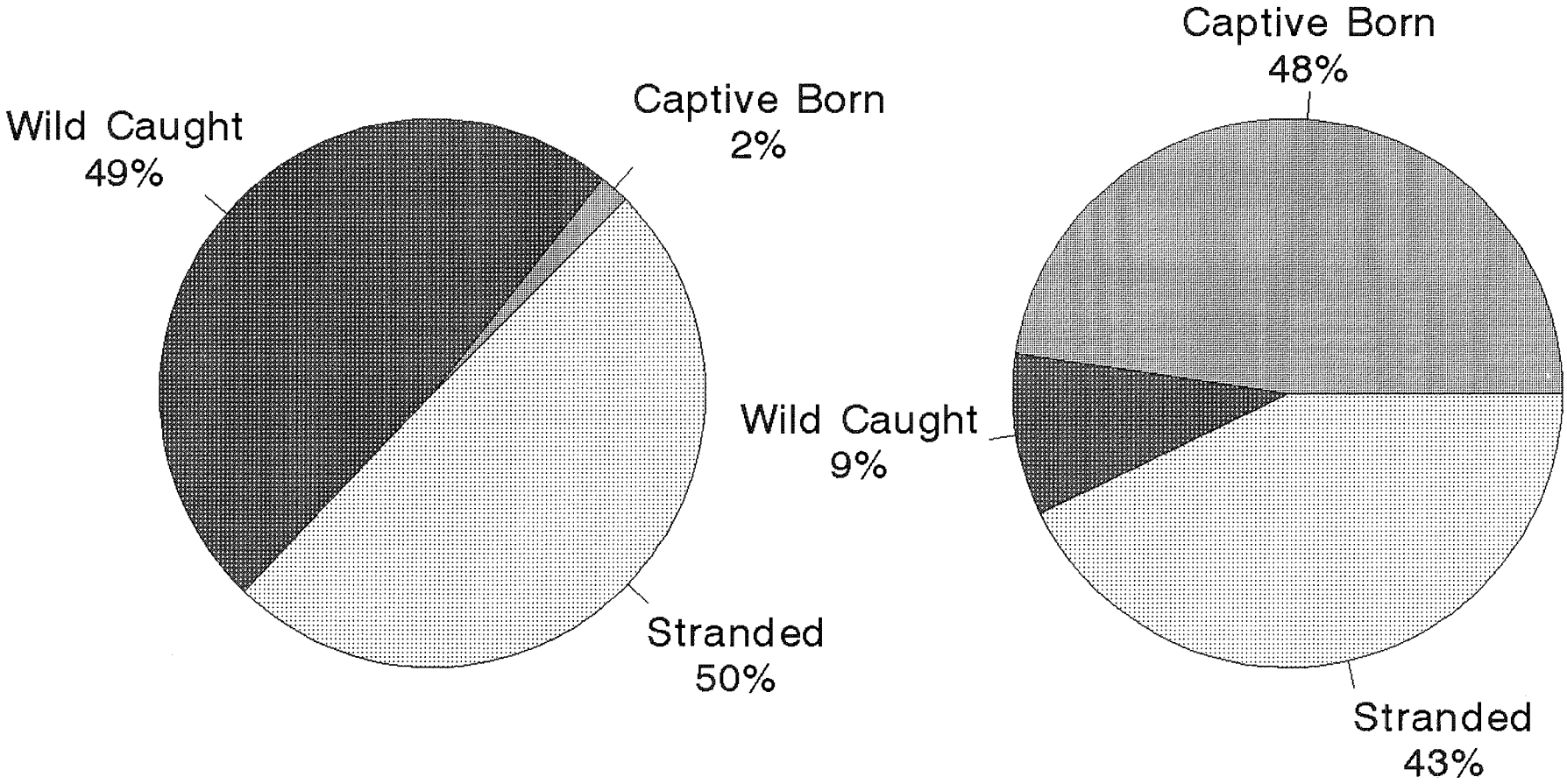
Figure 4. Sources of 565 animals by year of acquisition in the North American population of *Phoca vitulina.*

Figure 5. Births by year in the North American captive population of *Phoca vitulina*with 246 births recorded in the studbook.

Figure 6. Survivorships of wild born *Phoca vitulina* in the North American captive population. The values are very similar for the first 6-8 years but slightly favor the captive born animals.

Figure 7. Survivorships of captive born *Phoca vitulina* in the North American captive population. The values are very similar for the first 6-8 years but slightly favor the captive born animals.

