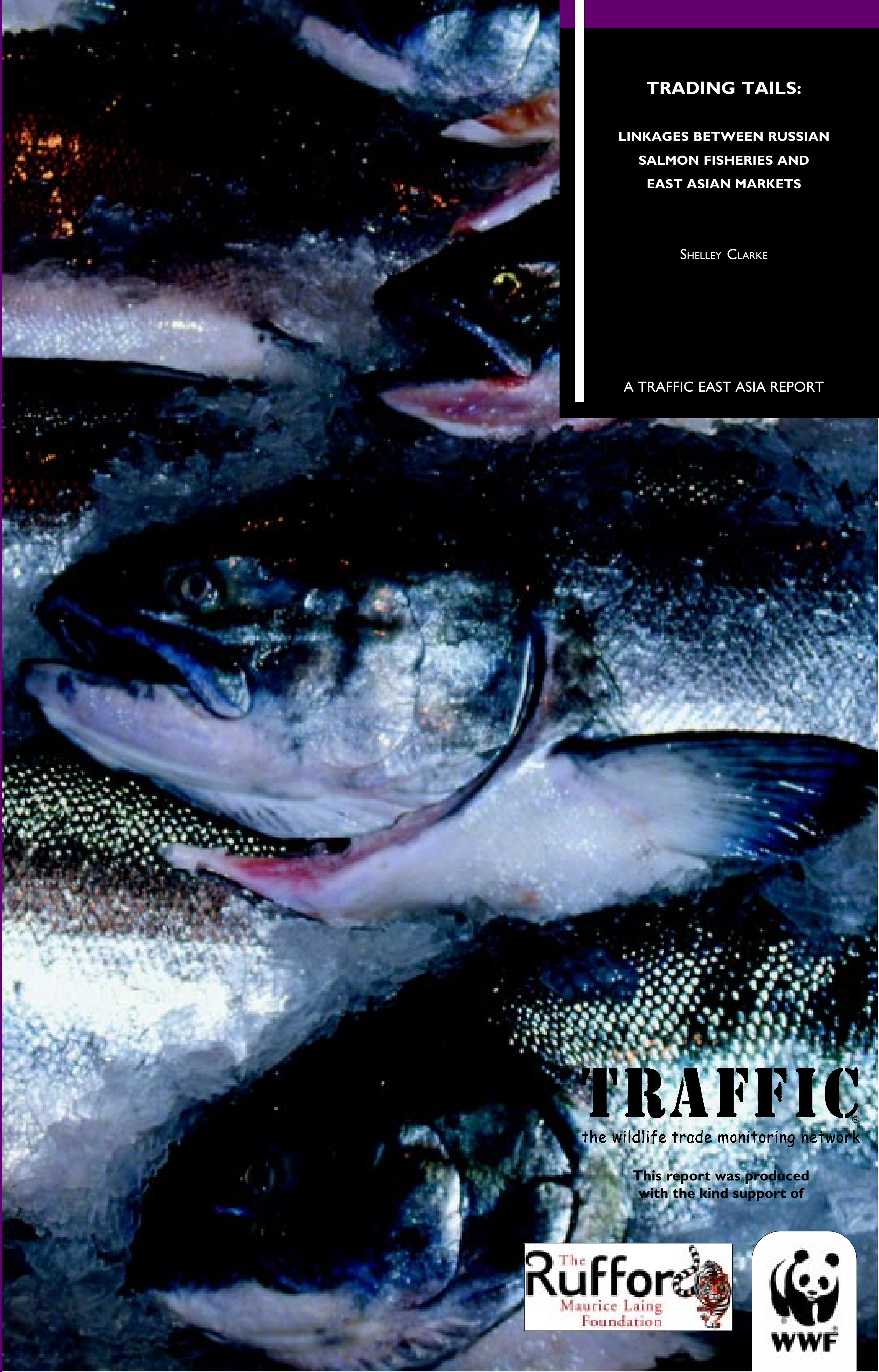

TRADING TAILS:

LINKAGES BETWEEN RUSSIAN SALMON FISHERIES AND EAST ASIAN MARKETS

SHELLEY CLARKE

A TRAFFIC EAST ASIA REPORT

TRAFFIC
the wildlife trade monitoring network

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TRADING TAILS:

LINKAGES BETWEEN RUSSIAN SALMON FISHERIES AND EAST ASIAN MARKETS

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Credit: S. Clarke

Salmon on sale in Japan

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EXECUTIVE SUMMARY

The Bering Sea is one of the world's most productive cold-water ecosystems, but its resources have been subject to heavy fishing pressure, and oil and gas extraction proposals are heightening concerns for offshore, coastal and riparian habitat. Ongoing efforts to study and conserve salmon species are targeting areas with high natural species diversity, un-degraded spawning habitat and limited existing legal and regulatory protection, and thus the salmon of the Kamchatka peninsula are a particular focus. Import data clearly indicate that East Asian markets receive a large portion of the Russian Far East's salmon catch. These markets may also play an active role in creating incentives for the illegal salmon trade. Therefore, exploring the relationship between markets and fisheries for Russian Far East salmon can provide a unique window on current salmon use practices as well as lead to new insights for sustainable management.

In order to examine the roles of Japan, China and the Republic of Korea (South Korea) in the trade of illegal salmon from the Russian Federation, it is first necessary to describe the characteristics of the salmon distribution systems in East Asian markets. This study then compares the total quantity of Russian salmon in these markets to catch estimates from the Russian Federation. The methodology assumes that if quantities in the marketplace are larger than the quantities which could be produced by legal, reported catches, the magnitude of discrepancy may suggest the extent of illegal, unregulated and unreported (IUU) activities. After assessing the potential trade in IUU fishing products in this way, recommendations for trade measures to combat IUU activities are formulated.

Japan is the world's largest, single-nation importer of salmon products. Based on Customs statistics, the Russian Federation supplies 45–55% of Japan's frozen Sockeye Salmon (Sockeye) *Oncorhynchus nerka*, but only 4–5% of Japan's entire salmon/trout market. This low share overall is due to voluminous quantities of farmed Coho Salmon (Coho) *O. kisutch*, and domestic ranched Chum Salmon (Chum) *O. keta* and Pink Salmon *O. gorbuscha* in the Japanese market. Nevertheless, Sockeye is one of the most valued salmon species in Japan, and Russian Sockeye is said to be the most preferred type of Sockeye. In recent years consumers have turned away from more traditional forms of heavily salted, whole salmon towards ready-to-eat, lower salt forms like *kirimi* (small portion fillets). Another popular salmon product from the Russian Federation is salmon roe, either in the form of *sujiko* (whole ovaries) or *ikura* (loose eggs). According to Customs statistics, Japan does not import substantial quantities of *ikura* from the Russian Federation, but quantities of *sujiko* appear to be large and are probably processed into *ikura* once in Japan. With the rise of large supermarket chains, salmon is increasingly directly imported, processed and sold without passing through the central wholesale market system. This has resulted in a shift in the location of salmon processing centres away from Hokkaido and closer to large population centres. Japan requires complex and burdensome pre-approval documentation for all shipments of salmon arriving from China. This system effectively

prevents China from processing salmon for the Japanese market, although it does not restrict China's processing of Japanese salmon for other markets.

China plays a critical role in the worldwide seafood distribution chain by serving as a low-cost fish processing centre. This is particularly true in the case of Russian salmon. Although China's imports of Sockeye from the Russian Federation are only a fraction (ca. 3% in 2006) of the amount of Russian Sockeye imported by Japan, China imports large quantities of Chum and Pink Salmon from the Russian Federation (nearly 140 000 t in 2006). These imports have increased eight-fold since 2002, and in 2006 quantities supplied by the Russian Federation exceeded the quantities supplied by Japan for the first time. Almost all of the salmon imports are designated as "inward processing trade" meaning they are exempt from a 26% tariff and intended for re-export after processing. Chinese-processed salmon appears mainly destined for the US and European markets. Chinese factories opportunistically purchase salmon supplies but those with an ability to pay for high quality raw materials indicate a preference for Russian wild salmon, particularly from the north Kamchatka region. Since Chinese factories are not prepared to make upfront cash payments to Russian parties, they often obtain Russian salmon raw materials through brokers based in South Korea (and also Japan). Imports of Russian salmon by China, whether or not via Japan or Korea, require Russian Certificates of Origin* and problems with these documents have led to rejection of shipments in several cases.

South Korea does not have a thriving domestic market for salmon, but it appears to play a key intermediary role in the trade of salmon between the Russian Federation and consumers and processors in Japan and China. One of the reasons for this is South Korea's historical role in servicing vessels and equipment operating in the Russian fishing grounds. In addition, South Korea offers low-cost bonded warehouse facilities which can serve as duty-free storage areas for Russian salmon. In addition to lower costs, traders report that procedures for receiving product, transferring ownership, and shipping it on to its final destination are expedited in South Korea compared to other countries. This third-party trade through South Korea may be particularly attractive to both Russian fishery companies and Chinese processors because it allows brokers to buy fish from Russians with cash or other barter, then sell product to processors on credit. Since these bonded areas are not subject to Customs record-keeping, it is not possible to use South Korean import and export statistics to gauge the amount of trade passing through them unless the products are eventually imported into South Korea. The Russian Federation reports that 25% of its seafood is exported to South Korea, but at least in terms of salmon, South Korea's imports from the Russian Federation are minimal (<100 t of Sockeye and <3000 t of Chum and Pink per annum). Although third-party trade may increase the opportunities to tamper with Certificate of Origin documentation, there is no evidence that Russian salmon are being re-branded as South Korean products.

* (A Certificate of Origin is a document issued by the authorities in the country of origin serving to confirm the place of production.)

Compilation and modelling of catch, import and market data were undertaken to assess the potential extent of IUU Russian Sockeye products in East Asian markets. An initial, rudimentary comparison of catches and Customs data indicated that Japanese imports of Russian Sockeye exceeded Russian exports in all years, and exceeded reported Russian catches in three of five years examined. Despite different methodologies and data sources, Bayesian models of the quantity of Russian Sockeye in the markets of East Asia consistently indicated that traded quantities are large compared to reported catches. Furthermore, modelled catch and trade quantities showed statistically significant quantities of excess catch (traded quantities in excess of reported catches) in 2005 in both models, and a strong suggestion of excess catch in 2003–2004. For these years the median quantities of annual excess catch were estimated to range from 8000 to 15 000 t representing a value of USD40 to 76 million. These traded amounts are 150% to 190% of reported catches and compare closely with previous estimates suggesting that IUU activities in the Russian Far East represent an additional 40–60% above officially reported catch values. Since this analysis was focused on trade only, it was not possible to determine whether the excess catch represented illegal or merely unreported catch. However, consistency between the results for the Import Model and the Market Model suggests that excess catch reaches the market via a channel accounted for in both models, therefore pointing to a route involving cargo vessels rather than landings via fishing vessels.

An analysis of potential trade measures that are being or could be taken by East Asian markets to combat IUU salmon fishing in the Russian Federation was conducted for government, industry, and consumers. Although industry and consumers can assist in ensuring that particular supply chains exclude IUU fishing products, in the absence of strict government controls on ports and other Customs borders, the products of IUU fishing can continue to infiltrate other channels within East Asian markets. Therefore, in order to close East Asian markets to IUU salmon, many of the recommendations are focused on actions by East Asian governments. More broadly, since all of these actions would be implemented outside the Russian Federation, and would not necessarily affect operations in the Russian fishing grounds, they would not necessarily deter IUU fishing for other markets (i.e. either domestic or outside East Asia). It is thus critical to view the recommendations of this study as part of a package of measures which must be supplemented by corresponding actions within the Russian Federation.

Recommendations

- Russian control of export documentation would be considerably strengthened if transhipment at sea were prohibited and intelligence formulated on a shipment-by-shipment basis. East Asian import control officials should lend their support to such proposals when co-ordinating with their Russian counterparts.
- Co-operation between the Russian Government and East Asian port State control authorities should be expanded to include not only Russian flagged vessels but non-Russian flagged vessels operating in the Russian EEZ or adjacent high-sea areas.

- A co-ordinating group should be formed involving Russian, Japanese, Chinese and South Korean import control officials, to share information on counterfeiting and other import documentation irregularities for North Pacific fisheries products.
- Where the scope of national legislation is insufficient for validating Certificates of Origin in bonded warehouse areas, authority should be strengthened to prevent such areas being used as a means to facilitate IUU fish trade.
- Import control authorities should begin a programme of random inspections as a step towards confirming the accuracy of declared contents. In conjunction with this, a formal mechanism through which fisheries personnel can be consulted for specialist knowledge by Customs authorities should be implemented.
- China and South Korea should consider enhancing seafood labelling and traceability systems to incorporate information on species, fishing ground and country of origin where not already required.
- Japan and China should produce National Plans of Action under the International Plan of Action to Prevent, Deter and Eliminate IUU Fishing.
- China should be urged to join the North Pacific Anadromous Fish Commission (NPAFC) because of its major stake, as the world's leading fish processor, in managing Pacific salmon stocks and its important role in potential port State or trade measures to support such management.
- The NPAFC should expand the remit of its Enforcement Committee to consider port State and trade-related measures. Co-ordinated discussion of port State and trade-related measures can assist in curbing IUU fishing activities on the high seas and assist members with domestic EEZ issues, as well as support better estimation of actual catches and improved stock assessment.
- Seafood processors, distributors, wholesalers and retailers should comply with all national labelling and product traceability requirements, and when not already required, consider labelling all products with country of origin, species name and fishing ground.
- East Asian salmon producers who wish to gain a market advantage for their products should consider implementing voluntary codes of conduct to validate legal provenance. Certification schemes, such as the Marine Stewardship Council certification, can assist with chain of custody documentation as well as heighten public awareness of responsible fishing issues and serve to suppress demand for the products of IUU fishing.
- Consumers should take an active, rather than passive, role in obtaining complete and correct information regarding the provenance and production methods of locally offered supplies.
- Academics, independent researchers and environmental groups should continue to co-operate through existing fora such as the IUU Monitoring Network and the Chatham House initiative to advance research, influence policy and educate consumers, specifically in East Asia.

STUDY BACKGROUND AND OBJECTIVES

Kamchatka's salmon resources must be protected from overfishing

The Bering Sea is one of the world's most productive cold-water ecosystems, but its resources have been subject to heavy fishing pressure and previous studies have identified illegal, unregulated and unreported (IUU) fishing as a major issue for the area (Vaisman, 2001). In addition, oil and gas extraction proposals heighten concerns for offshore, coastal and riparian habitat (Augerot, 2005). Ongoing efforts to study and conserve salmon species are targeting areas with high natural species diversity, un-degraded spawning habitat and limited existing legal and regulatory protection, and thus the salmon of the Kamchatka peninsula are a particular focus. This peninsula alone may produce as much as one quarter of all wild salmon in the Pacific (Augerot, 2005). Import data clearly indicate that East Asian markets receive a large portion of the Russian Far East's salmon catch. These markets may also play an active role in creating incentives for the illegal salmon trade. Therefore, exploring the relationship between markets and fisheries for Russian Far East salmon can provide a unique window on current salmon use practices as well as lead to new insights for sustainable management.

The study has three specific objectives concerning East Asian markets

This study is a component of a larger project to conserve Russian salmon being conducted by WWF, the global environmental conservation organization, under a grant from the Gordon and Betty Moore Foundation. This study's main technical objective is to describe in detail the trade of Russian salmon through East Asian markets. The overarching aim is to identify means of encouraging demand for legally-sourced products and discouraging IUU fishing in the Russian Federation. Specific objectives of this study include:

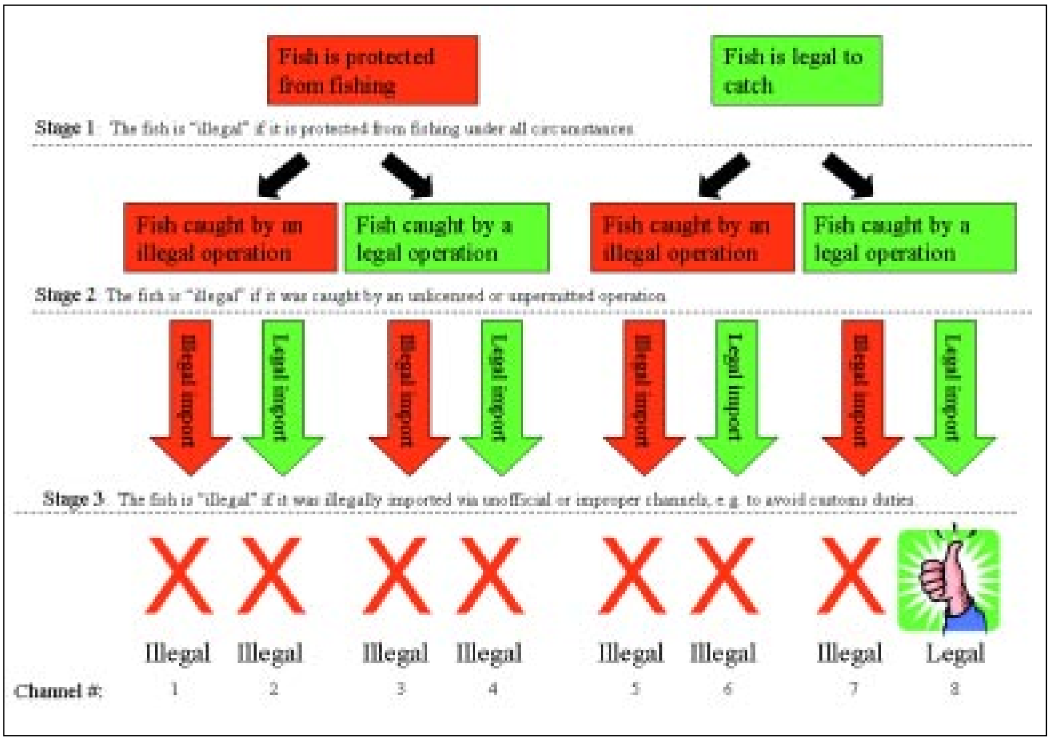
Objective 1: Investigate the legal salmon trade with a focus on Russian salmon and a view towards identifying existing supply chains with clearly traceable provenance and the potential for increasing transparency in other supply chains;
Objective 2: Examine the involvement of Japan, China and the Republic of Korea (South Korea) in the trade of IUU salmon products from the Russian Federation;
Objective 3: Recommend measures relevant for the trade in Japan, China and South Korea which can reduce the incentives for IUU fishing of Russian salmon stocks.

