C I E S M W o r k s h o p M o n o g r a p h s

Investigating the roles of cetaceans in marine ecosystems

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Mathematical models are currently the only way to quantitatively estimate the extent of competitive interactions between fisheries and cetaceans. However, such models can only demonstrate the probability that competition is occurring - they do not provide absolute evidence that there is or will be competition. Minimum data requirements for these models include numbers of predators and their dietary composition, abundance of prey, and amounts of fish removed by fisheries (see Table 5). Qualitative information that complements and reinforces the quantitative assessments include measures of nutritional quality (e.g., caloric densities of targeted fish), individual health (e.g., cetacean body size and condition) and population demography (e.g., pregnancy rates and birth rates).

5. CONSERVATION AND MANAGEMENT ISSUES

The benchmark on which to base our understanding of the mechanisms at play should be the intrinsic characteristic of the environment rather than potentially shifting baselines caused by anthropogenic effects, and our short-term memory of rapidly deteriorating oceans (Pauly and Christensen, 1995; Jackson *et al.*, 2001). To achieve this objective, we should be able to incorporate historical (qualitative) observations to infer what the past environment was like. Such historical evidence is often available in ancient records and writings, and should be taken advantage of when quantitative time series are lacking (see CIESM Workshop Monograph 22, 2003).

Box 2 - Investigating shifts in the Mediterranean ecosystem: the case of short-beaked common dolphins and striped dolphins

Giovanni Bearzi and Kostantinos I. Stergiou

It has become evident that fishing greatly impacts marine ecosystems (e.g. Jackson *et al*., 2001; Christensen *et al*., 2003; Myers and Worm, 2003). One major effect of fishing is the dramatic decline of animals having high trophic levels (i.e., "fishing down marine food webs"). This decline may be accompanied by an increase in highly resilient species such as cephalopods (Caddy and Rodhouse, 1998), myctophids (e.g. Trites *et al*., this volume), hydromedusae (e.g. Jackson *et al*., 2001; CIESM, 2001) and bacteria (Jackson *et al*., 2001; CIESM 2003). Such effects were also observed in some sub-basins of the Mediterranean Sea (e.g. Stergiou and Koulouris 2000), but there is an ongoing debate on whether such a trend has occurred in the whole Mediterranean (e.g. see Pinnegar *et al*., 2003).

Preliminary analysis of the available diet data of Mediterranean cetaceans indicated that the diet of common dolphins in coastal waters overlaps with fishery targets (e.g. European anchovy, European pilchard). In contrast, the diet of striped dolphins - which are typically pelagic and largely feed on mesopelagic cephalopods and non-commercial fish - suggests low levels of overlap with fisheries (Blanco *et al*., this volume; Kaschner *et al*., this volume; Pusineri *et al*., this volume). Therefore, striped dolphins might be affected mostly or exclusively through indirect food-web competition (*sensu* Trites *et al*., 1997).

Although overlap between cetaceans and fisheries does not necessarily imply direct competition, it may do so under fishing-induced strong reductions of fish stocks. This may have differential effects on these two dolphin species. It is reasonable to assume that common dolphins in the coastal zone would be negatively affected while striped dolphins in pelagic waters are less likely to be exposed to a detrimental impact, and might be even positively affected.

Striped dolphins have apparently increased in the Mediterranean in the last decades and are currently very abundant in pelagic waters throughout the basin (Aguilar, 2000). In contrast, common dolphins have declined in the past 30-50 years and remain relatively abundant only in a few areas (Bearzi *et al*., 2003).

The various approaches and technical methods discussed during this workshop would be valuable tools to test such a working hypothesis.