GLOBAL MAPS OF THE GROWTH OF JAPANESE MARINE FISHERIES AND FISH CONSUMPTION

by

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Abstract

Globally, consumers are increasingly relying on goods and services produced in other countries. This is particularly true for fish products, nearly 40% of world fish production is currently traded globally. Thus, there now exists a clear disconnect between resource harvesters and resource consumers. This research is concerned with an assessment of fisheries exploitation patterns based on consumption as a complement to assessment based on fisheries catch. Such research requires an examination of two primary modes of fish acquisition: the operation of a country's domestic fishing fleets, i.e., its landings and the purchase of fish caught by foreign fleets, i.e., its fish import.

Japanese fish consumption will be used as a case study. Japan has traditionally been one of the world's largest consumers of fish products, with considerable dependence on foreign fisheries resources, initially through the operation of its distant water fleets, and later through the purchase of foreign catches as import.

Global maps of Japanese trade statistics were constructed in terms of where catch were likely to have been taken, through a comparison with existing world landings maps. By combining Japan's trade maps with Japan's catch maps, one can then assess the spatial and temporal patterns of Japanese fish consumption. Examination of the consumption maps indicate that despite the reduction of its distant water fleets, Japan maintains high level consumption throughout the world oceans via its increased reliance on the import of foreign catches. Moreover, maps of Japan's consumption relative to the world catch reveal that Japan remains the most prominent consumer of fisheries resources from many regions of the world, particularly in the South Pacific and the waters around Antarctica. Such maps provide an alternative measure of the level of fisheries exploitation exerted by the demand of fish importing countries. Although the responsibility for ensuring the sustainability of the resource use is on the resource-extracting nation, an understanding of the exploitation pressure exerted by the demand of the importing countries is evidently in their best interest, as it dictates the long-term security and stability of the supply. The mapping of consumption undertaken in my research may lead to more thorough analyses of this issue.

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Introduction

Fish are important sources of both food and income for maritime countries. On a global scale, 19% of animal protein for human consumption is derived from fish, and more than 1 billion people rely on fish as an important source of animal protein, with some small island countries depending on fish almost exclusively (FAO 2002). The fishery industry has become a big business, employing close to 200 million people, with international trade of fisheries products reaching over US$50 billion per year (Vannuccini 2003).

However, fisheries are in crisis. Global landings are declining by about 500,000 tonnes (t) per year from a peak of 80 to 85 million t in the late 1980s (Watson and Pauly 2001). Furthermore, the United Nations Food and Agriculture Organization (FAO) (2002) reports that 75% of the world's commercially important marine fish stocks are either fully fished, overexploited, depleted or slowly recovering from a collapse. Although it has been suggested that the cause of this crisis is due to unspecified 'environmental changes,' an examination of the history of fisheries reveals that overfishing by humans is the fundamental cause of the collapse of exploited marine fish stocks (Jackson *et al.* 2001; Pauly *et al.* 2002).

With such bleak outlook for fisheries, there is a growing trend towards an ecosystem-based approach in fisheries management. Such an approach requires the use of geographical maps to capture the spatial patterns of exploitation, in addition to the conventional bivariate plots of time series that track its temporal patterns. The *Sea Around Us* project[1], based at the Fisheries Centre of the University of British Columbia, has been developing the use of geographical maps to demonstrate spatial changes in fisheries. This involves the identification of which species are being exploited by which country in which area. This is of particular importance for the fishery industry, which, by its very nature, tends to be borderless. Thus, its operations are not necessarily restricted within its domestic waters, and can easily occur in high seas and in foreign waters.

The exploitation of fisheries resources is further complicated by the high degree of international trade in fish commodities. Over 38% of world fish production[2] (in volume) is traded internationally, whereas less than 5% of world rice production is traded internationally (Vannuccini 2003). Consequently, the extractor of a resource is not necessarily its consumer.

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[1] For details on the *Sea Around Us* project, see www.seaaroundus.org.
[2] The term 'production' is used to denote both marine and freshwater catch and aquaculture production.

Indeed, it is estimated that over 75% of fisheries landings (in value) are consumed in countries other than those owning the Economic Exclusive Zones (EEZ) in which the landings were made (Pauly *et al.* 2003a).

The disconnect between extractor and consumer require that, to fully describe the impact of a population on marine fisheries resources, both consumption and extraction patterns must be described. The fisheries maps so far created by the *Sea Around Us* project are, however, representative only of exploitation patterns from the perspective of the extractor. This thesis presents the exploitation patterns of fisheries resources in the context of the consumer, thus allowing a more thorough representation of the impact of a population on marine resources. The concept of representing resource exploitation from a consumer perspective has already been applied in other resource management issues such as CO_2 emission (Bastianoni *et al.*2004 and Munksgaard and Pedersen 2001) and ecological footprint analysis (Wackernagel and Rees 1996).

In order for this thesis to achieve an accurate and thorough evaluation of consumption patterns, it is essential that the origins of the fish products imported by a population are mapped on the same spatial resolution as the existing global fisheries maps (of Watson *et al.* 2004). This allows for an accounting of total exploitation pressure exerted by the population on the resource through both direct exploitation, i.e., its fisheries, and indirect exploitation, i.e., its consumption of foreign catch.

This thesis will use Japan as a case study as it provides an excellent example of the need to examine the differences between extractor-based exploitation patterns and consumer-based exploitation patterns. Japan is not only a major consumer of fish products, but also an important exploiter of the world’s fisheries resources. Traditionally, fish has played a significant role in the diet of the Japanese; more recently the considerable buying power generated by its strong economy has enabled Japan to become one of the largest market for international fish trade. Moreover, this examination of Japanese fisheries identifies some of the challenges faced by developed countries in meeting their demand for seafood (Wildman 1993). These challenges include the overcapacity and depletion of domestic fisheries resources, increasing international and national restrictions on the operations of distant water fleets, increasing costs of fishing operations due to rising crew wages and fuel costs, and a shrinking fisheries sector in developed countries due to an inability to attract young job seekers into fisheries.

The thesis is organized as follows: Chapter 1 examines in detail the unsustainable state of the world fisheries, and presents the spatial disaggregation analysis developed by the *Sea Around Us* project. Chapter 2 presents an historical overview of the Japanese fisheries sector, including seafood consumption, catches and trade trends. Chapter 3 describes the analytical framework of the study, with emphasis on the spatial disaggregation of Japanese trade statistics. Chapter 4 examines the spatial and temporal patterns of post-Second World War fish consumption in Japan, mainly in forms of maps, and discuss the limitations of the method used here; as well, the policy implications of the study and concluding remarks are presented.

Chapter 1. Unsustainable State of World Fisheries: a Map-based Approach

State of World Fisheries

The sustainability of renewable resources such as fish stocks depends on the level of exploitation being less than the regenerative capacity of the resource. This means that consumption must not diminish or deteriorate the resource to such an extent that its decline threatens future generations' ability to extract the same level of benefits. In order to achieve sustainability in fisheries, several components must be attained (Karavellas 2000): the maintenance of healthy populations of targeted species; the preservation of ecosystem integrity; the retention of physical structures of ocean features and the reduction of wasteful fishing practices.

As stated in the Introduction, it is now evident that world fisheries are no longer sustainable. For example, there has been a significant decrease in fish biomass over the last century in the heavily exploited North Atlantic (Christensen *et al.* 2003), while more than 90% of large predatory fishes have been lost from the world's ocean (Myers and Worm 2003). The dire situation of many commercially important species such as southern bluefin tuna (*Thunnus maccoyi*) and northern cod (*Gadus morhua*) led the World Conservation Union (IUCN) to add these to its 'Red List' of endangered species[3] (IUCN 2003).

With the traditionally valuable predatory species being depleted, attention is increasingly being shifted to species further down the marine food web such as sardines, herring and anchovies (Pauly *et al.* 1998). Such "fishing down of marine food webs" greatly disrupts the structure of marine ecosystems, simplifying their food webs and consequently robbing the systems of their resilience to environmental variations and further increasing the risk of collapse. This shift in target species has been observed in the most heavily exploited waters from the North Sea to the Patagonian coasts of South America (Pauly and Watson 2003). Similarly fisheries may also change the evolutionary characteristics of populations by selectively removing the larger, fast-growing individuals (Pauly *et al.* 2002).

Furthermore, bottom trawling, dredging and trapping often reduce the ocean bottom to a hard substrate and simplify the topography of ocean floors (Hilborn *et al.* 2003). In addition to the

[3] Southern blue fin tuna is listed as 'critically endangered' and Atlantic cod is listed as 'vulnerable.'

diminished productivity of the benthic community, such destruction leads to the degradation or loss of habitat structures and severely impacts the survival of fish species that occupy these habitats (Turner *et al.* 1999).

While the trends of overfishing become increasingly prevalent, evidence is also mounting that fisheries are characterized by a high degree of wastage of resources from the discarding of unwanted catches at sea. Some of the reasons for the discarding include the low value of fish, also other species are unmarketable, and regulations on the volume of catch or size of fish caught (Hilborn *et al.* 2003). It has been estimated that discarded 'by-catch' represents about 30% of the global landings (Alverson *et al.* 1994). Moreover, the overexploitation of traditional fish stocks have led to geographic and depth expansion in fisheries (Pauly *et al.* 2003b). With inshore resources severely depleted, fisheries are increasingly targeting oceanic species further offshore and benthic species in deeper water. Not only are the slow-growing species dominant in these areas easily overexploited, but such expansions are also incurring higher operating costs and increased risks for fishers.

With considerable growth in aquaculture production, many people see this as capable of solving the problems of marine fisheries, by "relieving pressure on marine resources". Although this may be true for the farming of herbivorous species, the current trend toward intensive farming of commercially valuable carnivorous species, which requires a large input of wild fish in the form of feeds, tend to reduce net fish supply rather than adding to it (Naylor *et al.* 2000).

Geographical Map as a New Management Tool

Given the bleak state of the marine fisheries, there is a growing recognition that the management of fisheries must be put in an ecosystem context (Pauly *et al*. 2002). Although the meaning of 'ecosystem-based' management is not entirely clear, an assessment of fisheries in an ecosystem context entails an examination of the features of "places" (Pauly *et al.* 2003a).

Conventional fisheries assessment approaches have generally represented key fisheries variables, e.g., catch, fishing mortality, or biomass, as bivariate time series (Hilborn and Walters 1992). Pauly *et al.* (2003a) contend that although such time series are excellent tools in tracking the variability of fisheries in time, and hence continue to be of enormous scientific value for the insight they produce, they tend to lose track of their variability in space. Accordingly, Pauly *et* *al.* (2003a) propose the transition, in fisheries science, from bivariate time series to geographical maps as major heuristic devices.

Powerful, PC-based Geographic Information Systems (GIS) are proving to be an effective tool in examining spatial data. GIS can be used to collate, archive, display, analyze and model spatial and temporal data and has been successfully applied, in conjunction with the Remote Sensing (RS) technology, in assessing the spatial patterns of regional fisheries such as the East China Sea fisheries (Du 2003), or the cephalopod fisheries in the eastern Mediterranean (Valavanis *et al.* 2002). However, due to their reliance on the input of RS-based data, such assessments have been limited to relatively short (and recent) time scales.

The use of geographical maps can also be beneficial in reaching new audiences (Pauly *et al.* 2003a). Increasing public awareness of the unsustainable state of fisheries, promoted by conservation-oriented non-governmental organizations (NGO), has made it necessary for fisheries researchers to communicate with the public in addition to their traditional audiences, namely policy makers, politicians and industry representatives. As such, geographical maps are proving to be a useful means of educating wider audiences. Visual displays presented in an intuitive fashion convey far more information than text that is read or heard.

Spatial Disaggregation Analysis

The scope of fisheries science has traditionally been defined by the scale of the fisheries studied (Pauly and Pitcher 2000), ranging from a few square kilometres, such as an artisanal beach seine fishery, to thousands of square kilometers, such as a high seas fishery. Because fisheries research is generally driven by government (-funded) agencies, most of this research has focused on domestic fisheries. Thus basin-level analyses, let alone global scale analyses, have been rare, except for tuna fisheries which cover wide spatial areas and command a high-level of research interest owning to their commercial importance. Yet, in order to fully understand the impact of world fisheries, it is imperative that individual fisheries be examined on both an extended temporal scale (Pauly 1995) and on a global scale.

Historically, one of the most commonly maintained fisheries statistics has been records of fisheries landings. The FAO currently maintains the only global database of fisheries catches, updated annually since 1950. However, this database suffers from several vital shortcomings

(Watson *et al.* 2000). In addition to concerns as to the accuracy of the data (FAO statistics are based on voluntarily submitted data from its member countries), its statistics are beset with the issue of spatial ambiguity. Because spatial precision of fisheries statistics can often lead to the issue of confidentiality (with significant commercial consequences), reporting agencies are often prohibited from releasing fine-scale data in order to prevent individual fishing grounds from being revealed. Moreover, given the high degree of variation in the quality of data between reporting agencies, there is an effective dilution of the spatial precision of high quality data by low quality data. Consequently, the FAO statistics are very vague as to the location of the catch, with landings reported by vast statistical areas averaging more than 19 million square kilometres. There have been calls for the FAO reporting areas to be changed to reflect current fisheries practices (Pontecorvo 1988). However, it is doubtful that such changes would increase the spatial precision of past statistics.

It is evident that spatially vague statistics such as those provided to and by the FAO do not provide an accurate representation of spatial patterns of fisheries exploitation. Thus there is a clear need to improve the spatial precision of existing fisheries statistics. Recently, a method has been developed by the *Sea Around Us* project to disaggregate the existing fisheries statistics into a grid system of fine-scale "spatial cells" (30 minutes latitude by 30 minutes longitude) using a rule-based approach and ancillary data regarding the geographical distribution of taxa[4] included in catch statistics[5], the distribution of the fishing areas to which reporting countries have access, and the geographical extent of reporting areas, all are used to confine the possible location of reported catch (Watson *et al.* 2004).

The most obvious restriction on the possible location of the reported catch is the spatial distribution of the taxa caught, i.e., a catch cannot be made in an area where the taxon in question does not occur. Thus, the *Sea Around Us* project has developed a database of the global distributions of all taxa included in FAO statistics. Information in this database is derived in a variety of ways. Where available, the project utilizes published reports on fish distribution and observation records collected by scientific expeditions[6]. Additionally, distribution ranges such as

[4] Term 'taxa' is used rather than 'species' because commercial fishing records vary widely in their taxonomic precision. Not all records are described at the level of species, some are defined at the level of genera, families or higher.
[5] Available on-line at www.seaaroundus.org/distribution/search.aspx.
[6] Observation records are documented in an on-line database called FishBase (Froese and Pauly 2000, www.fishbase.org).

water depth (for demersal species) and latitudinal limits, as well as limitations based on proximity to critical habitats such as coral reefs, mangrove, seagrass, seamounts and estuaries are used. The taxa distribution database is not a simple presence/absence database but rather a density gradient based on triangular distribution defined by the distributional limits listed above. It is therefore assumed that areas on the fringe of distributional limits support less dense population and hence generate lower catch than near the centre of the distributional limits.

The second restriction utilized in the spatial disaggregation analysis is the areas where reporting countries are allowed or known to fish. Proclamation of sovereignty rights over marine areas, such as the declaration of territorial seas and more recently the 200-nautical mile EEZ, have made it necessary for fishing nations to negotiate access to the coastal waters of other countries. Thus, by examining fishing access agreements, one can infer where countries are fishing. However, documentation of fishing access is a challenging area of research. Fishing access agreements, whether they are inter-governmental agreements or private arrangements between companies and countries, tend to be viewed as commercial agreements and thus their contents are often considered confidential. What little could be gathered on such agreements has been, however, complied in a database[7].

Another manner in which the *Sea Around Us* project determines a given country's fishing access is via documentated observations of fishing operations. Prior to the proclamations of extended fisheries jurisdictions, countries did not require negotiation of access to the waters of maritime countries except for a narrow band of territorial waters, which are traditionally 'off-limits.' Thus in the pre-EEZ era, records of fishing access agreements were not accurate indicators of fishing access. Instead, the *Sea Around Us* project uses documented observations of one country's fishing activity in another country's coastal water as if they were the results of bilateral agreements.

Using the fishing access databases discussed above and the spatial extent of the reporting areas utilized by FAO for its statistic, the spatial disaggregation analysis thus assigns landing reported as spatially ambiguous statistics to those fine scale (1/2 degrees latitude and longitude) spatial cells that are (1) within the range of the taxa distribution, (2) in areas where the reporting country

[7] Agreement and observation records are included as a part of the country-specific information available online at www.seaaroundus.org/eez/eez.aspx.

is allowed or known to fish, and (3) within the original FAO reporting area. This way, the analysis can project the most probable distribution of the reported landings at a spatial resolution much finer than the input statistics. It should be noted that, because taxa distribution is defined as a density gradient, the reported landings are not disaggregated equally among the possible spatial cells but rather are allocated proportionately to a density gradient.

Analyses in which the FAO statistics were augmented by various regional and national data sets (Watson *et al.* 2004), has facilitated the use of spatial ecological models such as Ecospace (Walters *et al.* 1998) and has provided new insight into the state of world fisheries, including the global fisheries decline previously masked by systematic over-reporting by China (Watson and Pauly 2001) and basin-scale declines in the biomass of predatory fishes (Christensen *et al.* 2003) as discussed above.

The study undertaken here contributed to the improvement of the access database through an extensive review of various government publications and fisheries almanacs in documenting fishing access agreements involving Japan (Appendix A).

Chapter 2. Japan's Fish Consumption, Production and Trade Trends

Trends in Japanese Fish Consumption, Production[8] and Trade

Fish consumption

As an island nation, Japan has historically looked to the sea to supplement the limited food supply derived from its small agricultural land area. The Japanese diet has traditionally relied mainly on rice for calories and on seafood for animal protein. Japan's per capita fish consumption has consistently ranked among the highest in the world. The latest estimate for Japanese per capita fish consumption is 69.1 kg/year (as of 2001), far exceeding that of the world average, 16.0 kg/year, or 13.6 kg/year excluding China[9] (FAO 2002).