It is impossible to distinguish legal from illegal Russian salmon products in the marketplace

There are several ways in which IUU fisheries products can enter markets (**Figure 1**). With specific reference to Russian salmon, this study is tasked with identifying products which are IUU in Stage 2 (i.e. sourced from unlicensed operations). However, from a practical standpoint, for any study focused on markets it is difficult, if not impossible, to separate Stage 2 IUU fisheries products from those products which were caught in a legal manner, but imported or distributed improperly (Stages 3 and 4). Indeed, with the exception of Marine Stewardship Council (MSC) certified Alaskan salmon introduced in Japan in 2006, there are no reliable methods for distinguishing legal from illegal salmon products in any East Asian market. Even genetic methods, which could in theory identify stock origin, would not guarantee legal provenance.

Figure 1

Stages of production and trade at which fisheries products may be considered legal or illegal. The arrows and boxes refer to whether the fish is legal at the respective stage only; the ultimate legality is shown at the bottom. A fourth stage, in which fisheries products may be illegally distributed or sold (e.g. by unlicensed vendors or in violation of retail regulations), is not shown. Please note that the specific situation of Japanese vessels fishing by permit in the Russian EEZ and landing catches in Japan (see the section *Quantity and market share of Russian salmon products*) is not covered by this generic figure.



First, the salmon market is described without reference to product legality

The difficulties in knowing the provenance of salmon in the marketplace necessitated a two-stage approach in addressing Objective 1. The salmon market in East Asia is initially described without reference to whether products are legal or illegal; the issue of legality is subsequently addressed under Objective 2. Under both objectives, where possible, the portion of the market occupied by Russian salmon is specified. Chain-of-custody documentation systems and labelling requirements as they apply to salmon are discussed in support of Objective 1 under stakeholder actions in the section **East Asian salmon trade and role of Russian salmon**.

In order to examine the roles of Japan, China and South Korea in the trade of illegal salmon from the Russian Federation (Objective 2), it is first necessary to determine whether and to what extent illegal salmon products enter these markets. This study compares the total quantity of Russian salmon in these markets to catch estimates from the Russian Federation. Although this is a crude approach to identifying the potential contribution of IUU fishing activities to the market quantity (i.e. it may include Stage 3 illegal products), it is the only approach possible given the available data. If quantities in the marketplace are larger than the quantities which could be produced by legal, reported catches, the magnitude of discrepancy may suggest the extent of IUU activities. This analysis addresses Objective 2 and is presented in the section **Estimation of potential amounts of IUU Russian salmon in East Asian markets.**

A comparison between market quantities and catches indicates the potential for IUU

After describing the characteristics of the salmon distribution systems in East Asian markets which illegal products from the Russian Federation may infiltrate (Objective 1), and assessing the extent of the potential trade in IUU fishing products (Objective 2), recommendations for trade measures to combat IUU activities are formulated. These recommendations take into account government, industry and consumer-based initiatives. However, it is acknowledged that even the best trade measures are one step removed from the illegal activity to be curbed. Such measures are thus inherently less direct and usually less efficient than fishery monitoring and enforcement.

Even the best trade measures are one step removed from the illegal activity to be curbed

As will be seen in the following sections, this study relies heavily on data from Japan. This is because not only is Japan East Asia's largest salmon market, it is also arguably the best documented seafood market in the world. This focus on Japan is not meant to imply that other East Asian markets are less important: in fact, China's fishing processing industry may, in the future, play a major role in the continuing development of Russian fisheries. Furthermore, since the scope of this study is limited to Russian salmon, readers interested in the influence of the Japanese market on other salmon stocks are referred to Knapp *et al*. (2007).

This study focuses on the relationship between the Japanese market and Russian stocks

Practical and effective solutions to the problem of illegal salmon fishing in the Russian Federation will require this study of East Asian markets to be supplemented with studies of the fishery and markets in the Russian Federation itself. Additional information from Russian sources, such as fisheries observers and fishermen themselves, including better documentation of landings or transhipment operations, could provide more accurate estimates of total catches. Information on status and trends in domestic consumption of salmon could indicate that catches are even higher than estimated from foreign markets alone. While this study may identify problems with illegal Russian salmon in the markets of East Asia and propose some remedial measures, conditions in the Russian Federation will continue to determine the status of Russian wild salmon stocks.

Practical solutions will not be based on actions in foreign markets alone

METHODS

The information in this report is referenced to published (printed or web-based) data sources whenever possible. Additional information was gathered through numerous interviews with knowledgeable persons in industry, government and the press. The following sections provide details on the data sources for each market and a list of interview respondents.

Throughout the text foreign currencies are converted to US dollar values for April 2007. The exchange rates at this time were approximately 120 Japanese yen (JPY), 7.7 Chinese yuan (CNY), and 26 Russian roubles (RUR) to one US dollar (USD).

The abbreviation “t” denotes tonnes (1 tonne = 1000 kg).

Data sources—Japan

Japanese import statistics are more detailed and consistent than other East Asian countries

The diversity of commodity codes for salmon products under Japan’s Customs system is extensive (**Appendix 1**). There are a total of 39 codes under which salmon products can be correctly classified, of which 19 are salmonid-specific import codes. These codes span the range from meat to roe and include products in fresh, frozen, dried, smoked, salted or canned forms. One unique feature of Japan’s Customs commodity coding system is that codes for import and export of the same product may differ. Japan made several important changes to its commodity coding system for salmon in 2002, but in contrast to other countries which amended their systems at about the same time, most of Japan’s changes simply involved changing the codes for existing categories. For consistency with other countries, most of the discussion below uses data from 2002–2006 only, but where available and informative, longer time series are used.

Extensive annual statistics are available for Japan's markets

Market data for Japan are compiled by the Japan Fisheries Agency (MAFF, 2006a) in the form of four annual surveys covering: fish counts in landing ports; fish sales in major markets; amounts of fish processed; and amounts of fish in storage. At the time of writing these data were available in a generally consistent format for 2001–2005. In addition to these national datasets, major central wholesale markets provide site-specific data, often in a more detailed format (Tokyo Central Wholesale Market, 2007; Osaka City, 2005). In addition to the interview sources listed in this section, field visits were made to the Sapporo, Tokyo and Osaka central wholesale markets, and to the fishing ports of Abashiri, Nemuro, Otaru and Utoro during the course of this study.

Salmon species are sometimes called trout in Japanese

An important nomenclatural convention should be noted when working with Japanese salmon and trout statistics. In Japanese, salmon (鮭, *sake*) are considered to be Sockeye Salmon (Sockeye) *Oncorhynchus nerka*, Coho Salmon (Coho) *O. kisutch*, Chum Salmon (Chum) *O. keta* and Chinook Salmon (Chinook) *O. tshawytscha* only. Trout (鱒, *masu*) are considered to include Pink Salmon *O. gorbuscha* and Cherry Salmon *O. masou masou*, and Rainbow Trout *O. mykiss*, as well as the conventional trouts.

Data sources—China and Hong Kong

China and Hong Kong data are compiled separately

Customs statistics are compiled, held and published separately for the People's Republic of China (Mainland China) and for the Hong Kong Special Administrative Region (Hong Kong). Basic data by country of origin, quantity and value were obtained from Mainland China statistical yearbooks (GCBI, 2002–2005) and purchase of data for 2006, and through data collection at government offices in Hong Kong (Hong Kong Government, 2007). Additional data on date of shipment, routing country, and receiving location and company were purchased for consignments of Russian salmon in 2005 and 2006 (GCBI, 2007).

China does not record fish fillet quantities by species

Commodity codes for the two jurisdictions are given in **Appendices 2** and **3**. China uses 31 commodity codes which may contain salmon products, 13 of which are salmonid-specific, while Hong Kong uses 23 codes of which 11 are salmonid-specific. A key issue for China is that none of the fish fillet commodity codes (0304) are species-specific so it is impossible to track exports of fish fillets by species and thus to understand the share of domestic consumption within total imports. Hong Kong Customs statistics are unique among the data used in this study in that they provide imports by country of origin and by country of consignment. Both types of records were examined in this study. No standardized sales, consumption or price datasets are available for any type of salmon either in Hong Kong or the Mainland.

Data sources—Korea

South Korean data are limited to Customs statistics

Customs statistics for salmon products entering and leaving South Korea were obtained from an official source (KITA, 2007) using an English translation of the commodity coding system (KCS, 2006). South Korea uses 23 commodity codes which may contain salmon products, 12 of which are salmonid-specific (**Appendix 4**). No standardized sales, consumption or price datasets were located.

Interview respondents

38 interviews were conducted in Japan, China and the Russian Federation

Interview respondents graciously contributed a wealth of collective expertise to this project. The depth of understanding embodied in this report is a direct reflection of their generosity and helpfulness. However, in some cases, the information was provided on the condition that the source not be specifically identified, and in order to prevent attribution by a process of elimination, it was decided to maintain the confidentiality of all participants. A chronological list of the 38 interviews conducted for this project in Japan, China and the Russian Federation provides an overview of their scope (**Appendix 5**).

Probabilistic modelling techniques

Probabilistic, or Bayesian, modelling techniques are applied in this study to estimate the quantities of salmon caught in the Russian Federation and traded in East Asia. By using ranges of values for parameters, rather than point estimates, a Bayesian approach explicitly accounts for uncertainty and provides results in the form of probability intervals (Wade, 2000).

Modelling in this study was performed using WinBUGS software version 1.4 (Imperial College, 2004). WinBUGS uses Markov chain Monte Carlo (MCMC) integration methods and the Gibb's sampler to estimate parameters of interest. Prior probability density functions (pdfs) that represent initial beliefs about the credibility of the possible values for model parameters can be specified using any one of a number of pre-programmed statistical distributions. Statistical distributions are also specified for the expected error distribution of the available observations or data. The prior pdfs are then updated based on the input data, where available, to produce the posterior distributions (i.e. final estimates) for the parameters. As WinBUGS executes, it simulates random sequences of values for each parameter. The algorithm is designed such that the distribution of simulated values is expected to approximate more closely to the posterior distributions for the estimated parameters as the number of simulations increases. The first several hundred or thousand parameter values simulated using MCMC methods typically provide poor approximations of the posterior and need to be discarded; this discarded initial set of parameter values is commonly referred to as the "burn-in". The remaining parts of the simulated chains of values are used to provide approximations of the posterior distributions for the estimated parameters. Convergence diagnostics are evaluated to identify the length of the burn-in and to ensure that the remaining Monte Carlo chains have arrived at stable distributions for estimated parameters.

In this study, data were very limited and in some cases parameter estimation relied much more heavily on priors than on data. For this reason, convergence is not a major issue but the models are highly sensitive to the specification of priors. Where there is a high degree of uncertainty concerning the priors, sensitivity tests were conducted to assess the effect on the end results of the model. The algorithms presented in this report can and should be supplemented by further data collection, and perhaps modified as new data sources become available.

THE EAST ASIAN SALMON TRADE AND THE ROLE OF RUSSIAN SALMON

Customs data were compiled for Japan, China, Hong Kong and South Korea

This discussion seeks to describe the markets for salmon in Japan, China and South Korea based on available data. Customs datasets are a key source of information but they suffer from a number of important drawbacks. Most importantly, the usefulness of Customs data for particular products may be severely limited by the specificity of the commodity coding system. For example, most national databases separate only Sockeye from other species of wild Pacific salmon. Furthermore, China, arguably the world's most important centre for fish processing, records all exports of fish fillets under a single, generic category. Customs data also suffer from several biases including under-declaration, mis-declaration and non-declaration of traded quantities (Clarke, 2004a). With these caveats in mind, this section uses Customs data, supplemented by market and interview information, to map in broad terms the supply chain for salmon to East Asian markets. A description of each market is presented below.

Japan

Quantity and market share of Russian salmon products

Japan is the world's largest salmon importer

Based on 2004 global statistics (FAO, 2006), Japan is the world's largest importer of salmon products (183 040 t of salmon[1]), leading the second-largest importer (Denmark) by nearly 35 000 t per annum[2]. Japanese import data for the Russian Federation and in total (i.e. from all countries) were compared for the years 2002–2006 to investigate for which of the 19 recorded product types the Russian Federation is a key supplier (Japan Customs, 2006a). Russian imports contribute over 20% of total imports in any given year in only four categories: frozen Sockeye; frozen "other" Pacific salmon (not Sockeye and Coho Salmon); frozen livers, eggs or soft roes of fishes; and processed salmon in airtight containers (i.e. cans). The two species-specific product types will be assessed first, then the discussion will return to the final two product types.

Fresh/chilled and frozen salmon meat

Most imports from the Russian Federation are in frozen form

Japan's imported quantities of frozen Pacific salmon (Sockeye, Coho and "other"), 2002–2006, have averaged nearly 40 times greater than its imported quantities of fresh or chilled Pacific salmon (**Table 1**). In addition, almost none of its fresh/chilled imports originated in the Russian Federation.

The Russian Federation's main contribution to the Japanese market is frozen Sockeye

The Russian share of frozen Sockeye imports is slightly lower (37–55%) than that for "other" Pacific salmon, but the average annual quantity of Sockeye imported from the Russian Federation (22 700 mt) is higher. Japan imports little of its frozen Coho from the Russian Federation (<2%).

1 Calculated from FAO's three SITC groups for salmon and salmonids, excluding all non-salmon salmonids.

2 Based on a complex methodology for calculating consumption through 2004, Knapp *et al*. (2007) report that the European Union recently surpassed Japan as the world's largest salmon market. Nevertheless, if evaluated on the basis of imports reported to FAO by individual countries, Japan remains the largest importer.

Table 1

Japan's total imports (t, first line), and quantity (t) and percentage (in parenthesis) from the Russian Federation (second line), for fresh/chilled and frozen Pacific salmon, 2002–2006

	2002	2003	2004	2005	2006
Fresh/Chilled					
Sockeye	50	50	88	37	43
	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Coho	0	0	4	0.5	0
	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
"other"	1513	2136	1981	1447	1057
	0 (0%)	36 (2%)	0 (0%)	0 (0%)	68 (6%)
Frozen					
Sockeye	55 225	47 546	51 524	55 602	44 755
	24 562 (44%)	20 892 (44%)	18 827 (37%)	24 759 (45%)	24 649 (55%)
Coho	81 457	57 863	77 102	72 403	73 382
	614 (1%)	1074 (2%)	871 (1%)	1080 (1%)	632 (1%)
"other"	15 168	11 403	13 553	12 886	9 648
	6434 (42%)	5277 (46%)	5430 (40%)	6143 (48%)	5658 (59%)

Source: Japan Customs 2007a.

