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Fish Landings at the World's Commercial Fishing Ports

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1. INTRODUCTION

Ports play a major role in the fishing industry. They give vessels and crews access to essential services and supplies, and enable vessel operators to land their catch. While the vast majority of ports operate responsibly and seek to avoid becoming conduits for fish caught via illegal, unreported and unregulated (IUU) means some do not (Flothmann et. al, 2009). There are ports that accept IUU catch knowingly while others, because they lack sufficient resources, expertise and/or training, may unwittingly allow IUU caught fish to pass through their facilities. This study set out to identify the world's busiest and most important fishing ports.

IUU fishing is a global problem that undermines global fisheries governance and threatens the sustainable use of marine resources along with the social and economic wellbeing of the coastal communities that depend on those resources (Watson and Pauly, 2001).

In 2009, the United Nations Food and Agriculture Organization (FAO) adopted the Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated fishing (PSMA) (FAO, 2009). Countries that ratify the treaty commit to exert greater control at ports over foreign-flagged vessels to detect IUU catch before it is offloaded from vessels, and prevent the ill-gotten catch from entering the world's markets. The PSMA, when effectively implemented globally, will be a major deterrent to IUU fishing.

With or without the PSMA, a major challenge to selecting ports for enhanced controls has been the lack of data on which ports are the world's largest or busiest. There is no global ranking of major fishing ports of any kind, nor are there factual records, for example, of the volume of fish coming into ports or even the number of port visits by flag state. There are therefore also no reliable data on which ports accept the most IUU catch. Without such information, it is very difficult to determine where the PSMA can have the greatest impact or identify ports that might successfully improve port controls if they had more resources and capacity.

The original objective of this study was to segment existing data on tonnage of fish landed (sorted by factors such as type of fish where possible), port visits (sorted by vessel flag-of-registration where possible), and other basic elements that reflect a port's activity. Early in the study it became clear that such data were

rarely publicly available. As a result, the ranking of the top 100 ports (or in the case of China, provinces) by landings tonnage around the world as presented here and in the online Supplement is the product of a lengthy analysis of multiple, incomplete sources. To the best of our knowledge it is the first ranking of its kind to be published in the modern era of commercial fishing.

2. METHODS

To estimate commercial fish landings, we collected data from publicly available sources, including governments, intergovernmental organizations, and individual port authorities. Data include landings only from marine capture fisheries, including marine finfish, crustaceans and mollusks. It excludes marine aquaculture, freshwater fisheries production (both wild and farmed), marine plants and algae. Data used were reported on an annual basis for 2012, with exceptions for Denmark, Indonesia and Viet Nam, where the most recent port-specific data available are for 2011.

The goal of this work was to identify, rank and characterize the world's ports for the purpose of assessing what the impact the PSMA could have at the country level. A secondary goal was to identify landings at the individual port level, because identifying individual ports is required by the PSMA.

We ranked ports and countries by the volume of commercial fish landed. Landings by tonnage are most often reported at the regional or national level, not at the individual port level. In order to estimate port-level landings, we used reasonable assumptions and/or data extrapolations.

3. DATA SOURCES

3.1 Country and sub-country levels

FAO FishStat J: FAO's online fisheries statistics database is the only long-term global dataset providing the volume and values of fish landings for all species over the period 1950 to 2012. The 'Global Production by production source' dataset provides country of production, species, production area and production source. This information was used to estimate total production by country and to filter production from particular oceanic areas. The data was also used to focus

country-level investigations, a first stage in the process of estimating port-specific landings. In order to assign nationality to catches, the flag of the fishing vessel was used. This means that FishStat J does not give the volume of fish landed within a certain country (and its ports), but instead fish landed *by* a certain country. For example, tuna caught by Spanish purse seiners but landed in the Seychelles will be attributed to Spain rather than to the Seychelles[1].

