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ADJUSTING FOR CONTEXT IN EVALUATING NATIONAL FISHERIES STATISTICS REPORTING SYSTEMS[1]

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ABSTRACT

Fisheries management requires detailed catch time series. Thus, the effectiveness of countries' reporting system can be, in part, evaluated by the taxonomic resolution of the data they submit to annually to Food and Agriculture of the United Nation (FAO). However, the fish and invertebrate faunas in the Exclusive Economic Zones (EEZs) of these countries differ widely, as do the species that are exploited and considered important enough to be reported in fisheries statistics.

To adjust for the difference, an index of reporting performance was devised which is based, for each country, on the ratio of the reported taxa (numerators) relative to the number of commercial taxa whose distribution overlaps with at least 10% of its EEZ (denominator). Commercial marine taxa of fish or invertebrates are here defined as species, genera, families or higher group reported in the catch of at least one country in the FAO database, for any year from 1950 to the present. The result is a new Context-Adjusted Fisheries Statistics Indicator ($STAT_{rep}$).

Using the $STAT_{rep}$, New Zealand, Portugal and the US are the three countries that are performing best, while the worst performing countries are a group of mainly developing countries much of their catches as 'miscellaneous fishes', e.g., Myanmar. However, the $STAT_{rep}$ appears to overcome the developed *vs.* developing country dichotomy, with e.g., Senegal, in West Africa, ranking 12th of 53.

The $STAT_{rep}$ also appears to be suitable for tracking changes in the effectiveness of national fisheries reporting systems, except perhaps for countries with very small EEZs. This should, however, not affect the 53 countries that are being compared here, and which jointly account for 95 % of the world marine fisheries catch.

INTRODUCTION

In the early 1980s, maritime countries assumed the responsibility of managing their 200-nautical mile Exclusive Economic Zones (EEZ). One of their major tasks is managing the fisheries operating in their EEZs. Such management requires, among other things, that catches (= landings and discards) should be documented at the finest possible taxonomic scale (i.e., at the level of species) and, given the international nature of most fisheries, submitted to the Food and Agriculture Organization of the United Nations (FAO; www.fao.org). The contribution presents an approach to measure and compare the performance of countries, i.e., members of FAO, in accomplishing this.

Directly comparing the number of low-level taxa (e.g., species or genera) that countries report, while instructive[2], would not be a fair measure of their efforts to monitor and report on fisheries catches, as the number of species that can potentially be caught varies enormously between latitudes and ocean basins (Cheung *et al.*, 2005; Mora *et al.*, 2007).

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[2] As shown by the 'Spread-in-Catch Index' (SiC) of D. Pauly and D. Zeller (unpublished data; presented at the 5th ICEF: Environmental Future of Aquatic Ecosystems, Zürich, 23-29 March 2003).

A solution to the problem caused by variations of the underlying taxonomic diversity is to divide, for any given year, the number of taxa reported by a given country by the number of 'commercial taxa' available in that country's EEZ, the problem then being one of defining what 'commercial taxa' are in an operational sense.

One definition used earlier by Palomares and Pauly (unpublished data[3]) was to use the fish identified as 'highly commercial', 'commercial', 'minor commercial', etc. in FishBase (Froese and Pauly, 2000, p. 81). This did lead to a usable index. Ultimately, this approach was not followed up, because the definitions in FishBase lacked rigor, and were replaced by an assignment of market value, based on Sumaila *et al.* (2006; see www.fishbase.org). Also, using FishBase to define commercial taxa left invertebrate taxa undefined.

However, the FAO landings database itself can be used to obtain an operational definition: we can define 'commercial' taxa as any species, genus, family or higher category that is officially reported as part of fisheries catch to FAO by at least one of its member countries. The *Sea Around Us* Project maps reported catches as reported to FAO (Watson *et al.*, 2004), and thus it has drawn distribution range maps for all commercial fish and invertebrate taxa (see Close *et al.*, 2006). Each of these distribution range maps, corresponding to a specific taxon, overlaps with the fisheries of at least one country, which then reports it to FAO (because otherwise, it would not be counted among the commercial taxa, see definition above).

METHODOLOGY

In addition to overlapping with the EEZ of at least one country that reports on it, the distribution range of mapped taxa will generally overlap with the EEZs of other countries. (We used an overlap of at least 10 % of the EEZ area of a given country for a taxon to be considered to occur 'in' that country). We assume here that these other countries catch that these taxa as well, but do not report them (e.g., because they are not targeted, and they appear only in the by-catch, and/or because these countries do no monitor their fisheries adequately).

This led to our new Context-Adjusted Fisheries Statistics Indicator ($STAT_{rep}$), which assesses the quality of each country's reporting system in a regional context (defined by shared taxa) through the ratio (expressed as percentage) of reported commercial taxa to commercial, but unreported taxa occurring in a country EEZ.

