

Indicators of dynamics in fishery resource

Indicators of dynamics in fishery resource

Indicators

Indicators are data or combination of data collected and processed for a clearly defined analytical or policy purpose. That purpose should be explicitly specified and taken into account when interpreting the value of an indicator. Fisheries indicators should provide practical and cost-effective means for the evaluation of the state and the development of fisheries systems and the effects that policy changes have on those systems.

In considering the concept of indicators of sustainable development, a necessary first step is to define what is meant by sustainable development in the context of fisheries. Sustainable development is generally defined as being development that meets the needs of the current generation without compromising the ability of future generations to meet their own needs. In the fisheries sector, the use of biological indicators in the development of fisheries assessments and management plans has been standard practice, in some of the countries for many years. However, relatively little attention has been paid to the development of economic and social indicators that serve to assess progress on other aspects of sustainable development.

With respect to criteria for success it has been found, both theoretically and empirically that good indicators are easily measured, cost effective to collect, to calculate, and easily interpreted (to avoid confusion about the state of the system they are reflecting). Simple indicators are consistently found to outperform more complex (model-dependent) indicators, which are sensitive to data quality. There is consensus on the need for a suite rather than a single indicator and on the types of indicators that perform well regardless of system types.

Economic and Social Indicators

For the indicators to be effective and workable in assessing the economic and social performance of fisheries, they should:

- Have a clear **policy relevance** and in particular:
 - a) Provide balanced coverage of some of the key issues of **common concern**, and reflect changes over time;
 - b) Be easy to interpret (that is, movements in each indicator should have clear link to overall sustainability);
 - c) Allow **comparisons across countries**;
 - d) Lend themselves to being adapted to different **national contexts**, analysed at different levels of aggregation and linked to more detailed indicator sets.
- Be **analytically sound** in technical and scientific terms, based on internationally accepted standards and broadly accepted by stakeholders.
- Be based on **data that are available**, of known quality and regularly updated.

Uses of indicators

The main purpose in developing a set of sustainability indicators is to assist in assessing the performance of fisheries policy and management and to stimulate action to better pursue sustainability objectives. This can occur in a number of areas. For example, indicators can be used for ex-post evaluations of the impacts of management initiatives; assessment of progress towards medium and/or long-term objectives; and assessment of the impacts of fisheries.

They can also enhance communication, transparency, effectiveness and accountability in fisheries management. In this regard, indicators can be developed and reported at various levels of aggregation- international, national, regional and local levels. Many of the environmental indicators for fisheries referred to above are focused on the fishery level. Other aggregates that are regularly reported, such as the contribution of fisheries to exports, are reported at a national level. Yet others relate to fisheries that are managed regionally as straddling and/or highly migratory stocks.

Biological indicators

Relative biomass : specifically of gelatinous zooplankton, cephalopods, small pelagic, scavengers, demersal fish, piscivores, top predators, and biogenic habitat (cover forming species). Ease of sampling differs strongly between these groups (for instance external bodies, such as NGOs, often monitor the charismatic top predators, tourism can focus attention on coral reef fishes, snapshots of mangrove forests and shallow benthic habitat may be available from satellite images. It is possible to find proxies for even some of the most difficult groups. For example, changes in relative biomass of gelatinous zooplankton may be captured by frequency of bloom events, as this is a much more easily obtainable statistic due to the ability to generate it from expert information and fisher interviews.

Biomass ratios: in particular the biomass ratios of piscivore: planktivore (PS:ZP), pelagic: demersal (P:D) and infauna: epifauna. The last of these is probably not feasible in data poor situations, but the other two can be done.

Size spectra: which give an indication of perturbation in system structure (using the slope of the curve), but can also highlight changes in system productivity (via the intercept).

Maximum (or mean) length: this indicator is observed to work in practice even if simple rules of thumb regarding are used. Caution is needed regarding market driven changing in preferred sizes, however.

Total fisheries removals: (catch + bycatch + discards): this indicator considers the total biomass removed from the system versus what is left cycling in the system. While similar in concept to the widely used comparison of primary production vs. removals from the system, there is concern that it will not be suitable for data poor and dispersed small scale fisheries due to the lack of data on removals let alone discards.

Diversity: (counts of species): It remains an informative and fundamental piece of information about the system. Alternative measures of diversity or system structure may need to be considered too, depending on which operating model is used or what empirical data is available. One possibility is considering the value of changes in species-area curves (e.g. the slope and asymptote of the curve) through time (or spatially if under a perturbation gradient). It is likely that some simple or ordinal data can be collected on this from the fishers themselves given that they are acutely aware of what they catch. Looking at changes in these ranking could be highly informative.

Size at maturity (weight and length): It is a strong means of detecting change in the system and stock structure. It may be too difficult to use in data poor situations.

Biophysical (Chlorophyll a, temperature, dissolved inorganic nitrogen, and level of contaminants): these may be drawn from water quality monitoring programs or remotely sensed data sets, but are needed even if they aren't already being collected as they are means of teasing out causation. Indicators respond to any system change, including those caused by sectors other than fisheries, so any information that helps elucidate causation is extremely helpful.

While all of these indicators are not equally easily calculated in data poor situations, they are a good “straw-man” to start testing indicators for such fisheries in this study. It is critical that a suite of indicators, which are not all highly correlated, is used;

- Multiple time and space scales are spanned by the data sets.

Inclusion criteria

It is also critical that data include species that:

- are directly impacted
- have high turnover rates, which may provide a noisy but early warning;
- define the habitat, as these often have a disproportionate or keystone role in the system; and
- are from the upper trophic level, which are typically both vulnerable in their own right due to their life history characteristics, but also integrative of pressures and patterns at large scales.
- There is likely to be differential signal strength in pelagic and demersal system as pelagic systems are easier to characterize (require fewer parameters), but are more variable leading to longer periods before trends are detected. Concerns regarding the availability of extended time series at a single location may be addressed by considering snapshots at multiple different locations under differential perturbation (e.g., fishing) pressure, so that it will still be possible to get a gradient and contextualization for any individual location. Caution may be necessary in such a situation though, as there may be problems if a changing environmental (or other) effect is masking the fishing effect.

Fisheries Indicators and data sources

Statistical information needed are:

- Total Allowable Catch(TAC), Quotas, by species,
- Quantity and value of landings, by species
- Employment (total; full and part-time; male/female; capture fisheries/ aquaculture/ processing industry)
- Fleet capacity (number of boats, by length or by GT/GRT)
- Quantity and value of aquaculture production by species,
- Recreational fisheries (estimates concerning the production and the number of people involved),
- Trade in fish and fish products (by main species and main partners).
- Government financial transfers relating to the marine capture, aquaculture and processing sectors.
- Status of fish stock

In broad terms, the Pressure State Response (PSR) framework aims to identify the pressure on the environment from human and economic activities, which lead to changes in the state or environmental conditions that prevail as a result of that pressure, and may provoke responses by society to change the pressures and the state of the environment.

Classification of some indicators following the PSR framework

According to the PSR framework that has been developed and used extensively, the above indicators can be classified as follow:

Dimensions	Pressure	State	Response
Ecosystem (resource and environment)	- Total catch - Fish consumption	Stock status	TAC and quotas
Social	- Fishing effort - Number of vessels - Growth rate of number of fishers	Number of fishes	
Economic	- Subsidies - Excess fishing capacity	- Profitability - Sector employment	Economic incentives & disincentives (e.g., subsidies,

	- Profitability		taxes, buy-back)
--	-----------------	--	------------------

Source: "Economic and Social Sustainability Indicators for Fisheries" study