Live Inventory
Phoca vitulina



1972 Lives
n=109

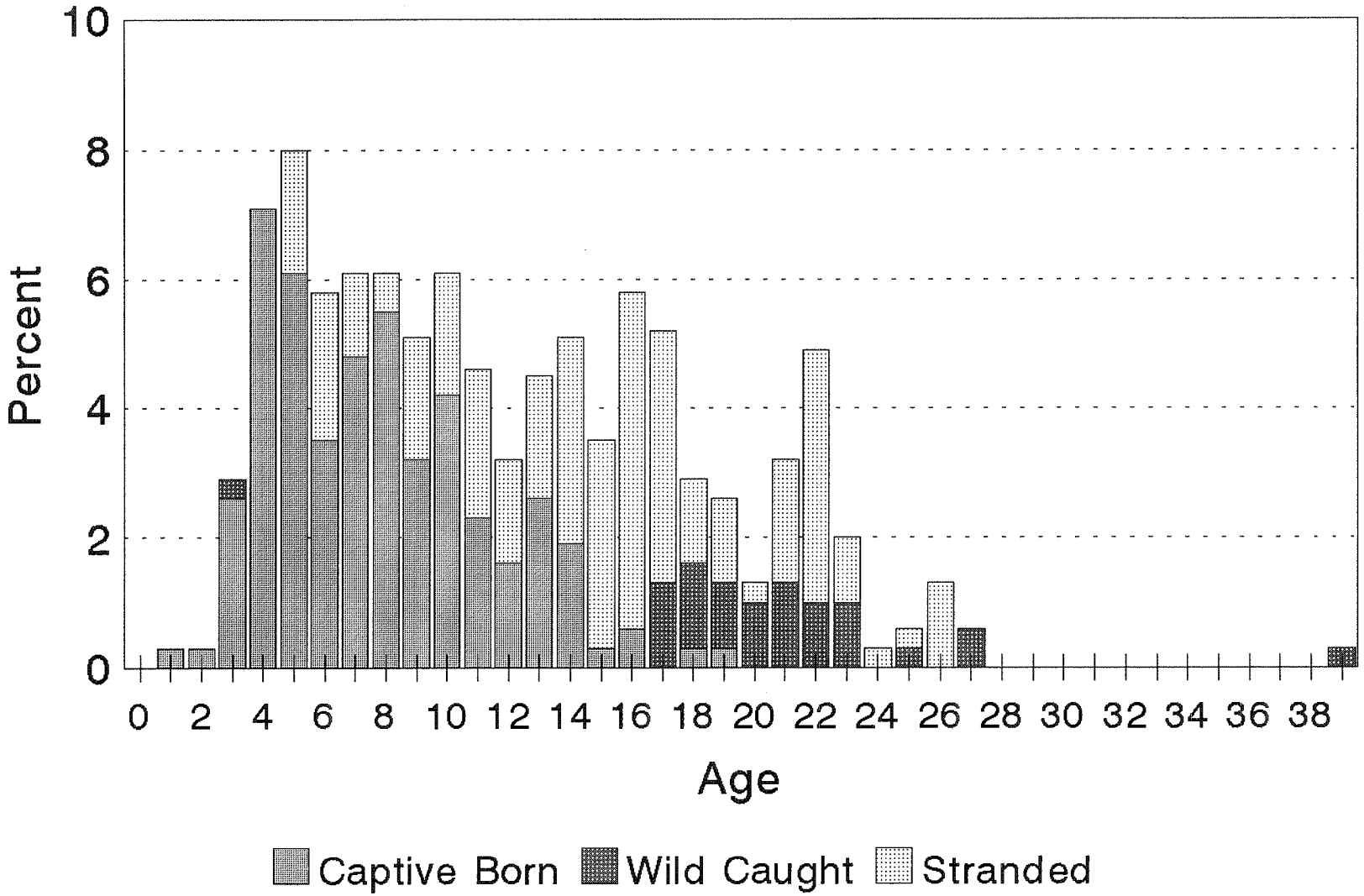
1992 Lives
n=310

Census Data: Duffield & Shell

Live Animals: September 1992

Phoca vitulina

n=310

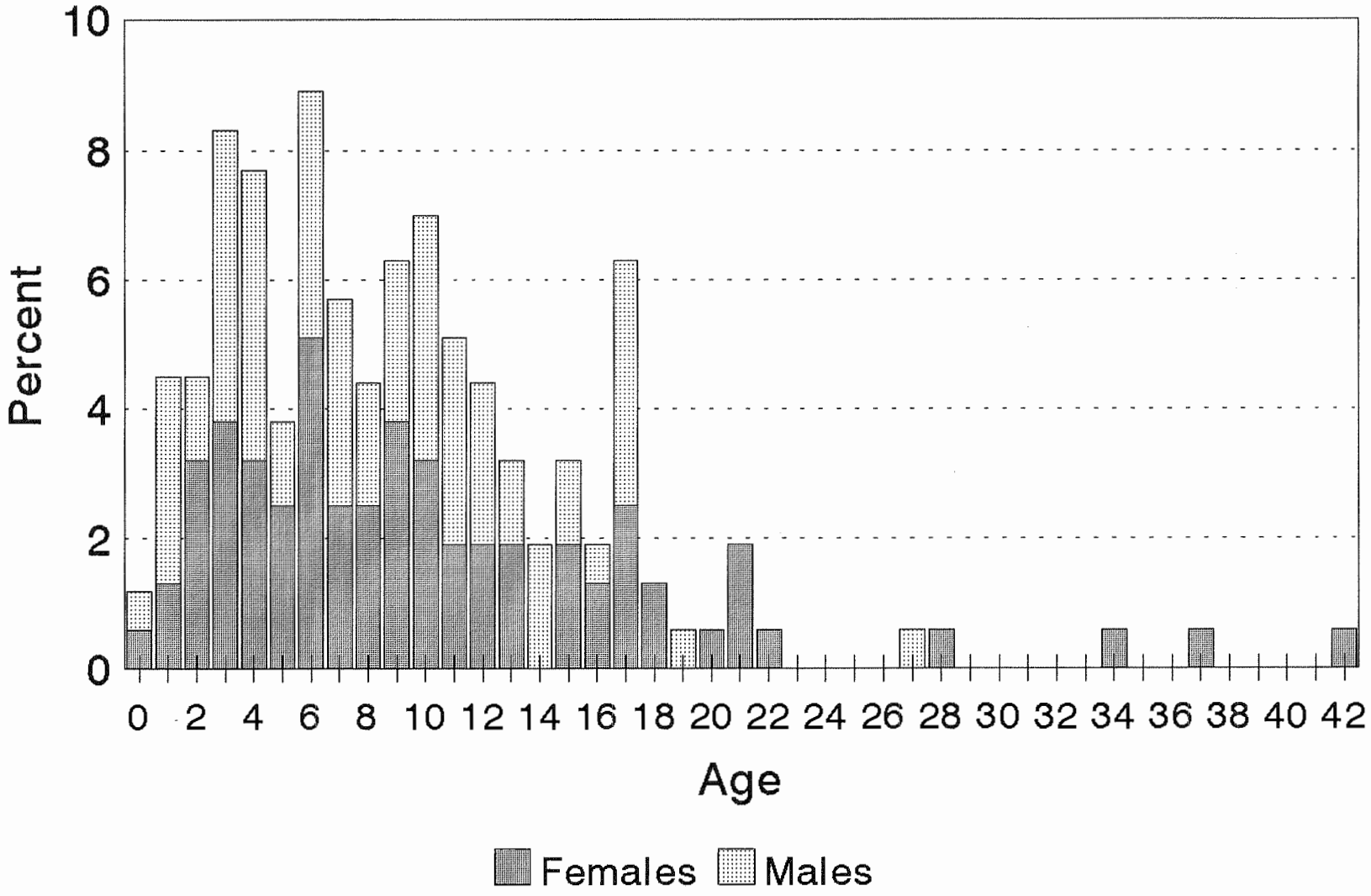


Census Data: Duffield & Shell

Dead Animals: September 1992

Phoca vitulina

n=157

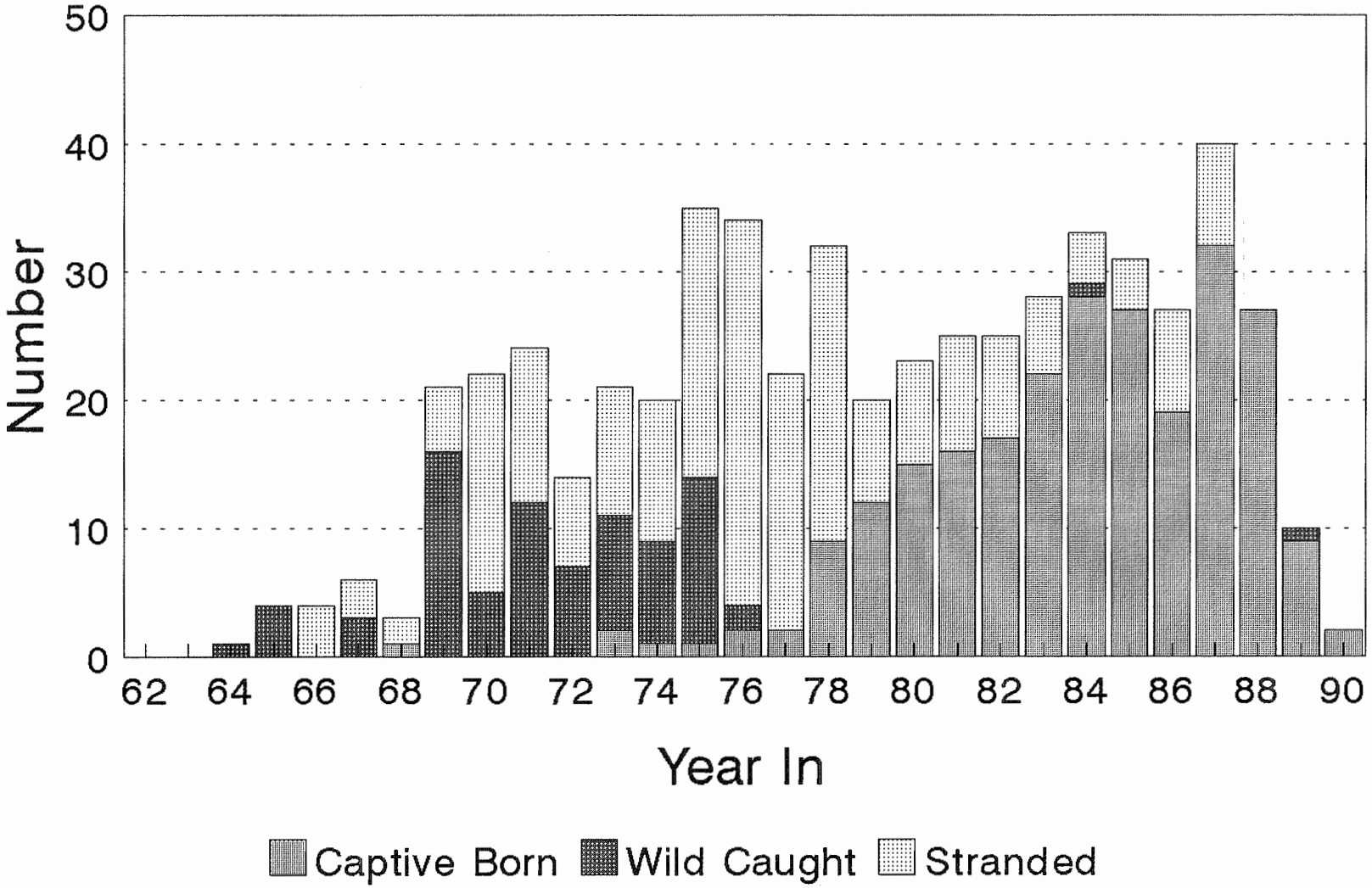


Census Data: Duffield & Shell

Acquisition Distribution

Phoca vitulina

n=565

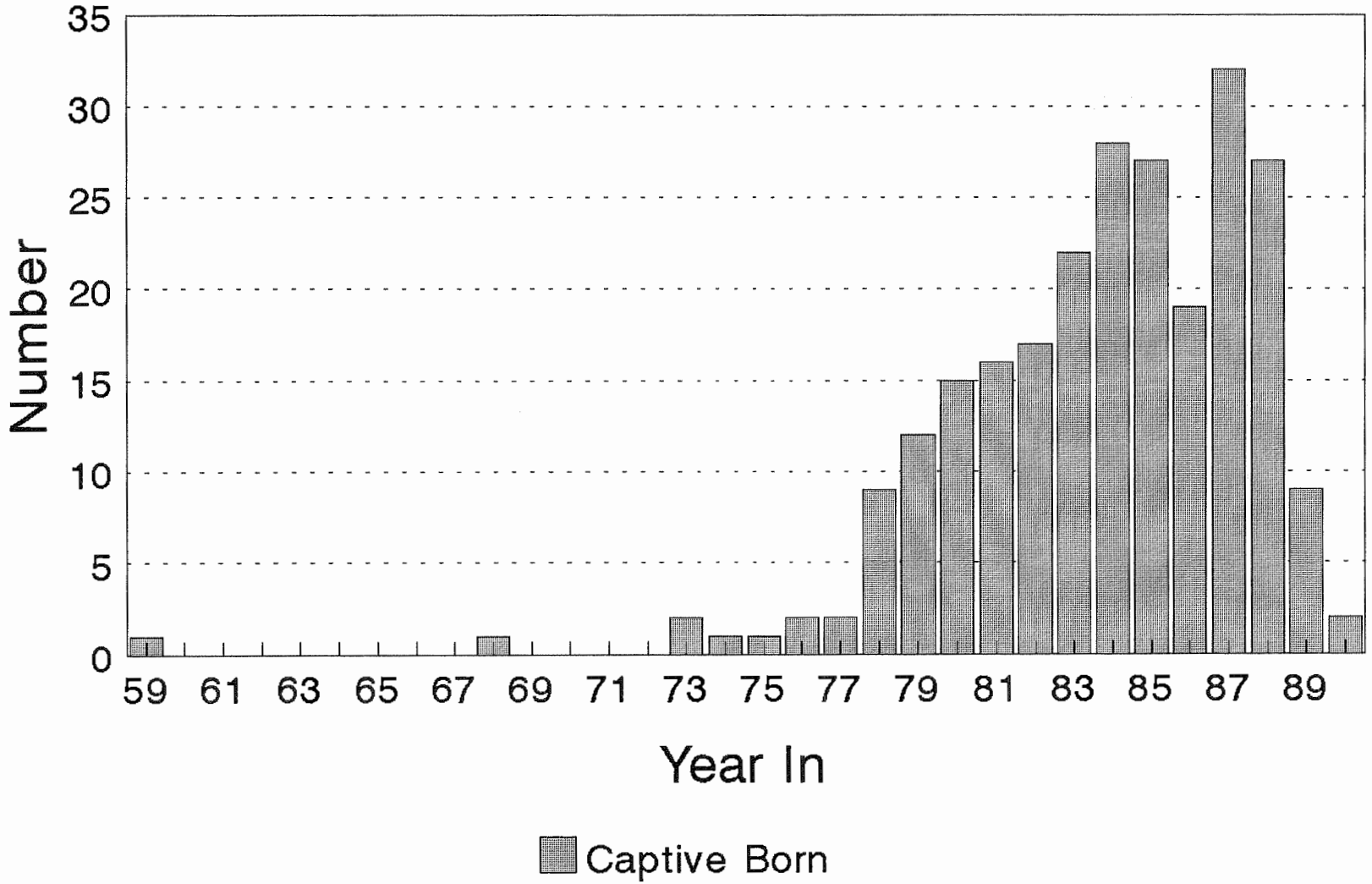


Census Data: Duffield & Shell

Birth Rate

Phoca vitulina

n=246

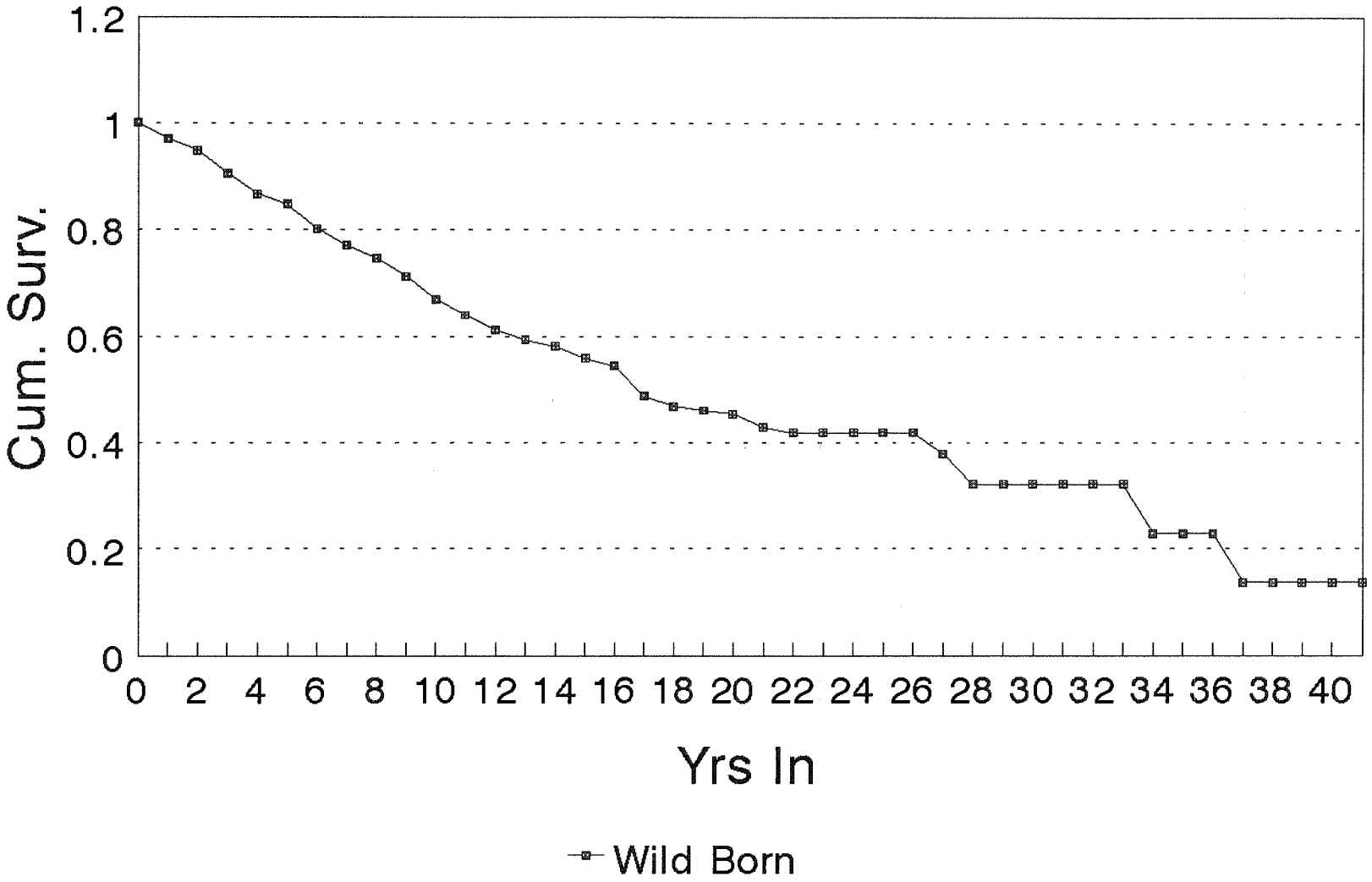


Census Data: Duffield & Shell

Surviorship Wild Born

Phoca vitulina

n=316

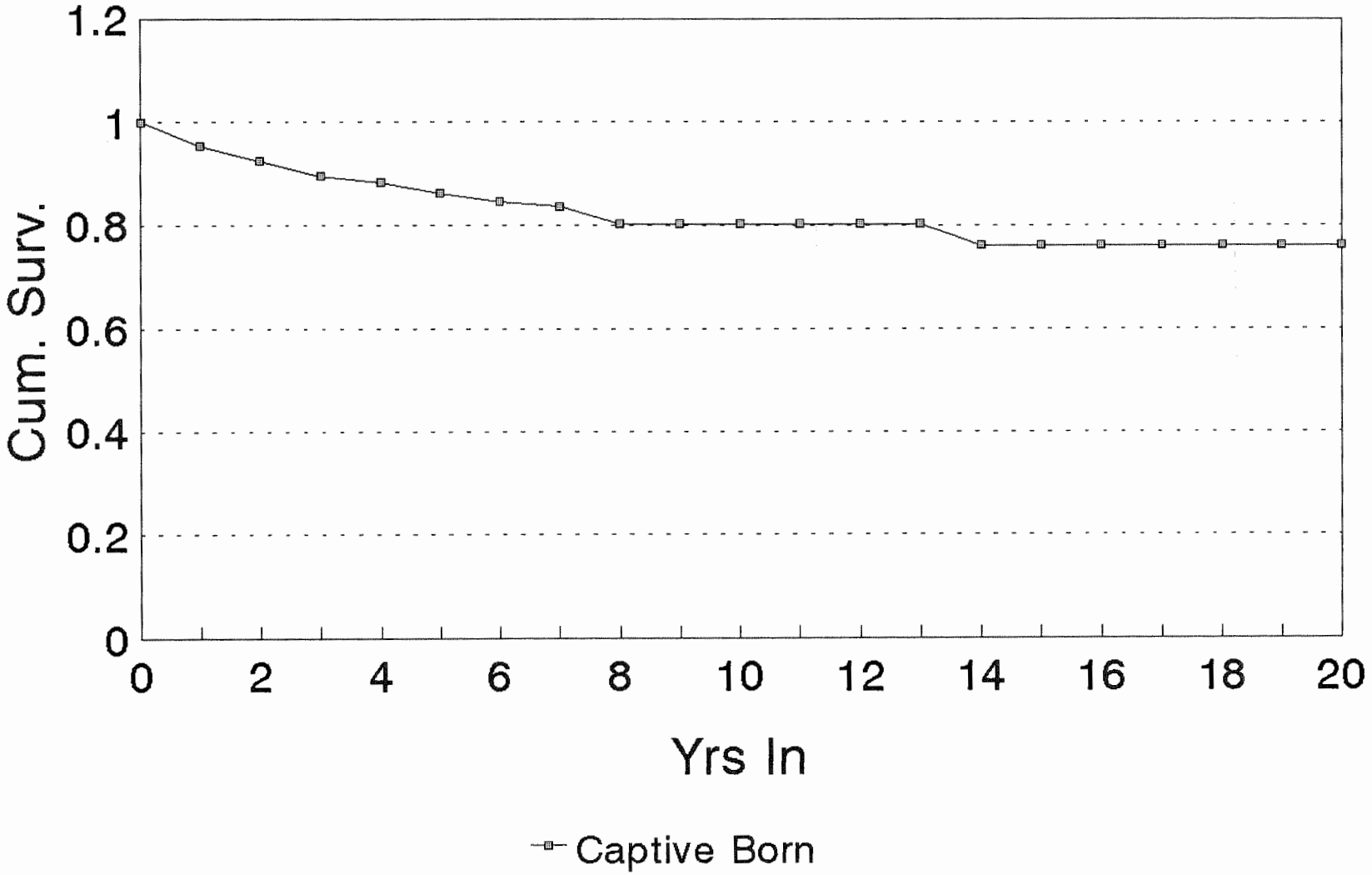


Census Data: Duffield & Shell

Surviorship Captive Born

Phoca vitulina

n=179



Census Data: Duffield & Shell

MEDITERRANEAN MONK SEAL
(*Monachus monachus*)

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SECTION 14

REPRODUCTIVE RESEARCH

Reproductive Research of Potential Usefulness for Conserving the Mediterranean Monk Seal.

David Wildt, Department of Reproductive Physiology, National Zoological Park, Smithsonian Institution, Washington, DC USA

Introduction:

The challenges to maintaining bio- and genetic diversity in situ and ex situ can be met using an arsenal of science, logic and technology. For ex situ (captive) breeding programs, assisted reproduction (techniques like artificial insemination) could be a powerful management tool for overcoming problems associated with geographically separated individuals, sexual incompatibility and aged or under-represented founders unable to contribute to species preservation. Especially important would be the ability to meet various recommended breeding and conservation mandates with fewer complications (for example, transporting frozen semen, rather than living animals, would be less stressful and costly).

Reproductive technologies also can contribute to preserving species in native habitats. Perhaps the most profound impact could be achieved by developing systematic 'genome resource banks', repositories containing germ plasm, blood products, tissues and DNA. Organized sampling and cryopreservation of, for example, spermatozoa from selected, free-living individuals would permit 'snap-shot' storage of existing diversity. The effect would be to provide insurance against future human-induced or natural catastrophes capable of reducing genetic diversity further or eliminating entire species. Because of habitat fragmentation and the resulting