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# Sourcing seafood for the three major markets: The EU, Japan and the USA

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ABSTRACT

This paper describes the marine fish and invertebrate consumption in three of the world's major seafood markets (the EU, Japan and the USA) using a series of global maps indicating the likely origin of the seafood consumed by each market. These maps display a high level of dependence by these markets on foreign sources as the serial depletion of local fisheries resources forced the fleets in search for new seafood supplies well beyond their domestic waters. The acquisition of foreign (and high seas) seafood by these markets is conducted through two channels: by dispatching distant water fishing fleets that directly exploit foreign stocks; and by importing catch landed elsewhere by local fleets. The results also demonstrate that each of the three major markets occupies a zone of influence within which it is dominant.



## 1. Introduction

Seafood consumption is on the rise. The global per capita seafood consumption has been increasing steadily, from an average of 9.9 kg in the 1960s to 16.7 kg (live weight equivalent) in 2006 [1]. Human population itself has doubled over the same period, resulting in a near quadrupling in the quantity of fish consumed. Increasing income and urbanization in many developing countries, most notably China, and health concerns about other sources of animal protein are expected to further fuel the global demand for seafood into the future [2].

However, the consumption of seafood is not distributed evenly, and considerable regional differences occur. In 2005, the annual per capita fish[1] consumption of the industrialized countries stood at 29.3 kg, nearly three times that of the developing countries (10.6 kg, excluding China). The difference is even greater when consumption in countries classified as 'low income and food deficient' is considered (8.3 kg [1]).

The bulk of this ever-growing demand is supplied by marine capture fisheries, not only as a direct source of seafood, but also indirectly via aquaculture production, which itself relies heavily on the input of marine fisheries catches in the form of feed, i.e., fishmeal and oil [3]. Indeed, mariculture has yet to make a significant net contribution to the global supply of fish [4]. This supply of seafood from marine capture fisheries, however, appears to have reached its limit, with global landings on a decline since the late 1980s (Fig. 1 [5]) and 80% of world's fish stocks now considered to be fully or over-exploited [1]. Closer inspection of the catch statistics reveals that there is considerable 'fishing down' [6] of the marine food web with invertebrates and low-trophic level fish replacing piscivorous species such as cod and tuna, which had historically met world demand. While such fishing down may contribute to some initial increases in catches of prey species, more common consequences of this fishing down are outbursts of previously suppressed species, which may or may not be suitable for human consumption (e.g., jellyfish [7]). Clearly, the current pattern of seafood consumption is not sustainable [8,9].

### 1.1. Globalization of fisheries

Although its multi-faceted nature makes globalization difficult to define in universally agreed terms, it can be summarized as 'the growth or more precisely, the accelerated growth, of economic activity that spans politically defined national and international boundaries' [10]. This definition clearly reflects the current trends in the world's fisheries. Sophisticated networks of trade relationships, supplied by large distant water fleets operating beyond the maritime boundaries of their home states, mean that in a large proportion of global fisheries landings are being consumed in countries outside the boundaries of the waters where the catches were taken. The disconnect between the regions of fish supply and consumption leads to the movement of fish into the markets and onto the tables of the affluent industrialized countries [11]. Such flow results in the skewed distribution of fish noted above,

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[1] Throughout this article, the words 'seafood' and 'fish' are used interchangeably. However, freshwater fish and algae, as well as fish and invertebrates of aquaculture origins, are excluded in the analysis.

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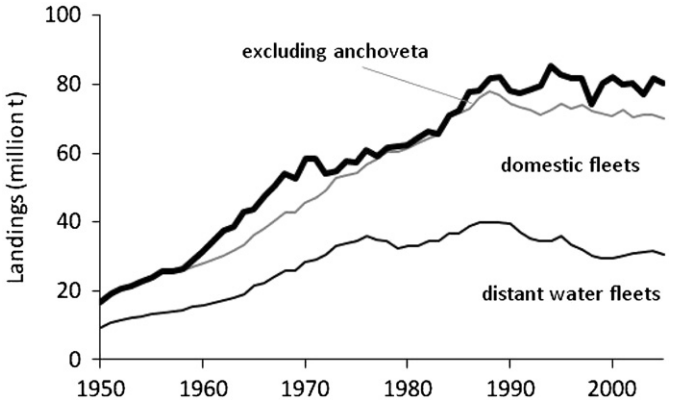


**Fig. 1.** Trends in global marine fisheries landings from 1950 to 2005 (www.seaaroundus.org). Note that total landings (bold) have levelled off at around 80 million tonnes since the late 1980s and are on a decline when the landings of Peruvian anchoveta (*Engraulis ringens*) are excluded (grey). The thin black line represents the landings by distant water fleets (i.e., catches occurring outside the domestic EEZs of the fleets).

with potential consequences to food security in many developing coastal countries [12].

