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The 'presentist bias' in time-series data: Implications for fisheries science and policy

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A B S T R A C T

The bias in catch time series data that occurs when improvements in fisheries catch reporting systems (e.g., consideration of a previously unmonitored fishery, or region) lead to an increase in current catches without the corresponding past catches being corrected retroactively, here called 'presentist bias' is described, and two examples, pertaining to Mozambique and Tanzania are given. This bias has the effect of generating catch time series at the aggregate that appear 'stable' or increasing when in fact catches are declining over time, with potentially serious consequences for the assessment of the status of national fisheries, or in interpreting the global landings data disseminated by the FAO. The presentist bias can be compensated for by retroactive national data corrections as done, e.g., through catch reconstructions.

1. Introduction

Like many other scientific, economic and policy endeavours, fisheries science uses time-series data as part of investigations and analyses, and derives both scientific conclusions and policy recommendations from such data. What if the gradual improvements of the data collection systems underlying these data, covering more fisheries over time generated increases of reported catches, without retroactive corrections of earlier data? One can infer that this would lead to a time-series bias, which would affect inferences on catch trends. This type of bias is defined and labelled here as 'presentist bias', and its occurrence in the reported fisheries catch data of several countries is illustrated. This bias is inadvertently built-in the history, development and evolution of national and global data collection systems, but is generally overlooked or ignored.

1.1. Fisheries data

One of the most basic and fundamental types of fisheries data are time-series of the catches taken by national fisheries [1,2]. These data are collected or estimated by nearly all countries in the world, usually by their fisheries departments or national statistics agencies, and are used for national fisheries assessments, and management and policy purposes [3]. Here, we define such data as 'official data' or 'officially reported data', in contrast to 'reconstructed data'. Furthermore, we define the term 'statistics' more broadly than many governmental or inter-governmental organizations, e.g., the OECD defines 'statistical data' as "data from a survey or administrative source used to produce statistics" (https://stats.oecd.org/glossary/detail.asp?ID=2543). We define 'statistics' (as in 'catch statistics') as equivalent to the term 'data' in the more broadly accepted scientific manner, namely as "the practice or science of collecting, analysing and interpreting numerical data in large quantities". We also define 'catch' as the sum of both 'landed catch' (i.e., landings) and 'discarded catch' (i.e., discards) [4]. In line with standard data practice of the Food and Agriculture Organization (FAO) of the United Nations, we treat 'catch' as being 'wet-weight' or 'whole weight' catch, i.e., not processed or product weight [4].

These official data are also requested, assembled and harmonized annually by the FAO which disseminates them to the global community. These national and (in aggregated form) global official, reported datasets are essentially time-series of fisheries catches (actually they are landings data, as discards are explicitly excluded from consideration, see [5]) by fishing country, year and taxon, and the globally assembled data are presented by FAO on behalf of the countries by a small number of very large statistical areas (19 marine areas covering all ocean basins, plus 7 terrestrial areas; www.fao.org/3/a-az126e.pdf). While some of these areas have some data by subareas, this spatially more detailed coverage is often incomplete.

Important in the present context is that the global data assembled and reported by FAO on behalf of countries are analyzed every two years by staff of the FAO for presentation as part of their widely distributed "*State of World Fisheries and Aquaculture*" report (SOFIA, most

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recent issue, [6]), which is timed to coincide with the biennial meeting of the "*Committee on Fisheries*" (COFI). This committee is the only UN-level, inter-governmental forum where international fisheries issues can be examined and discussed, often leading to important recommendations or even global agreements [7,8].

Thus, SOFIA and the underlying FAO data (reported by FAO on behalf of member countries) form a key information tool that influences national, regional and international fisheries policy developments, as well as informing global funding decisions by the international community, development aid agencies and international NGOs. It thus behoves the international scientific and policy community to be aware if the underlying data may have consistent problems associated with them, especially if any such problem leads to a fundamental bias that impacts catch trends, which [9], a FAO Fishery Statistician rightly sees as key in the interpretation of the data.

1.2. Catch reconstructions

Catch reconstructions have become an important component of the *Sea Around Us* research initiative. The earliest reconstructions were commissioned by the US Western Pacific Regional Fishery Management Council [10–13] and were intended to account for obviously missing catch data, such as fisheries sectors that were largely or completely omitted from official data collection/reporting systems (e.g., subsistence fishing, [14]). Later reconstructions, which eventually covered all maritime countries in the world, and their overseas territories, also emphasized recreational fisheries [15], assumed or demonstrated illegal fishing [16,17] and discarded catches [5]. The outcome of this decade-long endeavour by a team of over 300 collaborating scientists from around the world was not only a likely more *accurate* volume of catch (i.e., closer to the unknown true catch volumes), but more importantly a different *trend* in global catches than suggested by officially reported statistics [18,19].