Figure 2-1 illustrates the fish consumption trends in post-World War II Japan. Japan's consumption of fish has experienced a steady increase since the 1960s, reaching 13.5 million t in 1988. However, total fish consumption has somewhat lessened since, with the most recent estimate at 11.3 million t in 2001. The trend in fish consumption can be classified into three distinct periods. Through the 1950s and 1960s, the increase in the total fish consumption reflected the growth in the per capita consumption, amplified by the population increase. In 1970s, however, per capita consumption levelled off; thus, the increase in total fish consumption was sustained only through population increase. As the population increase lessened in the mid 1980s, the growth in the total fish consumption stagnated, with the fluctuation in total consumption driven by fluctuations in per capita consumption.

Although the Japanese population continues to consume a high volume of fish, the increasing consumption of beef and other meats over the last half a century, owing to the popularity of the North American-style diet, has diminished the role of fish in the Japanese diet. In 1960, fish consumption accounted for approximately two-third of total animal protein intakes; yet by 1970, fish accounted for less than half. Currently, fish consumption only account for 39% of total animal protein intake (MAFF 2003). However, recent surveys on food consumption observed a surging popularity of sushi among younger age groups, and a shift in diet preference from meat-oriented diet to fish-oriented diet among those age 40 and older (MAFF 1999).

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[8] The term 'production' is used to denote both marine and freshwater fisheries landings and aquaculture production.

[9] Because of the increasing indications that fisheries statistics for China may be overestimated (Watson and Pauly 2001), China is nowadays often discussed separately from the rest of the world.

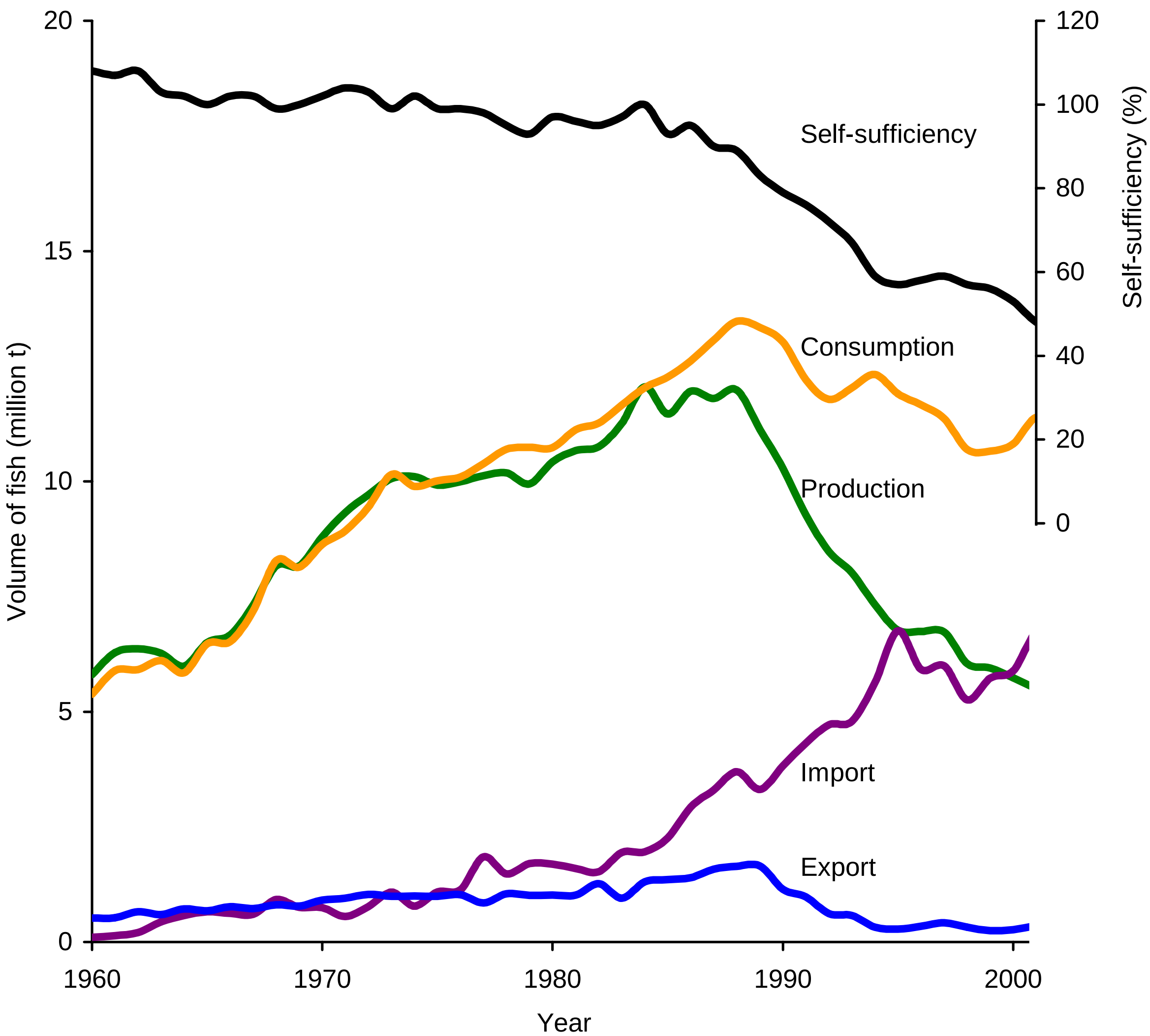


Figure 2-1 Japanese fish consumption, production and trade trends, 1960-2002 (based on the food balance sheet produced by MAFF).

Fisheries production

Japanese fish production consist of marine and inland water fisheries catches and aquaculture production. The marine fisheries are by far the most significant contributors to domestic fish production accounting for more than 90% of the total on average (Taha 1996). Japan recorded marine landings of 2.3 million t at the end of the Second World War (1945), significantly lower than the pre-war record of 4.3 million t. However, marine landings had recovered by 1952, exceeding the pre-war levels. Landings showed a steady increase from 1945 to 1973, levelling off through the late 1970s, only to increase again, recording a peak of 11.3 million t in 1984. Following the collapse of the Pacific pilchard (*Sardinops melanostictus*) fisheries, which had accounted for over 40% of the total marine landings between 1986 to 1990, by 2000 marine landings declined to about half of their peak, i.e., 5.7 million t. The decline of the Pacific pilchard fishery[10] marked the beginning of the end for Japan as the world's leading fishing nation. According to FAO statistics, in 1989, for the first time since 1950, Japanese landings were surpassed by those of the then Soviet Union (FAO 2003). As of 2000, Japan ranked third in marine landings, behind China and Peru (FAO 2002), though the former country, as stated earlier, may have over-reported its catches (Watson and Pauly 2001).

The marine fisheries in Japan are classified into three categories: coastal, offshore and distant-water fisheries. The coastal fisheries operate in coastal waters off Japan and use boats less than 10 gross registered tons (GRT). The offshore fisheries are carried out in waters beyond coastal waters but within Japan's EEZ and the EEZ of neighbouring countries, i.e., China, South Korea and Russia, using boats of more than 10 GRT but mainly around 100 GRT. The distant water fisheries operate in high seas and foreign EEZs using boats of 200 GRT or above[11] (AAFS 2000).

From 1956 until 1973, the fastest growing share of the total catch came from the distant water fisheries, owing to the rapidly increasing number of distant water trawlers, especially in the North Pacific Ocean. Favourable conditions such as vast high seas areas with no restrictions on fishing access, the availability of inexpensive fuel and the continued increase in the price of fish encouraged investment into the distant water fleets (MAFF 1993). Moreover, the depletion of Japan's coastal resources and the failure of coastal fisheries to meet the growing demand for high-valued demersal species further promoted the expansion of the distant water fisheries. In 1973, landings of the distant water fisheries reached their peak at 4 million t (41% of total marine landings), exceeding both offshore and coastal fisheries. Approximately 90% of their fishing grounds were in the coastal waters of foreign countries (Morikawa 1993).

[10] The abundance of Pacific pilchard is believed to undergo 'regime' shift between periods of high and low abundance in relation with global-scale climatic variation such as an El Niño-Southern Oscillation (ENSO) events (Wada and Jacobson 1998) While landings, where at their peak, Pacific pilchard was the species with the third largest catches in the world; surpassed only by Alaska pollock and Peruvian anchovy.

[11] Officially, distant water fisheries are classified as (a) distant water trawlers; (b) East China Sea trawlers; (c) distant water tuna and skipjack purse seiners operating in the central Pacific and Indian Ocean; (d) North Pacific bottom longliners and gill netters; (e) distant water tuna longliners; (f) distant water skipjack pole-and-liners; (g) distant water squid jiggers; and (h) other longliners including Atlantic longliners and those in joint venture/partnership with Russia (AAFS 2000)

In 1973, however, the operation of Japanese distant water fleets was impacted by the increase in the price of fuel and a few years later by the proclamation of extended fisheries jurisdictions around most of the world's coastal nations. Consequently, the distant water catch greatly diminished. By 1978, the first year after the declaration of EEZ by the United States and the Soviet Union, distant water landings were reduced to 2 million t. In 2001, landings by the distant water fleets declined to 820,000 t. Today, the operation of Japan's distant water fleets is sustained through exploitation of high sea resources and their active participation in fishing access negotiations. Due to the rising cost of fishing operations, the Japanese distant water fisheries now target primarily highly valued, large oceanic species, i.e., tunas.

Except for a brief period in the early 1970s, when the distant water fisheries were thriving, the offshore fisheries have always tended to be the most important fisheries in Japan (at least in terms of landed volume). These fisheries generally target small pelagic and demersal species in the Northwest Pacific. Following the increase of the price of fuel in the 1970s, many trawlers limited their operation from high seas to offshore waters to reduce their fuel consumption. This factor and the high abundance of mackerel and Pacific pilchard in the 1980s propelled the offshore fisheries to a decade of record landings (7 million t in 1984). However since the collapse of the Pacific pilchard fishery, the landings of offshore fisheries declined to 3.3 million t in 2001.

Unlike the other fisheries, the coastal fisheries of Japan do not experience significant fluctuations in their catch, which now fluctuate at around 2 million t. Despite their relatively low volume, coastal fisheries play an important role in Japan's fisheries sector as their catch consists mainly of high-valued species such as porgies (Family Sparidae) and amberjack (*Seriola quinqueradiata*). Although Japan's coastal resources were severely depleted in the early 1950s and were impacted by land-based pollution in the 1960s, a number of stock recovery programmes have been implemented by the Japanese government in recent years, with some success. One example is the management of the sailfin sandfish (*Arctoscopus japonicus*) fisheries in Akita, which compensated, to an extent, for the decline in the distant water and offshore catches (MAFF 2000).

International trade

Until the early 1970s, Japan was a net supplier of fish products to the international market with approximately 10% of its domestic production exported. As recently as 1976, Japan ranked as top of the world's countries in export value and fourth in export volume (MAFF 2004). Targeting markets in Europe and North America, Japan actively engaged in the production of canned salmon, tuna and crabs, frozen tuna fillets and fish paste products in the 1950s and 1960s. However, in recent years, Japan's export have greatly declined (in 2001, Japan's share of global fish exports plummeted to less than 4% and 5% in terms of value and volume respectively), and its primary market has shifted to the trade of low grade frozen fish destined for processing plants in developing countries (MAFF 2000). Interestingly, throughout the 1970s and 1980s, Japan's fish exports remained relatively constant at around 1 million t. Therefore, Japan's decline as a leading fishery exporter did not initially occur as a result of reduced exports but rather from its inability to keep pace with a growing international trade (Sproul 1992). However, following the collapse of the Pacific pilchard fishery, total export volume did diminish.

Following the Second World War, Japan instituted strict import quotas until 1961, when quotas for most major fish products including tuna, salmon and shrimps were abolished (Hasegawa 1993). Since 1960, fish import experienced steady increases, and by the late 1970s, the balance of fish trade became negative for the first time, transforming Japan into a net importer of fish products (Figure 2-1). Imports continued to increase through the 1980s and 1990s, and although they experienced some fluctuation in the late 1990s, total fish imports were in 2001 more than ten times larger than fish exports, i.e., 3.8 million t vs. 310,000 t (in product weight) respectively, whilst the number of Japan's trading partners has increased steadily (Table 2-1). Japan is currently the world's largest market for fish products, both in volume (in product weight) and value, i.e., 14% and 23%, respectively, of world's share in 2001 (FAO 2003).

The increase in fish imports appeared to be correlated with the strengthening value of the Japanese yen (Taya 1991, cited in Sproul 1992). In the wake of the signing of the Plaza Accord[12], the yen, which initially fluctuated between 200 and 250:1 against the US dollar in the early 1980s, appreciated to a 125:1 by 1987 and then further to a peak of 84:1 by April 1995.

[12] An agreement reached in 1985 by the G5 members (France, Germany, Japan, US and UK) to drive down the price of the US dollar. The coordinated efforts by these countries resulted in a 30% decline in the US dollar over the next two years.

Table 2-1 Number of Japan's international fish trade partners (countries) by continent (1950-2000; based on data from the Ministry of Finance trade statistics).

	Africa	Asia	Europe	North America	Oceania	Latin America & Caribbean	Total
1950	-	3	2	1	-	-	6
1960	-	4	6	2	1	-	13
1970	16	24	14	11	6	6	77
1980	16	22	15	8	10	11	82
1990	25	25	19	14	17	11	111
2000	25	28	23	14	15	10	115

Clearly, the strengthening yen increased the buying power of Japan on the international fish market, as reflected by the sharp increase in imports from 1985 to 1990.

Given its decreasing domestic production, Japan is increasingly dependent on supplies from foreign countries. Import volume (in live weight equivalent) first equalled domestic production in 1995, and although a few years of fluctuations followed, the supplies from international trade now surpass domestic production (Figure 2-1). Consequently, Japan now finds itself in a position of vulnerability, as it lacks self-sufficiency in fish (Le Sann 1998).

History of Japanese Fisheries

Pre-Second World War Era

Japan was already an important fishing nation prior to the Second World War. The rapid modernization of Japanese fishing fleets through motorization, and the utilization of more durable fishing gear in the early twentieth century resulted in the development of offshore and distant water fisheries, including industrial bottom and midwater trawls, tuna longlines, skipjack pole-and-line and purse seine fisheries (Takayama 1998). The Sino-Japan War (1894-95), Russo-Japan War (1904-05) and the First World War (1914-1918) expanded Japan's overseas territories and interests over the Pacific from the Bering Sea to the South China Sea and to the South Pacific. Not only did such an expansion create greater fishing opportunities for its distant water fleets, but also the economic boom following the First World War generated a sizeable demand for fish products. Furthermore, canned salmon and crabs took on an increasing role as valuable export commodities. In 1936, Japanese fisheries recorded its pre-WWII high of 3.8 million t of landed fish (MAFF and AAFS 1979). Given that world fisheries landings in the pre-WWII era

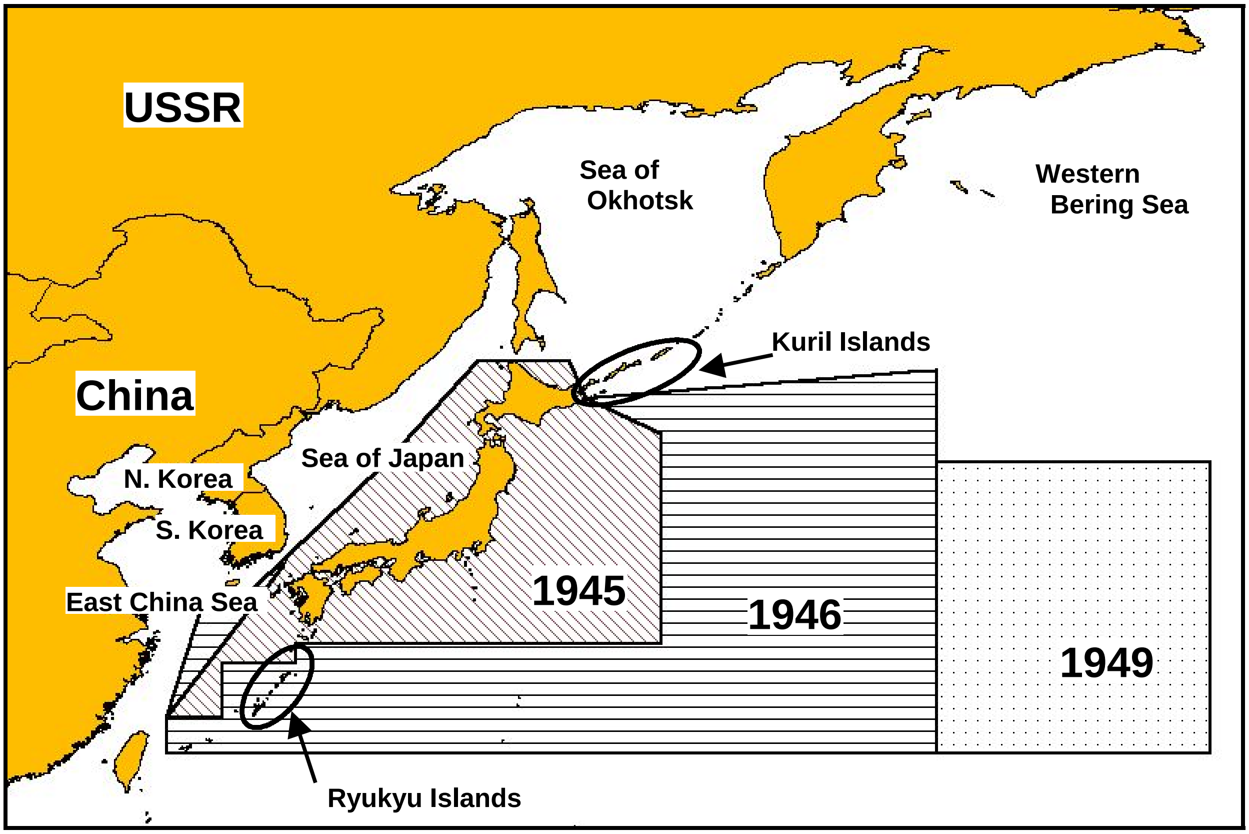


Figure 2-2 Map of the Northwest Pacific and MacArthur Lines; 1946 and 1949 refer to extensions of the original (1945) line; this system was abolished in early 1952.

were estimated at around 10 million t (Sarhage and Lundbeck 1992), Japanese fleets accounted for nearly 40% of the world catch.