"Other" Pacific salmon imports from the Russian Federation are likely to be Chum

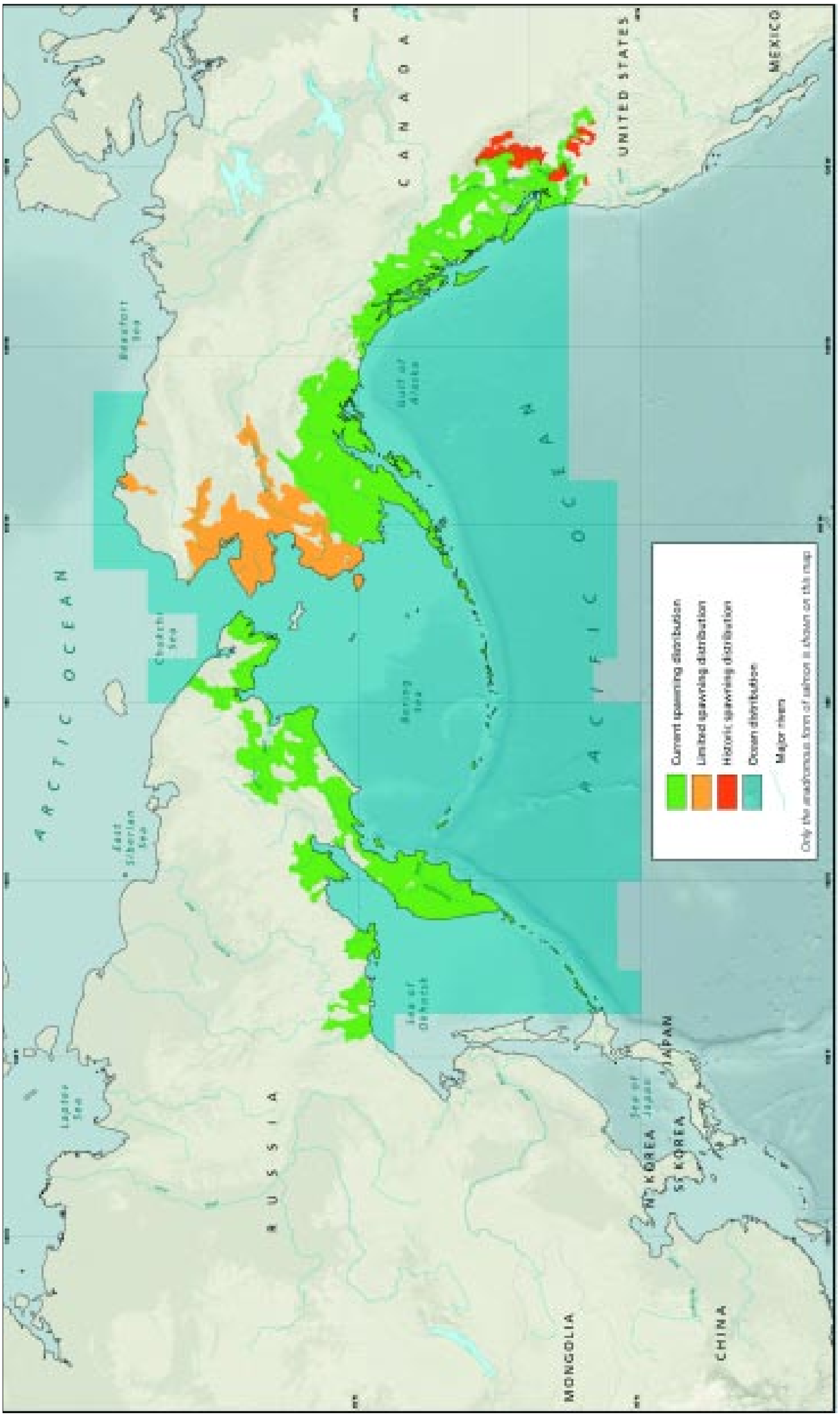
Russian imports command the highest share in the category of "other" frozen Pacific salmon where they account for 40–59% of the total imports or an average of 5800 t per annum. Of the seven species of wild salmon produced by the Russian Far East, i.e. Sockeye, Coho, Chum, Chinook, Rainbow Trout, Pink and Cherry Salmon (Augerot, 2005), only the first four are caught in quantities of consistently over 1000 t per year and thus represent at least 0.6% of the total catch (NPAFC, 2007a). Given these catch data, the fact that Sockeye and Coho should be recorded under separate import codes, and the classification of Pink Salmon in Japanese as "trout" (*masu*), it is reasonable to assume that most of the "other" Pacific salmon imported from the Russian Federation is Chum. Total fresh/chilled or frozen imports of "trout" (*masu*) from the Russian Federation amounted to 299 t in 2002 but have been nil in subsequent years.

Japan's Sockeye is supplied by the USA and growing Russian fisheries

While large quantities of Japan's imports of Sockeye and "other" Pacific salmon derive from the Russian Federation, it is also important to consider other sources of supply (**Figure 2**). Imports of Sockeye are shown by source country for the last 10 years in **Table 2**. These data indicate that in the late 1990s Sockeye supply was dominated by imports from the USA, but over the past 10 years the US supply has decreased while the Russian supply has climbed from 18% in 1996 to 55% in 2006. The US Sockeye is almost all (>98%) from Alaska (NPAFC, 2007a), and thus nearly all is certified to the Marine Stewardship Council (MSC) standard for sustainably managed fisheries. Although reliance on hatchery production for Alaskan Sockeye varies by region, overall only 12% of Alaska's Sockeye derives from hatcheries (Knapp *et al.*, 2007). In the Russian Federation, only 1% of released fry in 2004 were Sockeye (NPAFC, 2007a) and the fishery is not certified to MSC standards.

Figure 2

Map of Sockeye distribution



Source: Augerot, 2005, map reproduced by kind permission of the Wild Salmon Centre, Portland, Oregon.

Japanese catches in the Russian EEZ are considered landings not imports

In addition to Sockeye supplied by US and Russian fisheries, Japan also operates driftnet fisheries in the Russian Exclusive Economic Zone (EEZ) (WWF-Russia, 2004). According to official quota and catch records (TINRO, 2006; MAFF, 2006b) between 30 and 40% of the 11 000 t total driftnet catch is Sockeye, and Chum comprise most of the remainder. These fish are landed in Japanese ports as Japanese products and are not counted as imports (**Table 2**). The western Pacific Sockeye spawning distribution does not extend to Japanese territory (although it includes the disputed southern islands of the Kurile archipelago; Augerot, 2005). There is no fishery for Sockeye in Japanese waters although it is possible that small numbers of migrating Sockeye may be intercepted by Japanese set nets along the coast. For these reasons, with the exception of the catches of Japanese driftnet fishery in the Russian EEZ, and any minor incidental catches in coastal set nets, Japan's Sockeye supply is heavily reliant on imports.

Most of Japan's Coho supply is farmed

As noted above, imports from the Russian Federation of Coho are minor. Although the Russian Federation has stocks of wild Pacific Coho, the majority of Japan's Coho imports (averaging 72 000 t per annum) are from Chile (94–99% in 2002–2006) which has no natural salmon stocks but hosts large industrial salmon farms. Interviews with traders suggest that the Chilean Coho is preferred for *sushi* and *sashimi* because parasites can be controlled through antibiotics and/or freezing. Chilean Coho is also often sold for grilled (*yakisakana*) products in Japan. Domestic salmon farming operations in Japan produce approximately 10 000 t per annum of Coho (Sano, 2003; Hokkaido Economic News, 2005; Gyoren, 2006). The distribution of Coho is primarily north and east of Japan's territorial waters (Augerot, 2005), therefore Japanese wild or ranched production is not reported in substantial quantities.

Table 2

Frozen Sockeye supply (t) to Japan

	USA	Canada	Russian Federation	Percent of Imports from Russian Federation	Japanese Catch in Russian waters	Total Supply
1996	79 251	4030	17 901	18%	5200	106 382
1997	43 595	9958	10 368	16%	8800	72 721
1998	33 142	2491	11 412	24%	5000	52 044
1999	40 954	481	12 186	23%	6800	60 420
2000	35 397	2079	16 354	30%	4000	57 829
2001	29 166	2938	17 489	35%	4000	53 592
2002	26 366	3920	24 562	45%	2200	57 048
2003	24 885	1644	20 892	44%	2000	49 422
2004	30 980	1690	18 827	37%	2300	53 798
2005	30 212	510	24 759	45%	3000	58 482
2006	18 158	1942	24 649	55%	2990	47 739

Sources: Japan Customs, 2007a (USA, Canada, Russian Federation imports); various sources (Japanese catch data).

The situation with regard to Japan's supply of the other Pacific salmon species is more complex. The Russian Federation dominates imports of "other" Pacific salmon (**Table 1**), mainly Chum but potentially Chinook, but Canada and New Zealand also contribute up to 2000 t per annum. However, in contrast to the Sockeye market, imports comprise only a small proportion of the total supply. This is due to Japan's voluminous production of relatively low-value, largely "ranched" (i.e. originating from hatcheries) Chum by coastal set net fisheries (Edzure 2006). Japan's recorded catch in 2004 was 74% of the global total of Chum catches (262 000 t of 351 000 mt; FAO, 2006). Japan also catches 10 000 to 20 000 t of largely ranched Pink Salmon annually in its coastal set nets, driftnets and river fisheries (Kaga, 2005). Japan imports an average of 62 000 t per annum of "trout" (*masu*) which may include Pink Salmon, Cherry Salmon or Rainbow Trout, but >98% is from Norway, Chile or Denmark, suggesting it is mainly farmed species, i.e. Sea Trout *Salmo trutta* or Atlantic Salmon *Salmo salar*.

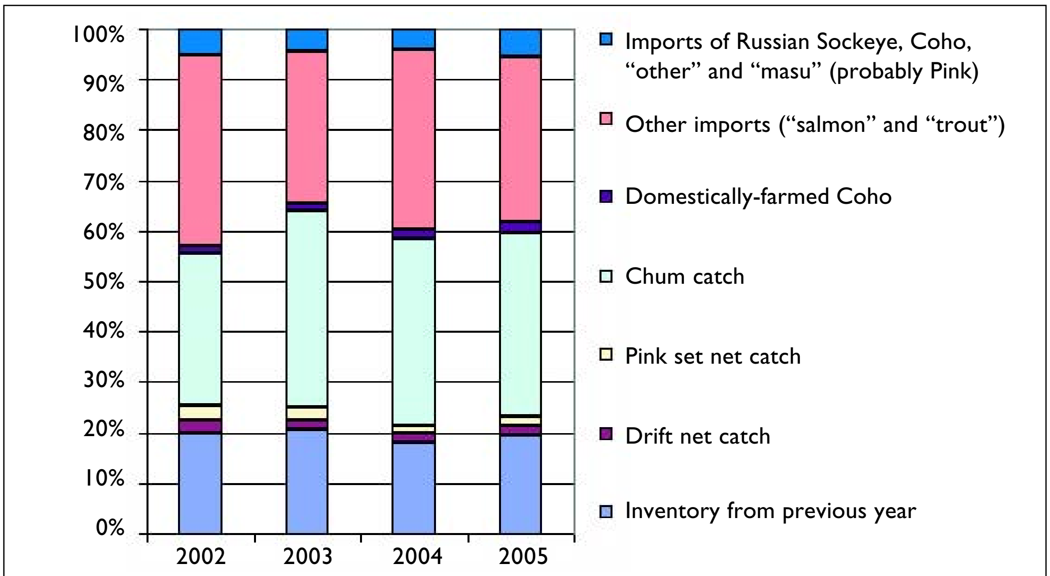
Quantities of imported "other" salmon are dwarfed by Japan's domestic production

When all of the domestic, Russian and other sources of salmon supplied to the Japanese market are considered, the portion represented by Russian wild salmon imports is minor. Part of this trend mirrors a worldwide decline in wild salmon market share due to increasing production of farmed salmon and trout: wild Sockeye comprised 33% of Japan's salmon supply in 1993 but only 11% in 2004 (Knapp *et al.*, 2007). **Figure 3** illustrates the impact of these trends on the Japanese market for the period 2002–2005. The total imported quantity of salmon and trout in each year ranges from 35 to 43% of the total supply, but much of these imports are farmed salmon. Imports of wild fish from the Russian Federation, including fresh/chilled or frozen Sockeye, Coho, "other" Pacific salmon (Chum or Chinook) and *masu* (Pink Salmon, Cherry Salmon, or Rainbow Trout) total only 4–5% of the Japanese market.

Russian imports of Sockeye, Coho, Chum and Chinook Salmon total only 4–5% of the total market

Figure 3

Total annual supply of "salmon" and "trout" to the Japanese market, 2002–2005



Sources: Gyoren, 2006; Japan Customs, 2007a.

Roe and canned products

Imports of* ikura *(loose eggs) are small, but imports of* sujiko *(ovaries) may be large

Returning to the final two product types frequently imported from the Russian Federation which lack species-specific information, quantities of *ikura* (processed loose salmon roe) imported from the Russian Federation to Japan comprise no more than 4% of total *ikura* imports during 2002–2004 and nil in 2005–2006. However, imports from the Russian Federation classified in the Customs system as “frozen livers, eggs and soft roes of fishes” (0303.80–090) are assumed by one source (Gyoren, 2006) to be entirely *sujiko* (whole salmon ovaries, **Figure 4**). Since this import category includes other products (e.g. livers, eggs and soft roes of other species), the total imported amount of *sujiko* is unknown, and it is not possible to determine what share of salmon roe (*sujiko* + *ikura*) in the Japanese market derives from the Russian Federation. However, during 2002–2006 the Russian contribution to the 0303.80-090 import category was 19–45% of the total.

Import data suggest Japan’s supply of salmon roe is contracting

Traders report a trend towards processing of *sujiko* into loose, flavoured roe (i.e. *ikura*) farther and farther upstream in the supply chain, in this case potentially in the Russian Federation. This trend is said to occur because the highest profit margins accrue at the point of processing, yield increases with the addition of flavouring, and there is a wider international market for *ikura* than for *sujiko*. Indeed, the inferred share of *sujiko* from the Russian Federation has decreased from 45% in 2002 to 19% in 2006, and the total quantity in the import category has fallen by one-third over this

Figure 4

***Ikura*, loose mature salmon roe flavoured in various ways (left), and *sujiko*, immature unflavoured roe still within the ovarian membrane (right)**

Credit: S. Clarke

Credit: S. Clarke

period. The expectation would then be that imports of *ikura* would rise in response, but the total amount of *ikura* imported by Japan has also fallen from 5132 t in 2002 to 2564 t in 2005 and 3157 t in 2006. An additional factor to consider is that import duties on processed salmon products are substantially higher (currently 12–15%, reducing to 8.4–10.5% of declared import value if the Russian Federation joins the World Trade Organization (WTO)) than import duties on raw products (currently 5%, reducing to 3.5%) such as *sujiko*. Therefore it is possible that the declining trend in imports indicates that Russian salmon roe is increasingly being traded to *ikura* markets outside Japan, including the western Russian Federation.

Roe products are almost always from wild fish, and best if unfrozen with large egg diameter

No quantitative data are available on the species composition of Japanese *ikura* or *sujiko*, though most sources believe that Chum and Pink Salmon are most commonly used. Traders stated that *ikura* prices are in part determined by the diameter of the eggs and thus species with small eggs, e.g. Pink Salmon, are not preferred. However, it is also the case that *ikura* which has never been frozen is preferred, thus domestic supplies, i.e. Pink Salmon and Chum, which can be transported to market quickly during the spawning season, would command higher prices than supplies from North America or the Russian Federation which must be frozen for transport. Fisheries in north-eastern Japan (Hokkaido) have increased exports of domestically produced salmon (i.e. Chum and Pink Salmon) from about 40 000 t in 2001 to 94 000 t in 2005. Fishermen and traders confirmed that *ikura* would be removed from these fish prior to export. One trader suggested that 70% of Japan's *ikura* derived from Chum. Another trader suggested that the highest quality roe derived from Sockeye and Coho but that this roe was only sold as *sujiko*. Such products are likely to be rare since there is a trade-off between meat quality and roe quality as the season progresses, and both Sockeye and Coho are valued for their meat. The same holds true for farmed Coho: although it could in theory produce *sujiko* (or *ikura*), traders stated that farmed roe is rarely used for these products (interview information and Knapp *et al.*, 2007).

The Russian Federation's share of the small market in Japan for canned salmon is minor

Canned salmon consumption currently accounts for 7% of global salmon consumption, but the primary markets for canned salmon are Europe and North America (Knapp *et al.*, 2007). From 2002–2005 Japan imported a total quantity of 300–650 t of canned salmon but in 2006 this amount nearly doubled to 1327 t of which 85% was imported from Thailand, China or Viet Nam. Japan's canned salmon imports from the Russian Federation were 28% of the total in 2002 but this had dropped to 6% in 2006. Japan's domestic production of canned salmon in 2006 was 3700 mt, more than double the size of the import market. Although the market for canned salmon in Japan is not large, it is historically important. In the 1950s, fishing rights for Sockeye in what are now Russian waters and canning of the product for export to Europe was a critical source of foreign exchange for post-war Japan and fuelled the rise of Nichiro, one of Japan's largest fish products companies (Honda, 2004).

Distribution and consumption of salmon products within Japan

This section of the report describes how frozen salmon meat and salmon roe are distributed and consumed within Japan. Specific topics include ports of entry, pricing, *This section focuses on frozen salmon and salmon roe*

distribution systems and location of consumption, and seasonality. The preceding discussion has established that the markets for fresh/chilled Russian salmon meat and canned salmon in general are minor, therefore the following discussion focuses on frozen salmon and *sujiko*/*ikura*.

Ports of entry

Market conduits for frozen Russian salmon are on Hokkaido and Honshu

Japanese Customs data allow identification of which ports in Japan serve as the main conduits for Russian salmon products (**Figure 5**). Frozen Sockeye from the Russian Federation is received primarily in Shiogama (roughly 30–45% in 2002–2006), the port city for Sendai in Miyagi prefecture. This area used to be a major processing centre for Skipjack *Katsuwonus pelamis* but this function is said to be waning. Some traders disputed the veracity of such large quantities of Sockeye received by Shiogama (i.e. they believed the data were the result of mis-declaring other species as Sockeye). Other traders cited Shiogama's traditional role in producing a special salted fillet product and high local consumption as the reason for its major role in Russian Sockeye imports.

Anecdotal evidence suggests some undocumented trade passes through northern Hokkaido

Ports receiving 10–20% of Russian frozen Sockeye imports in 2002–2006 include Kushiro, the home base of Japan's salmon driftnet fleet; Hakodate, a major fish processing centre; and Ishikari, a container terminal located approximately 15 km north of Sapporo which is the home of Hokkaido's largest fish market. The port of Otaru and Sapporo itself also receive 2–10% of total Russian frozen Sockeye imports. Other major fishing ports along the northern coast of Hokkaido, such as Wakkanai, Monbetsu and Abashiri do not play a major role in the official salmon trade with the Russian Federation (Japan Customs, 2006a), but anecdotal information suggests that these ports may receive undocumented salmon landings from Russian waters.