Organization for Economic Cooperation and Development (OECD) Review of Fisheries - Country Statistics 2013: OECD compiled statistics on fisheries from 2005 to 2013. The data cover fishing fleet capacity, employment in fisheries, fish landings, aquaculture production, recreational fisheries, government financial transfers, and imports and exports of fish. For some countries there are three sets of tables covering national landings in domestic ports, national landings in foreign ports and foreign landings in domestic ports. Produced on an annual basis, these tables provide the volume and value of the catch, broken down by species group and species. This is a more useful analysis than FishStat J, although like FishStat J, it does not give any information at the port level. Most importantly, in contrast to FishStat J, it is available for only 13 countries.

Regional Fisheries Management Organizations (RFMOs): RFMOs publish data on catch by species, gear type, vessel flag reporting country, catch and effort data, and fleet data. Some also have transshipment data, although these tend not to be publicly available.

3.2 Provincial and port levels

National statistics: A primary source of information on the location of landings is the national fisheries statistics published by various fisheries administrations around the world. However, only very few (Chile, Denmark, Iceland, Peru and the United Kingdom) directly publish port landings by species. The United States has an online database with national landings into U.S. ports, although species composition is not broken out. A number of other countries (Canada; China, PR; China, Rep. of (Taiwan); Indonesia, Japan; Malaysia and Norway) do not have

[1] FishStat J reports that 67,695 tons of fish were produced by Seychelles in 2012. However Seychelles
Fishing Authority (SFA) records show over 202,000 tons being landed in Port Victoria, showing the importance of foreign (mainly French and Spanish) landings.

port-level statistics but do show landings at the provincial (i.e., state) level which can act as a proxy in some cases where port landings are absent.

Port annual reports: Some major ports, such as Vigo, Spain (the largest fishing port in the European Union), do provide throughput of fish in their annual reports. This is not broken out by species, but in some cases is segmented into national landings and foreign landings.

3.3 Data robustness

The robustness of the data contained in the database is variable. Robustness is used as an indicator of the level of confidence in the data. A **high** level of robustness reflects that data are collected and published at port level. A **medium** level of robustness means reasonable estimates can be derived from robust secondary data. A **low** level of robustness reflects that either the base data are poor or that a high degree of estimation is involved. At the port level, approximately 75% of the records are considered to be highly robust, with 20% medium and 5% low.

3.4 Calculation methods

While a limited number of countries publish fisheries-related port data, the vast majority do not. For countries lacking those data we attempted to calculate the volume, and if possible the species composition of the landings, into ports from higher level data. Various methods were used, with differing levels of robustness as follows:

Proportion of national or provincial data. Where we found good information on aggregated landings into domestic ports, and could couple that with the relative importance of certain ports, we allocated production volumes to those ports. For instance, a number of the FAO Country Profiles often identify the main landing centers in the country and their importance related to other national ports. However, such data are often fairly outdated (from the mid 2000's) so FishStat J total volumes were used as a starting point. To strengthen this data, landings from a certain production area were used. Most of these records are considered to be of medium robustness.

Derived from monthly data. In some cases (e.g., India), port landings are published on a monthly basis. These have been raised to annual figures and have been considered of medium robustness.

Others: Various other methods were applied. For Mexico, the berthing capacity of the main fishing ports was used to apportion national landings to ports around the country. For Korea, the number of fishers in each port served to apportion national landings to ports around the country. For South Africa, port quota allocations and other information was employed to allocate landings to specific ports. Most of these estimates are considered to have low levels of robustness.

4. RESULTS

The database developed as part of this work provides port/province-specific fish landing data for 47 countries (see alphabetical list of countries in Supplement Table 1), with entries corresponding to 948 individual ports and 107 state provinces, which provide the most specific data when individual port data could not be obtained. The selection of countries with port landing data covers all important port States except China (where only data at the provincial scale was available), which has the highest volumes of landings worldwide (see below). The database lists over 1,000 entries for annual landings by country, sub-country region, province and/or port.

The top 20 ports and/or provinces by landed tonnage are presented in Table 1 (Data on the top 100 ports/provinces are available in the additional files accompanying this article). The proportion of landings for the key species group per port, the type of landings, and the level of data robustness are also listed.

At an aggregated national level, the largest level of total landings occurs in China, with 13.9 million metric tons, followed by Indonesia (5.7 million metric tons), U.S. (5.1 million metric tons), Peru (4.9 million metric tons), and Russia (4 million metric tons).