### 1.2. Gravitation of seafood at sea

Large numbers of industrial fishing vessels from developed countries fish in the waters of developing countries. The emergence of the United Nations Conference on Law of the Sea (UNCLOS), in the late 1970s, enabled coastal countries to claim exclusive rights to waters reaching 200 nautical miles into the open sea, including essentially all coastal shelves and their fisheries resources. Under this new regime, developed countries with established distant water fleets, could not dismantle them without significant economic and social consequences. Consequently, they began to engage in 'cash-for-access' fishing agreement. Under these arrangements, they secured fishing opportunities in the waters of developing countries in exchange for financial compensation (Fig. 1).

In some countries, fishing by foreign fleets far exceeds fishing by the host country [13,14]. While access agreements provide a valuable option for developing countries to extract economic benefits from their fisheries resource, there are concerns about the equity of these arrangements and their impact on local artisanal fishers and the development of domestic fisheries (see e.g., [15]). Moreover, in countries with limited resources for management, surveillance and enforcement, there are also concerns about the impact of distant water fleets on the environment and sustainability. Regional and distant water fishing by vessels from developing countries are also expanding and fishing fleets of 'flag of convenience' states are reportedly increasingly involved in illegal distant water fishing [14].

For developing countries with distant water fleets operating in such EEZs, the process of negotiating fair compensation is extremely difficult because detailed operational cost of distant water fleets is not available. In general, there seems to be little relationship between the value of the catch by distant water fleets and the level of fees they pay [15,16], indicative of weak negotiating power of the host countries, or, worse, possible corruption on both sides. Moreover, most of the hosts lack the capacity to monitor the catches of foreign fleets, making it difficult for host countries to assess the quantities and value of the fish caught by the distant water fleets. This further contributes to developing countries being underpaid and their waters overfished by foreign fleets.

In the 1990s, for example, fishing access agreements signed between the EU and developing countries generated on average, value added of EUR 694 million annually in the EU member states through processing and marketing of fish caught. This amount represented three times the benefits accruing to the host countries that have signed fisheries agreements with the EU [17].

Moreover, distant water fleets generally benefit from a variety of subsidies, including the payment of access agreement compensation by their home governments. With these subsidies, distant water fleets have been able to continue to operate even when the stocks have become too depleted to make their exploitation economically profitable [18]. This also results in unfair competition between industrialized distant water fleets and local fleets for access to resources and markets, especially for the artisanal fishers of developing world.

### 1.3. Gravitation of seafood via the international market

International trade in fish products, like other kinds of trade, is often assumed to benefit all involved actors. However, given the large amounts of fish entering into international markets, there are concerns that exported fish species will no longer be available for domestic consumption, thus compromising the food security of the exporting countries, particularly in low-income, food-deficient countries (LIFDCs).

Fish is one of the most widely traded commodities in the world with nearly 40 percent of world fish production entering the international market—significantly more than for other food staples such as wheat (20%) and rice (5%) [1]. The trends toward globalization of business, banking and telecommunications, as well as the policies of trade liberalization and expansion of global fishing fleets over the past 50 years have greatly contributed to this increase in fish trade. The total volume and value of fish trade have steadily increased from 8 million tonnes worth USD 8 billion in 1976 to 54 million tonnes worth USD 85.9 billion in 2006 (volume in live weight equivalent [1]).

Fish trade flows can be summarized as follow [1]:

- Developing countries accounted for just under 60% and 50% of exports in quantity and value, respectively. LIFDCs accounted for 20% of the total export value in 2006;
- A total of 97 countries, mostly in Latin America, the Caribbean, Africa and developing Asia and Oceania, were net exporters of fish and fisheries products. Europe, Japan and North America were characterized by a fish trade deficit;
- 85% of the value of developed country exports was destined to other developed countries; meanwhile, only 15% of the value of fishery exports of developing countries was to other developing countries.

It is evident from these statistics that there is a net flow of fish in the international market from developing to developed countries. Whether this should be viewed as problematic remains a matter of debate. Proponents of free markets would point out that a large share of traded fish products is comprised of high value products, such as shrimp and tuna, which may be of little interest to consumers in the poorer countries. Therefore, they would also argue that the substantial amount of foreign exchange earned from the export of these luxury fish products can be used to import much larger volumes of low cost foods, with a large net nutritional gain. But while increasing international trade in fish and fishery products undoubtedly provides social and economic benefits for developing countries, there is a need for caution.

