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MEDITERRANEAN ACTION PLAN

Meeting of Experts on the implementation of the Action Plans for marine mammals (monk seal and cetaceans) adopted within MAP

Arta, Greece, 29-31 October 1998

VULNERABILITY OF SMALL MEDITERRANEAN MONK SEAL GROUPS AND CONSERVATION POLICY

UNEP
SPA/RAC - Tunis, 1998

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Introduction

The critically endangered species Mediterranean monk seal *Monachus monachus* is estimated to number approximately 290-560 animals (Reijnders *et al.* 1997, updated after the monk seal die-off in the western Sahara in 1997. During that die-off approximately 200 seals died, nearly exclusively subadult and adult animals (Harwood *et al.* 1998)). Mediterranean monk seals are distributed over Madeira, the western Sahara, and the Mediterranean and Black Seas. The species is very thinly dispersed over a large area, exhibiting a scattered distribution pattern of groups, some of which are isolated, and usually comprising a dozen or less individuals. From a management perspective such a distribution poses a number of specific management problems. It is apparent that management authorities in different countries are dealing with small subpopulations or even only parts of small populations of the larger population. In conservation terms, small groups must be managed so as to benefit the entire population or species. However, it is evident that with decreasing size of the group to be protected, it becomes increasingly difficult to defend protection measures against cost perspective arguments or demands from other, *viz* human, users of the marine environment, such as fishermen, tourists and coastal developers. It is often asked, for example, whether the current numbers of monk seals are not too low and therefore doomed to extinction anyway because of *e.g.* catastrophic events and inbreeding. In this discussion paper, some aspects of the vulnerability of small groups of monk seals are elucidated and the values of protecting local monk seal units discussed. It is not the intention to present a comprehensive account of theoretically calculated probabilities for extinction, but rather apply the results thereof for practical conservation management considerations. In addition, it will be argued that besides numerical data other values have to be taken into account in designing a conservation policy.

Viability of small population units

The question of whether the numbers in certain monk seal units are too low in size to prevent them from recovery, going extinct or contributing to a population, can be addressed by using the concept of minimum viable population size (Soulé 1987). In general terms, a viable population is defined as a population surviving in a state where its vigor and its potential for evolutionary adaptation is maintained. In practice this is generally translated as the minimum number of individuals required to ensure that there is >95% probability that a population persists for at least 100 years.

Two issues are of particular concern when populations become reduced to low levels of abundance: genetics and demography. Genetic concerns relate to the loss of genetic variation in small populations, whereby fitness may decrease. Demographic concerns relate to the probability that extinction will occur through changes in demographic parameters.

Although interrelated, it is convenient to separate these two basic concerns in this paper. To illustrate their applicability, a specific case study of monk seals dealing with each of these concerns is elaborated. In addition, a study which addresses both genetic and demographic implications is discussed.

Genetic diversity

Until recently, very little information on the monk seal's biology was available (Reijnders *et al.* 1988, Reijnders *et al.* 1997), rendering the modelling of genetic and demographic consequences of catastrophic events a rather theoretical exercise. However, this was valuable as the models were helpful in identifying which demographic factors were critical and needed to be included in management plans (Harwood & Durant 1992). In the last couple of years, an increasing amount of population data has become available through the work carried out by research teams on colonies in the western Sahara, the Desertas Islands and in Greece.

Derry *et al.* (1997) investigated the effect of the 1997 mass mortality in the Cabo Blanco (=western Sahara) monk seal colony on the genetic diversity, using data collected from that colony by Forcada *et al.* (1996) and González *et al.* (1997). Derry *et al.* suggested that the effect of the mass mortality on genetic diversity was not large: a 12,5% reduction in allele diversity. They also demonstrated that genetic diversity is sensitive both to population size- this will be discussed later on- and to age-structure. With respect to the latter, it was concluded that the effects would have been more severe had mostly young or older animals survived. Regardless, it needs to be stressed that although the mortality did not substantially reduce genetic diversity, the genetic diversity of that colony was already very low (Pastor *et al.* 1997) and inbreeding depression can not be ruled out as a continuing conservation issue.

Extinction

Changes in demographic parameters can be caused by year to year variation in individual performance such as mortality and fecundity (*demographic stochasticity*) or changes in environmental conditions (*environmental stochasticity*). The first type of variability is intrinsic and affects each individual in a population independently, the latter type is an exogenously-caused effect and usually affects certain groups in a population. Examples of the latter are acute catastrophic events such as infectious diseases, cave collapse, and algal intoxication. Chronic effects such as pollution or decreased food availability, can be considered as an interacting version of both types of variability.

