Can cephalopods be used as environmental indicators for the Marine Strategy Framework Directive?

ME5311: Cephalopod Indicators for the MSFD

What's the problem?

The Marine Strategy Framework Directive requires Member States to consider 11 qualitative descriptors to determine good environmental status for that marine region. These descriptors include maintenance of biological diversity (D1), maintenance of populations of commercially exploited fish and shellfish within safe biological limits (D3), all elements of marine food webs occur at normal abundance and diversity (D4), and contaminants in seafood for human consumption do not exceed permitted levels (D9). The MFSD process involves development of indicators for these descriptors, monitoring programs and good environmental status by 2020. While indicators have been developed for many important marine taxa, especially in relation to descriptor 1, this is generally not the case for cephalopods. Cephalopods are among the pelagic species for which indicators are required under descriptors 1, 3 and 4. In addition, cephalopods are covered by EC legislation on animal welfare and they are important components of marine communities.

What are the aims of the project?

To evaluate the viability of developing MSFD indicators based on cephalopods. The main objectives are to:

(a) assemble and evaluate data on distribution, abundance and population parameters,
(b) review knowledge on threats,
(c) derive standardised abundance indices,
(d) analyse patterns and trends in distribution, abundance and population parameters,
(e) establish baseline levels and quantify variability,
(f) determine the degree to which variability is environmentally driven,
(g) collect new data on age-size relationships to evaluate the utility of size-based indicators,
(h) propose relevant indicators under descriptor 1,
(i) evaluate the monitoring required for the candidate indicators, and
(j) provide advice on the suitability of indicators based on cephalopods.

Figure 1: A catch of small squid in the Moray Firth, NE Scotland, where a seasonal, targeted, small-mesh trawl fishery operates during summer-autumn [Jennifer Smith].

Which policy areas will the research inform?

The Marine Strategy Framework Directive outlines an ecosystem-based approach to the sustainable management of resources and services. Member states are required to develop a marine strategy for the protection and conservation of the marine environment. This research will inform fisheries management, discharge licencing, sea bed operations and other activities likely to impact cephalopod populations.

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What are the results from the project and how will they be used?

Current threats to cephalopods include fishing pressure, pollution, habitat degradation, underwater noise and climate change. A reference/baseline level which might indicate GES is difficult to define though due to high variability, although sustained decline would be cause for concern. The "effect" of the previous year's landings was positive, with no apparent adverse effects of high landings. Landings were positively correlated with sea temperature and productivity.

Signals of abundance variation can be extracted, once spatial, seasonal and depth-related variations are accounted for. Interannual variation is linked to environmental conditions (e.g. NAO index). "Baseline" levels of abundance could be based on catch rates over a period of a decade or more and the standardised survey abundance could thus be used as an indicator. Comparable survey data series are available from IFREMER.

Trawl surveys undertaken by MSS also provide cephalopod data. . Annual abundance is highly variable. This interannual variation was related to environmental conditions and the previous year's landings (as also seen in the fishery data analysis) but the high proportion of unexplained variation makes it difficult to define baseline levels.

Analysis of the age-length relationship in *Loligo forbesii* based on age readings on statoliths revealed a consistent relationship once the month of hatching is taken into account. High catches of small squid would indicate fishing in recruitment areas, which could result in growth overfishing and have the potential to endanger the fished population. Our preliminary results suggest that certain species (e.g *Loligo forbesii, Sepia officinalis*) have potential as environmental indicators in UK waters.

Aside from MSFD descriptor 1 (biodiversity), cephalopods are also potential indicators for descriptors 3 (fished species), 4 (food webs), 7 (oceanographic conditions), 8 (pollution), 9 (contaminants in seafood) and 11 (underwater noise). However, suitable information is only currently available for descriptors 1 and 3. Bioaccumulation of heavy metals and organic pollutants by cephalopods could justify monitoring under descriptors 8 and 9.

Commercial categories could be brought into MSFD monitoring, since survey programmes provide data, and plausible indicators of abundance can be generated, allowing comparison with defined baseline levels and/or detection of sustained negative trends. Monitoring of size distributions could reveal effects of exploitation, through the use of a "small squid indicator" (i.e. avoidance of directed fishing on pre-recruits) as well as more sophisticated assessment approaches. The main caveat with the existing survey and fishery data is the lack of routine identification to species level, potentially causing difficulties in interpreting observed trends.

Figure 2: The two main commercial squid species in UK waters: Loligo forbesii (above) and Loligo vulgaris (below). The former is predominant in northern (colder) waters [Andy Lucas].

Where can I find further information about this and related research?

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Alternatively, please contact Defra's Marine and Fisheries Science Unit:

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