Although the export-oriented fisheries sector may present opportunities for developing countries to earn foreign exchange,

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the demand from international markets exerts huge pressures on fisheries resources. Thus, meeting demand may encourage intensive, destructive and illegal fishing to the detriment of sustainability. There are also concerns that promoting international trade in fisheries products could have negative consequences for local food security. Impacts may include reduced physical and economic access to fish by channelling fish away from local markets to international markets and perhaps of even greater consequence, a large increase in the local price of fish with considerable food security consequences to the poor parts of the population [11].

Moreover, in many cases, much of the foreign exchange earned from the export of fish is not devoted to purchasing low cost, nutritious foods for an undernourished population, but is diverted to the purchase of luxury products in demand by local elites or tourists [19]. Thus, participation in international fish trade may result in a net gain of benefit to the country as a whole, but a net loss to the poor majority.

New market opportunities for fishmeal, supported by the growth of aquaculture, could also lead to local artisanal fisheries exporting small pelagic species, which have traditionally been consumed locally—similar to the situation that occurred for demersal fish in West Africa with the artisanal fishery supplying the export market rather than local markets [20].

Moreover, many fisheries operations in developing nations are owned by people or firms from developed countries, thus contributing less to the local economies than it would seem. Participants in a joint fisheries venture often have contradictory objectives with regard to what they hope to achieve through the arrangement, which is a major obstacle in attaining a successful partnership [21]. For the local partner and the government of the host country, the primary concern is the long-term development of fisheries and the creation of associated social and economic benefits. They therefore assume that the joint venture arrangement will provide employment and training opportunities for the local population while providing a low cost food supply for the local market. On the other hand, foreign partners may be more concerned with short-term security of fishing access and the attainment of the maximum return on their investment. In some extreme cases, the joint venture is seen as merely a means of securing fishing access for the parent companies of the foreign partners, and not as a profit-generating system, their objective being to minimise costs, as documented in an older, but very thoughtful analysis of a Japanese joint venture in the Salomon Islands [22].

Lastly, heavy utilization of fishmeal and oil as livestock and aquaculture feed further contributes to the 'invisible' export of fish for many developing countries, when finished products, i.e., chicken, pork and salmon, are exported [23].

### 1.4. Globalization of 'consumption footprint'

As noted previously, the major consequence of the expansion of distant water fleets and the development of international fish market is that consumers in the developed world are now increasingly purchasing fish products originating from outsides the EEZ of their countries. In other words, countries can now consume fish at a level that exceeds the productivity of their domestic water, i.e., have their ecological footprints [24]—or 'fishprints', as it were—far exceeding the total area of their EEZ, as long as they have the economic means to do so [25].

That said, this contribution seeks to establish an overall picture of fish consumption by major markets in industrialized countries under globalization, and how the consuming countries influence marine fisheries resources across the world. The approach is as follows. First, using records of bilateral trade flows, the exporting country from which the traded fish commodity was likely to have been produced (i.e., source fisheries) is determined. Then, based on the spatial distribution of source fisheries and that of domestic fisheries of the three markets, the spatial patterns of their fish consumption are plotted onto global maps. These maps provide the basis for further discussion and exploration of the impact that the demands of these markets have had on the world's fish resource and the implications for the sustainability of marine fisheries.

## 2. Materials and methods

The methodology used to predict consumption footprints relies on two databases: one on spatially disaggregated marine fisheries catches and on bilateral trade flows of fisheries commodities. Consumption is computed using a 'disappearance' model where net domestic supply (domestic production, i.e., fisheries landings, plus import minus export) is assumed to be fully consumed each year with no carryover of supply to the following year [26]. Both food and industrial (i.e., fishmeal) consumptions are evaluated, although the analysis, which excludes trades of aquaculture product, considers industrial consumers of fishmeal as the final consumer and thus does not take into account the indirect consumption of fishmeal by the consumers of aquaculture products (e.g., farmed salmons and shrimps). Spatial patterns of the consumption footprints are derived from distribution of domestic fisheries and those of fisheries in trading partners.