Figure 5

Major trade flows for frozen Sockeye (orange) and "other" frozen Pacific salmon (green) from the Russian Federation to Japan based on Custom statistics and interview information

Source: Japan Customs 2006a.

The same ports handle most imports of Russian "other" frozen salmon except that the role of Shiogama is reduced. Kushiro imports up to 40% of the total followed by the ports of Sapporo and Ishikari, Hakodate and Otaru. Shiogama accepted 10% of the total imports in its peak year (2004), but only 1% in 2006. *Sujiko* imports from the Russian Federation, inferred from the general fish livers, eggs and roes category, generally follow similar routes. The port of Kushiro dominates *sujiko* imports and in 2006 received as much as 72% of shipments coming from the Russian Federation. Shiogama received between 4 and 24% during the period 2002–2006. Other ports receiving at least 10% of the total in any one year include Hakodate, Tokyo, Ishikari and Sapporo (Japan Customs, 2006a).

Generally the same ports handle "other" frozen salmon and salmon roe

Pricing

There is an extensive literature describing factors influencing the price of salmon in Japan (Shimizu, 2002; Shimizu, 2004; Shimizu, 2006). These studies identified that the amount of salmon landed in Japan, the amount of imported salmon, and the amount of salmon in inventories all influenced price. Information on long-term trends in salmon prices is also provided in Knapp *et al*. (2007). The analysis presented below focuses on short-term price information and on contrasts between the different types of imported wild salmon available in the Japanese market. A secondary objective of this analysis is to test whether prices derived from declared values of imports, which have been used in previous studies to represent country- and species-specific prices are accurate.

Determinants of price for Japanese salmon have been extensively studied

Price data for salmon by country of origin can be derived by dividing declared value by quantity in import data. Price data are also available for salmon in central wholesale markets, but most of these datasets group salmon products by form (e.g. frozen or salted) rather than by species, and none provide information on country of origin. This analysis uses data published by Japan's largest fish market, the Tokyo Central Wholesale Market (also known as Tsukiji) which gives prices for frozen Chum, Sockeye, Coho, Chinook, *masu* and "other" salmon but does not indicate origin.

Price data are available by country or by species, but not both

Wholesale salmon price trends for Tsukiji, and derived values of imports from the Russian Federation and imports from the USA for Sockeye are shown in **Figure 6**. Prices of Sockeye in the mid-1980s exceeded JPY1200 per kilogramme (Knapp *et al*., 2007) but currently, with the exception of the price point for February 2006, Sockeye prices at Tsukiji are stable at or above JPY600 (USD5.05) per kilogramme. This major decline in price is attributed to an increase in salmon supply as well as a slowdown in the Japanese economy and the rise of large-scale distributors, such as supermarkets (Knapp *et al*., 2007). When Sockeye prices are contrasted with declared values of imports from the Russian Federation and the USA, declared values are more variable and usually considerably lower at around two-thirds of the market value. Market prices might be expected to be higher because they may include cold storage costs, interest and dealer commissions, as well as the fact that markets may preferentially handle only the highest grades of salmon (G. Knapp, *in litt.* to R.C. Kirkpatrick, 12 June 2007). Conversely, declared import values may be suppressed by a desire to minimize import tariffs.

Wholesale market prices are better indicators than import-derived values

It is difficult to identify whether Russian Sockeye imports are more valuable than US Sockeye imports from these data. This may be because the quality of the fish will depend not only on the country of origin but also on the catch and handling methods. One specialist trader explained the grading of driftnet-caught Sockeye in the Japanese market as follows:

- Sockeye caught by Japanese in the Russian EEZ (price of JPY1500–2000, or USD12.50–16.60, per kilogramme);
- Sockeye caught by Russians in the Russian EEZ (JPY1000–1500, or USD8.30–12.50, per kilogramme);
- Canadian Sockeye and selected Alaskan Sockeye;
- Southeast Alaska Sockeye; and
- Bristol Bay Sockeye.

Russian Sockeye is said to be the most preferred wild species in Japan

Another trader explained that higher quality Sockeye had a higher fat content and that fat content was inversely proportional to water temperature. He stated that Sockeye off Hokkaido had a fat content of 13–15%, whereas as those caught off west Kamchatka averaged 15–16% and those off East Kamchatka 17–18%. River-caught Sockeye is generally of lower quality. Prices are reportedly as low as JPY300–600, or USD2.50–5.00, per kilogramme (V. Tsygir, TINRO, *in litt.* to R.C. Kirkpatrick, 29 May 2007).

Russian import-derived prices for "other" Pacific salmon more closely match Chum, than Chinook, prices

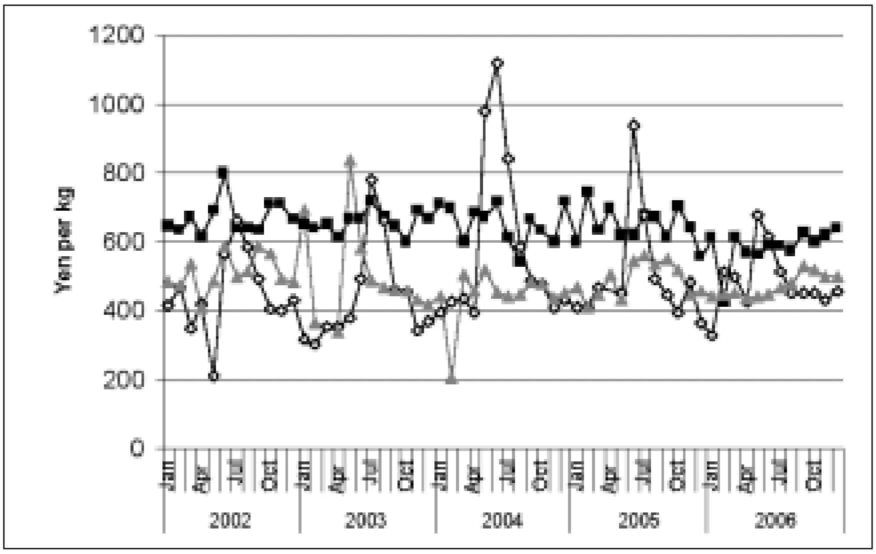
The price of "other" Pacific salmon varies more widely between the datasets than does the price of Sockeye (**Figure 7**). When sampling from the Tsukiji data, the prices of Chum were selected to compare to the price of "other" Pacific salmon in the import database from the Russian Federation. Chinook data are also shown (**Figure 7**) since imports of this species would also fall within this "other" category and may be substantial for Alaska. The Tsukiji Chum prices correspond closely to the prices derived from the Russian imports where the major species is expected to be Chum. These data indicate that the price is generally below JPY400 per kilogramme and thus approximately two-thirds the price of Sockeye. In the US data, some of the import prices approach those commanded by the highest quality Sockeye in the Japanese market (i.e. JPY1500–2000, USD16.60–12.50 per kilogramme). These fish may be high-grade Chinook but some of the US import prices exceed even the Tsukiji wholesale prices for Chinook (**Figure 7**). Prices appear to be rising for Chinook but relatively stable for Sockeye and Chum.

Prices trends for ikura *and* sujiko *appear related until 2006*

Tsukiji wholesale prices of *sujiko* and *ikura* are shown in **Figure 8**. As expected the two price series track each other for most of 2002–2005 but in early 2006 an inverse relationship is apparent. The overall trend since 2002 is one of declining price with a slight recovery in late 2006. These trends do not indicate that supplies of salmon roe to the Japanese market are decreasing as one might expect from the decline in imports of *sujiko* and *ikura* from the Russian Federation. Clear price increases leading up to the New Year's holiday (1 January), when traders expect *ikura* demand to peak, are also not apparent.

Figure 6

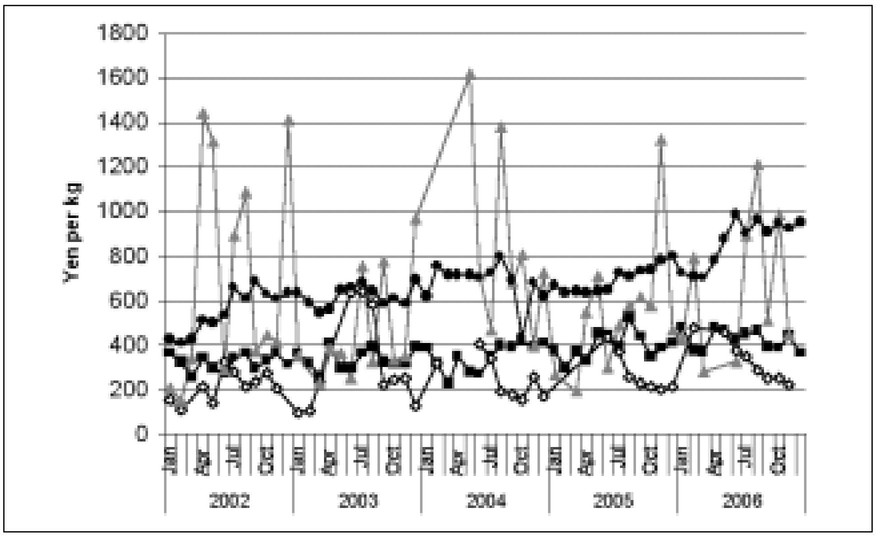
Prices for Sockeye, 2002–2006. Black squares are Tsukiji market prices; open diamonds are declared values from imports from the Russian Federation; grey triangles are declared values from imports from the USA. Missing data points (n=1 for imports from the Russian Federation; n=1 for imports from the USA) have been handled by interpolating between the nearest available points



Sources: Japan Customs, 2007a; Tokyo Central Wholesale Market, 2007.

Figure 7

Prices for "other" Pacific salmon, 2002–2006. Black squares are Tsukiji market prices for Chum; black circles are Tsukiji market prices for Chinook; open diamonds are declared values of "other" imports from the Russian Federation; grey triangles are declared values of "other" imports from the USA. Missing data points (n=14 for imports from the Russian Federation; n=9 for imports from the USA) have been handled by interpolating between the nearest available points



Sources: Japan Customs, 2007a; Tokyo Central Wholesale Market, 2007.

Prices of salmon roe show a long trend of decline, inconsistent with a scarcity of supply

Further context is provided for *ikura* price trends by **Figure 9** which illustrates the extent to which prices have fallen in the Japanese market since the late 1990s. These data track prices for "average quality" *ikura* from the area between Kamchatka and Hokkaido and for "good quality" Alaskan *ikura*. The *ikura* from the western north Pacific is generally JPY1000 per kilogramme more expensive than top quality *ikura* from Alaska, perhaps because the Alaskan *ikura* is necessarily frozen.

Distribution and location of consumption

Russian wild salmon are difficult to distinguish in market data

Assessment of regional preferences for salmon in the Japanese market, and Russian salmon in particular, cannot rely on Customs data. Market data must be used for such assessments. However, as previously explained, Russian salmon are mixed with large numbers of wild salmon from North America, domestically-produced "ranched" salmon and farmed salmon in the Japanese market and market data usually do not provide information on provenance. Of the four salmon species caught in the Russian Federation in large numbers (Sockeye, Coho, Chum and Pink), Russian supplies of wild Coho are swamped by huge quantities of foreign and domestic farmed Coho (see section **Quantity and market share of Russian salmon products**), and Russian wild Chum and Pink cannot be distinguished from Japan's voluminous domestic production of these species. Although Sockeye data are also complicated by the mixing of US and Canadian fish, Japan imports 4–5 times more Sockeye than all other species combined from the Russian Federation (**Table 1**), and the Russian Federation has supplied 45–55% of the Japanese frozen Sockeye in recent years (**Table 2**). Therefore, for frozen salmon meat, this discussion will focus on Sockeye only. Although Russian supplies of salmon roe appear to be small and contracting, and cannot be distinguished from domestically produced roe, a brief discussion of regional consumption patterns for *ikura* and *sujiko* is also presented.

Only for Sockeye do Russian supplies play a major role

Traditional, including heavily salted, product forms are becoming less popular

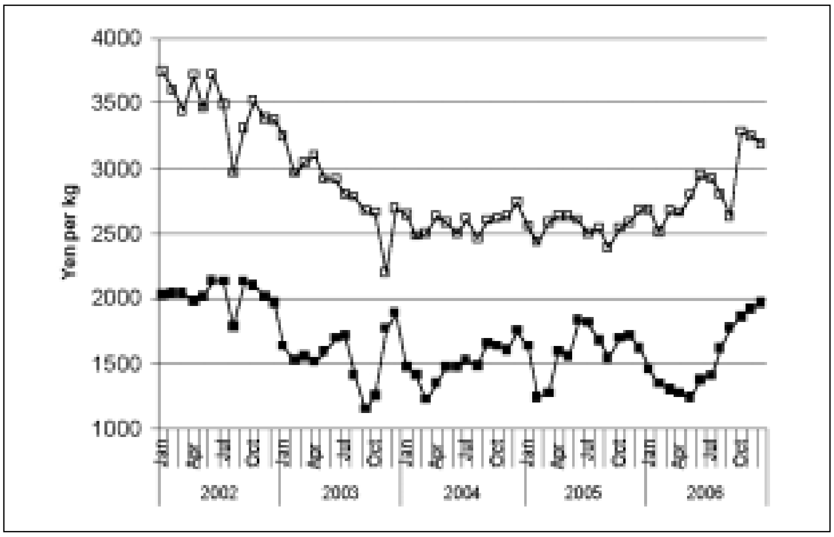
The oldest and most traditional areas for salmon consumption in Japan tend to be in areas with historical salmon fisheries. Per capita consumption is said to be particularly high in Niigata prefecture on the northern Japan Sea coast. Until the introduction of farmed salmon to the markets of Japan, most salmon were sold in heavily salted forms such as *yamadzuke* (**Figure 10**). As the number of consumers willing or able to fillet whole salmon for themselves has declined, and concerns regarding foods with high salt content have increased, more salmon are sold in ready-to-eat, lower salt forms such as "*amashio kirimi*" (low salt, small portion fillets). Traders currently estimate that between 70–90% of all Sockeye products are consumed as salted *kirimi*.

Less demand for traditional products is causing a shift toward more imports in "dressed" form

In response to lower demand for *yamadzuke* and other traditional product forms, which include the head, interview information suggests that since 2005 or so, Russian salmon supplies are increasingly being imported in dressed (headed and gutted) form. Prior to that time all Russian and Japanese catches in Russian waters were gilled and gutted (semi-dressed), salted and frozen. The weight remaining (yield) for dressed salmon is said to be about 75%, whereas the yield for semi-dressed salmon is about 85%. The yield for *kirimi* from dressed form is approximately 80%. These figures

Figure 8

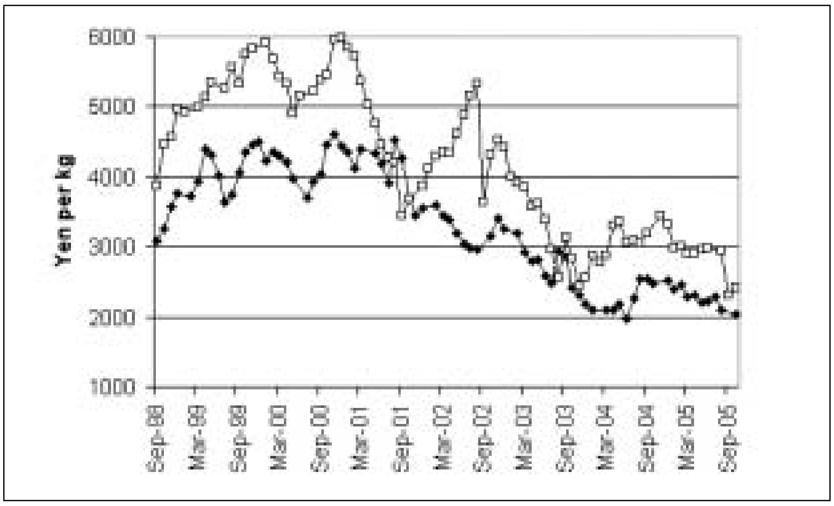
Tsukiji market prices for *sujiko* (black squares) and *ikura* (open squares), 2002–2006



Source: Tokyo Central Wholesale Market 2007.

Figure 9

Long-term trends in *ikura* prices for western north Pacific (open squares) and Alaskan (black diamonds) sources



Source: Hokkaido Economic News, 2005.

were consistently cited by numerous traders during interviews and are in general agreement with yields reported in Knapp *et al*. (2007).

In terms of total consumption, the Kansai (Osaka) region is known to have a particular preference for Sockeye. Knowledgeable trade sources stated that approximately 70% of all Sockeye, and 99% of all high quality Sockeye, is ultimately sold in the Osaka

Figure 10

Credit: S. Clarke

***Yamadzuke*, a traditional form of gutted, salted salmon presented in a wooden box in the Sapporo market. The name, which means "mountain pickling" derives from the fact that the fish are heavily salted, then piled into a mountain shape for several days while fermentation takes place. Labelling indicates this is Sockeye from the Russian Federation processed in Nemuro**

The Osaka area has a particular preference for Sockeye

market. This market is said to value the vibrant red colour of the Sockeye flesh particularly, but the reason for the preference is not traditional as Sockeye only became popular there in the last 30 years.