Durant & Harwood (1992) modelled the influence of demographic as well as environmental stochasticity on the time to extinction of individual monk seal populations. They found that the median time to extinction was independent of the frequency and severity of catastrophes, providing that birth rate in years without catastrophes was increased to a level that the overall birth rate was the same as if there had been no catastrophes. This latter provision is critical in the interpretation of those conclusions. It is evident that a severe reduction in e.g. mature females, will make it unlikely that such a provision will be met. Independency on the severity of catastrophes therefore holds only within certain limits. Moreover, they found that the effect of epidemic catastrophes (environmental stochasticity) may substantially shorten time to extinction.

Derry *et al.* (1997) investigated the effect of mass mortality on the probability of extinction for the western Sahara colony and found that the observed mortality did not drastically increase the probability of the colony's extinction, unless the population had fallen below 20 individuals. However, they indicated that if the average age of the animals in the colony had dropped to fewer than 11.8 (Forcada pers. comm.), as it is, in fact, at present, this threshold level could rise. Although these findings indicate that the mortality did not increase the colony's probability of extinction substantially, they should not distract from the fact that the low numbers of seals surviving the mass mortality render this colony susceptible to all the problems faced by small populations (Quattro & Vrijenhoek 1989; Fowler & Baker 1991; Mangel & Tier 1994) and its viability therefore remains compromised.

Threats by infectious diseases

Swinton (1997) examined the threats of infectious diseases to the Mediterranean monk seal. He concluded that smaller groups are less vulnerable to acute infectious diseases since these infections are unlikely to persist from year to year. Epidemics of generalist pathogens (e.g. morbilliviruses), which may be capable of intermittent inter-species transmission, pose a greater threat. In addition, he also drew attention to the threats from chronic infectious agents and pointed out that chronic infections with mild morbidity still can have large effects because they can persist within a population. This holds particularly for sexually transmitted diseases.

Implications for conservation policies

The studies discussed here, have revealed that the loss of genetic diversity from the recent mass mortality in the western Sahara was not large, even in such a small population unit. It needs to be emphasized that this would have been larger if the mortality had resulted in the survival of only young or older animals. A further observation is that the median time to extinction is independent of the frequency and, within limits, severity of disasters. However, of relevance is the finding that epidemic catastrophes can seriously shorten the time to extinction, if the population in question was already depleted through external factors such as killing or cave collapse. The consequences of the mass-mortality in the western Sahara colony for the viability of that colony, in terms of probability of extinction, nonetheless seem to be moderate. These would have increased considerably if the colony had dropped below 20 reproducing adults. The fact that this particular mortality had neither a substantial effect on the colony's genetic diversity nor on its probability of extinction, however, should not divert the attention from the observation that the remaining colony is very small in size. In effect, the number of adult animals potentially contributing to reproduction is at present estimated at 77 (Forcada & Aguilar pers. comm.). This is very close to the number, which, for many populations of large mammals, is suggested to be the minimum number of breeding individuals (around 50) required to maintain genetic variability and combat the effect of demographic stochasticity (Franklin 1980; Gilpin & Soulé 1986; Primack 1993).

Acute infectious diseases pose a threat to monk seals, although the consequences of acute infections are lower in small groups because of the short persistence time. A higher risk is posed by either acute infectious agents that are capable of inter-species transmission and therefore cause intermittent exposure, or by chronic infectious agents, with a low morbidity.

What can we learn from the recent mass mortality event?
In my view, the clear message is that catastrophic events can seriously deplete populations of monk seals. By contrast, even when this leads to low population size, these small groups are not doomed to go extinct through genetic loss, natural variability in mortality or fecundity, or another catastrophe. Much depends on the age-specificity of the catastrophe-related mortality. In other words, even smaller units have a realistic chance to survive and hence to contribute to the (meta)population they belong to. There is therefore every reason for management authorities to continue and intensify the strategy to designate and legally manage protected areas for monk seals, even when they contain only small groups. A related message is, that the best strategy for ensuring survival of the monk seal is not only to protect a few large populations, but as many remaining units as possible. This underscores the earlier findings of Harwood & Durant (1987) and is in accordance with the conservation guidelines as compiled by Johnson & Lavigne (1995).

Critical in this matter is the level of contacts between the scattered small groups. This holds in particular for those groups numbering a dozen or less individuals, comprising the majority of monk seal units in the Mediterranean. For that reason, knowledge on dispersal patterns becomes essential information to be collected via carefully planned research based preferably on satellite telemetry. Such information will furthermore help to evaluate how far the existing protected areas cover the important habitats and substantiate how urgently we need an extension of the number of adequately protected areas, including corridors between them.