In the present study, the databases developed by the *Sea Around Us* Project (www.seaaroundus.org) are used, particularly, its database of spatially disaggregated marine fisheries landing, which relies on reported statistics from the FAO and other national and international agencies for inputs [27]. For some countries and regions that have been historically underrepresented due to their relatively large informal fisheries sectors (i.e., subsistence fisheries), the officially reported landings are supplemented by estimates of unreported catches (e.g., [28]). Using ancillary data regarding the geographic distribution of commercially exploited taxa and fishing agreements that regulate foreign access to the exclusive economic zones (EEZs) of maritime countries as proxies for locations of reported catches, the database presents reported worldwide catches, from 1950 to the present, at a spatial resolution of 30′ latitude by 30′ longitude ocean grid system. This database, after accounting for exports (see below), composes the capture fisheries component of seafood consumption.

For the imported component of consumption, a database of bilateral trade flows of marine fish commodities is developed. Like the marine landings database, this trade database utilized reported statistics of the United Nations (UN ComTrade), regional (e.g., OECD, EU) and national agencies (e.g., Japan Customs Agency). Much of the reported statistics is expressed as processed products (e.g., fillets, cans); with the volume of trade given in product weights. In order to harmonize the trade with the fisheries landings information, the quantities in the trade database are re-expressed as live weight equivalents. Wherever possible, attempts are made to distinguish between commodities derived from marine fisheries and those derived from aquaculture or freshwater fisheries. However, under the current international reporting system (e.g., Harmonized System codes), distinctions between products of wild and farmed origins are not made. Thus, an algorithm that determines the likely origin of commodities using the relative proportions between fisheries landings and aquaculture production is used. Moreover, these commodity classifications are often based on non-biological characteristics, such as price and associated trade restrictions, rather than by

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their taxonomic relationships. For this as well, a rule-based algorithm that estimate the taxonomic identity of underspecified commodities using the catch composition of exporting countries is used.

Landings records for the year and exporting country corresponding to a trade record and for taxa within the range of all possible taxonomic identities of the commodity reported in the record are first extracted from the fisheries landings database. This yielded a subset of the exporting country's landings that are potential sources of the trade record. For some taxonomically underspecified commodities, this subset could include a great majority of the exporting country's landings. Therefore, this subset is further reduced to the top twenty landed taxa (by weight). If the total volume of the exporting country's landings within the subset is less than the volume reported to have been exported from that country in the trade record, then the volume reported in the record is assigned to all landings, and the portion exceeding the landings is logged as an 'error'. Otherwise the volume traded is assigned proportionally amongst the subset of the exporting country's landings. Once the trade volume is assigned to the landings, the portion of the landings assigned is removed from the exporting country's landings to prevent double counting. In doing so, it is assumed that a country is likely to export the species of fish that are most abundant in their reported landings.

Once records of imports have been identified with the exporting country's landings, spatial distribution of imports can be approximated using that of the exporting fisheries. Combining the distribution of imports with that of the domestic fisheries then yields the consumption maps for the three markets analysed in the study.

## 3. Results

Figs. 2–4 present the origins of fish consumed in the three markets examined. The patterns of their consumptions are described below for each market.

One of the major patterns that emerge from this study is the appearance of what could be referred to as 'spheres of influence' for each of the three markets in which the market constitutes as the major destination of fisheries catch in the region. These 'spheres of influence' demonstrate the occurrence of trading blocs [29], despite the perceived trends toward the 'globalization' of the world economies and trade.

### 3.1. European Union[2]

Expansions of the European distant water fishing fleets are well documented (e.g., [30,15]), particularly off the West African coast, where the EU has entered into fishing access arrangements with multiple countries in the region. Under the Common Fisheries Policy, the EU collectively enters into bilateral fisheries agreements with coastal countries with agreed fishing opportunities allocated to its member countries, mostly amongst the major fishing nations of Spain, Portugal and France, and mostly for tuna vessels and bottom trawlers. Over the past decade, the EU has increased its distant water fishing presence beyond their traditional fishing grounds of the West Africa, with newly negotiated fishing arrangements in the East Africa (e.g., Mozambique, Madagascar and Comoros Islands) and the South Pacific (e.g., Kiribati, Solomon Islands and Micronesia).

From 2001 to 2005, 29% (8.8 million tonnes) of the fisheries landings by EU countries originated outside their collective EEZs: 19% (5.6 million tonnes) from foreign EEZs and 10% (3.1 million tonnes) from the high seas.

In terms of trade, the EU countries are increasingly dependent on imports for their fish supply. While a large bulk of their imports is of an intra-EU origin, a large amount of fish enters EU markets from developing countries, particularly from those that qualify under the Generalised System of Preferences (GSP), which provides preferential access to its market. It is estimated that the EU annually imports over 9.5 million tonnes (live weight equivalent) of marine fish and invertebrates.