Most frozen imported and salted salmon are sold in Tokyo but Osaka also ranks highly

National data on salmon sales are not species-specific, but are presented separately for fresh, frozen (total), frozen imports and salted forms. As described previously, only frozen imports and salted forms are of interest for Russian fish. **Figure 11** illustrates that in 2002–2005 only six of Japan's top ten market municipal wholesale markets handled imported frozen salmon. Of these, Tokyo commands a 73% share followed by Osaka with 13%. All 10 markets handle salted salmon. Tokyo is again dominant at 33% but several other markets including Osaka, Kobe, Sapporo and Sendai are also substantial.

The proportion of Sockeye at Tsukiji is <27% but as high as 81% in Osaka

Despite the lack of species specificity in the national data, some information on the proportion of Sockeye is available for individual markets. **Table 3** gives the proportion of Sockeye to total frozen and total salted salmon sales at the Tokyo and Osaka markets[3]. Although the quantities traded in Osaka are considerably smaller, the proportion of Sockeye is much higher, reinforcing traders' intelligence regarding the importance of the Osaka market for high quality Sockeye.

3. The Tsukiji (Tokyo Central Wholesale Market) data covers all three central wholesale markets in the Tokyo area (Tsukiji, Daida, Sokuritsu) but while the MAFF (2006a) data for Osaka cover both the main and east markets, the data in **Table 3** derive from the *Honjo* only.

The recent growth of large supermarket chains in Japan, particularly over the past five years, has sparked a far-reaching change in the distribution patterns of seafood. Large trading companies which buy salmon from Russian and other fisheries are increasingly channelling these products directly to processors and on to distributors, rather than buying from central wholesale markets. Despite higher costs, much of the salmon processed for the Japanese market still takes place in Japan. Reasons for this include high quality standards particularly with regard to specifications for uniquely Japanese products, import restrictions vis-E0-vis China (see the section **China**), and a desire by trading companies to support the Japanese processing industry.

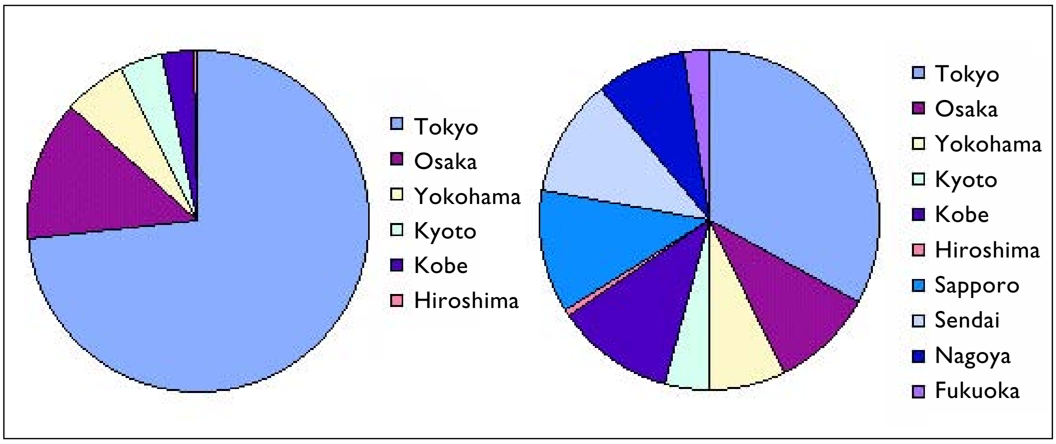
Japan still processes much of its own salmon products

The location of salmon processing in Japan may vary substantially from year to year based on the capacity of plants to handle widely fluctuating catch levels over a short harvest season. Although there are many established processors in Hokkaido it is believed that most of their supply is domestically produced *akisake*—"fall" (autumn) run Chum or Pink Salmon (**Figure 12**). In contrast, market channels aimed at supplying supermarkets prefer to choose processors closer to the major markets, thus factories in Ibaraki prefecture north of Tokyo or in Tokyo itself are increasingly preferred. If the market for frozen Russian Sockeye is mainly in Tokyo and Osaka, this may explain why Shiogama, rather than ports in Hokkaido, receives most of the Sockeye imports. National fish processing statistics indicate that in 2005 Hokkaido handled 75% of all salmon and trout processing and Miyagi prefecture, where Shiogama is located, only 6%. There is no means within the statistics, however, to distinguish between imported Sockeye and domestic *akisake*.

Imported Russian salmon may be processed closer to major urban markets than most domestic salmon

Figure 11

Share of frozen imported salmon (left) and salted salmon (right) sales by Japan's ten largest municipal wholesale markets, 2002–2005



Source: MAFF 2006a.

Table 3

Sales of total frozen and frozen Sockeye, and total salted and salted Sockeye (t) at Tsukiji and the Osaka Main Market (Honjo), 2002–2006.
Sources: Tokyo Central Wholesale Market 2007 and unpublished data from Osaka Honjo received December 2006.

	2002	2003	2004	2005	2006
TOKYO					
Frozen Salmon	37 759	36 885	34 768	28 092	35 087
Frozen Sockeye	2613	1888	2320	1748	2271
Frozen Sockeye Proportion	**0.07**	**0.05**	**0.07**	**0.06**	**0.06**
Salted Salmon	18 217	16 296	15 012	14 178	14 019
Salted Sockeye	3796	3881	3534	3251	3755
Salted Sockeye Proportion	**0.21**	**0.24**	**0.24**	**0.23**	**0.27**
OSAKA					
Frozen Salmon	9467	6739	10 453	8593	na
Frozen Sockeye	3653	3243	4183	2508	na
Frozen Sockeye Proportion	**0.39**	**0.48**	**0.40**	**0.29**	**na**
Salted Salmon	1517	1276	1355	1435	na
Salted Sockeye	1222	885	766	1058	na
Salted Sockeye Proportion	**0.81**	**0.69**	**0.57**	**0.74**	**na**

Figure 12

Credit: S. Clarke

***Akisake*—"fall" run Chum or Pink Salmon—usually caught by set net along the coasts of Hokkaido and Honshu on its way to rivers to spawn. Most *akisake* runs are supported by hatcheries.**

Large quantities of salmon are still traded through the central wholesale markets (**Table 3**) but a substantial and perhaps growing amount is traded outside these markets. National summary statistics (2002–2005) for the proportion traded through the central wholesale markets are available for five types of fish (MAFF, 2006a) and shown in **Table 4.**

The proportion of salmon traded through central markets may be as low as 20–30%

The proportion of salmon traded through the markets is expected to be lower than for fish such as tuna which require individual inspection before purchase. Skipjack and squid are likely to be sourced from domestic fisheries and thus may sell through the central markets because they lack direct sales opportunities. Representatives of two of the biggest marine products companies in Japan, both of which are known to import Russian salmon, estimated that the proportion of salmon channelled through the central whole markets was about 40% in the recent past but has dropped to between 20–30% now.

Salmon may also be double-counted in market data

The preceding information has demonstrated how failure to account for extra-market distribution may lead to underestimating the total product flow. There is also the potential for over-estimation bias when using market data. This bias may arise from double-counting of the same fish in various forms. For example, some of the salmon sold in the central wholesale markets may be sent to plants for processing into *kirimi* and then returned to the market to be sold again. There are no quantitative data available to estimate this effect and several traders refused to speculate citing a lack of information. One trader hypothesized that 70% of the *kirimi* sold in the central wholesale markets would have also been sold in primary processed form (e.g. dressed or semi-dressed).

Over 75% of salmon roe in central wholesale markets are sold in Tokyo, Sendai and Sapporo

National market data for "salmon and trout eggs" in Tokyo (MAFF, 2006a) were compared to published tallies for Tsukiji market for "*ikura*" and "*sujiko*" and found to match. However, there is no method by which to separate data for salmon roe

Table 4

Proportion of supply traded through central wholesale markets in Japan for five fish species, 2002–2005. *Source*: MAFF, 2006.

Fish Type	Mean	Standard deviation
Northern Bluefin Tuna *Thunnus thynnus*	0.77	0.04
Bigeye Tuna *Thunnus obesus*	0.43	0.03
Yellowfin Tuna *Thunnus albacares*	0.76	0.01
Skipjack *Katsuwonus pelagicus*	0.55	0.18
Common (Flying) Squid *Todarodes pacificus*	0.41	0.01

products by species. **Figure 13** illustrates that almost half (45%) of all salmon roe sold through the central wholesale market system is handled by Tokyo. The three biggest markets, Tokyo, Sendai and Sapporo, handle over 75% of the total supply. Information on the proportion of salmon roe traded outside the market system is not available.

Seasonality

US catches of Sockeye are considerably larger than the Russian Federation's and peak slightly earlier

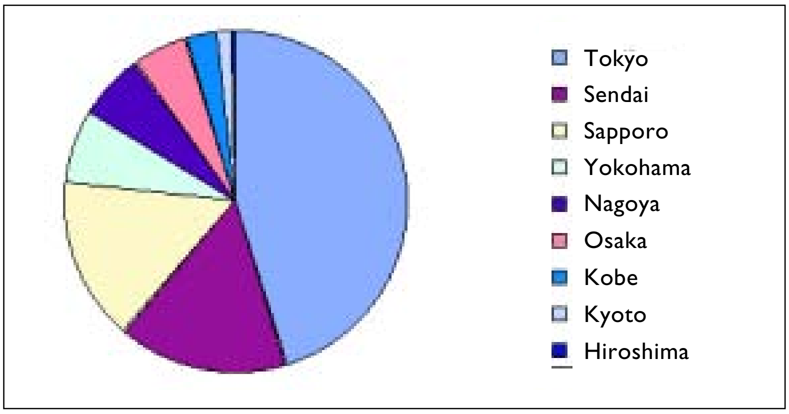
This section explores whether there are seasonal patterns in consumption and, if so, whether these patterns correspond to import and catch patterns. Sockeye data are used for this assessment since Sockeye is the most representative and easily distinguished (in the data), of the Russian salmon species. The fundamental seasonal pattern in the salmon trade is defined by the fishing season. **Figure 14** shows monthly catches of Sockeye for the three major producing countries, the USA, the Russian Federation and Canada, for 2002–2005. US catches are largest, thus both US and total catches peak in the month of July. Russian catches, which are considerably smaller by comparison, usually peak in August. The Russian Federation's highest catches were observed in 2002 when the reported Sockeye catch by the Russian Federation totalled nearly 25 000 t (NPAFC, 2007a). Preliminary data reported to the North Pacific Anadromous Fish Commission (NPAFC) by Russian fisheries authorities document that catches again exceeded 24 000 t in 2006 (TINRO, 2006).

Japan's Sockeye imports from the Russian Federation lag catches by several months

Monthly patterns in Japan's imports of frozen Sockeye (**Figure 15**) would be expected to parallel catch trends. Peak periods for imports from the USA, in August, lag peak catches by one month. In contrast, imports from the Russian Federation are observed at high levels for a longer period (September, October and even November) after the fishing season. This could be because of a longer time required for Customs clearance or holding of fish in frozen storage facilities (see the section South Korea) to avoid a

Figure 13

Share of "salmon and trout eggs" handled by each of Japan's 10 largest municipal wholesale markets (Fukuoka share is zero), 2002–2005



Source: MAFF, 2006a.

glut in supply to Japanese processors. In this time series, which includes 2006, the effect of the strong Russian Sockeye catch in 2006 causes imports from the Russian Federation to exceed those from the USA for the first time (see **Table 2**). Import activity in 2002–2005 was generally low from year end until the beginning of the fishing season in June. For unknown reasons, several thousand tonnes of Sockeye were imported from both the Russian Federation and the USA to Japan in the early winter and spring of 2006.

Since Tsukiji handles the largest quantity of Sockeye and provides sales data by species, this source is used to assess whether sales trends follow the seasonal patterns identified in catches and imports. **Figure 16** reveals trends for sales of frozen and salted Sockeye which are different from each other, but are internally consistent month by month over the five-year period from 2002–2006. Sales of frozen Sockeye always crest in September, one to two months after peak catches. In some years a slight rise is observed at year's end, probably due to holiday demand. Salted Sockeye sales are more stable throughout the year but increase substantially in December of each year. This information implies that frozen Sockeye flows quickly through the distribution system whereas salted Sockeye supplies may be in circulation for longer periods.

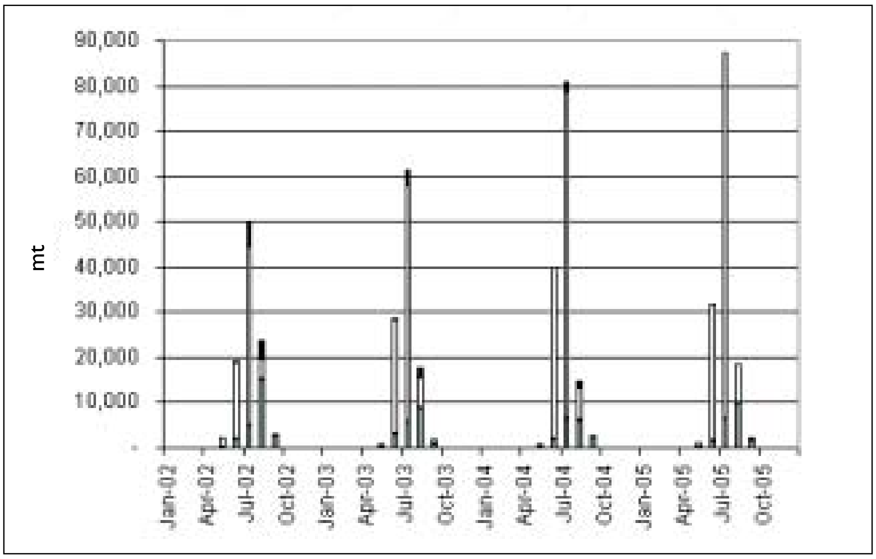
Sales of frozen Sockeye show seasonal trends consistent with catch rates; salted Sockeye sales are flatter with a year end peak

Inventory data reveal distinct trends for storage facilities near fishing ports versus storage facilities near major distribution centres (**Figure 17**). Quantities at the two largest port storage facilities for salmon in Japan, Kushiro and Otaru, begin to rise

Inventory data for the Tokyo area show two peaks in salmon stocks: a mid-summer peak may represent imported Sockeye

Figure 14

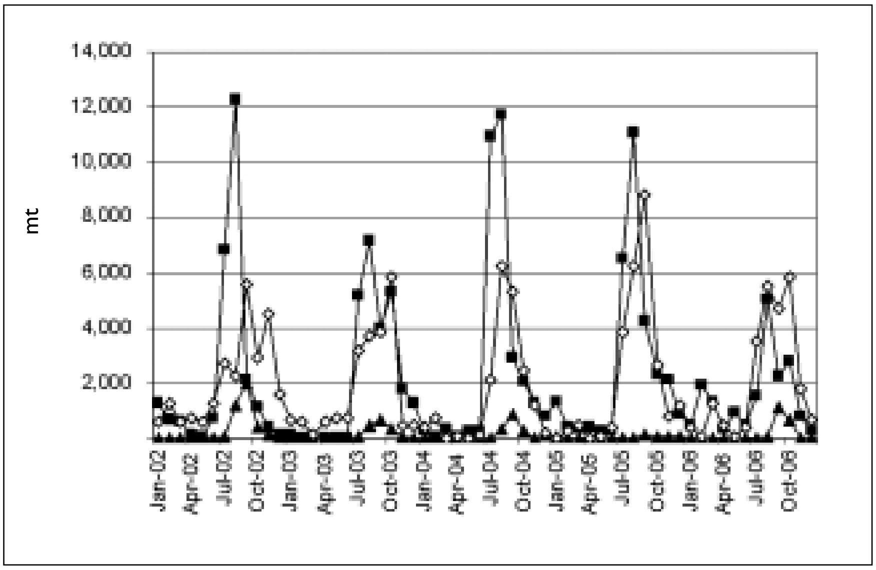
Monthly catches of Sockeye for the Russian Federation (grey), the USA (white) and Canada (black), 2002–2005. Canada and continental USA data for 2005 are not yet available



Sources: Alaskan data for 2002–2006 from ADFG (2007); the Russian Federation, Canada and continental USA data for 2002–2004 from NPAFC (2007a); the Russian Federation data for 2005 from TINRO (2006).

Figure 15

Japanese imports of frozen Sockeye (t) from the Russian Federation (open diamond), the USA (black square) and Canada (black triangle) by month, 2002–2006



Source: Japan Customs, 2007a.

in August and peak in October, then decline through mid-summer. This pattern follows catch trends in Russian waters, though it should be noted that the majority of the inventory is likely to be composed of domestic Chum. Inventory trends for storage facilities in the Tokyo district show an interesting bi-modal pattern with local maxima in February/March, and August, with lower values in each of the subsequent three-month periods. The actual reason for these patterns is unknown but it is possible that the lower August peak is composed mainly of Sockeye from the opening of the north Pacific fisheries. The Japanese Chum fisheries, which open in late summer and early fall may accumulate after the year-end holiday season to form the second peak. Since most of the imported Sockeye appear to bypass Kushiro and Otaru (see Ports of entry section above), this could explain why these major frozen storage areas do not record the same mid-summer peak.