Impact of the Second World War and revival of Japanese fisheries under GHQ/SCAP

The effects of the Second World War on Japanese fisheries were devastating. Allied bombing of the Japanese mainland led to widespread destruction of port facilities, and Japanese vessels were requisitioned by the military and converted to mine sweepers (trawlers) and transports and supply vessels ('motherships'[13]). Japan also experienced a severe shortage of the resources required for effective fishing, e.g., fuels and gears. Japanese fisheries ceased to operate following Japan's unconditional surrender in August of 1945, when a total ban on navigation by all Japanese vessels was imposed (Konuma 1998). At that time, Japan had lost all of its motherships, 72% of its trawlers and half of its tuna fleet (Konuma 1998). Furthermore, Japan

[13] The 'mothership' fleets consisted of large factory vessels capable of onboard processing. These motherships did not participate in the catching of fish, but processed the catches of scores of affiliated trawlers.

was stripped of all overseas territories, as well as the Ryukyu Islands (to USA) and the Northern (or Kuril) Islands (to the USSR), resulting in an enormous loss of fishing grounds (Figure 2-2).

Following its surrender, Japan came under the occupation of the US-dominated allied forces, the General Headquarters under the authority of the Supreme Commander of Allied Power (GHQ/SCAP), headed by General Douglas MacArthur, which instituted sweeping political, social and economic reforms in an effort to democratize Japan. GHQ/SCAP targeted the fishing industry as an area crucial to revitalization, since it would provide an important source of animal protein for a country facing an impending food shortage. Moreover, the recovery of Japan's fishing industry would relieve the United States of burdensome aid expenses and would allow Japan to use fish products for export in order to meet its financial reparations to the allied countries (Iwasaki 1997). The rebuilding of fisheries-related industries such as ironworks and shipbuilding would also stimulate the recovery of Japan's economy (Smith 2003). In 1946, GHQ/SCAP authorized the construction of 795 steel fishing vessels and by 1949 Japan fishing capacity had exceeded its pre-WWII levels (Morita 1998). A key element in the rebuilding was the availability of cheap labour: in the post-war years an influx of the urban population to rural fishing communities occurred, largely due to the destruction of cities, the collapse of city-based military-related industries and the return of civilians and military personnel from overseas territories. This created an increased rural population, whose members could participate in the fisheries (Iwasaki 1997).

Although Japan did implement a considerable programme of rebuilding under the GHQ/SCAP occupation, there were nonetheless limitations to its success. Although GHQ/SCAP immediately lifted the navigation bans on Japanese vessels in September of 1945, their operations were initially restricted to coastal waters within 12 nautical miles from Japan's shorelines. Two weeks following the reopening of its coastal fisheries, GHQ/SCAP authorized the operation of Japanese offshore and distant water fleets within the narrowly defined area of approximately 630,000 square nautical miles known as the MacArthur Line (Figure 2-2). Consequently, Japanese fisheries operated in only 40% of the areas to which they had access in the pre-WWII period (Morita 1998). Whilst there were expansions both to the east and to the south in 1946 and 1949 respectively, which significantly helped the distant water tuna fisheries, expansion to the East China Sea and Bering Sea, which had earlier been important fishing grounds for its trawl fisheries, was still restricted.

Expansion of distant water fisheries

The geographical expansion of Japanese fisheries began in 1952 when Japan regained its sovereignty, and all fisheries restrictions imposed by GHQ/SCAP, including the MacArthur Line, were lifted. By this time, it became evident that the rapid revival of Japan's fishing capacity, together with the severe restrictions on its operation imposed under the GHQ/SCAP occupation had led to overcapacity within the restricted fishing area, which had led to the depletion of the local resources (Iwasaki 1997). In an effort to alleviate the excess fishing pressure on Japan's coastal resources, the Japanese government in 1954 implemented a policy of fleet relocation under the slogan "*from coastal to offshore, offshore to distant water*" (Nakajima 1998). This 5-year programme relocated offshore vessels to distant water fishing grounds and removed the excess fishing capacity of the coastal fisheries by relocating it offshore. The programme's main concern was the conversion of coastal bottom trawlers, which were frequently in conflict with other coastal fisheries, into newly revived salmon mothership fleets in the North Pacific and distant tuna fleets, which had begun to expand into the East Pacific and Indian Oceans.

Favourable conditions also existed during this period that assisted the expansion of distant water fisheries (MAFF 2000). First, fuel prices were low: the increase in vessel size and gear mechanization, in addition to an expansion of fishing grounds and an extended travel distance to fishing grounds, resulted in increased fuel consumption, thus the availability of a cheap and abundant fuel supply was of critical importance in order for such expansion to be economically viable (Iwasaki 1997). Second, the availability of many unexploited fisheries resources in high seas provided opportunities for expansion. World fisheries through the 1950s and 1960s operated in the 'framework of freedom of high seas', characterized by open and free access beyond narrow territorial seas, generally defined as up to 3 nautical miles from coastlines. Under this international regime, fisheries were able to operate along the productive waters of a country's continental shelf without any restrictions from coastal countries. Lastly, the significant economic growth experienced in Japan (between 1960 to 1969, the Japanese gross national products increased by an average of 11.4% per year) led to a growing domestic demand for fish products. Subsequently, despite the growing supply from expanding fisheries, the prices of fish products continued to increase. Moreover, with the development of processing and preservation technologies, in particular the frozen surimi production and ultra-low (-60^{o}C) refrigeration respectively, new opportunities for domestic fish consumption were created.

At the onset of their expansion, Japanese fisheries were predominantly export-oriented, targeting markets in North America and Europe. From 1952 to 1961, Japan's total fish exports increased 3.5 fold; in particular, the export of canned tuna and frozen tuna increased 3.9 fold and 5.4 fold respectively (Iwasaki 1997). Moreover, the export of canned salmon grew considerably following the revival of the North Pacific salmon fisheries. The reliance on export markets allowed the Japanese distant water fisheries to undergo significant expansion in their landings, whilst the domestic market for their catch developed at a slower rate. Additionally, these fisheries were seen as important generators of foreign currency for the Japanese economy, which was still recovering from a post-war depression.

The expansion of the salmon fishery spearheaded the development of distant water fisheries during the post-GHQ era. Three fleets were dispatched immediately following the abolition of the MacArthur Line. Within two years the fishery had expanded to 7 fleets and by 1956 had reached 16 fleets, with 500 affiliated catcher vessels (Nakajima 1998). The United States and the Soviet Union were concerned about the impact of this expanding fishery on salmon bound for the rivers in their territories. As a consequence, Japanese salmon fisheries in the North Pacific were forced to operate under two distinct international management frameworks. One was the International Convention for the High Seas Fisheries of the North Pacific Ocean (INPFC), as ratified by Japan, Canada and the United States. The other was the Convention Concerning the High Seas Fisheries of the North West Pacific Ocean between Japan and the Soviet Union (Japan-Soviet Agreement). These two conventions effectively divided the Pacific Ocean into two zones along 175^{o} W longitude line for the conservation and management of salmon resources. Both conventions had the clear objective of drastically restricting Japanese salmon fisheries in the region, with the Japanese salmon fleets prohibited from operating in the eastern region (Hiyashi, 1991).

Despite the restrictions salmon catches reached over 163,000 t in 1955. Although salmon landings did not again reach this level, they did however maintain a consistent level through the 1960s between 90,000 and 110,000 t (Nakajima 1998).

Another fishery that played an important role in the initial expansion of Japanese distant water fisheries was tuna longlining. Tuna longline fleets, by their nature, operate in the high seas, thus allowing for practically no restrictions on their operations. This factor meant that considerable investments by Japan could be made in the 1950s, in particular as a part of its fleet relocation strategy for coastal and offshore vessels. The landings recorded by the tuna longline fishery experienced a 3.9 fold increase in the ten years subsequent to the initiation of the expansion. Its fishing grounds also expanded from the South Pacific to the Indian Ocean during this period, and by 1959 had expanded even further into the Atlantic (Iwasaki *et al*. 1998).

Prior to the introduction of cryogenic techniques for the onboard freezing of catch distant water tuna, its fleets were unable to preserve the high quality of the fish on their long trip back to Japan. Therefore, rather than operating out of Japanese ports, the fleets established numerous base ports near their distant fishing grounds (Bergin and Haward 1995). For example, in the South Pacific, bases were established in Samoa (1955), Vanuatu (1957), and Fiji (1964). In the Indian Ocean bases were set up in Penang, Malaysia (1960). As well, a base was set up in St Maarten (1960) for operations in the central Atlantic. Additionally, fleets operating in the Atlantic regularly landed their catch directly in the ports in Europe (Italy, Yugoslavia and France) and central South America (Panama, Trinidad and Brazil) (Suisansha 1961).

With the advent of deep freeze technology, these fleets gained the ability to maintain the quality of their catch and thus meet the growing domestic demand for sashimi-grade tuna. At the same time, these fleets were facing increased competition from emerging South Korean and Taiwanese tuna fleets. Ironically Japan had supported the development of longline fisheries in both South Korea and Taiwan by selling its old vessels and providing finances (Howard and Bergin, 2001). As a consequence of increasing domestic demand and local competition, Japan withdrew from its foreign bases, which had supplied foreign cannery markets, and instead, by the late 1960s, operated predominantly out of Japanese ports to supply the domestic sashimi markets. Accordingly Japanese tuna longline landings shrank to half their size from 1963 to 1973. Yet due to the transition to the more lucrative sashimi market, the value of the catch more than doubled over the same period (Iwasaki 1997).

Although salmon and tuna longline fisheries were undoubtedly the leaders in terms of the development of Japanese distant water fish fleets in the 1950s, the area of the fastest growth in the 1960s was the trawl fisheries, in particular the North Pacific groundfish fishery, which began its development in 1954. The lack of a management framework within INPFC and the Japan-Soviet Agreement provided an opportunity for unregulated growth of the groundfish fishery in the North Pacific (Iwasaki 1997). The fleet size increased from two mothership fleets in 1954 to 33 fleets, with a total of 377 affiliated trawlers in 1961. These fleets consisted of frozen fillet processors and fishmeal processors as their motherships, with flounder (*Paralichthys olivaceus*) as the primary target; in 1961, for example flounder accounted for three-quarters of the fishery's catch (Nakajima 1998). Under such a rapid increase of effort, the flounders stock was quickly depleted. Consequently, the primary target of the groundfish fishery shifted to Alaska pollock (*Theragra chalcogramma*). This transition was further encouraged by the development of onboard surimi technology, which relied on Alaska pollock as its main input (Iwasaki 1997). By 1970, the groundfish fishery in the North Pacific recorded total landings of over one million t, of which 86% was Alaska pollock. Onboard surimi production by these fleets that same year accounted for 56% of all domestic surimi production (Suisansha 1971).

The 1960s also saw the expansion of trawl fisheries beyond the North Pacific. Following the abolition of the fishing ban imposed by GHQ, there was significant overexploitation of traditional distant water fishing grounds in the East China Sea, Yellow Sea and South China Sea. As a consequence, Japanese trawl fisheries began exploratory operations beyond these grounds, i.e., the South Pacific off Australia and New Zealand, and off the coast of West Africa. This expansion was further encouraged by the high uncertainty of the future of the North Pacific salmon fisheries, which were being increasingly restricted under the Japan-Soviet Agreement (Iwasaki 1997). Trawling in West Africa was conducted primarily off the coast of the Spanish Sahara and Mauritania (Suisansha 1961). Despite the great distance from Japan, the high catch of valuable demersal species, such as porgies and hakes, as well as cuttlefish and octopus, made fleet operations in this area commercially viable. These fisheries were so profitable that even after the proclamation of 12 nautical mile territorial seas by Mauritania, private negotiations were arranged by the Japanese vessel owners to continue operations in Mauritanian waters, in exchange for financial compensation. By the 1970s, trawling had also expanded throughout the west coast of Africa from the Spanish Sahara to South Africa (Suisansha 1971).

Japanese trawlers also participated in shrimp fisheries along the Atlantic Coast of the South American countries of Colombia, Guyana, Surinam and Brazil. By 1973, over a hundred vessels operated in the region and significant investments were made by the Japanese fleet operators who developed the necessary infrastructure in the local ports of these countries (Iwasaki 1997).

Fisheries diplomacy in pre-EEZ era

Although Japan underwent enormous expansion in the pre-EEZ era, development did not occur without increasing international pressure to restrict Japan's fisheries operations. Prior to the transfer of sovereignty to Japan in 1952 and the abolition of fishing restrictions, considerable apprehension existed on the part of South Korea and Australia, among others, regarding the revival of Japanese distant water fleets, mostly arising from the poor reputation of Japanese fishers in the pre-war period (Smith 2003). As a result, the San Francisco Peace Treaty, which officially transferred sovereignty to Japan, included an article that required Japan to "enter promptly into negotiations with Allied Powers so desiring for the conclusion of bilateral and multilateral agreements providing for the regulation or limitation of fishing and the conservation and development of fisheries of the high seas". Although Japan's official position was to defend the principle of "freedom of the high seas" (i.e., avoiding any restrictions on fishing activities), this article obligated Japan to enter into negotiations with other coastal countries.

Prior to the ratification of the San Francisco Peace Treaty, Japan, the United States and Canada began the negotiations that led to the INPFC, in an effort to establish a precedent for the high seas agreements. The United States and Canada were concerned about possible impact of Japanese fisheries on salmon bound for North American rivers, and thus aimed to restrict Japan's fishing operation in the North Pacific, whilst Japan was adamant that the principle of the high seas be maintained (Hayashi 1991). The requests of the United States and Canada were, however, brought into effect, and the convention adopted an 'abstention principle', which obligated Japan to abstain from participation in the North Pacific salmon fisheries, as well as herring and halibut fisheries, on the basis that these fisheries were already fully developed, and Japanese participation would only lead to overexploitation. Although abstention was technically voluntary, and thus the freedom of the high seas as the overriding principle was preserved, this agreement marked the beginning of an international management framework for Japanese fisheries in the high seas (Hayashi 1991).

As already stated, the Soviet Union was concerned about the rapid expansion of Japanese salmon fisheries in the early 1950s. In 1956, in response to this growing fear, the Soviet Union unilaterally issued a decree establishing an arbitrary line, referred to as the Bulganin Line, enclosing the entire Sea of Okhotsk and a vast high seas area to the east of the Kamchatka peninsula and the Kuril Islands. This decree required Soviet permission for fleets to operate within this enclosed area. The declaration had serious implications for the Japanese salmon fisheries which had relied heavily on the waters in the Sea of Okhotsk as their fishing grounds. Immediately subsequent to the decree, Japan approached the Soviet Union and within two months of the decree's proclamation, the Japan-Soviet Agreement was signed. Under the agreement, which was concerned with the management of salmon, as well as herring and crabs, annual catch quotas and area closures were established. Representatives from Japan and the Soviet Union annually re-negotiated these restrictions. Although the quota was generally consistent, areas of prohibition were gradually expanded. By 1961, the entire Sea of Okhotsk, the Sea of Japan north of the 45^{o} N latitude and the western Bering Sea were designated as prohibited areas. This framework lasted until 1977 and was terminated following the proclamation of 200 nautical mile EEZ by the Soviet Union.

There was considerable resentment on the part of South Korea towards Japan as a consequence of the Second World War and the colonization effort that preceded it. This resentment heavily influenced negotiations between the two nations. Prior to the ratification of the San Francisco Peace Treaty, South Korea declared the 'Rhee Line,' which asserted South Korean marine sovereignty over the vast high seas around the Korean peninsula. South Korea proceeded to enforce the Rhee Line against Japanese fishing vessels, resulting in numerous instances of Japanese vessel seizures by South Korea (Kim 2003). Fourteen years of fisheries negotiations followed, frequently interrupted by military coups in the South Korea. In 1964, Japanese and South Korean officials reached the Japan-Korea Agreement. Under this agreement, Japan regained access to waters within the Rhee Line, on the basis that Japanese fleets would not operate within the 12 nautical miles of the South Korean coast, which were deemed the territorial seas of South Korea. A joint regulation zone was established in the area outside of the South Korean territorial seas, and the operation of Japanese fleets was managed through effort restrictions and catch quota regulations (Kim 2003).

The political tension following the Korean War and the absence of diplomatic ties between China and Japan rendered the fisheries relationship between the two countries purely private, i.e., the operation of Japanese fleets off the Chinese coast was negotiated between private fisheries associations. As was the case with Japan's relationship with South Korea, the expansion of Japanese fisheries into the South China Sea was frequently met with hostility, with many Japanese vessels seized by Chinese authorities. In 1955, an agreement was reached, in which numerous no-entry zones were established along the Chinese coast. As this agreement was private, it was very vulnerable to changes in the intergovernmental relationship and was suspended from 1957 to 1963. Following the normalization of diplomatic ties in 1972, this private agreement was upgraded to the status of a formal intergovernmental agreement, with no substantial changes from the version signed in 1955.

The 1960s also witnessed the declaration of extended territorial seas from the conventional 3 nautical miles to 12 nautical miles by numerous coastal countries. In order for Japan's distant water trawl fleets to continue their operation within these productive waters, a series of bilateral agreements were reached. For example, 24 Japanese trawlers agreed to financially compensate the Mauritanian government in exchange for fishing access to its waters. Similar agreements were negotiated with Australia (1968), Mexico (1968), and Indonesia (1968) (Suisansha 1971).