isolation of populations, these germ plasm reserves also could be used for transferring genetic vigor (i.e., interchanging genes by periodically capturing and artificially inseminating females from one isolated population using sperm from another). Each animal is producing surplus germ plasm, and, given that this material is on reserve, there is no longer need to supplement captive populations with animals from the wild. In essence, reproductive technologies could assist in keeping wild populations healthy and numerous. The most important by-product would be the sheer presence of a wild population which, in turn, justifies and promotes habitat protection.

Advantages of genome resource banks go beyond supporting in situ populations. A natural benefit would be allowing the interactive movement of biological materials between living populations, especially transporting wild germ plasm to invigorate captive populations that have become genetically stagnant. Sperm (and eventually embryo) repositories also could help resolve the major crisis always facing captive breeding programs -- lack of space. This problem could be alleviated, in part, by maintaining portions of needed genetic diversity in liquid nitrogen, thereby reducing the number of living animals required and freeing space for other species at high risk.

Finally, a genome resource bank provides support for other management/research disciplines. For example, the systematic storage of tissue, blood products and DNA affords ready availability to the biomaterials needed for addressing questions about taxonomy (i.e., species versus subspecies), genetic variability within species or populations and disease outbreaks and epidemics (i.e., surveillance).

It is possible to use assisted reproductive technology and fresh or frozen-thawed germ plasm to generate offspring in endangered wildlife species. To-date, offspring have been produced in a wide array of species. However, the rate of success has been directly proportional to the amount of fundamental (basic) knowledge available for each species of interest. It now is well-established that species-specific idiosyncrasies often prevent directly applying technologies developed in closely-related species. However, given a sound database, all evidence suggests that basic reproductive knowledge can be translated into the production of living young and the support of both in situ and ex situ wildlife populations.

A potential reproductive research/management plan for the Mediterranean monk seal:

The Mediterranean monk seal could benefit by the eventual establishment of a systematic research program that focuses on understanding the fundamental reproductive biology of the species. These findings, in turn, eventually could have broad and profound implications to managing extant, free-living populations and, if established, any captive (reservoir) populations.

The priority need is for more basic information (see below) that will provide the normative data for the species and for specific subpopulations. This information is most important for understanding what factors regulate reproductive success. These data also will be the driving force to achieving success if captive breeding, assisted reproduction or genome resource banking eventually are recognized as important management tools for the in situ and/or ex situ populations. The tremendous promise of assisted techniques and genome resource banking should be motivation for considering how to begin to collect more specific reproductive data. Once the fundamentals of the reproductive system are understood for the Mediterranean monk seal, then assisted reproduction can be exploited to keep the extant population healthy, genetically-vigorous and 'insured'.

In essence, current specific knowledge about the reproductive physiology and endocrinology of the Mediterranean monk seal is non-existent. Therefore, any opportunity for adding to the database should be taken. Given the impossibility and extreme difficulty of collecting longitudinal data from the free-living population, most of the recommendations suggested below only can be implemented in two ways: 1) using a captive population, much like has been proposed in the French 'feasibility' study (a plan to develop a captive program in 1994 using perhaps six seal pups); and 2) in a 'surrogate' species that already is in captivity (i.e., the Hawaiian monk seal, see below). Presently, there is no plan to develop a captive breeding program for the Greek population of Mediterranean monk seal. Nonetheless, reproductive research recommendations for this species (presented below) are made (1) as a contingency (in

the event that any animals become available for study in captivity) and (2) to emphasize the eventual importance of establishing these kinds of data for all phocid taxa. It also may be possible to consider the short-term capture and ex situ maintenance of Mediterranean monk seals for the collection of some data (described below). After data are produced, animals could be reintroduced to original native habitat.