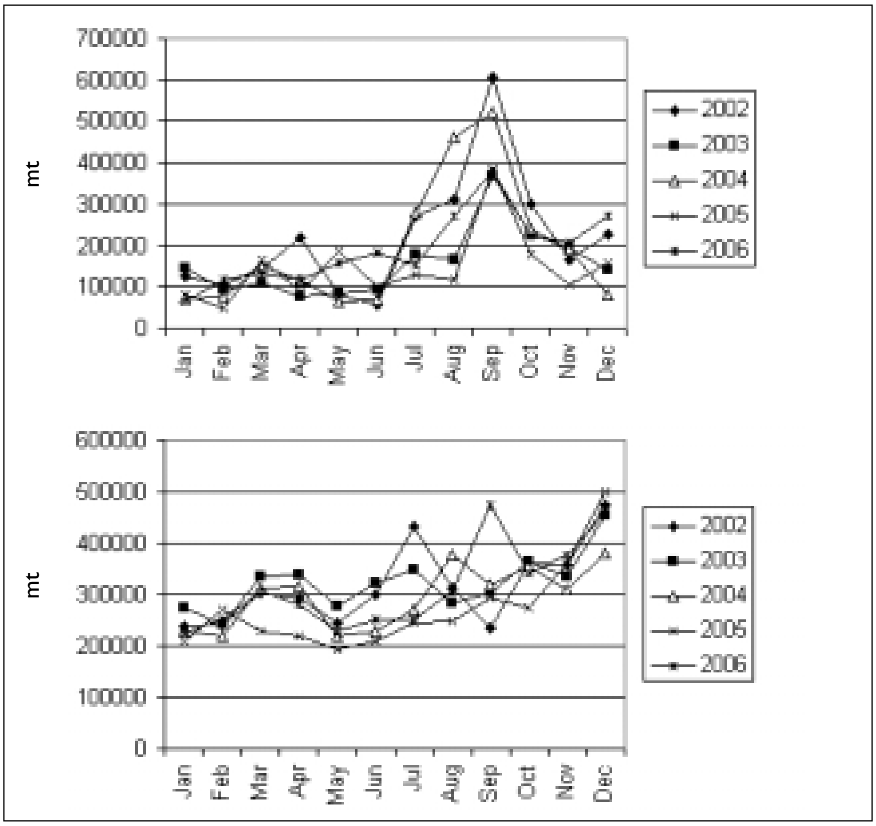
Summary of findings for the Japanese market

This section has identified the following key features of the Japanese salmon market relevant to Russian salmon fisheries:

- Japan is the world's largest, single-nation importer of salmon products (183 000 t in 2004);
- Customs statistics indicate that the Russian Federation's largest share (by quantity) of the Japanese salmon market is in frozen Sockeye, followed by frozen "other" salmon (probably Chum);

Figure 16

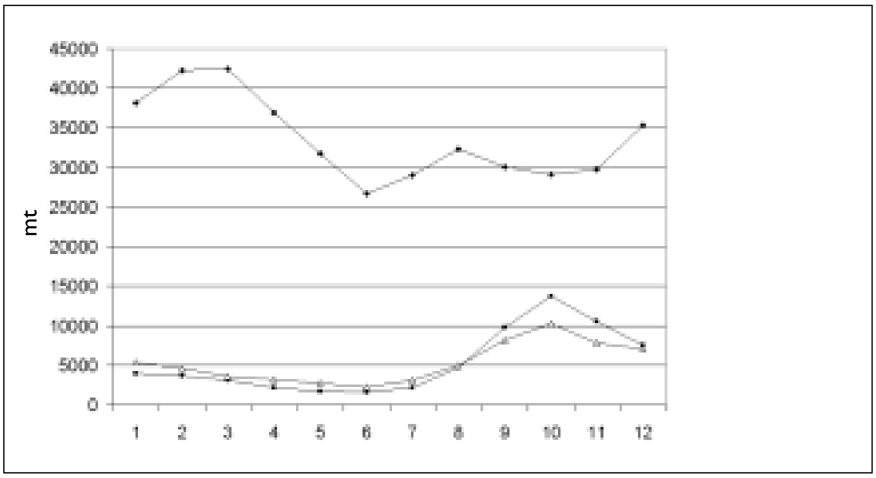
Monthly sales of frozen and salted Sockeye (t), 2002–2006



Source: Tokyo Central Wholesale Market, 2007.

Figure 17

Quantities of frozen salmon (t) remaining in storage at the end of each month in 2005 for Tokyo (black diamond), Otaru (open triangle), and Kushiro (black circle)



Source: MAFF, 2006a.

Twelve key features of the Japanese salmon market, relative to Russian salmon, have been identified

- Although exact amounts cannot be verified, it appears Japan also imports several thousand tonnes per annum of raw salmon roe (*sujiko*) from the Russian Federation, but this quantity has halved since 2002;
- In the past five years the Russian Federation has supplied 45–55% of the Japanese Sockeye market but only 4–5% of Japan's entire salmon/trout market;
- Owing to voluminous quantities of farmed Coho, and domestic ranched Chum and Pink Salmon in the Japanese market, the Russian Federation's contribution of wild fish to the total supply of these species is minimal;
- Most imported Sockeye enters Japan at Shiogama on northern Honshu, possibly because Shiogama's processors are closer to major distribution centres on central Honshu;
- Per capita Sockeye consumption is highest in the Kansai (Osaka) area but the total sales volume is greatest in Tokyo;
- Sockeye is one of the most valued salmon species in Japan, and Russian Sockeye is said to be the most preferred type of Sockeye;
- As demand for traditional Sockeye products decreases as consumers choose ready-to-eat, lower salt forms like *kirimi* (small portion fillets), this is leading to preferences for dressed (headed and gutted) imports;
- With the rise of large supermarket chains, salmon is increasingly directly imported, processed and sold without passing through the central wholesale market system;
- Central wholesale market data may thus drastically underestimate total sales volumes as well as over-estimate some quantities by double-counting products which are first sold in primary processed form and again in ready-to-eat form;
- Japan's Sockeye imports from the USA follow directly on from the catch season, but imports from the Russian Federation may lag by several months.

This basic understanding of East Asia's largest, most complex and best documented salmon market has highlighted the utility of high-value Sockeye in tracking Russian catches. Other species, such as Coho, Chum and Pink Salmon, do not figure prominently in Japan's market but are nevertheless produced in large quantities in the Russian Federation. The discussion now turns to the role of China as one of the world's major fish processing centres and a key conduit for these lower-value raw salmon materials from the Russian Federation.

China

Imports of Russian salmon to China

China's trade with the Russian Federation based on published Customs data

Mainland China's Customs data were analysed to determine which forms of salmon imports originated in the Russian Federation and how the imported quantities compared to quantities for other major markets like Japan. China only imports salmon from the Russian Federation in the categories of "fresh or chilled Pacific or Danube salmon", "frozen Sockeye" and "other frozen Pacific salmon" (**see Appendix 2**). The proportion of Russian imports relative to the total imports by China in these categories is shown in **Table 5**. For Sockeye, the total quantity of imports by China has fallen while the small quantity imported from the Russian Federation has risen slightly, leading to a substantial increase in the latter country's share of the supply. Although the actual quantity of Russian Sockeye imported by China has grown substantially between 2002 (16 t) and 2006 (860 t), it is still only a fraction of the quantity imported by the major market for Sockeye, Japan, which imported nearly 25 000 t of Sockeye per annum in 2005 and 2006 from the Russian Federation.

China receives only a fraction of the Russian Federation's Sockeye

Quantities are substantially greater in the "other" Pacific salmon category than in either of the other two categories. China's total imports in this category have more than tripled over the past five years (from 39 000 to 139 000 t), although the Russian Federation's share since 2003 has remained nearly constant at around 30%. China's imports of "other" Pacific salmon from the Russian Federation were nearly equal to Japan's imports from the Russian Federation in 2002 (ca. 6000 t) but have increased eight-fold since then (to 49 000 t in 2006). Imports by China from Japan began the period at a higher level (21 000 t in 2002) but have grown more slowly (to 47 000 t in 2006) and were exceeded by Russian imports for the first time in 2006.

China's imports of "other" Pacific salmon have more than tripled since 2002

China's imports of "other" salmon are expected to contain both Chum and Pink Salmon, and imports from the Russian Federation can be compared fairly with imports from Japan. However, if comparing China's imports of "other" salmon with Japan's imports of "other" salmon, an important coding difference must be taken into account. In the Chinese system, it is assumed that both Pink Salmon and Chum are classified as "other" Pacific salmon, whereas in Japan Pink Salmon are classified as "trout" (i.e. *masu*, see the section **Data sources—Japan**), therefore China's imports might be expected to be larger than Japan's. Nevertheless, given that China in 2006 imported 139 000 t of "other" salmon and Japan imported less than 10 000 t of "other" salmon,

Unlike Japan, China classifies Pink Salmon as "salmon"

Table 5

China's total imports (t, first line), and quantity (t) and percentage (in parenthesis) from the Russian Federation (second line), for fresh/chilled and frozen Pacific salmon, 2002–2006

	2002	2003	2004	2005	2006
Fresh / Chilled					
Pacific and Danube	1936	4022	1853	439	120
	14 (1%)	28 (1%)	36 (2%)	56 (13%)	65 (54%)
Frozen					
Sockeye	834	1660	3272	5901	8613
	16 (2%)	3 (<1%)	1227 (38%)	601 (10%)	860 (10%)
"other"	39 143	64 618	76 218	118 928	139 278
	5464 (14%)	18 688 (29%)	21 139 (28%)	40 380 (34%)	48 939 (35%)

Source: GCBI, 2003–2007.

it is not likely that coding is the sole cause of the difference. Rather, it is probably the case that Japan has no need to import "other" salmon, such as Chum, because of the surplus supply of this species owing to domestic production in Japan.

Third-party trade issues

Imports via a third-party country may or may not be marked as Russian origin

Published import statistics for China do not include information on routing country, and thus cannot address the issue of whether Russian salmon are shipped through a third-party country before arriving in China. If such third-party shipments occur they may take one of two forms:

- Russian fish may be imported by the third-party country; then re-exported to the destination port in China; or
- Russian fish may be sent to a bonded (or similar) area within the third-party country and then shipped, without being re-exported, to the destination port in China.

In the former case, when the goods are re-exported they may be declared as originating in the third-party country. In the latter case, the goods should retain their documentation as products originating in the Russian Federation when entering the destination country. In the following discussion, the former case is assessed by examining whether substantial quantities of salmon are imported by China from non-producing countries. The latter case is assessed by accessing unpublished Chinese import data for 2005 and 2006.

Japan ships large quantities of salmon to China

In addition to receiving nearly 50 000 t of "other" salmon supplies from the Russian Federation in 2006 (**Table 5**), China also received similar or larger quantities of "other" salmon from Japan and the USA (about 47 000 t and 34 000 t, respectively, in 2006). Since the USA produces large quantities of Coho, Chum, and Pink Salmon, and it would not make sense to ship Russian salmon to the USA prior to delivery to China, these US imports are assumed not to be of Russian origin. In contrast, although Japan produces large quantities of these lower value salmon species, it might also serve as a third-party player in supply transactions between the Russian Federation and China. This possibility is even higher for Sockeye. Even though Japan has no Sockeye resources of its own, and would almost certainly domestically consume the Sockeye it catches in Russian waters (see the section **Japan**), China reported receiving nearly 4000 t of Sockeye, nearly half of its total supply, from Japan in 2006. In the same year, Japan's reported exports of Sockeye to China totalled only 143 mt. This information suggests these fish would not have been imported by Japan from the Russian Federation, and then re-exported to China. Instead, it is more likely they represent Russian-caught Sockeye shipped through Japan and mistakenly classified as being of Japanese origin, or that they actually are Japanese salmon but are misclassified as Sockeye. Interview information confirmed that large cold storage facilities in Otaru, Kushiro, and according to some sources, but not others, Hakodate, are used as storage and import conduits for Russian salmon. These facilities are probably part of a system known in Japanese as *hozei* in which goods can be stored

Japanese cold storage facilities may act as a conduit for Russian salmon en route to China for up two years in special port areas until they are either imported for domestic consumption or sent on to another country (Tokyo Customs, 2006).

Interviews suggest South Korea is a major third-party trader of Russian salmon but hard evidence is lacking

In addition to Japan, South Korea is another potential third-party partner in the salmon trade between the Russian Federation and China. Interview information continually suggested that South Korea served as a convenient storage and/or brokerage area for Russian salmon. More information on the situation in South Korea is provided in the section **South Korea**, but with reference to China, Customs-based evidence for South Korea's role in supplying China with Russian salmon is limited. First, China's imports from South Korea are reported for Sockeye only in 2004 (75 mt) and 2005 (42 mt), and for "other" salmon since 2003 in gradually increasing, but small, quantities from 224 to 471 mt. The highest of these quantities represent <2% of China's annual Sockeye imports and <1% of annual "other" salmon imports. Second, as will be discussed further in the section **South Korea**, South Korean exports of salmon to China during this period only amounted to 46 t of Sockeye in 2002, 48 t of "other" salmon in 2003, and 121 t of "other" salmon in 2006. These data further suggest that if South Korea is involved in the trade of Russian salmon to China, these fish do not pass the South Korean Customs border.

Detailed import data from China show 11–23% of Russian salmon may arrive via Japan or Korea.

To provide further insight into third-party trade issues, unpublished data for import of Russian salmon available on a shipment-by-shipment basis were purchased for 2005–2006 (GCBI, 2007). These data provide information on the routing country, if any, for each shipment. Of the 40 981 t of Russian origin Sockeye and "other" salmon imported by China in 2005, 74% were shipped directly from the Russian Federation, 16% arrived by way of Japan, and 7% were shipped by way of South Korea. Of the 49 799 t imported in 2006 more imports arrived directly from the Russian Federation (88%) and only 9% arrived via Japan and 2% via South Korea. In the past two years, 71–77% of the imports from the Russian Federation arrived in the three-month period between September and November. During this period over 80% of the Russian salmon imports were shipped to Qingdao in Shandong province, 8–10% were delivered to Dalian in Liaoning province, and 7–8% to Yantai in Shandong province (**Figure 18**).

Disposal of Russian salmon entering China

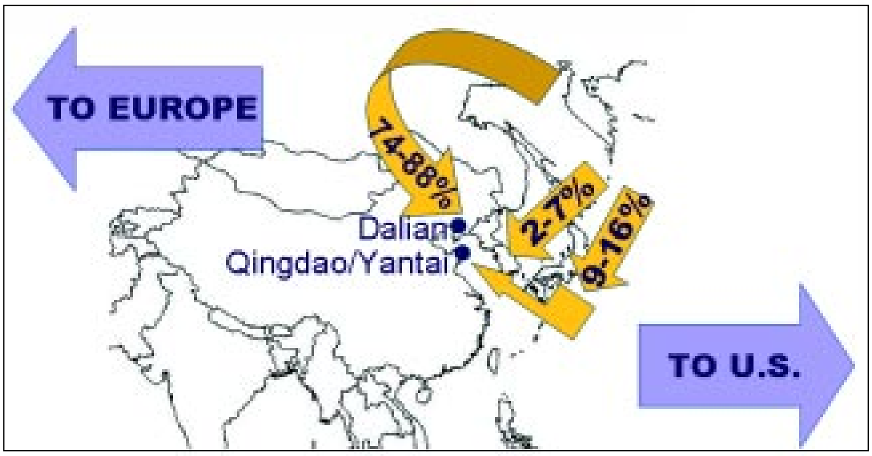
Import for processing and re-export

Mainland China is a processing centre for low-value salmon products from the Russian Federation and Japan

Redmayne (2004) and interview information indicate that China serves as a processing centre for low-value salmon products (mainly Chum and Pink) destined for the USA and European markets (**Figure 18**). Trade statistics document that China receives voluminous raw material supplies of these species not only from the Russian Federation (see section **Imports of Russian salmon to China**) but also from Japan, as well as the USA. In 2002–2005 export of "other" (probably Chum) salmon from Japan to China rose from nearly 23 000 t to over 56 000 t per annum (Japan Customs, 2007), i.e. was larger than Russian export of the same (**Table 5**). In 2005, this quantity, when converted to whole fish equivalents, represented 39% of Japan's domestic production of Chum (Gyoren, 2006). As discussed in the section **Imports of Russian salmon to China**, China

Figure 18

Patterns of import and export of salmon to and from China. Yellow arrows show the percentage of "frozen other salmon" imported to China from the Russian Federation directly (74–88%), via Japan (9–16%) and via South Korea (2–7%) in 2005–2006. Lavender arrows show the probable direction of exported salmon fillets



Sources: imports from CGBI (2007); exports from Redmayne (2004) and interview information.

receives relatively small quantities of Sockeye from the Russian Federation and Japan, probably surplus stocks excess to demand in the main Japanese market.

