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Why fisheries management without spatial considerations is ineffective: Interview with John Caddy

It makes intuitive sense that if a given area of ocean offers several types of seafloor habitat, and if commercially targeted fish populations prefer one habitat over the others (particularly at different life stages), then stock assessments should account for the spatial distribution of the habitats.

However, says fisheries scientist John Caddy, this is too seldom the case. Caddy, former chief of FAO's Marine Resources Service, says stock assessments typically ignore habitats - particularly habitats that are uncommon, like those of high structural complexity in shelf waters. Instead, the assessments assume that the habitat across the fishery is homogenous and non-complex. As a result, fisheries are allowed to work in (and potentially damage) areas that are highly structured, and which may be disproportionately important to the health of a targeted stock.

In a paper published this April 2013 in the ICES Journal of Marine Science, Caddy suggested that fisheries assessments that do not account for uneven spatial distribution of structurally complex habitats are doomed to error ("Why do assessments of demersal stocks largely ignore habitat?" is available for free at http://icesjms.oxfordjournals.org/content/early/2013/05/23/icesjms.fss199.full?keytype=ref&ijkey=SePs6l3rReZLjjM). MEAM spoke with Caddy about his conclusions, and the first part of the interview appears below. The full interview - including journal citations, as well as Caddy's views on why it has taken fisheries scientists so long to build spatial distribution into their models, and whether the health of fisheries could be improved through vast deployment of artificial reefs - is here.

MEAM: Our contributing editor Tundi Agardy has called your conclusion the "grand unifying principle of ecosystem-based management": that is, management must be built on a foundation of ecosystem understanding, which in turn is made possible by the use of physical cues to help identify priority areas. What are your thoughts on that?

John Caddy: The fact is that applying ecosystem-based management requires us to incorporate the complexity of physical structure, as well as the biological components of the habitat into our models. The majority of fishery models now in use do not do this, and hence, strictly speaking, are not ecological models. They tend to assume either that habitats are uniform in fish-producing capability (the "dynamic pool" assumption), or that calorific transfers in food webs alone are a realistic model of what goes on in a marine ecosystem. (How likely is a food shortage to occur for a depleted species?).

Obviously, the quantity of food available is important. But for juveniles of demersal fishes to harvest food organisms safely, suitable cover should be available nearby to protect them between feeding forays. Putting my ideas in their global context, terrestrial ecology has found that the disappearance of complex structures (forests) is the main reason for declines in biodiversity. Not having monitored how our activities affect those structural elements in the sea that are required for life-history completion, we are a long way from a similar perception.

As indicated in Walters and Juanes (1993), the absence of adjacent cover for demersal juveniles next to their food resources drastically restricts the proportion of a food easily available, given that distant excursions across open bottom are unwise in the presence of predators. One could reasonably postulate that a linear measure of the interface between structurally-complex habitats and open bottom (which is very sensitive to the impact of dredges and trawls) should be a good indicator of the potential survival of the juvenile stages of many species! More realistically, incorporating habitat and spatial components into fisheries models seems the way to go, at least for the benthic/demersal resources I was writing about. In addition, in many cases the micro-habitats are fractal in configuration, which has important implications for size selectivity of juveniles. It can be demonstrated that an increase in organism size in fractal habitats drastically reduces suitable cover for them, and leads to their dispersion or migration elsewhere: a high-risk process.

A more general comment is that ecological considerations dictate that for spatial management to be realistic, we must map habitat configurations more carefully. We need to include geological factors (outcrops, sediments, and structural complexity), and this requires underwater mapping capability. The critical habitats encountered must then be protected by introducing spatially focused management measures. A number of papers in the literature have emphasized the importance of restrictions on bottom-towed gear, including the protection of spawning, nursery, and migration routes from incidental damage (see Caddy and Seijo 2011). Experience in the Mediterranean suggests that establishing closed areas (reproductive refugia) for the larger spawners offshore could be an effective management measure. Now that satellite monitoring of fishing fleets is a reality, combining area/resource allocations to fleets in open areas, with realistic penalties for fishing closed areas, could become the norm.

For MEAM's full interview with Caddy, including citations, click here.

For more information:

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Caddy also publishes a fisheries blog - titled "My Published Work on Fisheries Science" - at www.myfisherywork.com