In addition to these bilateral agreements, Japan also participated in numerous multilateral agreements that were established to jointly manage and conserve the resources of the high seas. Japan joined the International Commission for the Conservation of Atlantic Tuna in 1966, the Inter-American Tropical Tuna Commission and the International Commission for Northwest Atlantic Fisheries (and later the Northwest Atlantic Fisheries Organization) in 1970 and the Southeast Atlantic Fisheries Organization in 1971.

Impact of energy crisis and EEZ proclamations

By the early 1970s, the distant water fisheries had become the most important sector in Japanese fisheries in terms of landings. However, from 1973 onwards, major changes occurred which drastically altered the structure of Japanese fisheries.

Political instability in oil-producing regions, namely the October War of 1973 between Israel and Egypt and the Iranian Revolution of 1978, resulted in two pronounced energy crises, with the price of fossil fuels sharply increasing. In Japan, the price of Grade A petroleum used in fishing vessel operations increased 3 fold from 1972 to 1973 and 8 fold from 1972 to 1978 (Iwasaki 1997). For energy intensive industries, such as the large-scale distant water fisheries, these increases in the price of fuel had significant implications for the economic viability of their operation.

The Third United Nations Conference on the Law of the Seas convened during the period of the oil crises. One of the major areas of discussion was the expansion of fishery jurisdictions by coastal countries beyond their territorial seas and the establishment of a 200 nautical mile EEZ. Given the considerable growth of distant water fisheries, there was a corresponding movement by the coastal countries toward official recognition of their sovereignty over adjacent waters. Due to the large number of participating nations in the conference and strong opposition toward official recognition of 200 nautical mile EEZ (of which Japan was the loudest opponent), the conference proceedings were very slow.

In 1977, amidst the long conference process, the dominant coastal countries, namely Canada, the United States, the Soviet Union, and the European Economic Community, declared 200 nautical mile EEZ. A few months later Japan declared its own EEZ. When the conference finally concluded in 1982, the principle of extended fisheries jurisdictions had already become an international norm (Munro 1990). The United Nations Convention on the Law of the Sea (UNCLOS), which resulted from the conference, officially recognized the rights of the coastal state to their offshore fisheries resources within 200-nautical mile EEZ in Article 56, "In the exclusive economic zone, the coastal State has sovereign rights for the purpose of exploring, conserving and managing the natural resources, whether living or non-living…"

The international acceptance of EEZ profoundly altered the relationship between coastal countries and distant water fishing nations. The principal consequence of this new international framework was that fishing access to the productive continental shelf waters, which accounted for over 95% of the world catch (Juda 1991), was now at the discretion of the coastal states. The authority of the coastal countries to impose terms and conditions of fishing access is clearly stated in Article 62 (4) of UNCLOS, which requires nationals of countries fishing in the foreign EEZ to comply with the conservation measures and other terms and conditions established in the laws and regulations of the coastal countries. This meant that in order for Japan to maintain its distant water fisheries, it would have to operate under the framework of fishing access agreements with coastal countries, which commonly entailed the payment of access fees (Juda 1991).

With Japanese fisheries already facing increased operating costs due to the oil crises and access fee payments, a further development adversely affected the Japanese fisheries sector, namely the stagnation of fish prices. Despite the increase in the supply of fish in the 1960s, fish prices in Japan had consistently increased during this decade due to Japan's growing economy, which resulted in an increased demand for fish products. However, the oil crises of the 1970s halted Japan's economic growth, and the emerging popularity of meat consumption caused the domestic fish demand to stagnate (Iwasaki 1997).

Thus, in the late 1970s, the three factors that contributed to Japan's distant water fisheries expansion in the 1960s, i.e., an inexpensive and abundant supply of fuel, vast high seas with limited restrictions on access to productive fishing grounds, and a surging domestic demand for fish, had disappeared. Consequently, the Japanese fisheries sector underwent considerable restructuring. This restructuring was most pronounced in the North Pacific groundfish fisheries. Prior to the advent of the EEZ regime, Japanese fisheries in the region operated predominantly in the waters above the continental shelf of the Bering Sea and the Gulf of Alaska, which were areas mostly encompassed by the 200 nautical mile EEZ of the coastal countries. Following the declaration of the United States EEZ in 1977, the country began to enforce strict catch quota allocations of groundfish resources to foreign fleets operating within its EEZ, with the objective of gradually phasing out all foreign fleets and replacing them with domestic fisheries.

From 1977 to the late 1980s, Japan was able to secure a relatively high level of the catch quota in US waters. This was due to active negotiations by Japanese officials with the US government, and also because of the strained relationship between the United States and the Soviet Union in the wake of the Soviet Union's invasion of Afghanistan in 1979. This invasion caused the United States to reallocate the Soviet Union's catch quota to Japan. In 1981, for example, Japan was allocated a total groundfish quota of 1.4 million t (Iwasaki 1997). However, with the rapid development of US fishing capacity, the United States implemented a 'fish and chips' policy, in which the allocation of quotas to foreign fleets was tied to several criteria that would contribute to the development of US domestic fisheries, including the extent of tariff and non-tariff barriers to US fish and fish products, the extent to which a country buys or imports US fish and fish products, and the extent to which a country contributes to the development of the US fishing industry through programmes such as joint ventures (Mansfield 1999). In order to comply with this United States policy, Japan began the onboard purchase of US Alaska pollock catch for its processor vessels and liberalised its import quota for seafood from the United States, including products made from Alaska pollock. Despite these efforts, the quota allocated to Japanese fleets progressively diminished, and in 1988, the Japanese fleets were completely phased out of US waters.

As Japanese fleets were excluded from the waters of the US EEZ, they began to exploit newly discovered Alaska pollock resources in the central Bering Sea high seas, beyond the 200 nautical mile EEZ. The success of Japan's exploratory fisheries in this high seas area encouraged participation from other distant water fishing nations, such as South Korea, Poland, China and the Soviet Union (Canfield 1993). It is estimated that, by 1988, the total groundfish catch in this high seas region reached 1.5 million t, with 800,000 t by the Japanese fleet alone (Hayashi 1991). Unsurprisingly, the resource was depleted by the early 1990s. In 1994, in an effort to conserve and manage this stock, distant water fishing nations signed and ratified the Convention of the Conservation and Management of Pollock Resources in the Central Bering Sea, in which Japan agreed to abstain from fishing in the Bering high seas, in return for an allocation of pollock quotas in what had just become the Russian EEZ.

The implementation of the 200 nautical mile EEZ also had serious implications for Japanese distant water tuna fisheries. In the pre-EEZ era Japan's tuna fleets operated in the coastal waters of over 50 states in the Pacific and Indian Oceans, South East Asia, Central and South America, and Africa. In order to cope with the extended EEZ, Japan had to negotiate numerous access agreements with coastal states (Appendix A). At the same time, rising fuel costs, higher wage costs and the extended duration of fishing trips had made the continuation of tuna fisheries difficult, and in 1980, the Japanese government instituted a 20% reduction in the number of its distant water tuna longline vessels (Haward and Bergin 2001). The Japanese tuna industry also faced stiffer competition from Korean and Taiwanese fleets, which had begun to target Japan's domestic sashimi market. Many of these problems continued into the 1990s, and in 1998, Japan instituted further reductions in its tuna fleets.

In the 1980s, the Japanese distant water fisheries, in particular, the operation of large-scale pelagic driftnets in the high seas, began to raise concerns among coastal countries and environmental groups (Hayashi 1991). The most widespread concern was over the by-catch of non-targeted species and the subsequent discarding of this by-catch species. Furthermore, serious objections were voiced regarding the loss of the driftnets, which were made of monofilament plastics, and thus would continue to entangle marine organisms for a long time, causing damage to marine ecosystems through 'ghost fishing'. Subsequently, in 1992, a moratorium on large-scale pelagic driftnet fisheries was imposed. This had serious implications for Japan's high seas salmon, squid and tuna fisheries.

Fisheries diplomacy in EEZ era

Under the new international framework Japan's fisheries diplomacy focused on securing continued access to waters which were now encompassed by the countries' EEZs. Iwasaki (1997) identifies four different groups of coastal countries in terms of their fishing access negotiation policy:

i) Countries that allowed Japanese fleets access to their EEZ, only for as long as there was excess quota beyond the capabilities of their domestic fleets. These countries gradually developed their domestic fishing capacity, with a view to phasing out Japanese fisheries. This strategy was common among economically developed countries, with North Pacific groundfish fisheries as an example;

ii) Countries that negotiated bilateral access with Japan, i.e., countries that had fishing interests within Japanese waters. Following the declaration of the EEZ, Japan gained marine sovereignty to the seventh largest EEZ in the world. These Japanese offshore waters were highly productive fishing grounds for small pelagic species, thus countries such as Russia were keen to negotiate access, in exchange for Japan's access to its Far East waters;

iii) Countries that would allow fishing access to Japanese fleets in exchange for financial contributions, including economic aid and licensing fees. Many South Pacific island nations fall into this category. These countries lacked the capital and technological know-how to successfully develop their own national fleet. Therefore some of the financial contributions included investment by Japanese industry into joint venture arrangements with local partners in coastal countries;

iv) Countries that prohibited the participation of distant water fleets within their EEZ, with access to these waters by Japanese fleets achieved solely through joint ventures and vessel chartering arrangements with local partners. South American countries and India fell within this category.

For Japan, securing access to Soviet waters in the wake of the EEZ declaration was of great importance. In 1975, Japan had recorded landings of 1.7 million t within the waters that were later claimed as the Soviet EEZ, and approximately 6,000 vessels, the majority of which independently owned and operated, fished in the region (Morikawa 1993). Japan thus engaged in access negotiations immediately following this EEZ declaration. The negotiations were complex as they involved a territorial dispute about the ownership of the Kuril Islands. The provisional agreement was reached after six months of negotiation. From 1979 to 1983 the countries agreed a catch quota of 750,000 t for Japanese fleets within the Soviet EEZ and 650,000 for Soviet fleets within the Japanese EEZ (Morikawa 1993). Following several years of low catch by the Soviet fleets, in which they failed to achieve their quota, Soviet officials demanded equal quota allocation for both countries. Consequently, from 1986 onwards quotas were drastically reduced to about 200,000 t per country per year. This reduction was particularly difficult for Japan, which had relied heavily on this quota. To maintain its earlier quota, Japan was forced to pay. This framework was sustained following the collapse of the Soviet Union and continues to this day in the form of agreements with Russia.

Japan's declaration of an EEZ in 1977 was designed primarily to improve its negotiating position vis-à-vis the Soviet Union. As a result, Japan did not enforce its marine jurisdiction in the East China Sea and the southern section of the Sea of Japan, where Korean and Chinese vessels operated under their respective fisheries agreements (Kim 2003). However, problems began to arise in the late 1970s, as Korean and Chinese vessels became much more active in the waters off the Japanese coast. Following the ratification of UNCLOS in 1996, there was increasing demand from within Japan and from China and Korea to restructure the international framework of the East China Sea fisheries. As was the case with the Japan-Soviet Agreement, territorial disputes existed between Japan and Korea, and Japan and China, most notably about the Takeshima Islands and the Rokkaku Islands. Agreements were reached with Korea in 1999 and with China in 2000, with the three nations adopting joint management zones in waters surrounding the disputed areas.

In the South Pacific, in addition to financial compensation paid in exchange for fishing access of its tuna fleets, Japan also contributes fisheries development aid (Bergin and Haward 1995). This aid is administered by the Overseas Fisheries Cooperation Foundation and is jointly funded by the Japanese private fisheries sector and the Japanese government on a 25:75 basis. The amount of the aid is substantial, averaging US$20 million per year between 1982 and 1992, compared to the total Japanese access fees for the region in 1992 of around US$14.5 million. While the Japanese government denies that it links aid to fisheries agreements, it does admit that the state of a country's fisheries relationship with Japan could influence the priority of an aid project (Bergin and Haward 1995).

Recently, criticisms of this practice have been voiced, on the premises that coastal countries are not receiving the full economic benefit from their fisheries resources under the current system. Petersen (2003) argues that in order to secure foreign aid, Pacific island nations are granting fishing access to their EEZ for an access fee less than the level paid by the European countries to secure their access in African waters[14]. Petersen suggests that greater benefits may be realised if access fees were increased to a more appropriate level, which would allow the capital generated from access fee payments to be freely utilised, unlike capital from development aid, which is generally constrained by stipulations in the aid package. Another criticism is that because the Japanese government pays 75% of the aid, the grants can be viewed as a subsidy for the Japanese fishing industry (Bergin and Haward 1995). Such subsidies enable distant water fleets to continue operating in the waters that are already depleted, thus further depressing the local benefits that could be generated from the resources (Munro and Sumaila 2002).

Japan's Participation in Foreign Fisheries

With the phasing out of Japanese distant water fisheries from foreign EEZ, the Japanese fishing industry is increasingly participating in foreign-based fisheries as a means of securing continued involvement in the fisheries of foreign waters and a stable supply of fish to the Japanese market. Japan's participation in foreign fisheries can be grouped into several categories (Iwasaki 1997):

i) Formation of joint ventures with local partners, either the government or from the private sector, in the coastal countries. Under these joint venture arrangements,

[14] Note that the European-funded access agreements have also been criticized as offering very low compensation to the coastal countries (Kaczynski and Fluharty 2002).

Japanese fishing vessels are transferred to joint ventures. The crew may include Japanese fishers but are intended to be gradually replaced by local employees through training programmes;

ii) Chartering of Japanese vessels to local partners. Under these arrangements the vessels operate under the Japanese flag, thus the arrangement is in essence the continued operation of Japanese fisheries. This kind of participation is common in Latin America, where direct access by distant water fisheries is prohibited by the government;

iii) Japanese fishing companies do not dispatch their vessels to foreign waters, but rather provide technical and financial assistance to local partners in exchange for exclusive rights to purchase their catch;

iv) Japanese involvement in fisheries related sectors such as storage and processing and aquaculture.

For Japanese fishing companies, cost benefits, including those associated with lower wages and financial incentives provided by host countries, e.g., preferential access to local waters at a cost lower than the access fees charged to other distant water fleets and certain tax concessions (Campbell and Hand 1998), make joint ventures an attractive option. From the host countries' perspective, joint ventures, in principle, facilitate investment of capital, infrastructure and equipment, present opportunities for the transfer of technology and technical skills from Japanese partners, and provide necessary management, marketing, production and organizational skills, as well as potential access to the Japanese market, particularly if there is no domestic market for fisheries resources to be exploited by the joint venture (Greboval 1979).

The number of Japanese joint ventures rapidly increased through the 1970s, particularly following the series of EEZ declarations in the late 1970s, with the total number reaching 215 in 1979 (Figure 2-3). There was a slight decrease in the early 1980s, but the trend is increasing again, due to the development of a favourable investment climate in Russia and China. Interestingly, the number of coastal countries involved in joint ventures is decreasing, probably because they have realised, after a period of trial and error, that the agreement does not bring them the expected benefits (Nakai 1995). The joint venture has also diversified in nature, from

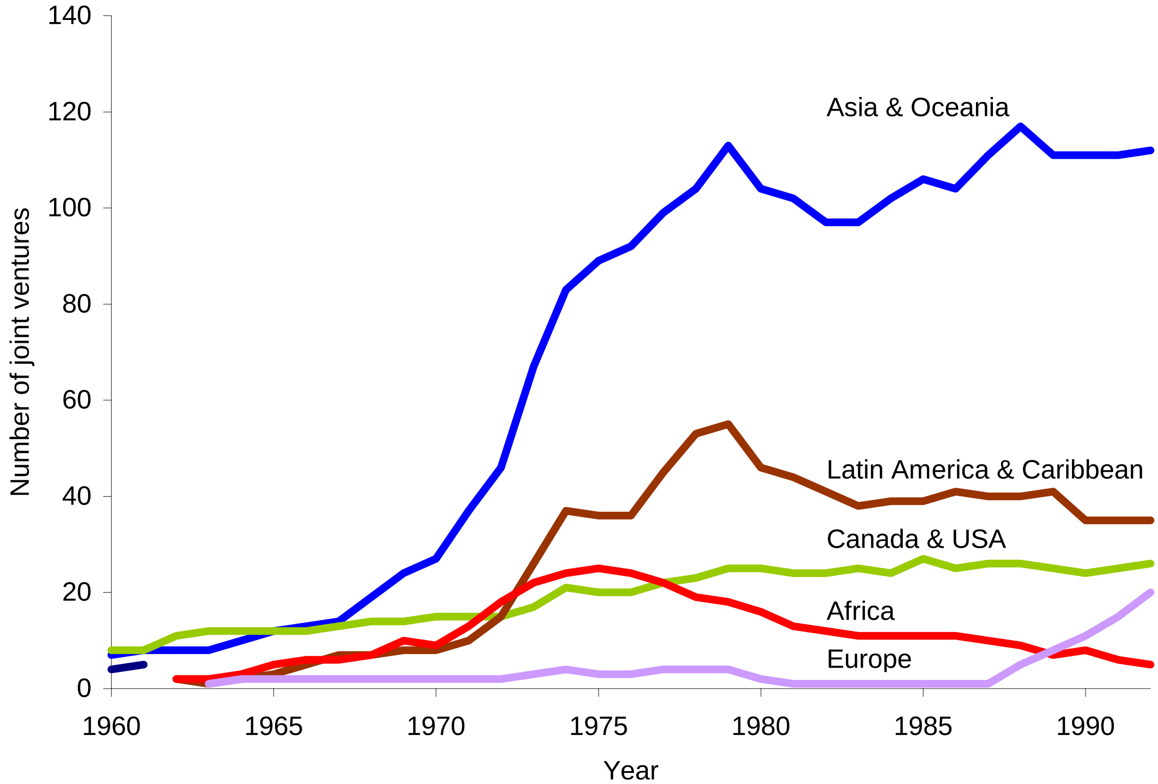


Figure 2-3 Number of fisheries joint ventures involving Japanese partners (based on estimates from Nakai 1995).

focusing solely on the harvesting, it is now concerned with other related sectors, including cold storage and processing sectors.