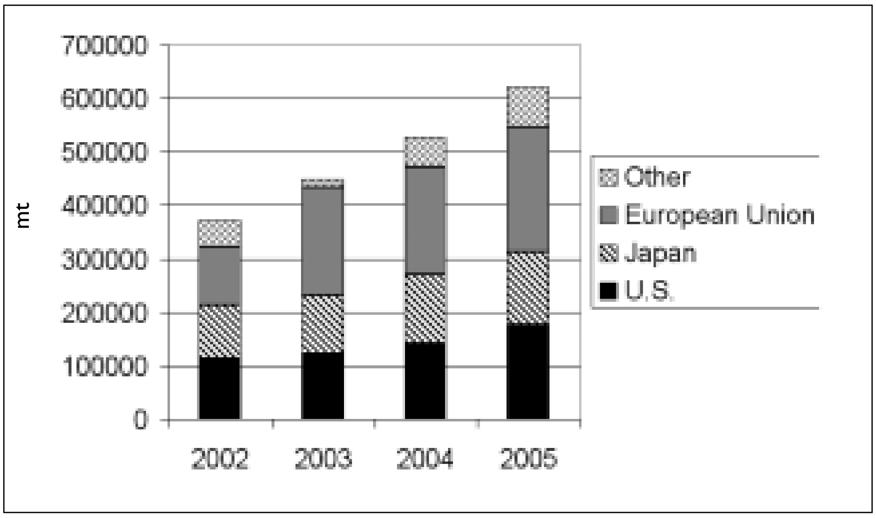
It is not possible to verify China's ratio of consumption to re-export, but China's fish processing trade is still booming

The growth of China's fish processing industry is illustrated by a steady increase in exports of frozen fish fillets from 371 426 t in 2002 to 621 678 t in 2005 (**Figure 19**). But because of the lack of species-specificity in China's export codes (see **Methods**) it is impossible to verify the quantity of salmon fillets exported from China to foreign markets. Therefore, it is also impossible to confirm how much, if any, wild Pacific salmon is consumed domestically in China. Unpublished Customs information documents that nearly all of China's salmon imports from the Russian Federation are declared as being "for inward processing" (GCBI, 2007). Under this system certain goods imported for the sole purpose of processing are exempt from Customs duties as long as the imported and [processed] exported weight conforms to the expected ratio of raw product to processed product yield (Jin, 2005). In the case of salmon, which is usually received in semi-dressed (i.e. gutted) form, the standard yield for fillets is 40%. Therefore, in order to avoid a 26% tariff, Chinese processors must re-export 40% of the imported raw material weight as fillets. For trade tracking purposes, it is fortunate than China complies with United Nations recommendations to include imports for "inward processing" in trade statistics (United Nations, 2003), otherwise such shipments would be invisible in Customs data.

None of the sources consulted in this study suggested that China was a major processing centre for salmon consumed in Japan. This is surprising given that in 2002–2005

Figure 19

China's exports of frozen fish fillets to major consumer markets, 2002–2005



Source: GCBI, 2003–2006.

between 22 and 27% of the frozen fish fillets exported from China were destined for Japan (**Figure 19**). The reason for this probably lies in a regulation implemented by the Japanese government which imposes a special pre-approval requirement for salmon imported from China (**Box 1**). Chinese processors stated that the time required to satisfy the pre-approval requirements can easily add two months to their turnaround time.

Documentation required to import salmon from China to Japan is onerous

When the background to this regulation was explored with Japanese government officials, they explained that pre-approval procedures apply to several fish products including species listed under the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), bluefin tuna, Bigeye Tuna *Thunnus obesus*, Swordfish *Xiphias gladius*, and salmon and trout (METI, 2007). The Japan Fisheries Agency explained that the procedures apply to salmon and trout in whole or processed form, imported to Japan from China, Taiwan or North Korea. The rationale for the system was explained as follows:

Officials state the reason for the pre-approval is that China is not a member of the NPAFC

"*China, Taiwan and North Korea are not bound by or participating in the North Pacific Anadromous Fish Commission (NPAFC). Member countries, including Japan, the United States, the Russian Federation and Canada co-operate to prevent countries which are not participating from gaining anything from salmon or trout resources. This is why these procedures have been instituted for non-participating countries*"[4].

In reality, the system simply prevents China from exporting any processed salmon, most of which probably originates from Russian and Japanese fisheries, back to Japan.

4. Email communication from Kagenumazawa Manabu, Japan Fisheries Agency to the author on 13 February 2007 (translation by the author).

Box 1. Japan's pre-approval system for imports of salmon or trout from China

1. Application form must be submitted to Ministry of Economy, Trade and Industry including the following information: product name; form and brand; number, weight and units; value and units; foreign currency conversion; place of origin; port of lading (consignment); planned arrival date; and product description and use.

2. Application materials:
   (1) Application form T2010;
   (2) Import certificate (apply separately to the Japan Fisheries Agency);
   (3) Statement regarding the reason for the application;
   (4) If the product is processed, include the shipping documents, e.g. invoice, bill of lading;
   (5) Processing certificates:
   - export certificates from Chinese authorities;
   - processing inspection report by Chinese authorities;
   - processing production report;

   (6) Processing trade consignment contract;
   (7) If the product was exported in raw form, include the shipping documents (i.e. invoice, bill of lading, and if exported from Japan the export permits);
   (8) Source of materials and purchaser delivery documents:
   - purchase of source material contract, delivery of goods document;
   - production certificate;
   - cargo contents certificate from the source location (e.g. certificate of commodity);

   (9) Other:
   - if the application is by mail include a stamped, self-addressed envelope;
   - if the application is by proxy including proxy authorization.

Source: Fax communication from Ms. Itomi, Ministry of Economy, Trade and Industry to the author on 16 February 2007 (translation by the author).

Yet China still profits from salmon resources

Despite Japanese stated intentions, China still profits from salmon resources by selling processed products to Europe and the USA. Japan also profits from China's salmon processing activities because they provide a valuable outlet for Japan's over-supply of domestically produced salmon. At the same time, by discouraging export of China-processed products to Japan, the system also serves to protect Japanese salmon processors who would not otherwise be cost-competitive with Chinese operations.

China's salmon processing industry

Field visits were conducted at a factory handling about 12% of all China's Russian salmon imports

Field visits were conducted to the premises of two major fish processing plants in Qingdao, one of which was the second-largest importer of Russian salmon in China, capturing 12% of the total in both 2005 and 2006 (GCBI, 2007). According to factory management, this factory was recently ranked as the fourth-largest of all China's seafood processors. It is not known to what extent these factories' operations are typical of factories in China handling Russian salmon. Nevertheless, the information they provided regarding their operations provides very useful insights into at least some of the ways in which Russian salmon are sourced and handled.

Most salmon from the Russian Far East is Pink or Chum, and is usually (80% of the time) semi-dressed but sometimes (20%) dressed (**Figure 20**). One factory insisted they did not aim to specialize in Russian salmon but because they had a stable client base, they could afford to pay top prices for the best quality salmon and they claimed that this was the Russian salmon. In particular, they mentioned that they always carefully judge the quality of the fish before purchase and prefer to buy salmon from Koryakia (an autonomous sub-region located at the northern base of the Kamchatka peninsula)[5] rather than from southern waters near the Kuriles (**Figure 21**). The majority of salmon are processed into Individual Quick Freezing (IQF) fillets or fillet blocks, but sometimes "flake" (small dried flakes used as seasoning) is produced. Factories in China receive frozen fish which have been stripped of roe; they do not produce salmon roe products. Fillets are usually shipped to the USA or Europe and only about 1% of their production is sent to Japan.

This factory considers Russian supplies, especially from northern Kamchatka, to be the best quality

The techniques used in processing salmon are illustrated by photo documentation of a typical production run for Russian salmon at a Qingdao plant (**Appendix 6**). Polyphosphates (also known as STPP or sodium tripolyphosphates), are controversial additives, prohibited by the European Union (EU) but allowed by US regulations. These additives act to improve gloss, reduce drip during thawing, and increase product weight by 3–5% (Aitken, 2001). Despite the lack of regulation of these additives by the USA, interviews suggest polyphosphates are not used by these factories even for the US market. One factory claimed this is because polyphosphates are not particularly effective for salmon. This factory also stated that no colour enhancement for salmon products destined for the USA or Europe is ever used.

A typical production run is shown in Appendix 6

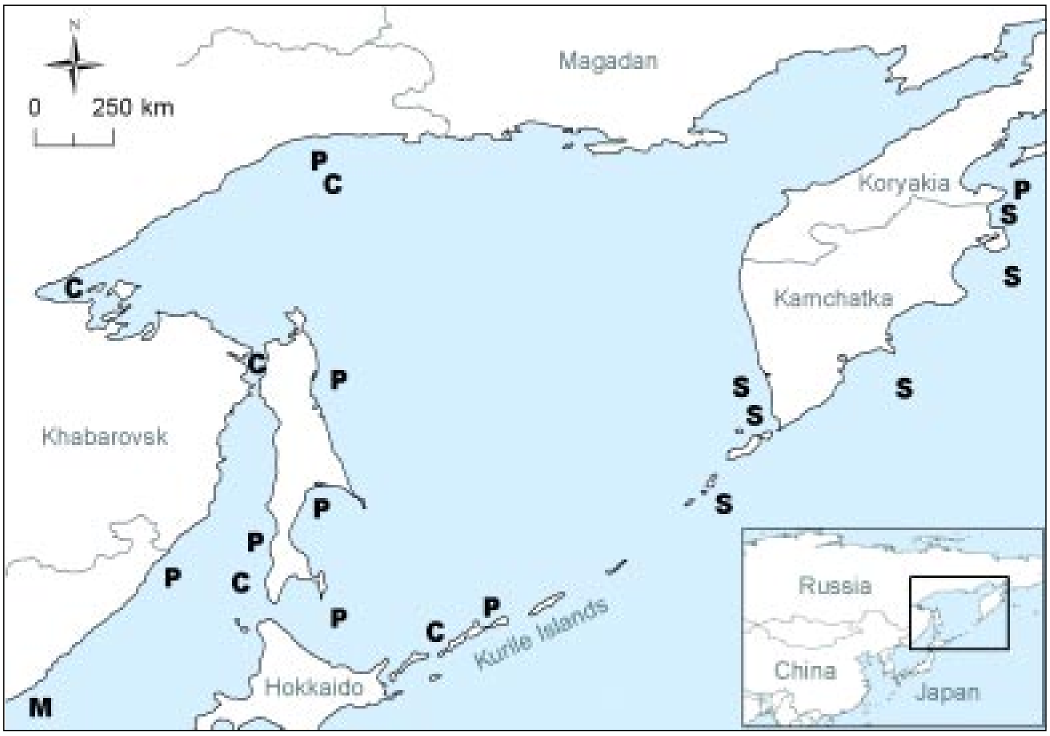
Figure 20

Credit: S. Clarke.

Pink Salmon from the Russian Federation thawing in a Chinese fish processing factory

5. On 1 July 2007, Koryak Autonomous Okrug merged with Kamchatka Oblast to form Kamchatka Krai.

Figure 21. Map of the Russian Far East fishing grounds. Locations of salmon fishing are shown for Sockeye (S), Pink (P), Chum (C) and Cherry (M) salmon



Credit: D. Greenberg.

Source: Hokkaido Economic News (2003).

Russian salmon is said to pass through Pusan because of brokers who play an essential role in trade between Russians and Chinese

A typical route for Russian salmon to Qingdao was described. First, the catch would be landed in the Russian Federation usually in a Kamchatka port. Sometimes these fish will have been gutted and frozen on board but often, due to insufficient vessel freezer capacity, the fish is processed onshore after landing. The fish is then loaded on a steamer ship which either goes directly to Qingdao or to Pusan, South Korea[6]. If the steamer ship docks in Pusan, the cargo is usually re-loaded onto a container vessel which then goes to Qingdao. Since the cargo never enters South Korean territory it is not subject to tariff and not recorded in Customs statistics. These factory managers explained that Pusan is involved in the salmon trade between the Russian Federation and China for financial reasons. Russian fishing companies demand payment on delivery for fish, whereas Chinese factories are used to operating on a line-of-credit basis, under which an invoice is issued and payment can be deferred for a fixed amount of time. This mis-match in expectations between Russian and Chinese parties creates an opportunity for large brokers, who can buy fish immediately from Russian parties and sell it under favourable credit terms to Chinese factories. (More information on brokers operating in South Korea is provided in the section **South Korea**). In total, there is at least a six to eight week lag between the time the fish is caught to the time it is shipped, in processed form, from a Chinese factory to consumer markets.

6. This information contrasts with unpublished China customs statistics (GCBI, 2007) which show that more Russian salmon reaches China by way of Japan than by way of Korea. In fact, according to 2005 statistics, this factory imported 42% of its Russian salmon via Japan and only 2% via South Korea. In 2006 the statistics show this factory imported 5% of its Russian salmon via Japan and 3% via South Korea.

A Certificate of Origin is a document issued by the authorities in the country of origin serving to confirm the place of production. It is required for some products, notably fish, often, but not always, for the purpose of determining which tariffs apply. Both factories had experienced difficulties in obtaining Russian Certificates of Origin for fish. Both related experiences in which they initially agreed to purchase shipments, but eventually had to abandon the deal when the Certificate of Origin could not be produced. One representative felt that, given that such cases often occurred, it was not likely to be easy to forge Russian Certificates of Origin, since, if so, the number of such broken deals would be much lower.

Problems with Russian Certificates of Origin have caused supply problems

Hong Kong and the Russian salmon trade

Hong Kong records large quantities (7000–8000 t per annum) of imported fresh or chilled Pacific salmon but only small quantities of frozen Pacific salmon (**Table 6**). None of this supply reportedly originates in the Russian Federation and 89–97% of the fresh or chilled Pacific salmon is recorded as originating in Norway. Since Norway produces Atlantic Salmon and Rainbow Trout (FAO, 2007a), this suggests that species information in these statistics may be unreliable (see **Appendix 3**).

Hong Kong sources almost no salmon from the Russian Federation

Although Hong Kong may be a major market for sturgeon caviar, and sturgeon caviar and processed salmon roe are recorded under the same commodity code, none of the 23–31 t of caviar imported by Hong Kong in 2002–2005 were shipped from the Russian Federation. In 2006, only 54 kg of the total 25.4 t imported by Hong Kong were shipped from the Russian Federation. Import statistics by country of origin list the Russian Federation as the source of 115 kg of caviar in 2003, <20 kg each in 2002 and 2004, and the 54-kg shipment in 2006. Japan, which does not produce sturgeon caviar but does produce salmon roe, was the major supplier (15–18 ; 48–69%) of Hong Kong's caviar in 2002–2004 but in 2005 was surpassed by France (16 t; 68%) and in 2006 came second to Germany (17 t; 68%).

The Russian Federation does not supply large amounts of caviar (sturgeon or salmon) to Hong Kong

Table 6

Hong Kong's total imports (t, first line), and quantity (t) and percentage (in parenthesis) from the Russian Federation (second line), for fresh/chilled and frozen Pacific salmon, 2002–2006

	2002	2003	2004	2005	2006
Fresh / Chilled					
Pacific salmon	8644	7768	7170	7135	7484
	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Frozen					
Sockeye	0	59	150	48	68
	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
"other"	123	78	143	86	84
Pacific	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Source: Hong Kong Government, 2007.

The logistics of storing Russian salmon in Hong Kong are unlikely to be cost-effective

Hong Kong possesses many bonded warehouse facilities and it is theoretically possible that Russian salmon could be stored in Hong Kong without being recorded in Customs statistics. However, given the distance of Hong Kong from the Russian salmon fishing grounds as well as from the major consumption and processing centres in Japan and northern China, it is unlikely that the logistics of storing Russian salmon in Hong Kong would be cost-effective.

Summary of key findings regarding Russian trade in salmon with China

The following key points have been highlighted in this section:

- China's imports of Sockeye from the Russian Federation are only a fraction (ca. 3% in 2006) of the amount of Russian Sockeye imported by Japan (nearly 25 000 t).
- China's largest salmon imports in total (nearly 140 000 t in 2006), and the largest consistent share from the Russian Federation (ca. 30%), are "other" Pacific salmon (probably Chum and Pink Salmon).
- China's imports of "other" salmon from the Russian Federation (49 000 t in 2006) have increased eight-fold since 2002, and in 2006 exceeded the quantities supplied by Japan (47 000 t).
- Japan and South Korea both maintain bonded warehouse facilities which can serve as duty-free storage areas for Russian salmon.
- Since such areas are not subject to Customs record-keeping it is not possible to use import and export statistics to gauge the amount of trade passing through these areas.
- Unpublished statistics on Russian salmon shipments into China reveal that in 2005–2006, 9–16% passed through Japan and 2–7% passed through South Korea.
- It is impossible to confirm how much imported salmon is consumed in China but almost all of the imports are designated as "inward processing trade" meaning they are exempt from a 26% tariff and intended for re-export after processing.
- Chinese-processed salmon appears mainly destined for the US and European markets because import of such salmon to Japan requires complex and burdensome pre-approval documentation.
- Chinese factories opportunistically purchase salmon supplies but those with an ability to pay for high quality raw materials indicated a preference for Russian wild salmon, particularly from the Koryakia (north Kamchatka) region.
- Since Chinese factories are not prepared to make upfront cash payments to Russian parties, they often obtain Russian salmon raw materials through brokers based in South Korea (and also Japan) which may or may not use or declare South Korea or Japan as a routing country for the shipment.
- Imports of Russian salmon by China, whether or not via Japan or Korea require Russian Certificates of Origin and problems with these documents have led to rejection of shipments in several cases.
- Hong Kong reportedly imports no fresh/chilled or frozen Russian salmon and only negligible quantities of Russian caviar (sturgeon or salmon).

South Korea

As reported in the previous sections, South Korea may play a substantial role in the third-party trade of Russian salmon to other East Asian markets, i.e. China and Japan. It is also possible that a market for Russian salmon exists within South Korea itself. These issues are further explored below using trade statistics, interview information, and a review of other published information.