Fig. 2B shows that the EU seafood supply covers most of the world's productive coastal waters, from the Humboldt Current system off South America to the Benguela system of the South Africa to the South China Sea. Fig. 2C, which portrays the areas of world's ocean for which EU serves as the major destination of their fisheries catch, shows that the EU is a major market for the catches in the east Atlantic, not only in the northeast but also in the waters off the West Africa. This is likely due to two contributing factors: geographical proximity of EU to these regions and historical ties that EU countries have had with countries of Africa, as exemplified by the Lomé Convention, which provided a framework for preferential treatment of trades with developing Africa, Caribbean and Pacific (ACP) countries, in particular former British, Dutch, Belgian and French colonies.

### 3.2. Japan

Japan, once the largest fishing nation in the world, has undergone a transition from the world's major fish exporter to its biggest importer over the latter half of the 20th century [31]. Its distant water fisheries, once operating around many of the world's productive fishing grounds, have been on a decline since the late 1970s, faced with increased cost of operations following the oil shocks of 1972 and 1979 and the increased costs of accessing the foreign fishing grounds under the emerging EEZ regime. Nonetheless, Japanese fishing fleets continue to operate beyond their domestic EEZ, particularly its tuna longline fleets across the Pacific. At present, half of Japanese marine catches originate from outside the Japanese EEZ. Of these, 60% are caught within foreign EEZs, mostly among its neighbouring EEZs of China, South Korea and Russia, where reciprocal fishing arrangements are agreed upon annually.