Specific recommendations:

1. Encourage and continue to support the development of databases using 'surrogate' species, especially the Hawaiian monk seal. For example, recent data from Atkinson and Gilmartin (manuscript in press, Marine Mammal Science) demonstrate the exciting potential of measuring the reproductive cycle of the Hawaiian monk seal non-invasively using salivary hormone monitoring. Additionally, Parsons and colleagues (Dalhousie University, Halifax, Nova Scotia) recently have successfully collected semen by electroejaculation from grey seals (preliminary unpublished data), and a similar procedure now is under evaluation in Hawaiian monk seals by Atkinson and Gilmartin. These kinds of techniques have extraordinary potential for generating the types of fundamental information so crucial to understanding reproductive mechanisms and eventually developing assisted reproduction for phocids. The two techniques deserving highest priority attention for further development in a surrogate species are:

a. electroejaculation as a safe and reliable tool for collecting sperm. Such studies should focus on developing safe and effective anesthetic/electroejaculation protocols that will result in consistently high quality semen samples. Once developed for a more 'common' species, less time and 'experimentation' will be required using the rare Mediterranean monk seal.

b. non-invasive monitoring of reproductive status including using saliva, urine and/or feces. Recent findings have illustrated the usefulness of salivary monitoring. However, it is important to determine the primary routes whereby phocids excrete reproductive steroids to systematically determine the relative utility and validity of assessing reproductive status using saliva versus urine versus feces. These studies also will provide indications on the practicality of collecting these three biomaterials on a routine basis from phocids.

2. tIn the event that a captive breeding program ever is established for the Mediterranean monk seal (similar to the feasibility program now planned by the French), systematic studies should focus immediately on the following areas:

a. onset of puberty (especially if young animals are used to initiate the captive breeding program). Data should be generated by monitoring reproductive/endocrine status non-invasively using hormonal monitoring of saliva, urine and/or feces.

b. determining seasonality in the female. Data should be generated by monitoring reproductive/endocrine status non-invasively in adult females using hormonal monitoring of

saliva, urine and/or feces. If feasible, vaginal cytology and behavioral cues should be examined. Progress should be accelerated by the findings and techniques developed in the surrogate species studies (see Recommendation #1b).

c. determining the natural reproductive cycle of the adult female. Data should be generated by monitoring reproductive/endocrine status non-invasively using hormonal monitoring of saliva, urine and/or feces. If feasible, vaginal cytology and behavioral cues should be examined.

d. determining onset of ovulation with respect to the reproductive cycle. Data should be generated by monitoring reproductive/endocrine status non-invasively in adult females using hormonal monitoring of saliva, urine and/or feces. If feasible, vaginal cytology and behavioral cues should be examined.

e. assessing the responsiveness of adult females to exogenous gonadotropins. If the natural reproductive cycle of the seal is ever to be manipulated, it will be necessary to determine its responsiveness to conventional hormonal therapies. The ability to artificially induce ovarian activity, including ovulation, will be necessary for 'timed' natural matings or for facilitating artificial insemination. Data should be generated by treating females with hormones and then measuring response using non-invasive monitoring of reproductive endocrine status, vaginal cytology, behavioral cues and, if possible, natural breeding with a male.

f. determining seasonality in the adult male. Data should be collected by monitoring reproductive/endocrine status non-invasively using saliva, urine and/or feces and by measuring sperm production and quality over time. This study naturally also will comprise a parallel effort to optimize electroejaculation for the species focusing on identifying the optimal anesthetic and semen collection protocol. Progress should be accelerated by exploiting knowledge generated in the surrogate studies (see Recommendation #1a).

g. determining the 'normative' ejaculate characteristics for the species including identifying expected seminal volummes, sperm morphologies, concentrations and motility traits. Data will be generated by electroejaculating multiple, adult, fertile males over time.

h. identifying appropriate laboratory processing procedures to promote sperm viability in vitro to eventually allow successful artificial insemination while avoiding the transmission of disease. There are a host of laboratory processing procedures already available for other species that simply can be adapted and tested for the Mediterranean monk seal.

i. conducting systematic studies of how monk seal sperm react to cryopreservation. This study primarily will focus on the impact of various cryoprotective diluents and cooling/freezing protocols on monk seal sperm viability. Again, standard protocols and techniques already available for other mammalian taxa simply can be adapted and tested in the monk seal.

3. In the event that a captive breeding program ever is established for the Mediterranean monk seal (similar to the feasibility program planned by the French) , then long-term systematic studies also should be considered. However, it must be emphasized that these investigations only will be possible if most (or all) of the studies outlined in Recommendation #2 are achieved first.

a. determining rate of fertilization and understanding the phenomenon of delayed implantation.

b. establishing routine protocols for artificial insemination using fresh or frozen/thawed spermatozoa.

NOTE: Given the paucity of information currently available for the taxon and logistical difficulties, it is not recommended that embryo research (including embryo transfer and in vitro fertilization) be considered as either a short- or long-term useful research option for the Mediterranean monk seal.

4. In the event that fresh gonadal tissue can be collected from Mediterranean monk seals that recently have died, then the following studies should be considered:

a. detailed anatomical and histological descriptions of the reproductive tract including the ovaries, oviduct, uterus, cervix and vagina for the female and the testes, epididymides and the ductus deferens for the male. Associated with this analysis should be parallel examinations for evidence of reproductive tract disease, pathogens or other anomalies.

b. the 'rescue' of ovarian oocytes or epididymal/ductus deferens spermatozoa. These studies should focus on determining the potential of growing and maturing ovarian oocytes in vitro for the eventual purpose of developing an in vitro oocyte maturation and fertilization system. Likewise, it should be determined if sperm collected from recently dying males can be recovered and motility provoked and maintained in vitro.

5. The development of a systematic genome resource bank should be considered either now or in the future for helping manage and sustain genetic diversity in the wild (and perhaps captive) population.

a. when appropriate and ready, managers of the Greek population should contact the Captive Breeding Specialist Group for advice and assistance in developing a systematic Genome Resource Banking Action Plan.

Summary:

Based upon evidence with other rare wildlife species, certain reproductive biotechniques could become useful, supportive tools in the conservation of phocid taxa. But, the primary emphasis now should be on using these methods to define and interrelate fundamental reproductive phenomena rather than immediately attempting large scale, 'artificial' breeding programs. Especially helpful will be testing and developing 'model' data from ongoing studies of the Hawaiian monk seal and the feasibility captive breeding studies for the Mediterranean monk seal planned by French investigators. These kinds of studies will provide crucial normative information that can be helpful for designing propagation masterplans and for reinforcing both in situ and ex situ conservation efforts. Of particular importance will be the development of genome resource banks that will serve as reservoir repositories of biomaterials useful for maintaining genetic diversity, providing insurance and addressing taxonomic, heterozygosity and disease issues.

MEDITERRANEAN MONK SEAL
(*Monachus monachus*)

GREEK POPULATION

POPULATION AND HABITAT VIABILITY ASSESSMENT

Athens, Greece
4-7 April 1994

Report

APPENDIX

SECTION 15

THE MONK SEAL REGISTER

The Monk Seal Register

The Monk Seal Register is a project coordinated by the Institut Royal des Sciences Naturelles de Belgique in collaboration with the Sea Mammal Research Unit. The European Commission has agreed to provide a large proportion of the funding for the project until the end of 1994. The Register is a service which is offered to all groups who are engaged in efforts to conserved the Mediterranean monk seal. It provides three complementary functions:

1. An archive, in standard format, of all available information on the conservation of the monk seal.

2. A facility for exchanging information between all of the groups involved in monk seal conservation.

3. Standardized methodologies for data collection, data extraction and presentation, and data analysis.

Archiving is the primary function of the register. For a rare and widely distributed species, which is difficult to study and which has been investigated by many different groups over a long period like the monk seal, it is important that all observations are used effectively. It provides a relational database for handling information on surveys, site descriptions, records of visits to sites, encounters with seals, descriptions of individual animals, post-mortem reports and associated analyses, and on individual research workers in an integrated way.

The Register provides a means of communication between national and international authorities, scientific institutions, teams working in the field, and all individuals who have contacts with the species. At present, the Register includes information from more than 50 groups in 8 countries.

The development and evaluation of conservation measures for the monk seal requires the best possible information on the ecology and population dynamics of the species. The concept of the Register was developed in order to respond to this need. The information in the Register is being used to guide a number of specific actions:

1. the choice of important sites for the conservation of the monk seal and the marine resources associated with it, particularly in the framework of the CORINE classification of habitat types and NATURA 2000, a European Union programme associated with the Commission's Habitats Directive.

2. an analysis of population trends, ecological constraints and factors affecting population vulnerability.

3. the development of non-intrusive techniques (such as the use of automatic cameras and videocameras in the caves used by seals) to identify individuals and determine habitat preferences, the use of GPS technology to determine the location of caves more precisely, and the estimation of observer effort in different areas.