The majority of joint ventures in Latin America involve trawling, e.g., shrimp trawling along the northern coast of South America. In Asia and Oceania, the most common joint ventures are those involving tuna fisheries, e.g. skipjack pole-and-line fisheries and purse seine fisheries. Few tuna longline joint ventures exist, as such vessels would intensify competition for Japan's distant water tuna longline fisheries; thus they are discouraged by the Japanese government (Nakai 1995). The most popular regions for joint ventures are Asia and Oceania, comprising over half of all joint venture arrangements.

The participants to a joint 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 (Greboval 1979). For the local partner and the government of the host country, the primary concern is the long-term development of the fishery and the generation of associated social and economic benefits. They therefore assume that the joint venture arrangement will provide employment and training opportunities for the local population and the provision of a low cost food supply for the local market. On the other hand, foreign partners, e.g. Japanese investors, are 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, and their objective is simply to minimise cost.

Another concern is that often a joint venture does not have an identity separate from its parent company. In a detailed examination of the joint venture in the Solomon Islands, Meltzoff and LiPuma (1993) found that Japanese managers of the joint venture were loyal to their parent company and not to the joint venture. These managers were dispatched by the parent company, and their future career opportunities were dependent on it. Consequently many of the transactions between the joint venture and its parent company were found to be biased toward the latter. For example, the services rendered by the parent company, such as vessel charter, were cost well above market cost, while the price of the catch is usually set very low. Moreover, in some extreme cases, the local partners involved in joint venture arrangements, are acting entirely on behalf of Japanese firms (Nakai 1995).

Chapter 3. Spatial Disaggregation of Japanese Trade Statistics

Spatial Resolution and Temporal Intervals

The analysis presented in this thesis builds on a disaggregation of trade statistics into spatial units of 30 minutes of latitude and longitude. These units, the 'spatial cells' of Watson *et al.* (2004), were chosen to complement the existing, spatially disaggregated fisheries landings database (see below). This was a necessary compromise if one was to obtain spatial details of the consumption patterns, yet at the same time allow for an analysis of a dataset on a global scale. Over the world's seas and oceans, the selected spatial resolution requires a matrix with approximately 180,000 spatial cells. It should be noted that because these cells are defined by latitude and longitude, and the distance between degrees of longitude varies with latitude, the area of the cells varies from only a few km^2 at the poles to a maximum of about 3000 km^2 at the equator.

Due to the vast amount of trade records that needed to be examined (no electronic database of Japanese trade exists prior to 1989), the analysis was conducted in ten-year intervals for the reporting period from 1950 to 2000. These intervals appear to adequately represent the various stages in the evolution of Japanese fish consumption, and appear sufficient to provide reasonable insights into its trends.

Data Source

Trade statistics

These are trade data from the Report on Trade Statistics (*Boeki tokei*) by the Ministry of Finance Japan (MOF), with import and export volume reported by year, country of origin or destination, and type of commodity. For the years 1990 and 2000, an electronic version of the statistics was downloaded from the Japan Customs' homepage (www.customs.go.jp). The traded commodities for these years (1990 and 2000) were classified under the Harmonized Systems code (HS code), and descriptions for the HS code were obtained from the World Customs Organization (WCO) homepage (www.wcoomd.org/ie/En/en.html) and the Japan Tariff Association (JTASS) homepage (www.kanzei.org). These official statistics were based on trade documents submitted to Japanese customs.

In these statistics, imports are defined as "goods which were carried into Japan as foreign goods" (JETRO 2003). They included items caught by vessels of foreign nationality in the high seas and landed in Japan, and those caught by vessels under the Japanese flag and initially landed in ports of other countries (these catches were recorded as Japan's export) and then brought into Japan. The statistics include all commodities traded at sea (transshipment), but do not account for commodities that enter or leave the country as small packages worth JPY 200,000 (approximately US$1,800) or less, passenger luggage, gifts, equipment for itinerant performances (theatre, concert, circus etc.) or temporary exhibitions (museums, aquariums etc.), cargos destined for the US and UN military personnel stationed in Japan, and obviously, smuggled items.

Only marine fish, crustaceans, molluscs and echinoderms were considered, while the trade of freshwater (e.g. carp and goldfish) and diadromous (e.g. salmon and eel) species as well as miscellaneous marine invertebrates (jellyfish, sponge and coral) and marine mammals was excluded.

Landing data

Spatial disaggregation of the MOF statistics involved the allocation of traded commodities among their exporting country's landings. Therefore, the process required the use of spatially specific landings database. For this study, such data was supplied by the *Sea Around Us* project through the courtesy of Dr. R. Watson.

The landing database of the *Sea Around Us* project was derived from the global landings statistics compiled by the FAO, and at the time of this study, supplemented with regional statistics including STATLANT statistics from International Commission for the Exploration of the Sea (ICES), statistics from Northwest Atlantic Fisheries Organization (NAFO), and national landings statistics from Fisheries and Oceans Canada (DFO). This database was based on the official statistics and did not include catch discarded at sea, but only the part of the catch that was landed and reported to the management agencies. Thus, no corrections were made to account for illegal, unauthorized and unreported (IUU) catches. However, reductions were made to the catch reported by China since 1994, in keeping with the over-reporting biases documented by Watson and Pauly (2001). Unlike its input statistics, which lack taxonomic and spatial precision, the *Sea Around Us* database has been taxonomically disaggregated so that most landings are reported at a 'precise' taxonomic level (species, genus or family) and spatially disaggregated into spatial cells as detailed in Chapter 1.

As was the case for the MOF statistics, the *Sea Around Us* database contained only the landings of marine fish, crustaceans, mollusks and echinoderms. It did not include catches of miscellaneous marine invertebrates (jellyfish, sponge and coral) and marine mammals, nor production from aquaculture and freshwater fisheries.

Data Modification

Commodity type

Prior to spatial disaggregation, some modifications were necessary to strengthen the connectivity between trade statistics and the landing database. Firstly, all commodities were reclassified by their taxonomic identity and by their mode of processing.

Customs personnel often have difficulties in ascertaining the taxonomic identity of some traded commodities; indeed many marine species are hard even for experts to identity. This problem is amplified by the large proportion of traded commodities that are processed (e.g. filleted, canned, etc.) prior to being exported, making their identification even more difficult. Furthermore, commodities' classifications are frequently based on a variety of non-biological characteristics, such as price, handling requirement, and associated trade restrictions (e.g. tariffs, trade quotas), resulting in a hodgepodge of diverse taxonomic groups with the majority of commodities falling under generic "other …" categories, except for highly valuable commodities such as tunas, which are specified to the species level.

In an attempt to mitigate this problem, commodities were reclassified here by their 'taxonomic range,' i.e., all possible identities of the commodity on species, genus and family levels. For any given taxonomic identity, the taxonomic range was defined as all taxa of lower levels belonging to that taxon and all taxa of higher level to which the taxon belong. For example, the taxonomic range of 'albacore: *Thunnus alalunga*' includes all taxa of higher level to which *Thunnus alalunga* belongs, i.e., the Genus *Thunnus*, and the Family Scombridae, whilst the taxonomic range for 'tuna (Genus *Thunnus*)' includes all taxa of lower levels, i.e. *Thunnus alalunga*, *Thunnus albacore*, *Thunnus thunnus*, *Thunnus atlanticus*, *Thunnus maccoyii*, *Thunnus obesus*, *Thunnus orientalis*, and *Thunnus tonggol*, and all taxa of higher level to which the Genus *Thunnus* belonges, i.e., the Family Scombridae. If the taxonomic identity of the commodity was not defined, then its taxonomic range is all fish (or crustaceans, molluscs or echinoderms) families, genera and species while taxonomic ranges for commodities defined as 'other fish (crustaceans, molluscs or echinoderms)' were all fish families, genera and species except those included elsewhere. Such reclassification also allows for various combinations of taxa regardless of their evolutionary relationship (e.g. the taxonomic range of a commodity described as 'herring and cod' is all *Gadus* species, Genus *Gadus*, Family Gadidae, all *Clupea* species, Genus *Clupea* and Family Clupeidae). For the MOF statistics, it is assumed that all taxonomically ambiguous commodities, e.g., 'all fish,' are of marine species, except for those exported by landlocked countries. For older statistics, whose taxonomic identities were described only by their common names, it is assumed that they refer to the same taxa as the common names used in more recent statistics.

The mode of processing was also classified into seven categories: live/fresh/chilled/frozen; fillets and other fish meats; cured; prepared; surimi; fishmeal; and byproducts. Fresh or chilled was described as "kept at a temperature near 0^{o}C without being frozen", frozen as "maintained at a temperature below the freezing point and frozen all the way through", fillets as "fish meat cut parallel to backbone with head, entrails and fins removed" and surimi as "minced fish meat to be used for fish paste products". In addition "fishmeal" here referred to products used for human consumption, as well as those used for agriculture and aquaculture proposes. "Cured" denoted products smoked, dried, salted or in brine, and the term "prepared" referred to the preserved fish listed in Chapter 16 of the HS code or 'canned' and 'bottled' products in older statistics. "Byproducts" were defined as fish roes, liver or fins, extracts (fish oils) and those classified as "fish waste". Such reclassification was necessary to improve estimation of live weight equivalents.

Live weight conversion

In general trade flows are analyzed in terms of value, as a large proportion of the traded commodities have undergone a value-adding process (Ruckes 2000). However, to assess the ecological impact of fish consumption, it is essential that trade be expressed in terms of biomass removed from marine ecosystems (Alder and Watson in review). It was thus necessary to convert the trade statistics, which report volume by their product weight, to an estimate of their live weight equivalent using conversion factors. There are, however, various difficulties when assessing conversion factors, namely the variation in processing methods between countries and between years and variation in species composition and size of export, which potentially alter their conversion rates. Consequently, estimation of conversion factors has become overly complicated and in most cases unrealistic: even the most comprehensive database of conversion factors compiled by FAO recognized that their data were "incomplete and, in some cases, technically dubious" (FAO 2000).

In order to find a workable approach, a series of assumptions needed to be made. Live, fresh, chilled and frozen fish were assigned a conversion factor = 1, assuming that these are un-gutted and un-dressed fish. To eliminate double counting, all byproducts were assigned a conversion factor = 0. For all other commodities, taxa-specific conversion factors from FAO database and other sources (BC Fisheries 2000; Bjorndal and Tveteras 2002) were used. When none were available, the conversion factor was to be estimated from those of similar taxonomic groups. For all commodities for which product types were not specified, a conservative conversion factor = 1 was used. Conversion factors were kept constant for all countries and years.

Considerations for aquaculture production

With a substantial increase in its production over the last two decades, aquaculture has begun to have a major influence on the trade of export-oriented species such as shrimp. As an example, farmed shrimp now compose over 26 percent of total world shrimp production (FAO 2002), and 80 to 95% of farmed production is estimated to be entering the export market (Anderson and Fong 1997). However, the exact extent of international trade in aquaculture products is still difficult to analyse because most trade statistics, including those of Japan, do not distinguish between products of wild and farmed origin (Josupeit *et al.* 2001). This study assumed that the ratio of capture fisheries landings to the aquaculture production of a given country was representative of the market share of wild to farmed products of its export, thus allowing for an estimate of the fraction of the export volume derived from the capture fisheries.

Using the FAO Aquaculture Production database, exporting countries' aquaculture productions were obtained. From this database, ratios of fisheries landings to aquaculture production were calculated for each ISSCAAP group (International Standard Statistical Classification for Aquatic Animals and Plants which divides commercial species into 50 groups on the basis of their taxonomic, ecological and economic characteristics). This procedure was performed only for aquaculture products that were taxonomically specified, i.e., it did not include aquaculture production of "miscellaneous marine fish."

Table 3-1 Variations in country identities used in MOF trade statistics and the landings database of the *Sea Around Us* project.

Year	Country identity in MOF statistics	Country identity in *Sea Around Us* database
1960	Formosa	Taiwan
1960-1970	New Hebrides	Vanuatu
1960-1970	South Vietnam	Vietnam
1960-1990	West Germany	Germany
1970	American Samoa	USA
1970	Ceylon	Sri Lanka
1970	Bismarck Archipelago	Papua New Guinea
1970	Netherlands West Indies	Netherlands Antilles
1970	North Vietnam	Vietnam
1970	Territory of New Guinea	Papua New Guinea
1970	Territory of Papua	Papua New Guinea
1970	Southwest Africa	Namibia
1970-1980	Malayan Federation	Malaysia
1970-1980	Marianas, Marshal and Caroline Islands	Micronesia
1970-1980	Sabah	Malaysia
1970-1980	Sarawak	Malaysia
1970-1990	South Yemen	Yemen
1970-2000	Canary Islands	Spain
1980	Burma	Myanmar

Country classification

Some differences between the *Sea Around Us* landings database and Japanese trade statistics for country identities are of note: FAO catch statistics (from which the *Sea Around Us* database was derived) reported their statistics based upon the current identity of countries, whereas the trade statistics reported their statistics based upon the identity of countries at the time. As a consequence, the landings database showed no distinction between the catches of Japan, Ryukyu (occupied by USA until 1972) and Ogasawara (occupied by USA until 1968). Thus trade between these countries as reported in the trade statistics was treated as domestic transactions and was excluded from the analysis. Additionally, other updates were made to the countries' identity to allow comparison between the landings database and trade statistics (Table 3-1).

Spatial Disaggregation

Assigning trade records to exporting countries' landings

Using modified trade records (in live weight equivalent and corrected for aquaculture production where necessary), a rule-based process was developed to assign trade statistics to a subset of exporting countries' landings within the traded commodities' taxonomical range (Figure 3-1). The following procedures were performed for each trade record, progressively from the most taxonomically specific commodities, i.e., those identified to species level, to the least taxonomically specific commodities, i.e., “all fish, crustaceans or molluscs.”

Landings records for the year and country corresponding to a trade record and for taxa within the taxonomic range of the commodity reported in the record were first extracted from the *Sea Around Us* database. This yielded a subset of the exporting country’s landings that were a potential source 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 was further reduced to the top twenty landed taxa (in volume). If the total volume of the exporting country’s landings within the subset was less than the volume reported to have been exported from that country in the trade record, then the volume reported in the record was assigned to all landings, and the portion exceeding the landings was logged as an ‘error’ (not enough fish!). Otherwise the volume traded was assigned proportionally amongst the subset of the exporting country’s landings. Once the trade volume was assigned to the landings, the portion of the landings assigned was removed from the exporting country’s landings to prevent double counting. In this, it was assumed that a country is likely to export the commodities of fish (or invertebrates) that are most abundant in their landings. In this way, the portions of the foreign landings that were consumed in Japan were accumulated as each record was processed.

There were two potential sources for the allocation errors. The first was the misallocation of taxonomically ambiguous statistics in the landings database. As stated above, the *Sea Around Us* database was derived from input from other global and regional landings databases, which often contained records in highly aggregated taxa (e.g. order, class or ISSCAAP groups). In order to increase the taxonomic and spatial precision of the statistics, the *Sea Around Us* database was subjected to a process of taxonomic disaggregation. It was thus possible that the landings of countries such as North Korea, simply described as ‘miscellaneous marine fish’ in the input data, were disproportionately misallocated. The second potential source of allocation error was the nature of the fish trade in some countries. It has been documented that some countries, such as American Samoa, act as regional fish processing centres. These countries generally import high volumes of unprocessed fish, often exceeding their domestic catch, and export them as processed fish. Additionally, distant water fleets are known to land their catch in local ports, e.g., the landing of Japanese tuna in Guam, and then air freight the catch to international markets. In both cases, the exporting country reported in the trade statistics was not the country that reported the catch. Thus, their domestic landings may not be sufficient to account for the reported export. Ideally, one would examine the trade records of each exporting country to trace the traded commodities back to their origin, but the majority of such countries were developing countries, which do not maintain such records or do not make them publicly available.