The former discussion on the value of small groups in terms of contributing to the viability of the population in question is a "technical" conservation biology issue. It is emphasized that this is just one view within a conservation context. Small groups, even when they contribute little or nothing to the viability of a population or a species, have other values as well (see also Lavigne *et al.* in press). The survival of small units, apart from their intrinsic value as living beings, also has e.g. ecological, social and other (such as educational) values. These considerations have to be taken into account, in the formulation and implementation of conservation policies.

REFERENCES

Derry, J.F., Halley, J. & Harwood, J. 1997. Implications of the 1997 mass mortality in the western Sahara for the viability and genetic diversity of the Mediterranean monk seal population in the Atlantic. Working paper presented to the Workshop on the causes and consequences of the 1997 mass mortality of Mediterranean monk seals in the western Sahara, and referred to in the Workshop report (Eds. J. Harwood, D. Lavigne & P.J.H. Reijnders 1998. *Workshop on the causes and consequences of the 1997 mass mortality of Mediterranean monk seals in the western Sahara, Amsterdam, 11-13 December 1997).*

Durant, S.M. & Harwood, J. 1992. Assessment of monitoring and management strategies for local populations of the Mediterranean monk seal *Monachus monachus.* Biol. Conserv. 61: 81-92.

Fowler, C.W. & Baker, J.D. 1991. A review of animal population dynamics at extremely reduced population levels. Rep. Int. Whal. Commn. 41: 545-554.

Franklin, I.R. 1980. Evolutionary change in small populations. In M.E. Soulé & B.A. Wilcox (eds), *Conservation Biology: An evolutionary-ecological perspective.* pp. 135-149. Sinauer, Sunderland, MA.

Gilpin, M.E. & Soulé, M.E. 1986. Minimum viable populations: processes of species extinction. pp. 13-34. In M.E. Soulé (ed.), *Conservation biology: The science of scarcity and diversity.* Sinauer, Sunderland, MA.

Harwood, J. & Durant, S.M. 1987. The dynamics of small monk seal populations. pp. 51-60. In J. Harwood (ed.), *Population biology of the Mediterranean monk seal in Greece.* Report to the Commission of the European Communities. Contract no. ENV 853 UK(H).

Harwood, J., Lavigne, D. & Reijnders, P.J.H. 1998. *Workshop on the causes and consequences of the 1997 mass mortality of Mediterranean monk seals in the western Sahara. Amsterdam, 11-14 December 1997.* IBN Scientific Contributions 11, Institute for Forestry & Nature Research, Wageningen, The Netherlands. pp. 32. ISBN 90-76095-04-3.

Johnson, W.M. & Lavigne D.M. 1995. *The Mediterranean monk seal; Conservation guidelines.* International Marine Mammal Associates, Guelph, Canada, 52 pp.

Lavigne, D.M., Scheffer, V.B. & Kellert, R.S. (*in press*). The evolution of North American attitudes toward marine mammals. In J. Twiss & R. Reeves (eds), *Marine Mammals.* Vol 2. Smithsonian Press, Washington, DC.

Mangel, M. & Tier, Ch. 1994. Four facts every conservation biologist should know about persistence. Ecology 75: 607-614.

Pastor, T., Allen, P. Amos, W. & Aguilar, A. 1997. DNA microsatellites in Mediterranean monk seals. pp. 321-324. In P.G.H. Evans (ed.), *European Research on Cetaceans* 10.

Primack, R.B. 1993. *Essentials of conservation biology.* Sinauer, Sunderland, MA., 564 pp.

Quattro, J.M. & Vrijenhoek, R.C. 1989. Fitness differences among remnant populations of the endangered sonoran topminnow. Science 245: 976-978.

Reijnders, P.J.H., de Visscher, M.N. & Ries, E.H. 1988. *The Mediterranean Monk Seal.* IUCN, Gland. 59 pp.

Reijnders, P.J.H., Verriopoulos, G. & Brasseur, S.M.J.M. 1997. *Status of pinnipeds relevant to the European Union.* IBN Scientific Contributions 8, Institute for Forestry & Nature Research, Wageningen, The Netherlands. 195 pp. ISBN 90-76095-01-9.

Soulé, M.E. 1987. *Viable populations for conservation.* Cambridge University Press, Cambridge. 189 pp.

Swinton, J. 1997. Infectious disease threats to the Mediterranean monk seal. Working paper presented to the Workshop on the causes and consequences of the 1997 mass mortality of Mediterranean monk seals in the western Sahara, and referred to in the Workshop report (Eds. J. Harwood, D. Lavigne & P.J.H. Reijnders 1998. *Workshop on the causes and consequences of the 1997 mass mortality of Mediterranean monk seals in the western Sahara, Amsterdam, 11-13 December 1997).*