Table 1. Illustrating how the same 3 species (belonging to the same genus, and hence family, order, etc) would score on the $STAT_{rep}$ of various countries (A-F), depending on the taxonomic level they are reported in. A country's overall $STAT_{rep}$ score will depend on how it reports all components of it catch.

Reporting level	A	B	C	D	E	F
Species	3	-	-	-	-	-
Genus	1	1	-	-	-	-
Family	1	1	1	-	-	-
Order	1	1	1	1	-	-
Class	1	1	1	1	1	-
ISSCAP*	1	1	1	1	1	1
Component of $STAT_{rep}$ score (numerator)	8+	5+	4+	3+	2+	1

*International Standard Classification of Aquatic Animals and Plants

We built into the design of the $STAT_{rep}$ the fact different countries may report the same target for fish or invertebrate at different taxonomic levels. Thus, for example, a country may report catch of groupers by their species name, (say *Epinephelus* species a, b, and c), another country by their generic name, "*Epinephelus* spp" and yet another by their family names ("Serranidae"), or even as "Perch-like fish" (Percoidae). Since it is better to report catches at the lowest possible level, a country reporting such catch is given not only a score for a species, but also for the genus to which it belong (so far it is also a commercial taxon), and correspondingly for families and higher taxa (Table 1). The example illustrates how six countries (A-F) reporting the same 3 species at various levels (from species to ISSCAP) would score on the $STAT_{rep}$.

[3] Palomares, M.L.D. and Pauly, D. (2004) A biodiversity-based data quality indicator for fisheries catch statistics. Presentation at the International Symposium on Quantitative Ecosystem Indicators for Fisheries Management, 30 March to 4 April 2004, Paris, France.

Data Sources

Data were derived from the *Sea Around Us* Project's landings and species distribution databases (www.seaaroundus.org), and FishBase (www.fishbase.org).

RESULTS AND DISCUSSION

We report $STAT_{rep}$ scores for a list of 53 countries contributing over 95 % of the world catch (Alder and Pauly, this vol.), although all countries reporting to FAO were used to compute these scores.

Table 2. The 10 countries with the highest $STAT_{rep}$ (for 2000-2004 inclusive), based on the number of taxa reported versus those that occur in their EEZs.

Country	Numerator	Denominator	$STAT_{rep}$
New Zealand	149.2	204.0	73.1
Portugal	110.0	157.2	70.0
USA	72.4	104.4	69.3
Spain	268.0	396.8	67.5
France	446.4	702.4	63.6
Chile	62.0	99.6	62.2
UK	288.0	474.0	60.8
Russian Fed	118.4	210.0	56.4
Norway	131.2	245.6	53.4
South Africa	75.2	141.6	53.1

Of these 53 countries, the top 10, i.e., those with the highest mean level of $STAT_{rep}$ in the last 5 years (Table 2) generally report between 53 and 73 % of the commercial taxa occurring in their waters. These countries together report about 23% of the total global reported catch. This relatively low figure is still an overestimation of their performance, as hundreds of species may be caught regularly, by the trawlers and other fishing vessel of such countries which, however, fail to be reported by any country, and thus not defined as commercial taxa (i.e., not including in the denominator).

Table 3 gives the 10 countries that have the lowest $STAT_{rep}$. As might be seen, in spite of the $STAT_{rep}$ adjusting for the high taxonomic diversity in low latitudes (by comparing countries with shared, and hence similar faunas), the list contains mainly low latitude developing countries. The only exceptions are North Korea and Poland, which occurs at middle latitudes. While the position of North Korea is not surprising, that of Poland is. Perhaps it is due to its small EEZ, i.e., to the fact that the distribution range map of many commercial species overlap with the Polish EEZ, although the taxa they represent being, in the central Baltic, at the edge of their distribution, do not support fisheries, and thus are not there to be recorded. We will investigate this possibility in a future contribution, in conjunction with a number of countries with even smaller EEZs (Iraq, Slovenia, etc).

Table 3. The 10 countries with the lowest $STAT_{rep}$ (for 2000-2004 inclusive), based on number of taxa reported versus those that occur in their EEZs.

Country	Numerator	Denominator	$STAT_{rep}$
Poland	65.2	403.6	16.2
India	112.8	716.4	15.7
Egypt	103.2	662.4	15.6
China	114.0	755.2	15.1
Yemen	94.0	808.4	11.6
Sri Lanka	58.0	761.2	7.6
Korea (North)	24.0	582.4	4.1
Bangladesh	18.0	818.4	2.2
Viet Nam	12.0	810.8	1.5
Myanmar	2.0	140.0	1.4

The 53 countries that are considered in other contributions in this volume are ranked in Table 4 in terms of their mean $STAT_{rep}$ score for the years 2000 to 2004. The list shows that the $STAT_{rep}$, at least in part, overcomes the developed *vs.* developing country dichotomy that hobbles many other indicators. Rather, the $STAT_{rep}$ succeeds at detecting countries, including developing ones, that give attention to their fisheries data. Thus, Senegal, a developing country, ranked 12th (of 53), confirming what was previously known of the detailed nature of fisheries statistics maintained by that country (Gulland and Garcia, 1984; Ferraris *et al.*, 1994).