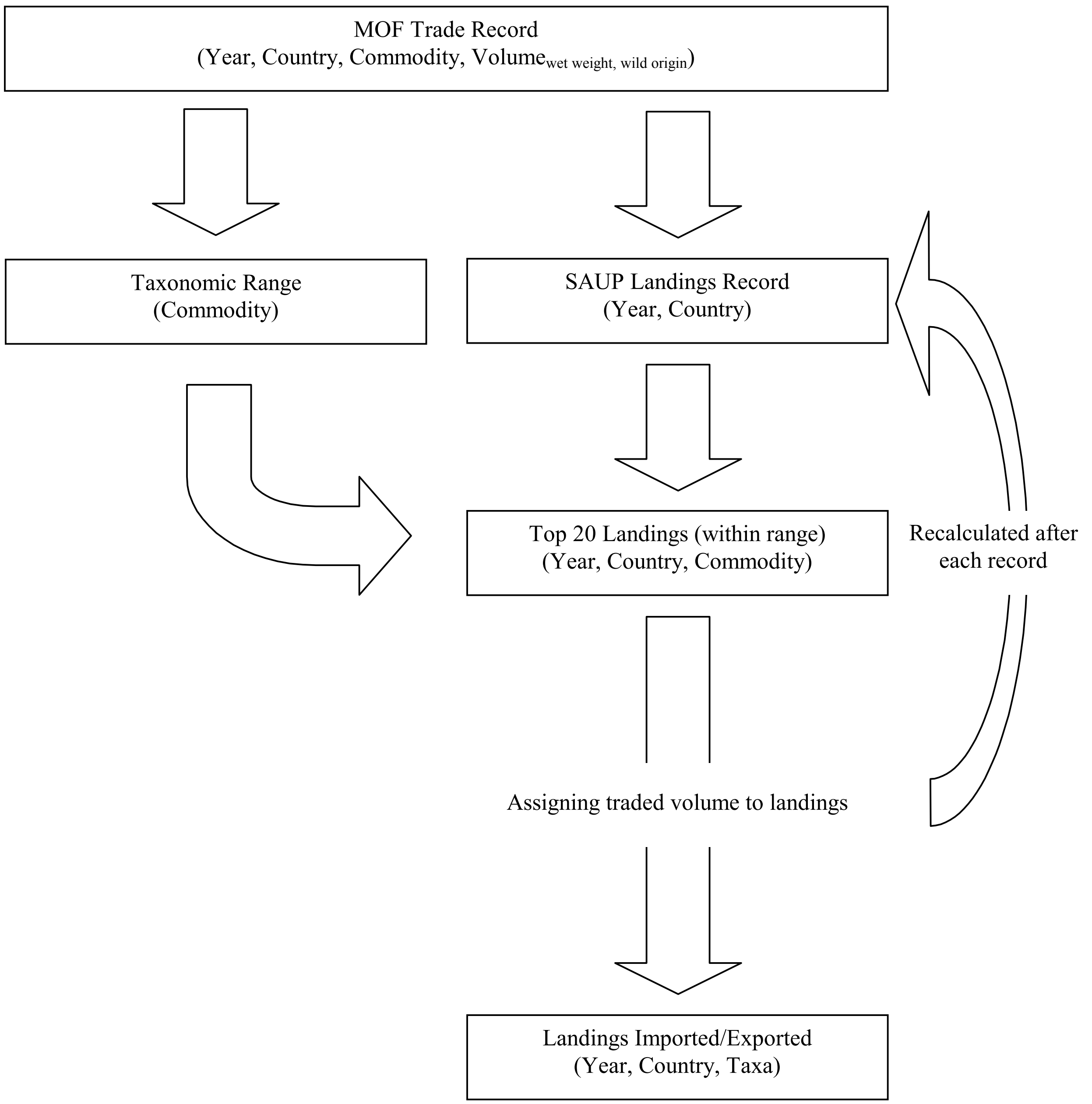


Figure 3-1 Schematic diagram of iterative allocation procedure used for Japanese trade statistics.

Fortunately, for about 92.6 % of the import statistics and 97.6 % of export statistics, there were enough landings recorded in the exporting countries (or in Japan for export records) to account for the volume traded (Table 3-2). The remaining 7.4 % were reprocessed, with their taxonomic ranges broadened, so that all fish commodities could be assigned to any fish landings and all non-fish commodities could be assigned to any marine invertebrate landings. This was done to correct the misallocation in the *Sea Around Us* database.

Following the second allocation run, 99.7 % of import and 100 % of export statistics could be allocated. The remaining unaccounted trade records were then assigned in the same manner among landings of all countries under the assumption that they referred to third country transactions. It is important to note that these third country transactions may involve the landings of Japanese fleets. Therefore, in this third allocation run, the portion of Japanese landings that were exported, as determined in the first two runs, were included as the potential source of these traded commodities. In this way, all reported trade records were assigned to the landings of exporting countries including Japan.

Spatial disaggregation

Once all trade records were assigned to exporting countries' landings, it was then possible to calculate the proportion of exporting countries' landings that were traded to the importing country. This ranged from close to 100% for export-driven fisheries with an exclusive foreign market to 0% for fisheries supplying domestic markets. It should be noted that this calculation was done for each taxon caught by exporting countries. Spatial disaggregation of trade records can then be accomplished by simply taking the calculated proportions from all spatial cells where exporting countries' catch was recorded.

Table 3-2 Success rate of the iterative allocation procedure used for MOF statistics.

Run number		Import records (by % volume) successfully allocated	Export records (by % volume) successfully allocated
Run 1:	all trade records allocated among exporting country's catch within traded commodity's taxonomic range:	92.6	97.6
Run 2:	all unaccounted trade records allocated among exporting country's catch	99.7	100
Run 3:	all unaccounted trade records allocated among world catch	100	n/a

Thus, for this study, a database was created whereby, for each spatial cell and for each year, a record of global and Japanese landings (from the *Sea Around Us* landings database), a fraction of the global landings imported by Japan and the fraction of the Japanese landings exported by Japan were assigned. It should be noted here that all records were expressed as rate ($t \cdot km^{-2}$ of ocean surface) to allow comparison between areas. All catch rates less than 0.001 $t \cdot km^{-2}$ were deemed as 'statistical noise,' resulting from the allocation of an extremely low proportion of landings to cells at the edge of taxa distribution, i.e., extremely low catch density, and were not considered in further analysis.

Chapter 4. Results and Discussion

Global Maps

Japanese fisheries landings and consumption

The foundation of this study is that because of the international trade in fish commodities, there are clear differences between a country's pattern of resource extraction, i.e., its fisheries catch, and its overall fish consumption. Therefore, examining a country's impact on marine fisheries resources cannot be done based only on its fisheries catch. The disparity between catch and consumption becomes apparent when comparing Japanese fisheries landings maps (Figure 4-1) with the corresponding consumption maps (Figure 4-2).

In 1950 and 1960, the spatial patterns of Japanese consumption closely mirrored those of its catch. This is because fisheries trade during this period was predominantly export-oriented. Apart from the imports from Norway, the majority of Japanese consumption was sustained through its fisheries. Japan's role as a fish exporter was most evident in the central Atlantic, where much of its fisheries catch was directly exported onto foreign ports. Consequently Japan's catch intensity in the central Atlantic is more pronounced than consumption intensity.

The disparity between catch and consumption patterns became apparent in 1970. While Japan reports no catch from the North East Atlantic, Japan's consumption map shows that they were consuming the fisheries resources of the region. Again, this consumption consisted largely of imports of fish commodities from European countries. Furthermore, a high level of consumption was achieved along the Pacific coast of South America. This consumption can be attributed to the import of fishmeal from the region. Fishmeal may have been imported to supply Japan's growing amberjack aquaculture industry.

In 1980, as Japanese fisheries began their decline, consumption remained widely distributed. For example, the Japanese fisheries fleets appeared to left the western Indian Ocean, yet consumption of the fisheries resources of the western Indian Ocean continued. Moreover, although Japanese fisheries fleets moved out of many foreign EEZ in 1990, consumption remained unaffected. In fact, in some regions, such as the Argentinean coast, consumption intensifies from 1980 to 1990. A similar trend continues in 2000, most notably in the North East Pacific.

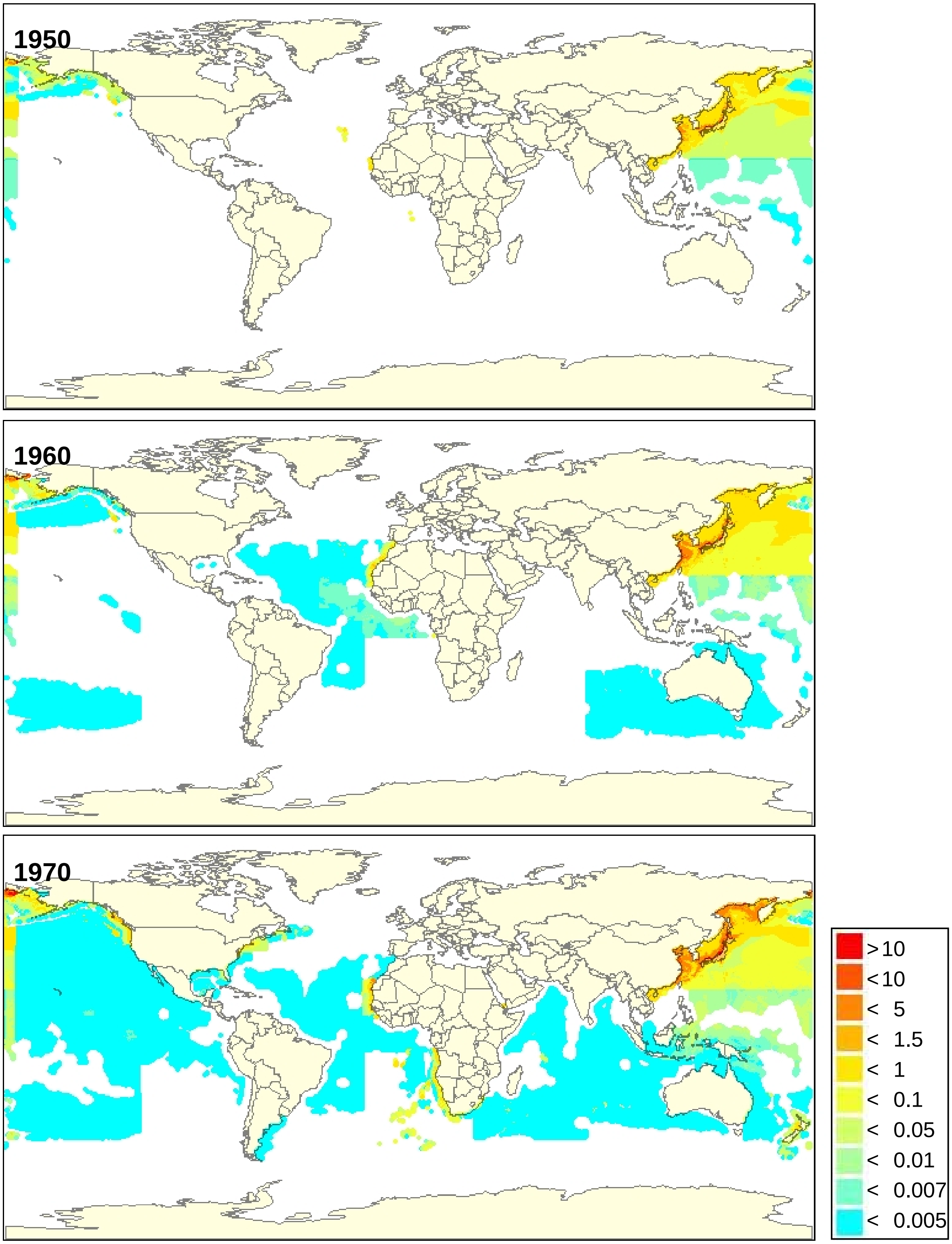


Figure 4-1 Japanese fisheries landings (t·km^{-2}) at 10-year intervals (1950-2000). Blue (light) region represents areas of low catch while red (dark) regions represent areas of high catch. White regions denote areas where catch rate were not high enough (less than 0.001 t·km^{-2}) to be considered in the analysis. The 1950 map portrays Japanese catch beyond the Northwest Pacific; given that Japanese fisheries were then restricted by the MacArthur Line (see Figure 2-2), this suggests an error in the underlying FAO statistics.

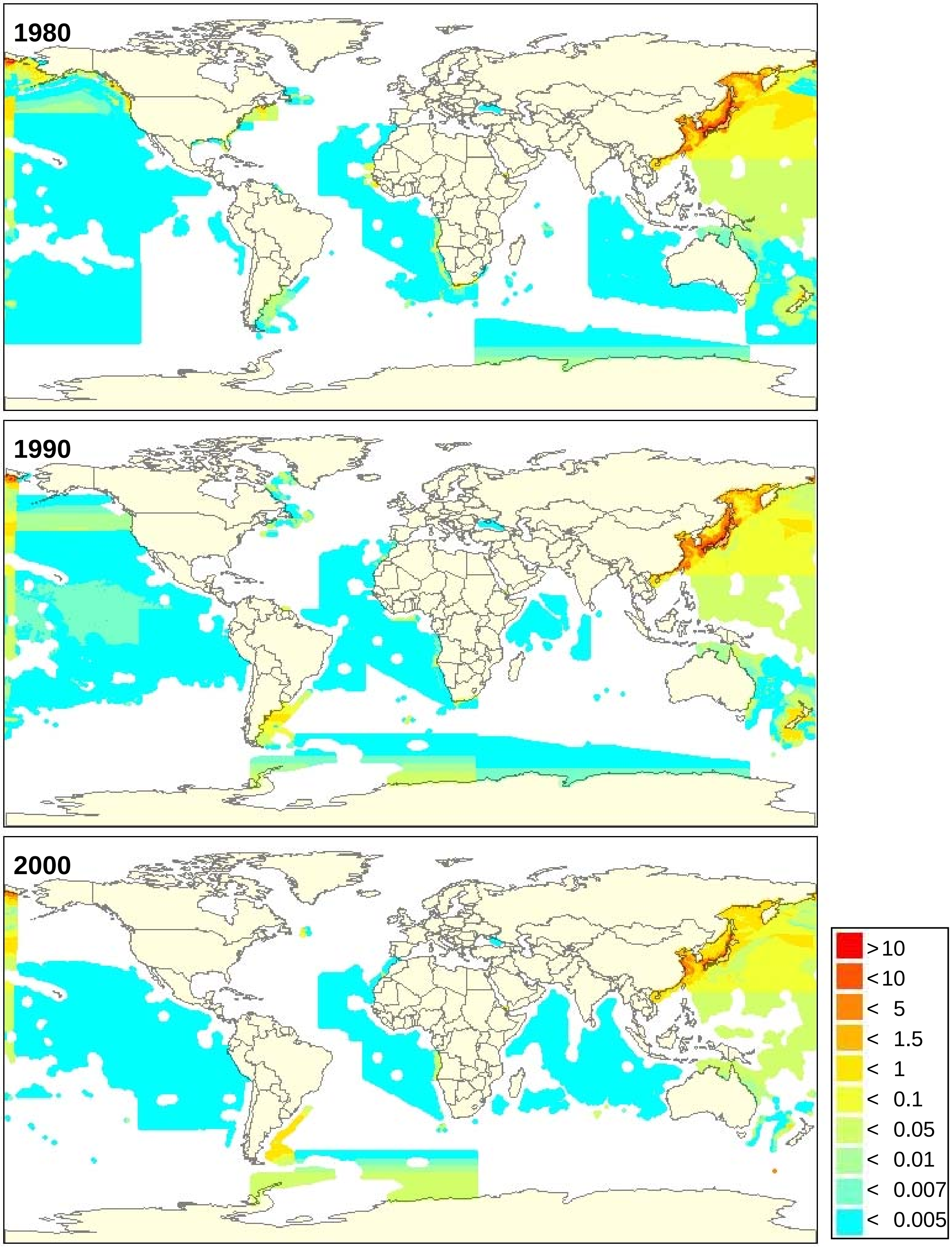


Figure 4-1 Continued.