Japan is also a major destination for marine fish export, importing approximately 5.5 million tonnes of seafood annually. Their major trading partners are Peru (for imports of fish meals), China and the USA, as well as many Asian countries such as Taiwan, South Korea, Thailand and Indonesia. Fig. 3C shows that Japan is the major destination of catch taken in the Pacific as well as for the high seas catches in the Southeast Atlantic. This pattern is because of the geographical proximity of the region and because Japan is the largest market for tuna, the important export fishery for many of the countries in the South Pacific.

### 3.3. United States of America

The United States, a relative late comer to international fisheries, has a small distant water fisheries presence, except for its tuna fisheries in the South Pacific. In fact, following the declaration of its EEZ in 1977, the primary focus of its fisheries development policy was to phase out distant water fisheries operating within its EEZ (e.g., Japan and Russia) and replace them initially by joint ventures between US and foreign fleet operators,

[2] For consistency, the EU market is defined as those of EU-27 for both 1950 s and 2000 s analyses: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom. For countries that were part of the former USSR, the disaggregated USSR landings as described in [32] are used.

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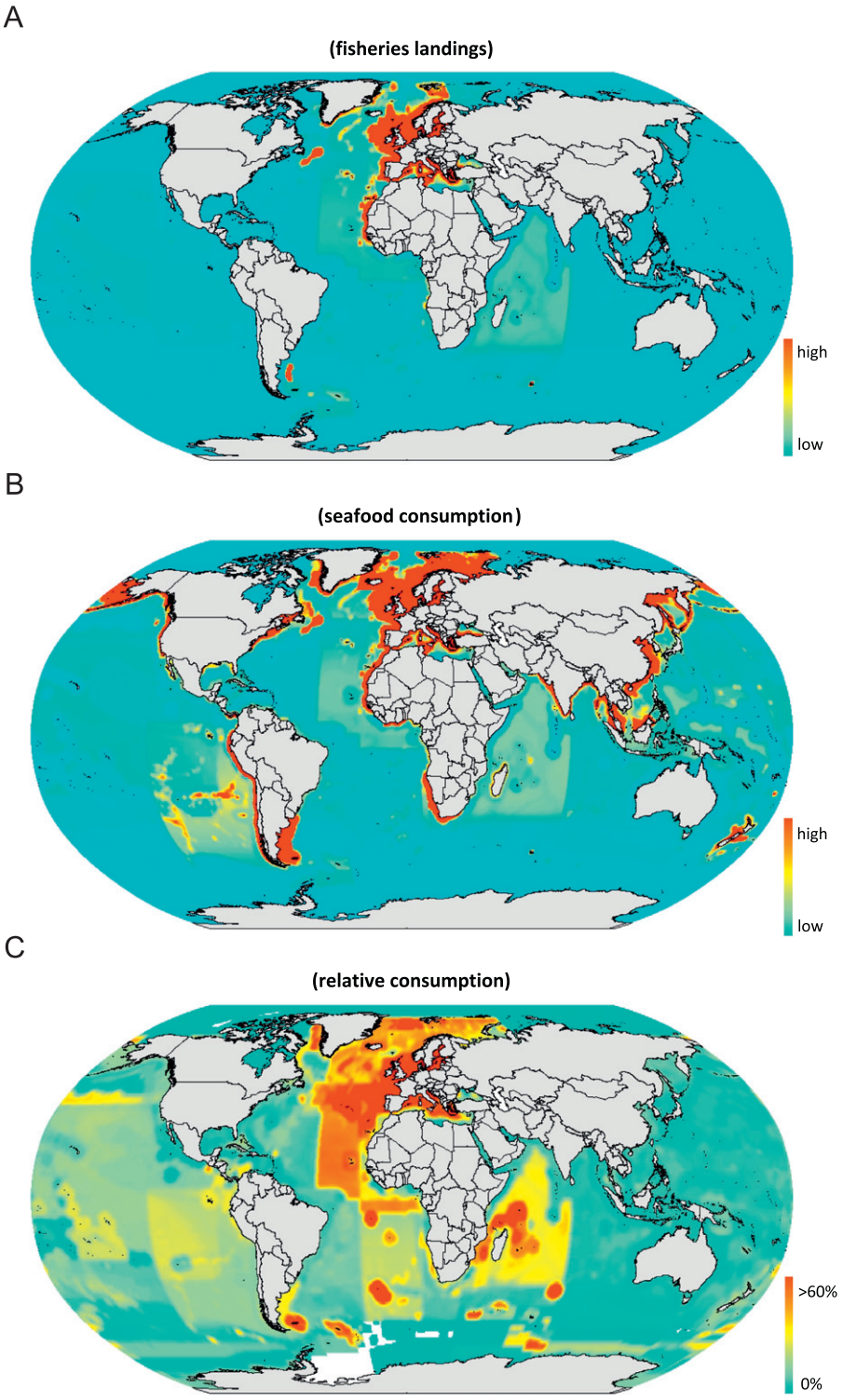