MEDITERRANEAN MONK SEAL
(*Monachus monachus*)

GREEK POPULATION

POPULATION AND HABITAT VIABILITY ASSESSMENT

Athens, Greece
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APPENDIX

SECTION 16

VORTEX MODELLING INPUT AND OUTPUT TABLES

BASIC DEMOGRAPHY, ONE POPULATION

INPUT TO VORTEX

Input common to all scenarios

No inbreeding depression
No correlation in EV between reproduction and mortality
Polygynous mating
Age of first breeding in males: 7 years
Even primary sex ratio
Maximum litter size: 1
Proportion adult females giving birth per year: 50%
S.D. in proportion adult females giving birth: 12.5 percentage units
Mortality at age 1: 10%, with S.D. 5 percentage units
Mortality at age 2: 10%, with S.D. 3 percentage units
Mortality at age 3: 8%, with S.D. 3 percentage units
Mortality at age 4: 6%, with S.D. 3 percentage units
No catastrophes
All males participate in breeding
Initial populations at stable age distribution
Carrying capacity: 500
No environmental variation in carrying capacity

Variables:

Initial population size, INPOP	90, 180, 360
Age of first breeding in females, BREED	5, 6 years
Maximum age, MAX	25, 40 years
Mortality at age 0, JUVMORT	20%, with S.D. 10 percentage units
	40%, with S.D. 20 percentage units
	60%, with S.D. 20 percentage units
Adult mortality, ADMORT	2%, with S.D. 1 percentage unit
	4%, with S.D. 2 percentage units
	6%, with S.D. 3 percentage units

LABEL	INPOP	BREED	MAX	JUVMORT	ADMORT
BO001	180	5	25	20%	2%
BO002	180	5	25	20%	4%
BO003	180	5	25	20%	6%
BO004	180	5	25	40%	2%
BO005	180	5	25	40%	4%
BO006	180	5	25	40%	6%
BO007	180	5	25	60%	2%
BO008	180	5	25	60%	4%
BO009	180	5	25	60%	6%
BO011	180	5	40	20%	2%
BO012	180	5	40	20%	4%
BO013	180	5	40	20%	6%
BO014	180	5	40	40%	2%
BO015	180	5	40	40%	4%
BO016	180	5	40	40%	6%
BO017	180	5	40	60%	2%
BO018	180	5	40	60%	4%
BO019	180	5	40	60%	6%

LABEL	INPOP	BREED	MAX	JUVMORT	ADMORT
BO021	180	6	25	20%	2%
BO022	180	6	25	20%	4%
BO023	180	6	25	20%	6%
BO024	180	6	25	40%	2%
BO025	180	6	25	40%	4%
BO026	180	6	25	40%	6%
BO027	180	6	25	60%	2%
BO028	180	6	25	60%	4%
BO029	180	6	25	60%	6%
BO031	180	6	40	20%	2%
BO032	180	6	40	20%	4%
BO033	180	6	40	20%	6%
BO034	180	6	40	40%	2%
BO035	180	6	40	40%	4%
BO036	180	6	40	40%	6%
BO037	180	6	40	60%	2%
BO038	180	6	40	60%	4%
BO039	180	6	40	60%	6%

BO041	360	5	25	20%	2%
BO042	360	5	25	20%	4%
BO043	360	5	25	20%	6%
BO044	360	5	25	40%	2%
BO045	360	5	25	40%	4%
BO046	360	5	25	40%	6%
BO047	360	5	25	60%	2%
BO048	360	5	25	60%	4%
BO049	360	5	25	60%	6%
BO051	360	5	40	20%	2%
BO052	360	5	40	20%	4%
BO053	360	5	40	20%	6%
BO054	360	5	40	40%	2%
BO055	360	5	40	40%	4%
BO056	360	5	40	40%	6%
BO057	360	5	40	60%	2%
BO058	360	5	40	60%	4%
BO059	360	5	40	60%	6%
BO061	360	6	25	20%	2%
BO062	360	6	25	20%	4%
BO063	360	6	25	20%	6%
BO064	360	6	25	40%	2%
BO065	360	6	25	40%	4%
BO066	360	6	25	40%	6%
BO067	360	6	25	60%	2%
BO068	360	6	25	60%	4%
BO069	360	6	25	60%	6%

LABEL	INPOP	BREED	MAX	JUVMORT	ADMORT
BO071	360	6	40	20%	2%
BO072	360	6	40	20%	4%
BO073	360	6	40	20%	6%
BO074	360	6	40	40%	2%
BO075	360	6	40	40%	4%
BO076	360	6	40	40%	6%
BO077	360	6	40	60%	2%
BO078	360	6	40	60%	4%
BO079	360	6	40	60%	6%
BO081	90	5	25	20%	2%
BO082	90	5	25	20%	4%
BO083	90	5	25	20%	6%
BO084	90	5	25	40%	2%
BO085	90	5	25	40%	4%
BO086	90	5	25	40%	6%
BO087	90	5	25	60%	2%
BO088	90	5	25	60%	4%
BO089	90	5	25	60%	6%
BO091	90	5	40	20%	2%
BO092	90	5	40	20%	4%
BO093	90	5	40	20%	6%
BO094	90	5	40	40%	2%
BO095	90	5	40	40%	4%
BO096	90	5	40	40%	6%
BO097	90	5	40	60%	2%
BO098	90	5	40	60%	4%
BO099	90	5	40	60%	6%
BO101	90	6	25	20%	2%
BO102	90	6	25	20%	4%
BO103	90	6	25	20%	6%
BO104	90	6	25	40%	2%
BO105	90	6	25	40%	4%
BO106	90	6	25	40%	6%
BO107	90	6	25	60%	2%
BO108	90	6	25	60%	4%
BO109	90	6	25	60%	6%
BO111	90	6	40	20%	2%
BO112	90	6	40	20%	4%
BO113	90	6	40	20%	6%
BO114	90	6	40	40%	2%
BO115	90	6	40	40%	4%
BO116	90	6	40	40%	6%
BO117	90	6	40	60%	2%
BO118	90	6	40	60%	4%
BO119	90	6	40	60%	6%

BASIC DEMOGRAPHY, ONE POPULATION

RESULTS FROM VORTEX

Result parameters:

Deterministic r, exponential rate of increase, DET r
Realized r, taking stochastic events into account, REAL r
S.D. in realized r, SD r
Probability of extinction, PE
Final population size for surviving populations, N
S.D. in final population size, SD N
Remaining proportion of expected heterozygosity, H
Mean time to extinction for populations that go extinct, T

LABEL	DET r	REAL r	SD r	PE	N	SD N	H	T
BO001	0.068	0.067	0.046	0	499	5	0.97	
BO002	0.056	0.055	0.050	0	498	10	0.97	
BO003	0.044	0.043	0.054	0	494	13	0.97	
BO004	0.044	0.042	0.055	0	494	14	0.97	
BO005	0.032	0.030	0.060	0	488	22	0.97	
BO006	0.019	0.018	0.066	0	469	37	0.96	
BO007	0.014	0.012	0.058	0	453	60	0.97	
BO008	0.001	-0.003	0.070	0.04	157	127	0.89	166
BO009	-0.013	-0.018	0.095	0.49	25	25	0.71	150
BO011	0.077	0.076	0.046	0	499	6	0.97	
BO012	0.064	0.063	0.050	0	498	7	0.97	
BO013	0.051	0.050	0.054	0	496	10	0.97	
BO014	0.057	0.055	0.055	0	498	8	0.97	
BO015	0.043	0.042	0.060	0	493	13	0.97	
BO016	0.029	0.027	0.066	0	483	27	0.97	
BO017	0.032	0.030	0.055	0	492	14	0.98	
BO018	0.017	0.015	0.061	0	471	32	0.97	
BO019	0.003	0.000	0.066	0.01	226	147	0.96	169
BO021	0.059	0.059	0.044	0	499	7	0.97	
BO022	0.047	0.046	0.048	0	496	10	0.97	
BO023	0.034	0.033	0.053	0	491	18	0.97	
BO024	0.038	0.037	0.053	0	494	12	0.97	
BO025	0.025	0.024	0.058	0	481	25	0.97	
BO026	0.012	0.010	0.065	0	428	84	0.96	
BO027	0.009	0.008	0.057	0	423	92	0.96	
BO028	-0.004	-0.008	0.075	0.09	79	80	0.85	158
BO029	-0.018	-0.024	0.110	0.71	18	25	0.64	142
BO031	0.070	0.070	0.043	0	499	7	0.97	
BO032	0.056	0.055	0.048	0	499	7	0.97	
BO033	0.043	0.042	0.052	0	495	12	0.97	
BO034	0.052	0.051	0.053	0	498	9	0.97	
BO035	0.038	0.036	0.058	0	492	16	0.97	
BO036	0.023	0.022	0.064	0	476	34	0.97	
BO037	0.028	0.027	0.053	0	490	18	0.98	
BO038	0.013	0.012	0.059	0	458	47	0.97	
BO039	-0.002	-0.004	0.075	0.025	119	101	0.88	177