A large and growing number of peer-reviewed reconstruction studies are being published in the scientific literature ([3,14,15,20–24], all listed at www.seaaroundus.org/articles), contributing to and resulting in increased use of reconstructed data, e.g., by the Ocean Health Index [25,26] and the Environmental Performance Index [27], both examined and monitored closely by many countries; by UN affiliated organizations and groups such as the Biodiversity Indicators Partnership (www.bipindicators.net) as part of indicator requests of the Convention on Biological Diversity (CBD) and other biodiversity-related conventions, for the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), for reporting on the UN Sustainable Development Goals, and for use by national and regional governments; as well as by other global studies, e.g., on human nutrition [28,29]. Some criticism has been levied at the globally reconstructed catch data of the *Sea Around Us*. These criticisms were either directed at details of individual reconstructions [30,31], or took issue with novel approaches to aid in estimation [32,33]. All these criticisms were examined, and either addressed or refuted [34,35]. Also, some worried about the perceived 'uncertainty' associated with estimates of unreported data, despite officially reported statistics (all without their uncertainty ever being assessed or reported) also largely consisting of 'estimates' [36–38].

Thus, much focus was aimed at the methods and details used to address the fundamental under-reporting in official statistics of most countries, rather than the underreporting itself, or the potential impact of improvements in data collection systems over time on time-series catch data. With few exceptions [37,39,40], this under-reporting by official data is the result of most countries unfortunately not having the financial or technical resources to monitor and report on all their fisheries (e.g., large subsistence sectors on Pacific islands, [14]), or making deliberate choices to not report to FAO on certain fisheries components (e.g., the domestically well monitored but internationally unreported recreational catches in the USA, [41]). Obviously, this leads to differences between officially reported and reconstructed data (which incorporate official reported data); indeed, this was, jointly with the decision to include clearly-labelled discards in all reconstructed catch data [5], the main reason for reconstructing fisheries catches in the first place.

2. 'Presentist bias'

Interestingly, these various critiques missed the data bias which should be considered a major point of concern about officially reported catch time-series. What is now termed 'presentist bias' is an inadvertent by-product of the often intense and laudable efforts of most countries, often commendably aided and supported by FAO, to improve their national data collection systems over time. Essentially, a 'presentist bias' occurs when an improvement in an official catch reporting system (e.g., consideration of a previously unmonitored fishery, sector, fleet, gear or region) leads to an increase in reported catches for more recent time periods without the corresponding past (unmonitored) catches being corrected for retroactively. The presentist bias thus over-emphasizes 'the present' vis-à-vis 'the past', and it generates an often subtle, but consistent bias over time, due to the commendable efforts of countries to improve the quality of their data collection systems over time. It needs to be emphasized that this is inadvertent and not deliberate.

The statistical reporting systems of countries are subjected to presentist bias when improvements account for a growing share of actual catches, e.g., by adding new or improving existing data collection efforts for previously non-sampled or unmonitored fisheries sectors or components. Crucially in the present context, however, countries do these improvements for data going forward in time without making retroactive corrections for the previous under-reporting (or non-reporting) of such catches in earlier years and decades. It should be acknowledged that FAO has previously indicated this point [9], and does seem to encourage countries to do retroactive corrections. However, such corrections, if they are made, rarely go far enough back in time, mainly due to perceived data' quality' or' reliability' concerns. In cases where retroactive corrections are comprehensive back in time, obviously the reported data no longer contain a presentist bias, and the present argument becomes moot. However, most corrections do not go back far enough to remove this bias, as will be illustrated by the example of Tanzania below. This can then lead to inconsistent historic baselines and the illusion of stable or even increasing catch trends when none occur, even in the face of actual declines [19,36,37].

The existence of such unintentional, but structurally deeply embedded data omissions over time was first pointed out on page 3 of [19] as a "*gradually increasing incorporation of artisanal and other small-scale catches in the officially reported data presented by FAO on behalf of countries …*", but was first clearly emphasized in [36]. Below is an illustration of this presentist bias through examples.

The purpose here is not to point fingers, as the existence of this bias is an inadvertent by-product of important improvement efforts for data collection systems, which in themselves are a worthy and important cause. Rather, the point is to draw attention to this issue, and encourage countries to retroactively correct for the entirety of this bias, which can be easily achieved via in-depth corrections of past data, e.g., through data reconstructions. Retroactive data corrections are commonly practised with many national datasets, and accepted and supported by FAO if they come from national reporting agencies [6,38]. The *Sea Around Us* is also willing to engage with countries that wish to address this data bias, or other missing data issues, and improve their historical national catch data [36], something that is already happening in some countries that are open to the concept and concerns of time-series data [15]. It needs to be clearly re-emphasized here (as was done previously elsewhere; e.g., [4]) that reconstructions always contain data estimates, with accompanying uncertainty that at times can be higher than the uncertainty around official reported catch data (official reported