As explained, the data have different levels of robustness and the entire dataset from which the list of the top 100 was drawn contains a mix of these levels. In addition to the very limited information on commercial fish landings at an individual port level, we found little data that allow for the differentiation of

port landings by foreign and domestic fleets. It is likely that at least some of those data exist, but they are either not well-archived, or are recorded but not available publicly.

Efforts were made to individually contact a number of port officials, but even direct communications often yielded no further information. Considering port management needs, it would be expected that port authorities or other government entities would have an interest in monitoring this commercially-relevant information.

Table 1. Top 100 Ports or Provinces by Landing Tonnage for 2012 (Denmark, Indonesia and Vietnam from 2011)

Rank	Port / Province	Country	Landings / metric tons	Demersal %	Pelagic %	Shellfish %	Type	Robustness
1	Chimbote	Peru	**677,753**	1%	93%	7%	All landings	Medium
2	Vladivostok	Russia	**604,645**	80%	15%	5%	Domestic fleet landings	Low
3	Nahodka	Russia	**604,645**	80%	15%	5%	Domestic fleet landings	Low
4	Maluku (Ambon)	Indonesia	**567,953**	27%	53%	14%	All landings	Medium
5	Chicama	Peru	**566,100**	0%	100%	0%	All landings	Medium
6	Chonnam	Korea	**523,931**	No data by species			All landings	Medium
7	Callao	Peru	**510,537**	0%	96%	4%	All landings	Medium
8	Coronel	Chile	**506,866**	3%	95%	2%	All landings	High
9	Iquique	Chile	**488,092**	3%	93%	0%	All landings	High
10	Paita	Peru	**483,721**	0%	96%	3%	All landings	Medium
11	Zhejiang Province - Zhoushan City region - Putuo District	PRC	**481,017**	34%	33%	32%	All landings	Medium
12	Tromsø	Norway	**474,571**	39%	20%	2%	All landings	High
13	Pisco	Peru	**473,991**	0%	97%	3%	All landings	Medium
14	North	Indonesia	**463,201**	27%	39%	14%	All	Medium

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Rank	Port / Province	Country	Landings / metric tons	Demersal %	Pelagic %	Shellfish %	Type	Robustness
	Sumatra (Medan)						landings	
15	Shandong Province - Yantai City outskirts - Rongcheng City	PRC	**454,762**	30%	39%	26%	All landings	Medium
16	Zhejiang Province - Ningbo City region - Xiangshan County	PRC	**449,863**	34%	33%	32%	All landings	Medium
17	Tarawa	Kiribati	**443,750**	0%	100%	0%	All landings	High
18	Zhejiang Province - Wenzhou City outskirts - Wenling City	PRC	**433,576**	34%	33%	32%	All landings	Medium
19	Ålesund	Norway	**421,237**	36%	28%	0%	All landings	High
20	Walvis Bay	Namibia	**418,037**	7%	93%	1%	All landings	Medium

5. CONCLUSION

In drawing our conclusion, it should be noted that port-specific fish landing data is less robust, consistent and accessible than is ideal. As such, the information in this paper must be treated with some caution. Nevertheless, this list of the top 100 ports by landed tonnage is one of the first of its kind to be published as a single consolidated dataset, and it is intended as a starting point in the further assessment of activity in the world's fishing ports. In order to better characterize the respective contributions of these ports to the global fish trade – both legal and IUU – additional information on the species and values landed and the percentage of vessels offloading or receiving port services that are foreign-flagged would be

valuable. These data would inform any assessment of a port's susceptibility to IUU fishing activities.

A key finding of this work is that the largest landings occur in countries that have not ratified the PSMA and do not have well documented port State controls in place. This illustrates the pressing need for international agreements like the PSMA to enter into force to ensure that the largest fish landings in the world do not include IUU caught fish.

These findings will inform work to support port States as they ratify the PSMA and implement port State controls. Port State controls are an important facet of monitoring, control and surveillance schemes that play a key role in making IUU fishing activity more difficult to participate in and much less profitable for vessel owners/operators.

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