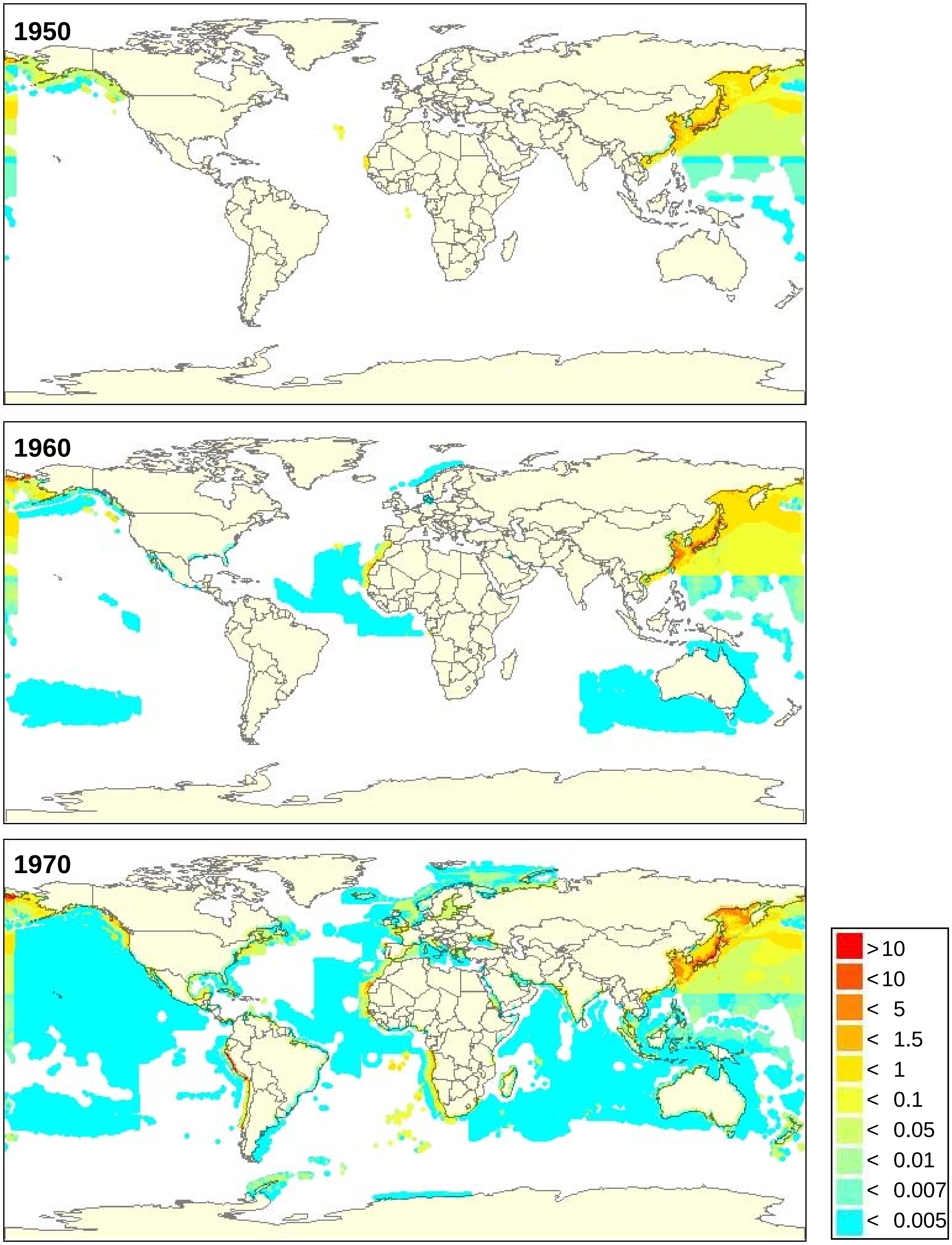
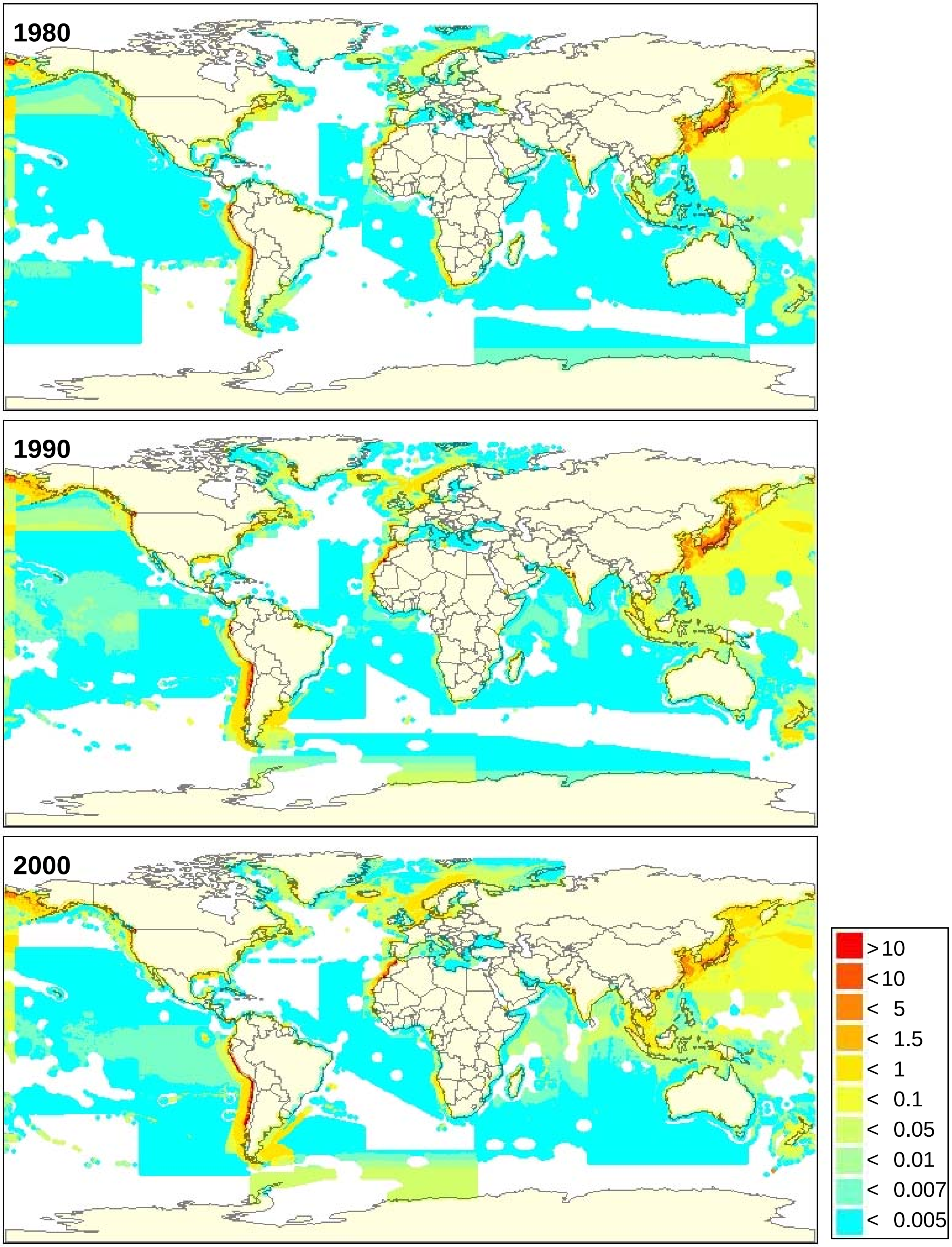


Figure 4-2 The origin of fish consumed by the Japanese population (t·km^{-2}) at 10-year intervals (1950-2000). The colour scheme used for these maps is the same as in Figure 4-1.



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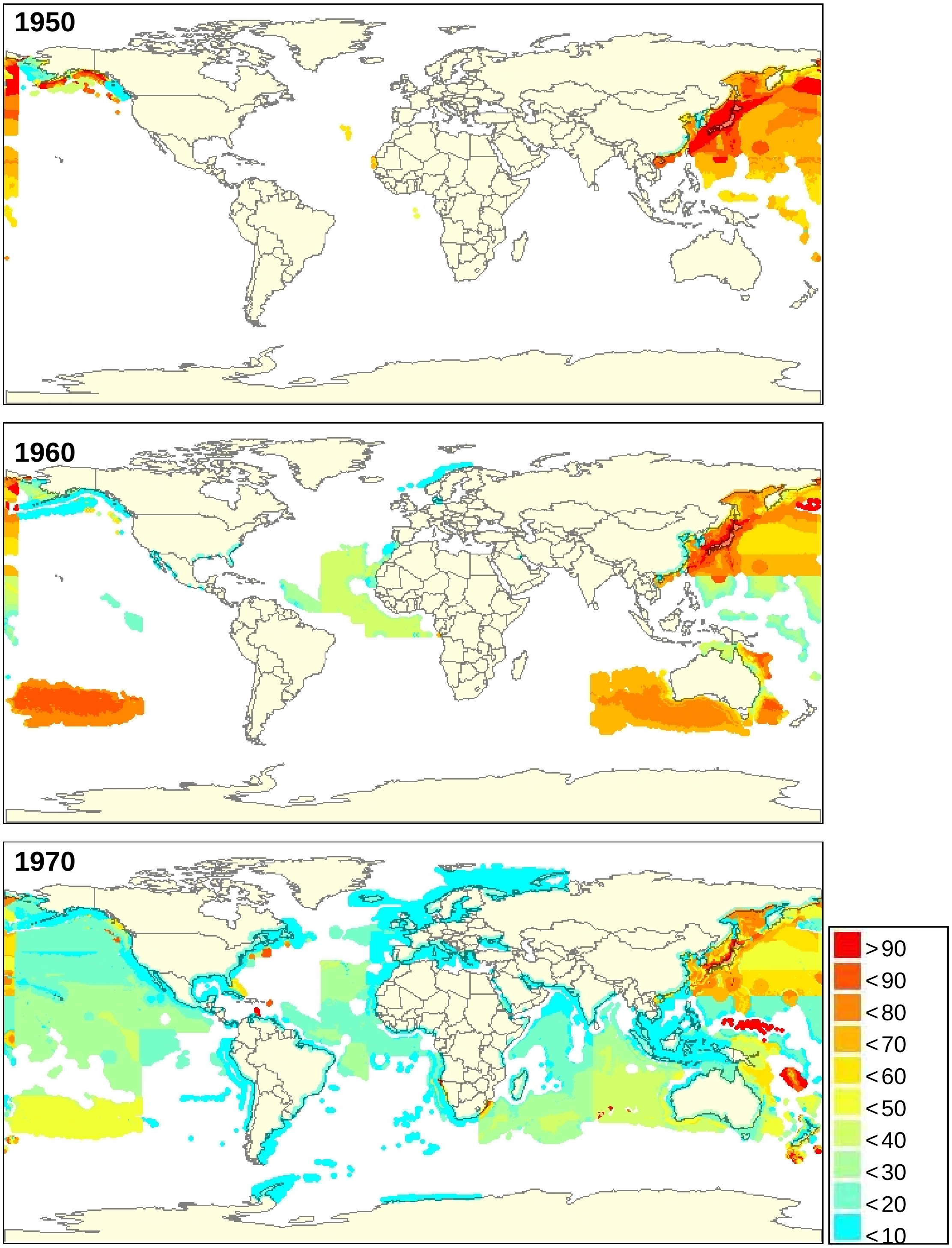

Figure 4-3 Global consumption by Japan (catches and imports), expressed as % of total catch (i.e., global consumption) at 10-year intervals. Blue (light) regions represent areas where consumption by Japan accounts for a small fraction of the global consumption, whilst red (dark) regions represent areas where consumption by Japan accounts for a large fraction of the total. White regions denote areas where Japanese consumption (in absolute terms) was too small (less than 0.001 $t \cdot km^{-2}$) to be considered in the relative consumption estimation. Note that some regional landings bases (Trinidad and Tobago, Micronesia and Vanuatu in 1970; New Caledonia in 1980; El Salvador, Malta and New Caledonia in 1990; and El Salvador and Equatorial Guinea in 2000) are identified as red 'hot spots' due to their involvement in third country transactions.

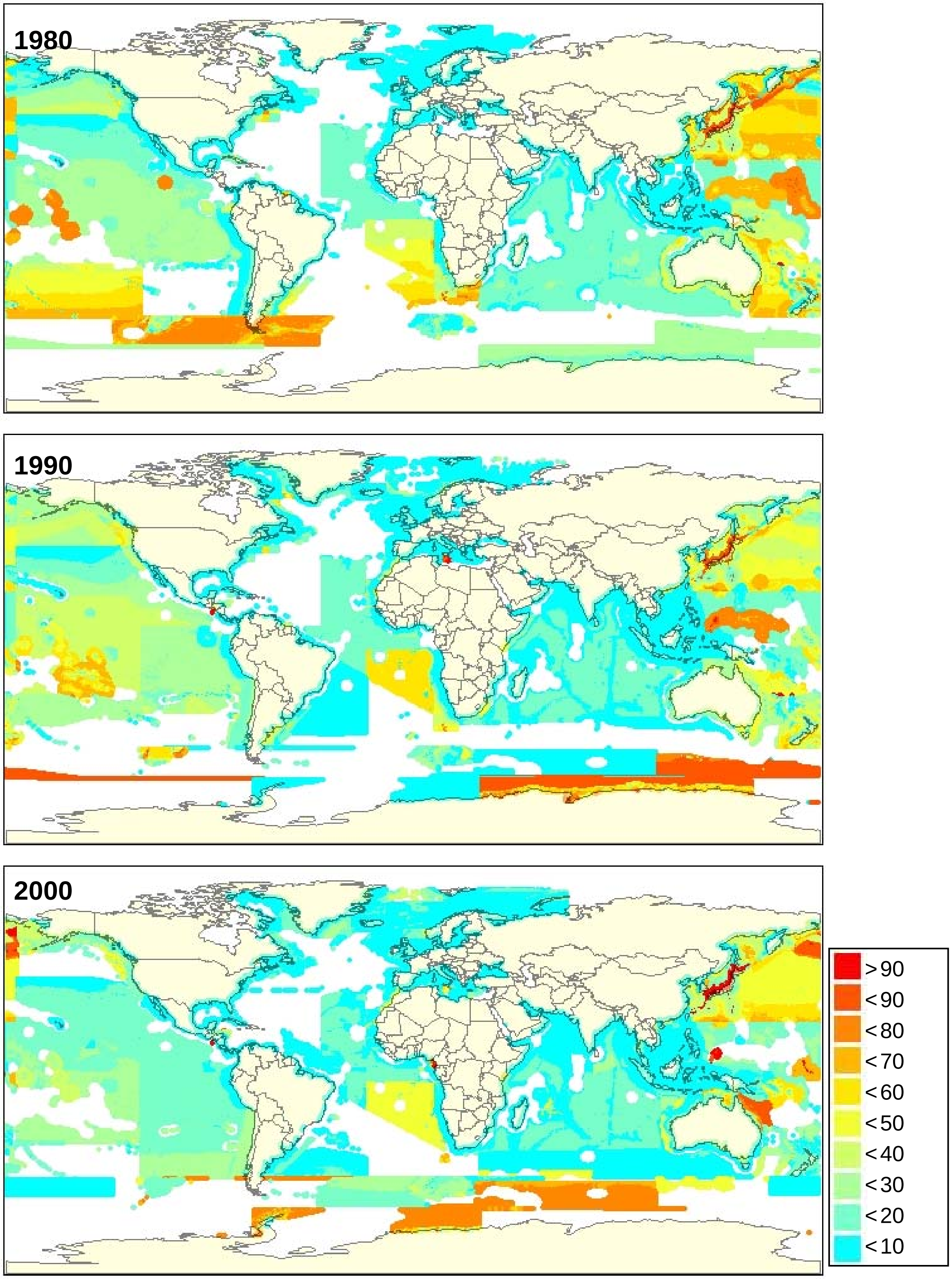

Figure 4-3 Continued.

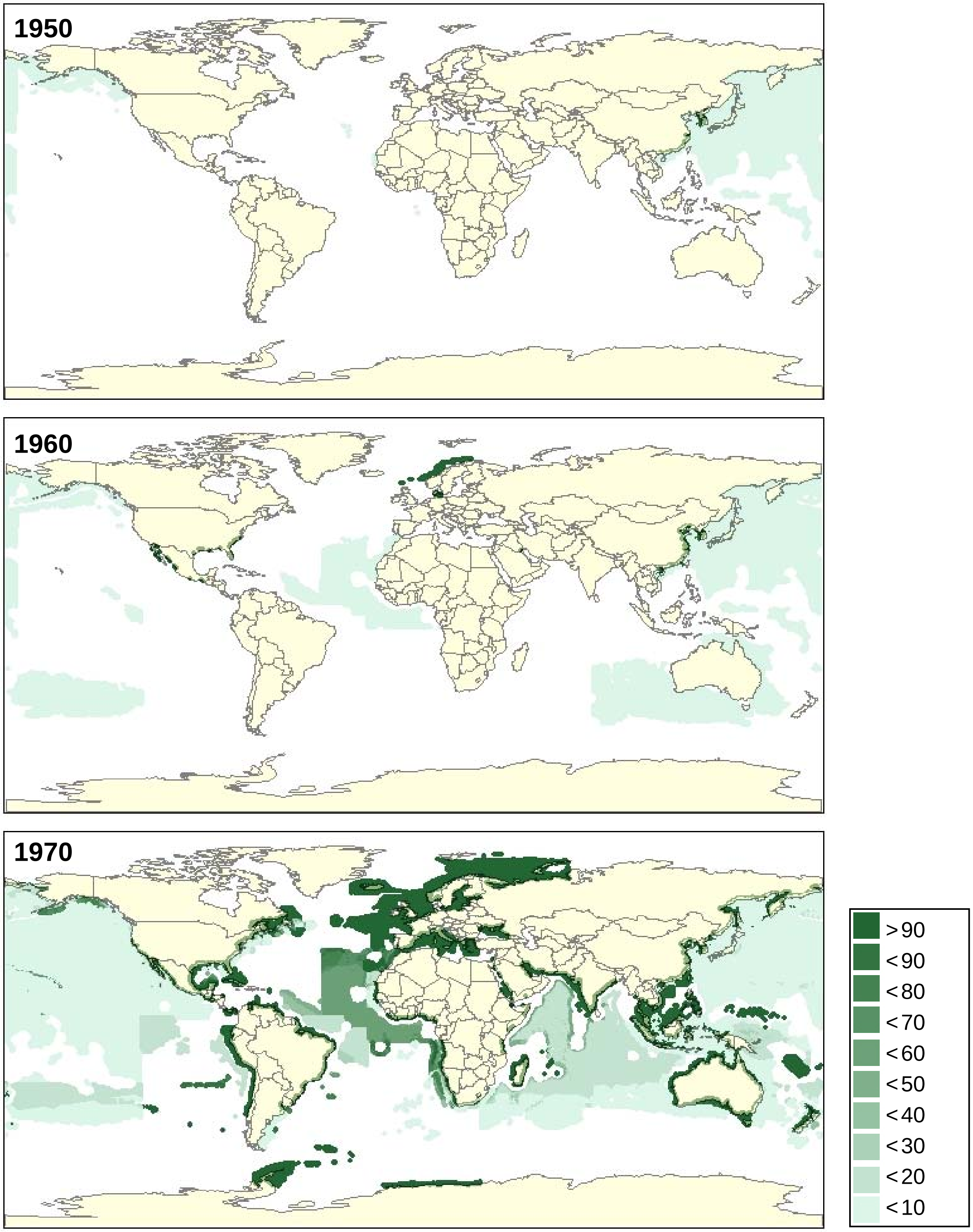

Figure 4-4 Mode of foreign fish acquisition by Japan, expressed as % of the total fish acquired through international trade. Light coloured regions represent areas where fish consumed in Japan were acquired through direct exploitation by its distant water fleets, while dark coloured regions represent areas where fish were acquired through international trade, i.e., import of foreign catches (including joint ventures). White regions denote areas where Japanese consumption (in absolute terms) was too small (less than 0.001 $t{\cdot}km^{-2}$) to be considered in the relative consumption estimation.