Finally, we want to highlight the potential of the $STAT_{rep}$ to identify changes in the quality of the reporting system of a given country, relative to the other countries' systems. Figure 1 illustrates this for a selection of 5 countries with low and 5 countries with high values of the $STAT_{rep}$.

Table 4. Mean $STAT_{rep}$ score for 2000-2004 for 53 countries jointly contributing about 95% of the world catch.

Rank	Country	% reported	Rank	Country	% reported
1	New Zealand	73.1	28	Taiwan	27.5
2	Portugal	70.0	29	Sweden	27.5
3	USA	69.4	30	Angola	27.4
4	Spain	67.5	31	Indonesia	27.0
5	France	63.6	32	Germany	26.9
6	Chile	62.2	33	Ukraine	26.4
7	UK	60.8	34	Philippines	26.0
8	Russian Fed.	56.4	35	Australia	26.0
9	Norway	53.4	36	Italy	23.1
10	South Africa	53.1	37	Iran	22.6
11	Ireland	51.1	38	Thailand	22.1
12	Senegal	46.8	39	Malaysia	20.6
13	Brazil	45.8	40	Latvia	20.2
14	Mexico	44.1	41	Ghana	20.1
15	Denmark	41.6	42	Pakistan	17.7
16	Faeroe Isl.	40.7	43	Nigeria	17.4
17	Korea (South)	39.8	44	Poland	16.2
18	Namibia	38.0	45	India	15.8
19	Canada	37.4	46	Egypt	15.6
20	Japan	36.8	47	China Main	15.1
21	Argentina	36.7	48	Yemen	11.6
22	Peru	36.0	49	Sri Lanka	7.6
23	Iceland	35.7	50	Korea (North)	4.1
23	Ecuador	34.6	51	Bangladesh	2.2
25	Netherlands	31.8	52	Viet Nam	1.5
26	Morocco	29.3	53	Myanmar	1.4
27	Turkey	28.0	--	--	--

As might be seem, the performance of the high- $STAT_{rep}$ countries, particularly France, increased in recent decade, despite the overall 'standard' (number of commercial species reported in denominator) doubling from an average of 35 in 1950 to 73 in 2004. Contrariwise, the low- $STAT_{rep}$ countries failed to improve their lot during the entire period considered here.

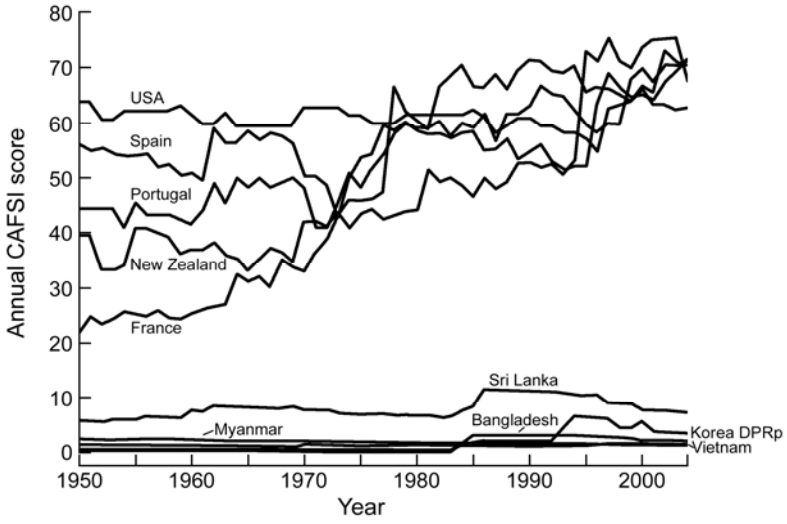

Figure 1. Time series of the STATrep for 10 selected countries (5 with high, 5 with low scores), showing changes in the performance of their fisheries statistical reporting systems.

Overall, the $STAT_{rep}$ thus appears useful for tracking the relative performance of countries in time, and for performing comparisons between countries. However, the validity of the $STAT_{rep}$ rests entirely on the assumption that a commercial fish or invertebrate taxon (i.e., a taxon reported caught to FAO by at least on country) will also be caught in all the other country in which it also occur, whether these countries target it or not. This implies that the $STAT_{rep}$, at least in part, measures countries' reporting of landed by-catch.

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