LABEL	DET r	REAL r	SD r	PE	N	SD N	H	T
BO041	0.068	0.067	0.046	0	499	6	0.97	
BO042	0.056	0.055	0.049	0	497	9	0.97	
BO043	0.044	0.043	0.054	0	494	14	0.97	
BO044	0.044	0.043	0.055	0	495	11	0.97	
BO045	0.032	0.030	0.060	0	486	20	0.97	
BO046	0.019	0.017	0.066	0	467	43	0.97	
BO047	0.014	0.012	0.057	0	464	50	0.97	
BO048	0.001	-0.002	0.064	0	237	135	0.94	
BO049	-0.013	-0.017	0.084	0.30	44	45	0.79	157
BO051	0.077	0.076	0.045	0	499	8	0.97	
BO052	0.064	0.063	0.049	0	498	8	0.97	
BO053	0.051	0.050	0.054	0	497	11	0.97	
BO054	0.057	0.056	0.055	0	498	8	0.97	
BO055	0.043	0.042	0.059	0	494	15	0.97	
BO056	0.029	0.028	0.065	0	481	25	0.97	
BO057	0.032	0.030	0.055	0	489	16	0.98	
BO058	0.017	0.016	0.060	0	472	31	0.98	
BO059	0.003	0.001	0.062	0	302	137	0.96	
BO061	0.059	0.059	0.044	0	499	6	0.97	
BO062	0.047	0.046	0.048	0	498	9	0.97	
BO063	0.034	0.033	0.052	0	492	16	0.97	
BO064	0.038	0.036	0.053	0	493	13	0.97	
BO065	0.025	0.023	0.058	0	480	27	0.97	
BO066	0.012	0.010	0.064	0	430	69	0.97	
BO067	0.009	0.008	0.056	0	436	73	0.97	
BO068	-0.004	-0.007	0.067	0.015	126	103	0.91	173
BO069	-0.018	-0.024	0.100	0.54	21	24	0.70	155
BO071	0.070	0.070	0.043	0	499	6	0.97	
BO072	0.056	0.056	0.047	0	498	7	0.97	
BO073	0.043	0.042	0.052	0	495	12	0.97	
BO074	0.052	0.051	0.052	0	498	7	0.97	
BO075	0.038	0.036	0.058	0	490	16	0.97	
BO076	0.023	0.021	0.063	0	473	32	0.97	
BO077	0.028	0.027	0.053	0	490	16	0.98	
BO078	0.013	0.012	0.059	0	459	41	0.98	
BO079	-0.002	-0.004	0.069	0.005	182	129	0.93	173
BO081	0.068	0.066	0.046	0	498	7	0.96	
BO082	0.056	0.055	0.050	0	497	8	0.96	
BO083	0.044	0.043	0.054	0	494	14	0.96	
BO084	0.044	0.043	0.056	0	493	13	0.96	
BO085	0.032	0.030	0.061	0	489	20	0.96	
BO086	0.019	0.017	0.068	0	457	58	0.94	
BO087	0.014	0.012	0.060	0	436	94	0.94	
BO088	0.001	-0.003	0.080	0.115	109	107	0.80	152
BO089	-0.013	-0.021	0.108	0.75	21	18	0.62	126

LABEL	DET r	REAL r	SD r	PE	N	SD N	H	T
BO091	0.077	0.076	0.045	0	499	6	0.96	
BO092	0.064	0.063	0.050	0	498	7	0.96	
BO093	0.051	0.050	0.054	0	496	10	0.96	
BO094	0.057	0.055	0.055	0	497	9	0.97	
BO095	0.043	0.042	0.060	0	492	15	0.96	
BO096	0.029	0.027	0.066	0	481	27	0.96	
BO097	0.032	0.030	0.056	0	490	17	0.97	
BO098	0.017	0.016	0.063	0	463	62	0.95	
BO099	0.003	-0.002	0.076	0.12	151	143	0.84	
BO101	0.059	0.059	0.044	0	499	7	0.96	
BO102	0.047	0.046	0.048	0	497	9	0.96	
BO103	0.034	0.033	0.053	0	490	16	0.96	
BO104	0.038	0.036	0.054	0	494	13	0.96	
BO105	0.025	0.023	0.059	0	483	23	0.96	
BO106	0.012	0.010	0.068	0.015	392	119	0.92	128
BO107	0.009	0.007	0.061	0.01	347	144	0.92	124
BO108	-0.004	-0.009	0.088	0.28	52	59	0.74	141
BO109	-0.018	-0.027	0.121	0.865	13	8	0.51	119
BO111	0.070	0.700	0.044	0	499	6	0.97	
BO112	0.056	0.055	0.048	0	499	7	0.96	
BO113	0.043	0.042	0.053	0	495	12	0.96	
BO114	0.052	0.051	0.053	0	497	9	0.97	
BO115	0.038	0.037	0.059	0	492	14	0.96	
BO116	0.023	0.022	0.065	0	476	34	0.95	
BO117	0.028	0.027	0.054	0	490	15	0.97	
BO118	0.013	0.012	0.061	0	436	86	0.95	
BO119	-0.002	-0.006	0.086	0.17	75	73	0.81	144

BASIC METAPOPULATION SCENARIO

INPUT TO VORTEX
Input common to all scenarios

No inbreeding depression
No correlation in EV between reproduction and mortality
Polygynous mating
Age of first breeding in males: 5 years
Age of first breeding in males: 7 years
Maximum age: 40 years
Even primary sex ratio
Maximum litter size: 1
Proportion adult females giving birth per year: 50%
S.D. in proportion adult females giving birth: 12.5 percentage units
Mortality at age 1: 10%, with S.D. 5 percentage units
Mortality at age 2: 10%, with S.D. 3 percentage units
Mortality at age 3: 8%, with S.D. 3 percentage units
Mortality at age 4: 6%, with S.D. 3 percentage units
Adult mortality: 6%, with S.D. 3 percentage units
No catastrophes
All males participate in breeding
Initial populations at stable age distribution
Initial total metapopulation size: 180
Total metapopulation carrying capacity: 500
No environmental variation in carrying capacity

Variables:

Number of subpopulations, SUBPOPS	2: Initial population sizes: 20, 160 Carrying capacities: 56, 444 3: Initial population sizes: 20, 60, 100 Carrying capacities: 56, 167, 277
Migration pattern, MIGRATION	A, B, C, D, E, F, G, H
Mortality at age 0, JUVMORT	20%, with S.D. 10 percentage units 40%, with S.D. 20 percentage units 55%, with S.D. 20 percentage units 60%, with S.D. 20 percentage units

Migration patterns:

A	From 1	From 2
To 1		0
To 2	0	

B	From 1	From 2
To 1		0.01
To 2	0.01	

C	From 1	From 2
To 1		0.1
To 2	0.1	

D	From 1	From 2	From 3
To 1		0	0
To 2	0		0
To 3	0	0	

E	From 1	From 2	From 3	
To 1		0.005	0.005	Propagule rain
To 2	0.005		0.005	
To 3	0.005	0.005		

F	From 1	From 2	From 3	
To 1		0.05	0.05	Propagule rain
To 2	0.05		0.05	
To 3	0.05	0.05		

G	From 1	From 2	From 3	
To 1		0	0.005	Stepping stones
To 2	0		0.005	
To 3	0.01	0.01		

H	From 1	From 2	From 3	
To 1		0	0.05	Stepping stones
To 2	0		0.05	
To 3	0.1	0.1		

LABEL	JUVMORT	SUBPOPS	MIGRATION
BM001	60%	2	A
BM002	60%	2	B
BM003	60%	2	C
BM004	55%	2	A
BM005	55%	2	B
BM006	55%	2	C
BM007	40%	2	A
BM008	40%	2	B
BM009	40%	2	C
BM010	20%	2	A
BM011	20%	2	B
BM012	20%	2	C
BM061	60%	3	D
BM062	60%	3	E
BM063	60%	3	F
BM064	55%	3	D
BM065	55%	3	E
BM066	55%	3	F
BM067	40%	3	D
BM068	40%	3	E
BM069	40%	3	F
BM070	20%	3	D
BM071	20%	3	E
BM072	20%	3	F

