Biodiversity Metric - Marine

Acronyms Areas Countries Marine Terms

Definition

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Description

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It is not possible to measure biodiversity in its entirety, so a biodiversity metric can be used to 'represent, and provide a measure of, overall biodiversity' [1]. As biodiversity is a vital part of economic development and contributes to local livelihoods [2], devising a way to measure it quantitatively is of interest to science, governments and businesses alike.

Marine biodiversity metrics are vital to give us an idea of how much we know (and don't know) about marine life globally. Without these metrics, we would not know where to focus marine conservation efforts.

Related definitions

Metric: a system or standard of measurement[3]

Measure: a standard unit used to express size, amount or degree[3]

Indices: a system of numbers used for comparing values of things that change according to each other or a fixed standard [4]

Indicator: a quantitative or qualitative factor or variable that provides a simple and reliable means to measure performance [5]

Background

The marine realm encompasses a broad range of different habitats and is home to a vast number of species. It covers a huge area and large parts of it are difficult to access (for example due to distance from land or depth). This means that there are a lot of gaps in the study, and therefore knowledge of, marine biodiversity. Consequently, it is likely that there are a lot of marine species that are not yet known to science, making species identification in some cases very difficult. Biodiversity metrics try to address this important but difficult problem by providing a way to quantify biodiversity, without relying on detailed records for every species or habitat.

However, quantifying biodiversity is difficult due to the arbitrary nature of defining the unit for which biodiversity is measured. Biodiversity metrics can measure species, ecological, genetic or morphological diversity, among other things. It is therefore difficult to make comparisons between metrics.

Where species are measured, sampling methodology, sampling effort, ease of access and taxonomic knowledge will impact how comprehensively species within a given area are identified. For example, it might be concluded that particular regions are more species rich than others simply because they have been more rigorously sampled, or because the sampling techniques developed are biased to a particular group of species inhabiting that region.

Different biodiversity metrics have been developed for use in a wide variety of habitat types and regions. The scale at which biodiversity is measured (for example site, ecosystem or regional scale) will define which metric(s) will appropriately represent diversity within the chosen context.

Biodiversity metrics are relevant to a number of biodiversity-related conventions, in particular the Convention on Biological Diversity (CBD) [6]. Biodiversity metrics are used by Contracting Parties in national-level monitoring, planning and implementation of biodiversity strategies.

Biodiversity metrics should be used with caution when informing decisions. As different metrics take different approaches, not all will take into account the biodiversity features which will be impacted by those decisions. For example, decisions impacting the deep sea marine environment may not be well informed by a metric based on data from coastal areas, due to the fundamental differences in deep sea and coastal ecosystems and their biodiversity.

Methods

There are a range of biodiversity metrics available. Two of the most common biodiversity metrics used in the marine realm are species richness and the Shannon Index of Biodiversity [7]. The Hurlbert's Index is an alternative to the Shannon Index.

Species richness

This metric aims to measure the number of species in a system, region or community.

Species richness is calculated by:

- undertaking fieldwork to count the number of species in a given area; or
- using existing species' occurrence data e.g. the Ocean Biogeographic Information System [8].

Broadly speaking, the more species recorded, the greater the species richness and the higher the 'biodiversity' in the area. However, species richness would also be expected to increase with:

- increasing surface area (i.e. the larger the area, the more species expected to be present); and
- increased sampling effort (i.e. the more time spent looking, the more species are likely to be identified).

Estimates of species richness in the marine realm vary greatly. One analysis[9] estimated that there are between 0.7-1 million marine species (based on a global meta-analysis of peer-reviewed literature), most of which remain unidentified.

Species richness is only one component of biodiversity. Another is relative abundance (i.e. density) of species, often described as their dominance or evenness.

Shannon Index of Biodiversity

This metric identifies biodiversity values based on the assumption that greater uncertainty of identifying individual species means higher biodiversity.

It looks at how many species there are (species richness), and whether those populations are evenly distributed (species evenness) within a community.

If there is high species richness and evenness, the Shannon Index assumes that it will be difficult to predict the identity of any given individual (i.e. there is greater uncertainty). A higher ‘uncertainty’ value therefore suggests greater ‘biodiversity’.

The Shannon index is a useful way to provide a simple summary. However, it can be difficult to compare communities with very different species richness or evenness values using this combined figure, and so they are often kept separate in comparative studies.

Hurlbert’s Index

Hurlbert’s Index (also known as ES for 'Expected number of Species') estimates the probability of a particular species being found in a random sample of individuals [10].

This biodiversity metric was designed to overcome a major drawback of many other diversity metrics (including the Shannon Index), namely the fact that their value changes depending on the size of the sample that is considered [11]. This “sample-size dependency” can be problematic when wanting to compare different communities’ biodiversity, for example across different geographic regions. This means that despite being very similar ecologically, two communities could have very different biodiversity metric results, simply due to the fact that they have different population sizes.

As Hurlbert’s Index calculates the expected number of species that can be found in random subsample of a community, it is not influenced by sample size. A high Hurlbert’s Index indicates a high species diversity.

This metric has in particular been applied in deep-sea studies, as it is sensitive to species rarity and can be used for small sample sizes [12].

Business relevence

Metrics can be used by businesses to measure biodiversity in a number of contexts relevant to their operations, such as understanding the biodiversity on which they may have potential impacts or their exposure to biodiversity risks. Metrics can be useful in establishing a biodiversity baseline, against which companies can track their performance and the efficacy of their

management interventions.

Biodiversity metrics are relatively well developed for use at site level, and can be used in environmental impact assessments, environmental management plans, biodiversity offset schemes and natural capital accounting. For example, in 2012, Defra developed a biodiversity metric specifically for biodiversity offsetting pilots in England. The metric allows the biodiversity impact of a development to be quantified so that the offset requirement, and the value of the compensatory action, can be clearly defined [1].

Biodiversity metrics may also be used within indicators so that businesses can demonstrate performance against certain internal or external biodiversity targets. Industry guidance on the use of biodiversity metrics and indicators include:

- The Energy and Biodiversity Initiative's Biodiversity Indicators for Monitoring Impacts and Conservation Actions [13];
- The International Council on Mining & Metals' Good Practice Guidance for Mining and Biodiversity [14]; and
- IPIECA's Biodiversity and Ecosystem Services Fundamentals [15].

However, there remain clear challenges translating the change in status of biodiversity seen through a metric and attributing that to the action of an individual company.

References & website

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Tools

- Ocean Data Viewer A tool for easy access to a range of datasets that are important for the conservation of marine and coastal biodiversity. The data can be downloaded or viewed online.
- Ocean+ Data A tool that provides an overview of a range of global marine and coastal datasets of biodiversity importance. The site allows users to filter by category, organisation and theme.

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