**Fig. 2.** Origin of fish landed by the EU (A), the origin of fish consumed by EU (B) and relative seafood consumption (C). Five year average from 2001–2005.

and eventually by its national fleets. As Fig. 4A depicts, fishing by the American fleets are concentrated in the North Pacific and in the Northwest Atlantic. Currently, less than 20% of the catches by the US fleets originate outside the American EEZ (560,000 tonnes from foreign EEZs and 300,000 tonnes from the high seas).

Despite the limited extent of its fisheries, US fish consumption, like for the other two markets, does extend to most of the world's productive waters, particularly off the coast of South America and along Southeast Asian coastlines (Fig. 4B).

### 3.4. Overall

The three markets, jointly, are estimated annually consumed an average of 28 million tonnes of non-farmed marine fish and invertebrates during the period 2001–2005, accounting for 35% of the total marine fisheries landings. Fig. 5, representing the proportion of the global catches consumed in the three markets, shows that in many regions, particularly in the high seas, consumption by these three markets accounts

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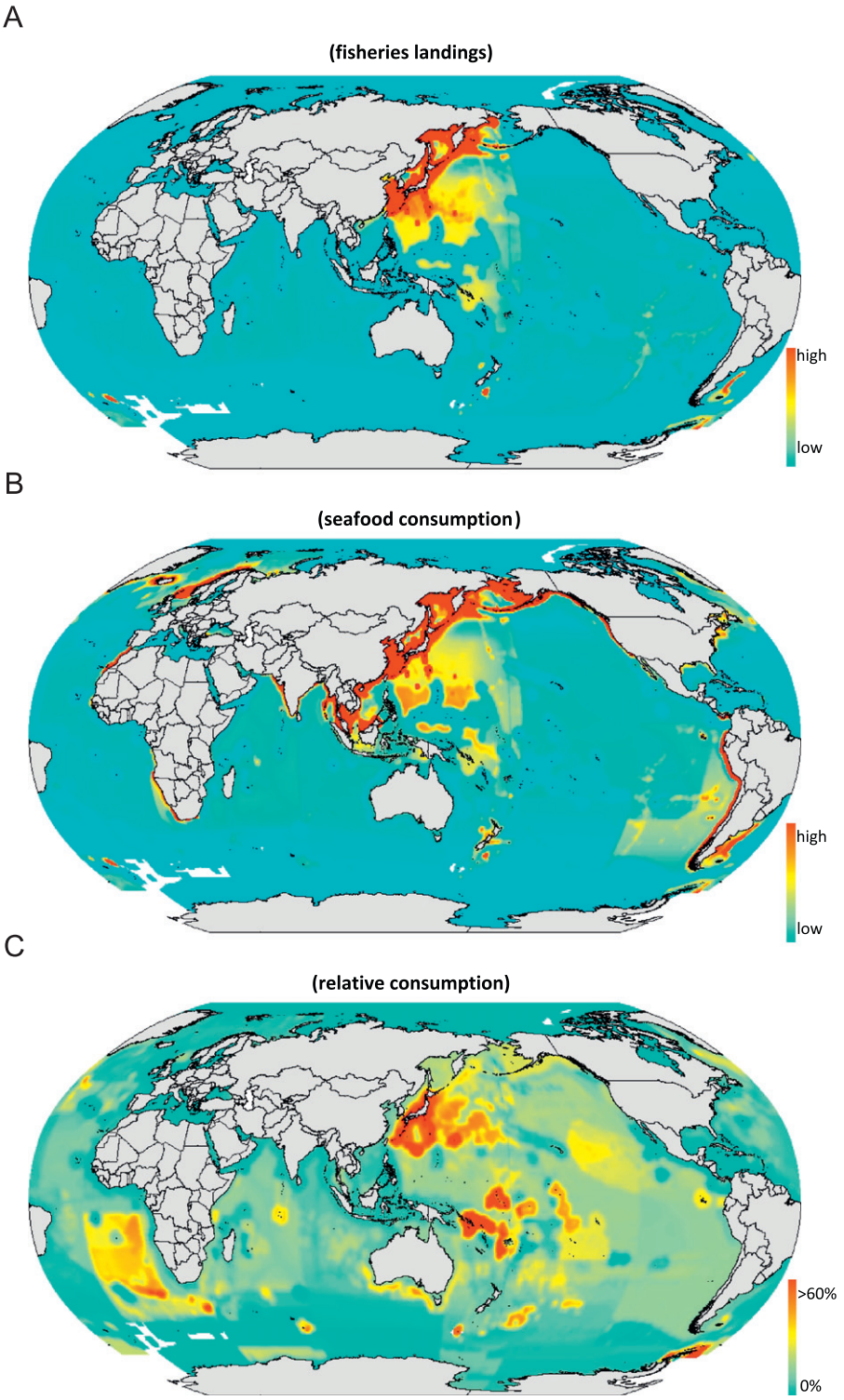


**Fig. 3.** Origin of fish landed by Japan (A), the origin of fish consumed by Japan (B) and relative seafood consumption (C). Five year average from 2001–2005.

for over 2/3 of the fisheries catch. The combined impact of the three markets, therefore, can be said to be truly global.

It should be noted that the seafood consumption described here does not include farmed fish. It is most likely that the footprints of the three markets would have been more pronounced had the 'shadow' trade of forage fish species, used for fish meal production that ultimately end up in these markets as farmed salmons, shrimps and increasingly tunas, been included.

## 4. Conclusion

This is the first time that global fisheries catch and fish import data have been integrated to establish, in this manner, the