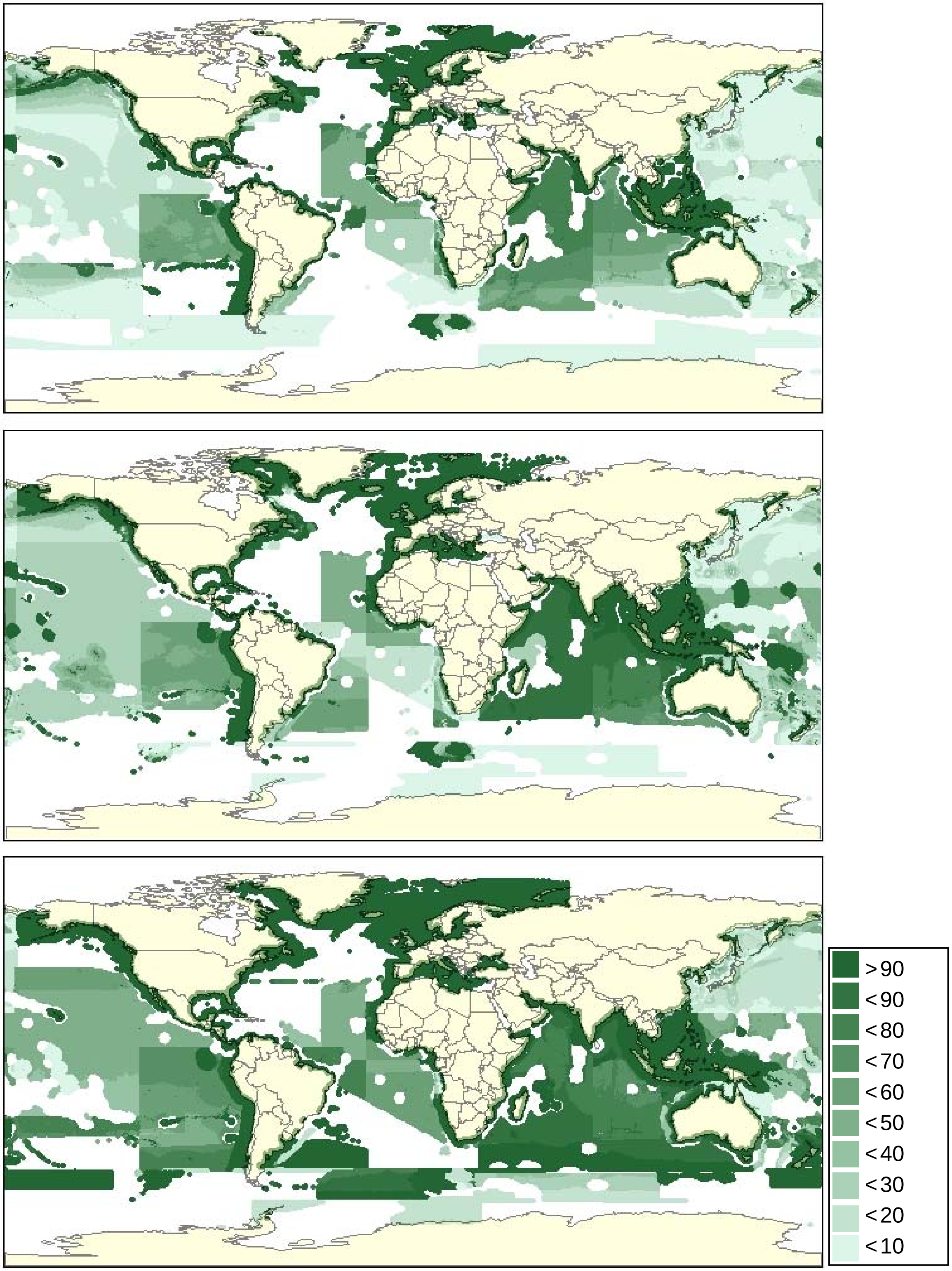

Figure 4-4 Continued.

Relative consumption

Given consumption disaggregated into a spatial grid, it is possible to construct various consumption-related indicators through a series of cell-based calculations. One such indicator is relative consumption. By comparing Japanese consumption with global consumption, i.e., global catch, one can estimate the proportion of global catch that is consumed in Japan. Figure 4-3 is a series of maps representing these relative consumption patterns.

As one would expect, Japan's relative consumption is extremely high in the North West Pacific, particularly in the waters around Japan, reaching between 90 to 100%. In 1960, a high level of relative consumption is also observed in the South Pacific and in the South East Indian Ocean. Consumption in these two regions consists of fisheries catches from its distant water fleets (Figure 4-1). The map also suggests that Japan was the first country fishing in these regions.

By 1970, despite the expansion in its spatial distribution, Japan's relative consumption appears to have diminished. Apart from the North West Pacific and several 'hotspots' around the waters of some South Pacific island countries, Japan's relative consumption remains below 50%. Since Japanese consumption in absolute terms increased from 1960 to 1970 (Figure 2-1), this decrease indicates increasing catches by other countries.

From 1980 to 2000, Japan's relative consumption continues to be high in the North West Pacific, although somewhat diminished from the previous years, and attains high levels within the EEZ of several South Pacific island countries. The high level of consumption within this area is likely the result of tuna imports. Another notable feature is a high level of relative consumption around Antarctica, which is largely due to Japan's consumption (both for human and livestock, as fishmeal, consumption) of krill from the region. Again, Japan appears to be pioneering the exploitation of this resource.

Transition in fish acquisition strategies

As discussed in Chapter 2, Japan has undergone a transformation from the world's most prominent fishing nation to the world's largest international importer of fish commodities. Using cell-based calculations, this transformation can be visualised in a form of global maps (Figure 4-4). Figure 4-4 shows, as one would anticipate, that there is a gradual transition from direct exploitation by Japan (light regions) to imports (dark regions). One exception is the North East

Atlantic, where highly developed European fisheries precluded fishing by Japanese fleets, and consequently the resources were acquired solely through trade.

Validation of the Results and Limitations of the Analysis

Validation of the above analysis can be achieved in two manners: through verification of the quantities consumed, and through verification of their distribution. Table 4-1 shows the difference between Japanese fish consumption, reported by the Ministry of Agriculture, Forestry and Fisheries (MAFF), and Japanese fish consumption, as estimated based on the consumption maps presented in this study. The percent difference indicates that the difference between the latter and the former is less than 10%, with values estimated in this study consistently less than those reported by the MAFF. This is to be expected, as the consumption reported by the MAFF includes aquaculture products and freshwater species. In fact, the difference between the two values has increased in recent years, indicating an increasing market share of aquaculture products.

Verification of spatial distribution it is more difficult, as global consumption maps do not exist. However, the spatial patterns of Japanese catch do appear to correspond with descriptive accounts of fishing operations during the different periods considered here. There are, however, some inconsistencies; for example, the catch map for 1950 shows Japanese catch beyond the North West Pacific. Since Japanese fisheries during this period were under spatial restrictions, all of their catch should occur within the North West Pacific. This disparity does not denote a failure of the spatial disaggregation process developed in the *Sea Around Us* project. Rather this reflects a problem with the underlying FAO database, which reports Japanese catch in the central Atlantic[15].

Regarding the distribution of traded commodities, several concerns exist. The primary concern is that third country transactions are not properly incorporated into the analysis. Consequently, the process developed in this study creates 'hotspots' in countries that act as processing or transhipment bases. As Japan's total import from these countries may exceed the country's catch, it is assumed that all of the country's catch is exported to Japan.

[15] This problem will be corrected in forthcoming versions of the *Sea Around Us* maps (see www.seaaroundus.org).

Table 4-1 Percent difference between the total Japanese fish consumption published by MAFF (based on its Food Balance Sheets 2003) and total consumption estimated by the study.

Reporting year	MAFF consumption estimate (in million t)	Consumption estimated in the study (in million t)	% difference
1950	n/a	2.72	n/a
1960	5.38	5.09	5.32
1970	8.63	8.38	2.95
1980	10.73	10.22	4.80
1990	13.03	11.82	9.26
2000	10.81	10.01	7.39

Another concern is that illegal, unauthorized and unreported (IUU) catches are not included in the global catch database. In general, import statistics are more accurate than catch statistics, particularly in the case of Japan, as importing countries like Japan utilise sophisticated statistical systems. As a result, when estimating relative consumption, Japanese relative consumption is overestimated in these places where catches by countries other than Japan are underreported.

Application of the Consumption Maps

The relative consumption maps produced in this study can be viewed as an exploitation footprint of Japan regarding the consumption of fisheries resources. In other words, the spatial patterns displayed in these maps represent Japan's impact on marine fisheries resources and the marine ecosystems within which these resources are embedded. The footprint examined in this study is different from the ecological footprint proposed by Wackernagel and Rees (1996)[16]. Their ecological footprint can be seen as an indicator of ecological sustainability through a comparison of the land area required to meet the consumption of a population and the total productive land area available to that population. The consumption footprint in this study is not a measurement of sustainability, as it is simply a proportional measure of resource exploitation, based on global exploitation. However, one area in which the footprint excels is in its ability to demonstrate the spatial features of resource use. Ecological footprint analysis is limited, in that its analysis is based on theoretical land areas and therefore is unable to pinpoint the geographical areas in which consumption pressure is exerted. I believe that the spatial details incorporated in this study are beneficial as they offer alternative approaches when examining a country's resource consumption.

[16] Wada (1999) found, with regard to the ecological footprint of Japan, that its aquatic consumption is equivalent of 580 million ha, more than six times the size of the Japanese EEZ.

Policy Implications

There is a general consensus that overall, more fish products flow from developing to developed countries than in the other direction (Kent 1998). Japan's consumption patterns presented in this study reinforce this notion, with Japan acquiring a high proportion of its catch from the coastal waters of developing countries. For many developing countries, fish is an important source of animal protein. Thus, consumption of their coastal fisheries resources by foreign countries, i.e., Japan, may have serious implications for their food security. Not only does consumption by Japan reduce the supply of fish to domestic markets in these developing countries, but the possibilities of short-term economic gain through export to Japan may also encourage overexploitation of the local resources, further reducing the local supply in developing countries. Whilst some argue that the loss of fish for domestic consumption is offset by economic gain, which can then be used to import alternative food supplies, this is in fact rarely the case (Alder and Sumaila 2004).

The strong reliance on foreign fisheries resources in meeting domestic demand revealed in this study may not be unique to Japanese fish consumption. Similar studies on the consumption patterns of North American and European countries, especially Spain, would certainly be of great value when addressing this issue.

Although the onus is ultimately on the resource-extracting nation to ensure the sustainability of resource use, it is essential that importing countries understand the ecological, social, and economic ramifications that their consumption pressure may have on exporting countries. This is particularly true for developing countries, which may not have the financial or political capabilities required to manage their resources. Moreover, recognizing the patterns of exploitation exerted by the consumption demand of importing countries and ensuring that this consumption demand does not negatively impact foreign fisheries resources is in the best interests of importing countries, as it dictates the long-term security and stability of the resource supply. I hope that the mapping of consumption undertaken in my research will lead to a more thorough analysis of this issue.

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Appendix A

Japanese Fishing Access Agreements with Coastal Countries: 1952-2004 (based on information from OFCF 2003 and MAFF 1995)

Country	Year	Note
Australia	1969 (Expired in 1977)	Intergovernmental agreement granting Japanese tuna longline fleets access to extended territorial seas (12 nautical miles) of Australia. Expired upon the declaration of 200 nautical mile EEZ by Australia.
	1979 (Suspended in 1997)	Intergovernmental agreement granting Japanese tuna longline fleets access to EEZ of Australia. Suspended in 1997 after failing to reach an agreement on catch quotas.
Canada	1978	Intergovernmental agreement granting Japanese tuna longline and bottom trawl fleets access to EEZ of Canada.
Cape Verde	1996	Private agreement granting Japanese tuna longline access to EEZ of Cape Verde.
China	1955 (Expired in 1975)	Private agreement granting Japanese fleets access to the coastal waters of China. Suspended from 1958 to 1963. Expired upon the normalization of Japan-China diplomatic ties.
	1975 (Expired in 1996)	Intergovernmental agreement granting Japanese fleets access to the East China Sea. Expired in 1996 upon the ratification of UNCLOS.
	2000	Intergovernmental agreement establishing joint management zones in the East China Sea.
Cote d'Ivoire	2002	Private agreement granting Japanese tuna longline access to EEZ of Cote d'Ivoire.
France	1979	Intergovernmental agreement granting Japanese tuna longline fleets access to EEZ of French Polynesia, New Caledonia and Wallis and Futuna. Access to French Polynesia suspended in 1992, Wallis and Futuna in 1996 and New Caledonia in 1997. Access to New Caledonia was renegotiated in 2003.
Fiji	1998	Private agreement granting Japanese tuna longline and purse seine and skipjack pole-and-line fleets access to EEZ of Fiji.
Gabon	2000	Private agreement granting Japanese tuna longline fleets access to EEZ of Gabon.
Gambia	1992	Private agreement granting Japanese tuna longline and purse seine fleets access to EEZ of Gambia.

Guinea	1995	Private agreement granting Japanese tuna longline fleets access to EEZ of Guinea.
Guinea Bissau	1993	Private agreement granting Japanese tuna longline and purse seine fleets access to EEZ of Guinea Bissau.
Kiribati	1978	Intergovernmental agreement granting Japanese tuna longline and skipjack pole-and-line fleets access to EEZ of Kiribati.
	1998	Private agreement granting Japanese tuna purse seine fleets access to EEZ of Kiribati.
Indonesia	1968 (Expired in 1980)	Private agreement granting Japanese tuna longline and skipjack pole-and-line fleets access to EEZ of Indonesia.
Madagascar	1997	Private agreement granting Japanese tuna longline fleets access to EEZ of Madagascar.
Marshall Islands	1981	Intergovernmental agreement granting Japanese tuna longline and skipjack pole-and-line fleets access to EEZ of Marshall Islands.
	1993	Private agreement granting Japanese tuna purse seine fleets access to EEZ of Marshall Islands.
Mauritania	1970 (Expired in 1982)	Private agreement granting Japanese trawl fleets access to extended territorial seas (12 nautical miles) of Mauritania. Suspended from 1979 to 1981 and expired in 1982.
	1991	Private agreement granting Japanese tuna longline and purse seine fleets access to EEZ of Mauritania.
Mauritius	2000	Private agreement granting Japanese tuna longline fleets access to EEZ of Mauritius.
Mexico	1968 (Expired in 1978)	Intergovernmental agreement granting Japanese fleets access to extended territorial seas (12 nautical miles) of Mexico. Expired in 1978 upon the declaration of EEZ by Mexico.
Micronesia	1992	Private agreement granting Japanese tuna longline and purse seine and skipjack pole-and-line fleets access to EEZ of Micronesia.
Morocco	1985	Intergovernmental agreement granting Japanese tuna longline fleets access to EEZ of Morocco.
Mozambique	1997	Private agreement granting Japanese tuna longline fleets access to EEZ of Mozambique.
Nauru	1994	Private agreement granting Japanese tuna longline and purse seine and skipjack pole-and-line fleets access to EEZ of Nauru.
New Zealand	1968 (Expired in 1978)	Intergovernmental agreement granting Japanese trawl fleets access to coastal water of New Zealand. Expired in 1978 upon the declaration of EEZ by New Zealand.

	1978 (Suspended in 1997)	Intergovernmental agreement granting Japanese tuna longline fleets access to EEZ of New Zealand. Suspended in 1997 after failing to reach an agreement in catch quotas.
North Korea	1977 (Expired in 1993)	Private agreement granting Japanese fleets access to EEZ of North Korea. Suspended from 1982 to 1984 and expired in 1993.
Palau	1992	Private agreement granting Japanese tuna longline and purse seine and skipjack pole-and-line fleets access to EEZ of Palau.
Papua New Guinea	1981 (Expired in 1987)	Private agreement granting Japanese tuna longline and purse seine and skipjack pole-and-line fleets access to EEZ of Papua New Guinea. Expired in 1987.
Portugal	1979 (Expired in 1986)	Intergovernmental agreement granting Japanese tuna longline fleets access to EEZ of Portugal.
Russia (USSR)	1956 (Expired in 1978)	Intergovernmental agreement granting Japanese salmon driftnet fleets access the Soviet coastal waters of the Northwest Pacific. Expired in 1979 upon the declaration of EEZ by the Soviet Union.
	1977 (Expired in 1984)	Provisional agreement granting Japanese fleets continued access to EEZ of the Soviet Union. Expired in 1984.
	1984	Intergovernmental agreement granting Japanese and the Soviet fleets bilateral access to EEZ of Japan and the Soviet Union.
	1985	Intergovernmental agreement granting Japanese salmon driftnet fleets additional catch quota in EEZ of the Soviet Union.
	1998	Intergovernmental agreement granting Japanese gillnet fleets access to waters around the disputed Kuril Islands.
Saint Helena	1988	Private agreement granting Japanese tuna longline fleets access to EEZ of Saint Helena.
Sao Tome and Principe	2003	Private agreement granting Japanese tuna longline fleets access to EEZ of Sao Tome and Principe.
Senegal	1992	Intergovernmental agreement granting Japanese tuna longline and purse seine fleets access to EEZ of Senegal.
Seychelles	1988	Private agreement granting Japanese tuna longline fleets access to EEZ of Seychelles.
	1990	Private agreement granting Japanese tuna purse seine fleets access to EEZ of Seychelles.
Sierra Leone	1993	Private agreement granting Japanese tuna longline and purse seine fleets access to EEZ of Fiji.

Solomon Islands	1978	Intergovernmental agreement granting Japanese tuna longline and skipjack pole-and-line fleets access to EEZ of Solomon Islands.
	2000	Private agreement granting Japanese tuna purse seine fleets access to EEZ of Solomon Islands.
Somalia	1998 (Expired in 1999)	Private agreement granting Japanese tuna longline fleets access to EEZ of Somalia. Expired in 1999.
South Africa	1977 (Expired in 2003)	Intergovernmental agreement granting Japanese tuna longline fleets access to EEZ of South Africa. Expired in 2003.
South Korea	1965 (Expired in 1999)	Intergovernmental agreement granting Japanese and South Korean fleets bilateral access in the East China Sea and the Sea of Japan. Expired in 1999 upon the ratification of UNCLOS.
	1999	Intergovernmental agreement establishing joint management zones in the East China Sea and the Sea of Japan.
United States	1964 (Expired in 1977)	Intergovernmental agreement granting Japanese crab gillnet fleets access to the US waters in the Northeast Pacific. Expired upon the declaration of EEZ by the United States.
	1967 (Expired in 1977)	Intergovernmental agreement granting Japanese trawl and bottom longline fleets access to the US waters in the Northeast Pacific. Expired upon the declaration of EEZ by the United States.
	1977 (Expired in 1987)	Intergovernmental agreement granting Japanese trawlers and bottom longline fleets access to EEZ of the United States. Expired in 1987 following no allocation of catch quota to Japanese fleets.
Tanzania	1998	Private agreement granting Japanese tuna longline fleets access to EEZ of Tanzania.
Tuvalu	1986	Intergovernmental agreement granting Japanese tuna longline and skipjack pole-and-line fleets access to EEZ of Tuvalu.
	1998	Private agreement granting Japanese tuna purse seine fleets access to EEZ of Tuvalu.