LABEL	JUVMORT	SUBPOPS	MIGRATION
BM121	60%	3	G
BM122	60%	3	H
BM123	55%	3	G
BM124	55%	3	H
BM125	40%	3	G
BM126	40%	3	H
BM127	20%	3	G
BM128	20%	3	H

BASIC METAPOPULATION SCENARIO

RESULTS FROM VORTEX
Result parameters:

Deterministic r, exponential rate of increase, DET r
Probability of extinction, PE
Final population size for surviving populations, N

Small population (initial size 20), SMALL
Large population (initial size 160), LARGE

LABEL	DET r	PE			N		
		SMALL	LARGE	ALL	SMALL	LARGE	ALL
BM001	0.003	0.51	0.02	0.02	29	178	193
BM002	0.003	0.01	0.02	0.01	40	77	116
BM003	0.003	0.03	0.03	0.03	35	37	72
BM004	0.010	0.26	0	0	38	351	379
BM005	0.010	0	0	0	53	219	272
BM006	0.010	0	0	0	47	51	99
BM007	0.029	0.01	0	0	51	426	476
BM008	0.029	0	0	0	55	415	470
BM009	0.029	0	0	0	54	74	129
BM010	0.051	0	0	0	54	439	494
BM011	0.051	0	0	0	55	438	493
BM012	0.051	0	0	0	56	111	167

Small population (initial size 20), SMALL
Medium population (initial size 60), MEDIUM
Large population (initial size 100), LARGE

LABEL	DET r	PE				N			
		SMALL	MEDIUM	LARGE	ALL	SMALL	MEDIUM	LARGE	ALL
BM061	0.003	0.51	0.14	0.06	0	30	66	118	183
BM062	0.003	0.01	0.01	0	0	40	63	75	177
BM063	0.003	0	0	0.01	0	40	42	42	123
BM064	0.010	0.38	0.03	0.01	0	40	116	217	352
BM065	0.010	0	0	0	0	52	128	182	363
BM066	0.010	0	0	0	0	51	65	63	178
BM067	0.029	0.02	0	0	0	51	158	266	475
BM068	0.029	0	0	0	0	55	161	260	475
BM069	0.029	0	0	0	0	55	122	126	303
BM070	0.051	0	0	0	0	54	165	275	495
BM071	0.051	0	0	0	0	56	164	274	494
BM072	0.051	0	0	0	0	56	162	212	430
BM121	0.003	0.03	0.04	0.02	0.01	36	60	115	208
BM122	0.003	0.01	0.01	0.01	0.01	38	39	74	150
BM123	0.010	0	0	0	0	49	127	217	394
BM124	0.010	0	0	0	0	52	80	150	282
BM125	0.029	0	0	0	0	54	158	262	474
BM126	0.029	0	0	0	0	56	148	252	456
BM127	0.051	0	0	0	0	55	165	274	493
BM128	0.051	0	0	0	0	56	163	270	489

MEDITERRANEAN MONK SEAL
(*Monachus monachus*)

GREEK POPULATION

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APPENDIX

SECTION 17

SAMPLING PROTOCOLS

INFORMATION SHEET 1

Samples Requested from Aquatic Mammals for Virological studies

In Case the Animal is Alive

Specification Of:
* animal species
* length and/or estimated age of this animal
* number of animal **(Makes Correspondence Easier)**

Material:
* serum
- anti-coagulant not necessary during blood sampling
_ supernatant obtained by centrifugation or decantation is OK

volume : $\geq$ 1 ml
storage until shipment : frozen (preferably $\leq$ -20 C

* if possible heparinized blood: : 10-20 ml

* swab material on indication (disease symptoms)
storage until shipment : frozen (preferably -70 C)

Shipment:
* by air mail (express service)
enclosure of freezer packs is preferable.
NB: import permit into The Netherlands is not necessary.
* Label: serum samples for laboratory investigation, no commercial value.

Please try to contact Prof. Osterhaus or co-workers by telephone or telex as soon as possible to discuss shipping details.

Please Send To:
Prof. A.D.M.E. Osterhaus
Erasmus University
Department of Virology
P.O. Box 1738
3000 DR Rotterdam
The Netherlands
Tel: 0031 10 408 8066
Fax: 0031 10 436 5145

INFORMATION SHEET 2
Samples Requested From Aquatic Animals

In Case The Animal Is Dead:

Specification Of:
* animal species
* length and/or estimated age of the animal
* date of sampling
* number of animal **(Makes Correspondence Easier)**

Note; The animal should be kept as cool as possible and organ samples should be taken as soon as possible. Autopsy should be carried out under aseptic conditions, and preferably by an expert (verterinarian or biologist).

Organ Material To Be Sampled:
* brain
* heart
* lung
* liver
* spleen
* kidney
* pancreas
* mediastinal lymph nodes (N = 2)
* intestinal lymph nodes (N = 2)
* small intestine (about 10 cm + contents, closed at two sides by a string.
* a serum sample prepared from the right heart ventricle or axillary vein ($\geq$ 2 ml).

All Samples: Should be collected in sterile dishes or mbags and frozen at -70 C as soon as possible. In case this is not possible, the material should BE FROZEN at -20 C or kept in the refrigerator at +4 C until shipment. Please contact Prof. Osterhaus or co-workers by telephone of telefax as soon as possible to discuss shipping details.

Please Send To:
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Erasmus University
Department of Virology
P.O. Box 1738
3000 DR Rotterdam
The Netherlands
Tel: 0031 10 408 8066
Fax: 0031 10 436 5145

INFORMATION SHEET 3

SAMPLES REQUESTED FROM AQUATIC MAMMALS FOR GENETIC ANALYSIS

NOTE: Any material at all is potentially of value. Please keep a sample from all possible individuals.

1. Samples from different individuals to be kept in separate containers and identified.
2. Try to prevent human cross contamination by handling the material with gloves or forceps, or just as little as possible.

ORGAN MATERIAL TO BE SAMPLED:

Skin

Skin form flipper or elsewhere is the best source.
A small (1 cm^2) piece is all that is required. It can be stored at ambient temperature.

Other Tissues

Muscle is the next best tissue, followed by kidney, liver, spleen, and lung. Any other tissue can also be used.

These tissues are best stored frozen if possible and/or in preservative buffer which can be provided by us. 95 or 100% ethanol is also a reasonable alternative

A 1 cm^3 piece is al that is required but, if possible, a few samples from different tissues would be ideal.

Samples of different tissues from any one animal can be stored in the same container.

Samples from different individuals should be kept apart.

Hair

Store dry or in ethanol at ambient temperature.
Samples from different individuals should be kept apart.

Teeth, Bone, and Faeces

NOTE: If possible, please enclose a copy of the attached import license with any samples shipped. An updated license will be sent when necessary.

Please Send To:

Dr. H. Stanley
Conservation Genetics Group
Nuffield Laboratory
Institute of Zoology
Regent's Park
LONDON NW1 4RY, UK

INFORMATION SHEET 4

SAMPLES REQUESTED FROM AQUATIC MAMMALS FOR ANALYSIS OF POLLUTANTS

Specification Of:

* animal species
* length and/or estimated age of this animal
* date of sampling
* number of animal **(Makes Correspondence Easier)**

Material From Live Animal:

* 10 ml of whole blood in glass tubes without an anticoagulant; freeze sample

* hair; store in plastic bag

Material From Dead Animal:

* 10 ml of whole blood in glass tubes without an anticoagulant; sample can be taken directly from the heart; clots are not a problem

* hair; store in plastic bag

Organ Material To Be Sampled

* blubber
* liver
* heart
* kidney

NOTE: Sample size should be approximately 3 cm x 3 cm x 2 cm. Replicate samples of each tissue are taken. One sample is wrapper in aluminum foil and the other in a plastic bag. Other organs than the ones listed above may also be sampled.

ALL SAMPLES should be frozen at -70 C as soon as possible. In case this is not possible, the material should be frozen at -20 C or kept in the refrigerator at 4 C until shipment.

Please Send To:

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MEDITERRANEAN MONK SEAL
(*Monachus monachus*)

GREEK POPULATION

POPULATION AND HABITAT VIABILITY ASSESSMENT

Athens, Greece
4-7 April 1994

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APPENDIX

SECTION 18

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MEDITERRANEAN MONK SEAL
(*Monachus monachus*)

GREEK POPULATION

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SECTION 19

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