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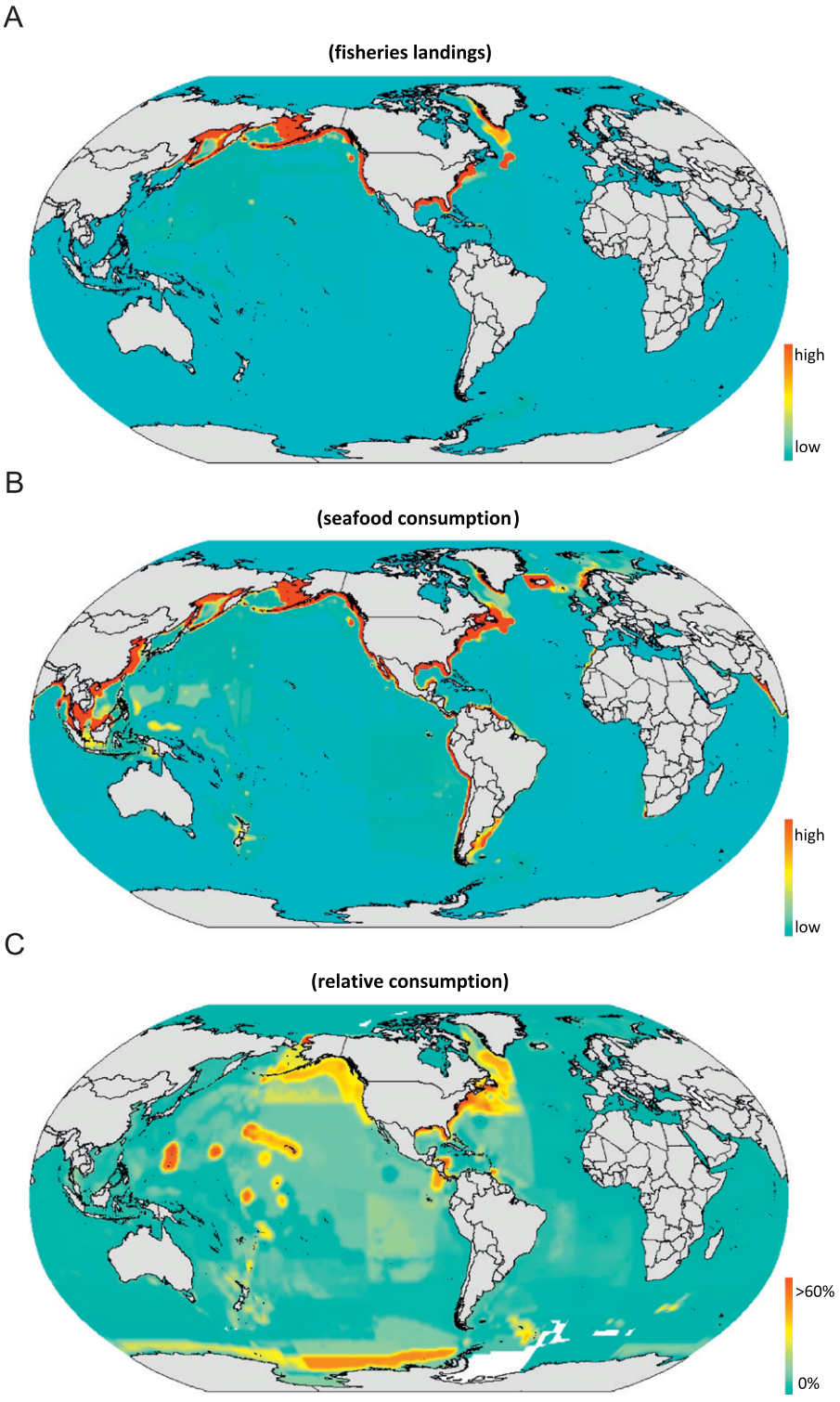


**Fig. 4.** Origin of fish landed by the USA (A), the origin of fish consumed by USA (B) and relative seafood consumption (C). Five year average from 2001–2005.

relationship between fisheries catch and fish consumption. The results are startling. Notably 12% of the world's population consumes 30% of world's fish supply. It is noteworthy that three markets, the EU, Japan and the USA, are amongst the most affluent. Since the types of fish and the quantities in which they are consumed can be considered to be a luxury, the fact that they gravitate toward these markets should not come as a great surprise.

However, the fact that these three markets have such distinctive 'spheres of influence' was unexpected, especially in view of what is commonly assumed to be the nature of globalization. Such result raises some interesting questions that demands further exploration. How and why did this pattern emerge? From the perspective of fisheries sustainability, or economics, or even a geopolitical view, is this positive or negative? And perhaps most importantly, what are the

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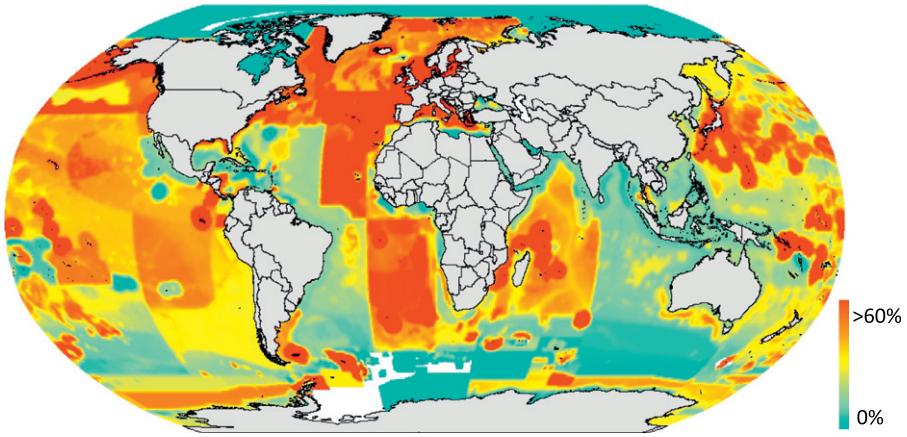


**Fig. 5.** Origin of fish consumed by the three markets expressed in percentage of total consumption. This map represents the geographic extent of the consumption footprints of the consumers in the industrialized countries. Five-year average from 2001 to 2005.

implications, both positive and negative, for the people in the countries whose waters and fleets are providing these fish?

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