Trade as documented by Customs statistics

Russian Customs statistics for 2004 document that South Korea receives 25% of all Russia's seafood exports, whereas Japan and China receive only 13% and 11% respectively (Eurofish, 2005). However, since it is also reported that Gadiformes (cods), herring and other pelagics, and crab comprise most of the exports, the distribution of Russian salmon may not follow this general pattern.

The Russian Federation exports 25% of its seafood to South Korea

Although Russian statistical systems may record South Korea as the destination, South Korean statistical systems would only record the fish if they were actually imported, i.e. moved from bonded warehouse areas into South Korean Customs territory. This could occur either for the purpose of domestic consumption or for processing and re-export. In the latter case, it is confirmed that South Korea records goods for processing in its trade statistics (United Nations, 2003), even if such goods are exempt from South Korea's fairly high (10%) tariff on raw salmon products (KCS, 2007). Although such imports would thus be recorded, salmon is not a traditional seafood in South Korea, and the low level of consumption and processing that occurs there is believed to be oriented towards farmed supplies (Canadian Government, 2003). This situation is confirmed by an analysis of trade statistics (KITA, 2007).

Trade would only be recorded by South Korea if for consumption or processing

Based on the preceding discussion of the Japanese and Chinese markets, the two main product forms for Russian salmon entering East Asian markets are expected to be frozen Sockeye and frozen "other" Pacific salmon, with perhaps some trade in fresh/chilled forms of the same species. As shown in **Table 7**, the quantities recorded by South Korea in these categories are very low compared to the quantities recorded by **Japan** and **China** (see sections Japan and China). In addition, there is no consistent pattern of Russian supply. For example, the Russian Federation contributed all or nearly all of South Korean Sockeye imports in 2002 and 2004, but only one third of imports in 2003 and none in 2005 and 2006. High variability is also observed in the imports from the Russian Federation of frozen "other" salmon.

Recorded imports are very low and vary greatly from year to year

In a statistical sense, if Russian salmon are not imported in large quantities to South Korean Customs territory, they would not, in theory, be exported in large quantities. Therefore, we would not expect that exported quantities would be greater than the small imported quantities observed in **Table 7** plus an allowance for the low amount of domestically produced Chum (55 t in 2005—NPAFC, 2006; Seki, 2005) which could, in theory, be exported. Indeed, exports are considerably less than imports in

Recorded exports are also very low

each year (**Table 8**). Once again, patterns are erratic with no clear directional trend and no apparent relationship to imports.

Korea's role in the third-party trade

South Korea is an intermediary in the salmon trade between the Russian Federation and Japan/China

The preceding section has indicated that South Korea's function in the trade of Russian salmon is not driven by obtaining supplies for consumption or processing. This section presents information regarding the importance of South Korea as a transactional intermediary in the salmon trade between Japan and China. Various factors contributing to the situation are discussed below including South Korea's historical ties with the Russian fishing grounds, its cost-effective bonded cold storage facilities, its expedited receiving and shipping procedures, and its more flexible financial arrangements for transferring product.

Historical ties with the Russian fishing grounds are maintained through ship repair and processing equipment

Several interview respondents suggested that South Korea's role in the Russian salmon trade dated back several decades. South Korean investors have a long history of financing joint ventures with Russian fisheries. In the past, South Korea used to be a major processing centre for Japanese seafood and at this time it also processed Russian salmon, but now South Korea's processing costs have become comparable to Japan's and as a result the processing industry has moved to China. South Korea is still said to maintain the region's best shipyards close to the Russian fishing grounds at Pusan. It is also estimated that Korea provides 19% of Russia's fish processing equipment and that 70% of all fish processing in the Russian Federation takes place onboard vessels (Eurofish, 2005). These factors serve to draw fishing and cargo vessels operating in the Russian fishing grounds into Pusan for equipment repair and/or refitting. While there they can take advantage of fish storage and transfer opportunities.

Cold storage facilities in Pusan compare favourably to those in Japan if storage times are long

South Korea has three kinds of bonded areas where goods can temporarily enter the country without going through Customs clearance. Duties are payable only when goods are cleared through Customs. The three types of bonded areas are: 1) designated bonded areas (designated storage sites and Customs inspection sites); 2) licensed bonded areas (bonded warehouses, bonded exhibition sites, bonded construction sites, and bonded sales shops); and, 3) integrated bonded areas (US Commercial Service, 2007). Pusan's fish storage facilities are said to be both ample and lower cost compared to other such facilities in Japan (e.g. Otaru, Kushiro) (Kim, 2005). According to traders, facilities in Japan, which are closer to the Russian fishing grounds and closer to end markets in Japan, can be cost-effectively used if the anticipated storage time is short ($\leq$ four months). However, if the fish will be stored for longer periods, the savings on the storage cost will justify the costs of transporting the fish to Pusan. Regardless of storage time, if the fish are destined for processing in China, Pusan is directly enroute from the Russian fishing grounds and might be preferred for that reason. Traders explained that storage of supplies is only necessary when either the processing industry or the consumer market does not have the capacity to absorb the fisheries' output. If so, there is expected to be more storage of Chum and Pink Salmon than of Sockeye, and more storage during the autumn than at other times of year.

Another attraction of Pusan is the reported ease with which fish may be transferred and sold. According to Japanese law, fish catches from foreign waters cannot be landed in Japan or transferred to other vessels in Japanese waters (Anon., 2006a). South Korean landings procedures may not be as strict and may allow foreign fishing vessels to land catches in South Korean ports. As for cargo vessels, in Japan there is a verification system in which the Russian and Japanese governments co-operate to approve documents presented by incoming Russian cargo vessels (see the section **Import control systems**). While there is at least some co-operation between Russian and South Korean authorities on trade in IUU fishing products (Interfax News Agency, 2005),

Procedures for receiving and shipping fish through Pusan appear to be faster than in other countries

Table 7

South Korea's total imports (t, first line), and quantity (t) and percentage (in parenthesis) from the Russian Federation (second line), for fresh/chilled and frozen Pacific salmon, 2002–2006

	2002	2003	2004	2005	2006
Fresh / Chilled					
Pacific salmon	862	902	1067	1329	1639
	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Frozen					
Sockeye	63	39	52	29	<1
	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
"other"	2904	2232	1146	1152	1776
Pacific	1709 (59%)	111 (5%)	27 (2%)	0 (0%)	66 (4%)

Source: KITA 2007.

Table 8

Exports of Sockeye and "other" Pacific salmon (t) from South Korea in total and to Japan, China and the Russian Federation, 2002–2006

	2002	2003	2004	2005	2006
Fresh / Chilled					
Total	**61**	**4**	**0**	**0**	**0**
To Japan	14	2	0	0	0
To China	46	0	0	0	0
To Russian Federation	0	0	0	0	0
Frozen "other" Pacific salmon					
Total	**148**	**89**	**51**	**560**	**988**
To Japan	54	<1	50	0	865
To China	0	48	0	0	121
To Russian Federation	45	0	0	<1	0

Source: KITA 2007.

it is not clear whether similar systems are operating between these countries. In any case, traders report that South Korea Customs procedures are less stringent than those in Japan or the Russian Federation and that cargo can easily be shipped in, exchanged and shipped out within four or five days. This is in contrast to complaints in presentations at the International Fishery Congress in Vladivostok in September 2006 which stated that up to five days were required to clear incoming Russian fish landing and declaration procedures alone. Perhaps for this reason, a recent analysis indicated that 70–% of Russian fish exports were transhipped at sea rather than landed in Russian ports (Eurofish, 2005).

Selling fish outside the Russian Federation may also allow for more flexible financial arrangements

In addition to possibly expedited receiving and shipping clearances in South Korea, Russian fish suppliers may benefit in terms of financial arrangements. As described in the section on **China**, it is often a problem when Russian salmon suppliers demand cash payments for fish. Cash payments, as well as payment in ship fuel or transferring payments through Russian-owned car dealerships, were mentioned as means of avoiding Russian taxes. Another reason to use cash and avoid line-of-credit payment schemes with Russian entities is that, as of September 2006, Russian bank fees on line-of-credit transactions were 6–7% (i.e. an extra 6–7% of the transaction fee must be paid to the bank for every transaction). Typical line-of-credit transaction fees elsewhere are reportedly of the order of 0.1%. There is no publicly available information that details which companies are most involved in the third-party trade of Russian salmon but companies mentioned by one or more respondents as being involved in purchasing salmon from the Russian Federation, potentially through South Korea included, Marubeni, Mitsubishi, Nippon Suisan, Kyokuyo, Nichiro, Mirror, Blue Ice, Ocean Trawlers and Pacific Andes[7].

Russian salmon, whether landed in the Russian Federation or transhipped to registered vessels, should have proper Certificates of Origin

Russian salmon bound for foreign countries, must first be landed in the Russian Federation or transhipped at sea to registered cargo vessels[8]. If landed or transhipped in a legitimate manner, a Russian Certificate of Origin should be produced. In theory, when the cargo is imported (e.g. to Japan or China) or when ownership is transferred without import (e.g. at South Korean bonded warehouse facilities), the Certificate of Origin should be produced. Cases in which Certificate of Origin paperwork is not legally correct would fall into two broad categories: the Certificate of Origin is unavailable or the Certificate of Origin is forged. Statistics are not publicly available on the number of cases in which shipments are rejected on the basis of problems with Certificates of Origin nor on the number of incidents involving forged Certificates of Origin.

While there is not necessarily a link between problems with the Certificates of Origin and trade through South Korea, interviews suggested that third-party trade would tend to increase opportunities to manipulate chain-of-custody documentation. None

7. Representatives of three of these nine companies were interviewed for this study.
8. As of October 2005, the Russian Federation was debating new regulations, designed to improve catch data and bolster the domestic processing industry, which would require that all catches from the Russian EEZ be landed in Russian ports before being exported (Eurofish, 2005). It is believed at the time of writing that this measure has not yet been implemented.

of the respondents admitted any knowledge of trade in illegal catch salmon, though many suggested specifically that third-party trade through South Korea was beneficial for speed and tax avoidance purposes. If Russian salmon are being laundered through South Korea (i.e. the third-party trade is being used specifically to conceal the Russian origin of the fish), it is surprising that more salmon do not appear as South Korean products in receiving country statistics (e.g. Japan and China). **Table 9** shows that in 2002–2006, less than 2% of frozen imports to Japan and China were declared as being from South Korea.

Trade of Russian salmon through South Korea may be preferred for speed, tax avoidance or obscuring fish origin, but the latter seems unlikely

According to one interview respondent, there is a considerable amount of South Korean vessel activity (fishing and cargo) in the area near the Kuriles and he believed these vessels may be funnelling Russian salmon to Pusan. Illegal fishing activities by South Korean vessels in the area north-east of Hokkaido have been documented (Associated Press, 2006a). Also, South Korean (and Chinese) flagged vessels were some of the 67 vessels sighted illegally fishing with driftnets for salmon just outside the Japanese EEZ in July–November 2006 (Kitagawa, 2007). However, no connection between these fishing vessels and the third-party trade in salmon from Russian fishing grounds could be further confirmed. Information on cargo vessel movements was not available.

There is no documented connection between IUU fishing by South Korean flagged vessels and the third-party trade

Table 9

Imports (t) by Japan and China of frozen salmon products from South Korea, 2002–2006

	2002	2003	2004	2005	2006
JAPAN					
Sockeye	0 (0%)	25 (<1%)	0 (0%)	46 (1%)	0 (0%)
“other”	0 (0%)	0 (0%)	16 (<1%)	11 (<1%)	0 (0%)
CHINA					
Sockeye	0 (0%)	0 (0%)	75 (2%)	42 (<1%)	0 (0%)
“other”	0 (0%)	224 (<1%)	324 (1%)	339 (1%)	471 (1%)

Source: Japan Customs, 2007a; GCBI, 2003–2006; GCBI, 2007

Summary of key findings regarding Russian trade in salmon with South Korea

This section has highlighted the following points about the relationship of the Russian salmon trade with South Korea:

- The Russian Federation reports that 25% of its seafood is exported to South Korea, but South Korea would only record this trade if the fish were imported for consumption or processing, not if they were held in bonded storage areas;

- Salmon consumption and processing in South Korea is believed to be low and this belief is supported by only small quantities of salmon imported from the Russian Federation;
- South Korea instead appears to act as an intermediary in the trade of salmon between the Russian Federation and consumers and processors in Japan and China;
- One of the reasons for South Korea's third-party trade is its historical role in servicing vessels and equipment operating in the Russian fishing grounds;
- South Korea also offers cost-effective bonded cold storage facilities which are likely to be used mostly for Chum and Pink Salmon bound for processing plants in China;
- Traders report that procedures for receiving product, transferring ownership, and shipping it on to its final destination are expedited in South Korea compared to other countries;
- Third-party trade may be particularly attractive because it allows brokers to buy fish from Russians with cash or other barter, then sell product to processors on credit;
- Russian salmon may be legally transhipped at sea to registered cargo vessels which carry the product to Pusan. A Certificate of Origin from the Russian Federation should be presented when such shipments are sold in South Korea as well as imported at the final destination;
- Although third-party trade may increase the opportunities to tamper with Certificate of Origin documentation, there is no evidence that Russian salmon are being re-branded as South Korean products;
- Some incidents of IUU fishing by South Korean vessels in or near Russian waters have been reported but these activities may be unrelated to the third-party salmon trade. South Korean cargo vessel involvement could not be assessed.

ESTIMATION OF POTENTIAL AMOUNTS OF IUU RUSSIAN SALMON IN EAST ASIAN MARKETS

There are no readily available data which address the source or scope of IUU salmon fishing in the Russian Federation

The preceding sections have documented the markets for Russian salmon in East Asia and how Russian products flow to these markets. Information on the quantity of salmon products, sometimes by species and sometimes by provenance, was presented from Customs and market data where available. Although it is likely that these quantities contain some fraction of salmon which is fished illegally in Russian waters, there are no readily available data which specifically address this issue. During the extensive interviews that were conducted for this study, many respondents acknowledged that IUU fishing was an issue in the Russian fishing grounds, but few were willing or able to provide information on the source or scope of the problem.

A model-based approach to estimating and catch and trade quantities will be applied

This section of the report is dedicated to addressing the question of how much salmon in the markets of East Asia derives from IUU fishing in Russian waters. The methodology is based on comparing two measures of the quantity of Russian salmon in East Asian markets (imports and market sales), to official data on catches in the Russian Federation and is thus an "accounting" method as classified by Agnew *et al.* (2006). If either imports or marketed quantities exceed officially recorded catches it can be argued that there is evidence of unreported catch, at a minimum, and potentially of illegal catch (e.g. catch exceeding the total allowable catch (TAC)). While there are a variety of other methods which have been used to estimate IUU fishing under different scenarios of data availability (Agnew and Kirkwood, 2005; Ainsworth and Pitcher, 2005; Agnew *et al.*, 2006), a version of the accounting methodology was chosen as the most appropriate given the data available to this study. This section first reviews existing information and estimates of IUU catches in the Russian Federation. It then describes the models developed for estimating IUU Sockeye catch in the Russian Federation from East Asian market data. The results are compared and discussed to provide an indication of the extent of IUU catch.

Existing estimates of IUU fishing in the Russian Far East

Products of IUU fishing in the Russian Federation may be consumed domestically or exported

Although it is commonly believed that a substantial amount of IUU fishing occurs in the waters of the Russian Far East, there are few data available to document the scope of activity. A report focused on the Bering Sea trawl fisheries (not including salmon) estimated that illegal fishing activities in Russian waters resulted in an economic loss of one to five billion US dollars per year (Vaisman, 2001). Given the high value of Russian seafood, particularly in neighbouring Japan, one would expect that a large proportion of IUU fishing products would be traded. In 2005, a Russian media report claimed that the illegal seafood trade between the Russian Federation and Japan was worth USD800 million in 2005 (IntraFish Media, 2006). It was also reported that in 2006 illegal seafood traded between Sakhalin[9] and Japan amounted to 9000 t and RUR15.5 million (USD600 000; ITAR-TASS, 2006). Either as an alternative, or in addition to these amounts, some Russian experts believe that most

9. The news report was not specific about whether or not "Sakhalin" included the Kurile Islands.

IUU salmon products remain in the Russian Federation and thus do not enter international trade (e.g. Senior representative of Sakhalin Federal Fisheries Agency (Sakhrybvod), pers. comm. to S. Clarke, November 2006).

Illegal seafood exports may be equal to 60% of the value of legal exports

One of the news reports stated that illegal seafood exports total about 60% of the value of Russia's legal seafood exports (IntraFish Media, 2006). With regard to the specific topic of this study, it is possible that all, or most, of the salmon trade between the Russian Federation and East Asian countries is legal and that the reported trade in IUU fishing products is focused on other species. However, in 2006, 16% of Japan's seafood imports from the Russian Federation were salmon, and thus it seems unlikely that the trade in IUU fishing products completely excludes salmon, particularly high value species like Sockeye.

An estimate for the Russian crab fishery indicates actual catches are 143% of reported catches

Another perspective on the issue of IUU catch is provided by a recent analysis of Russian crab fisheries (Asahi Shinbun, 2006). Professor Nobuo Arai of Hokkaido University compared Japan's imports of crab from the Russian Federation to Russian catch quotas for 2003 and found that imports exceeded the quotas by 22 000 t, and that actual catch would represent 143% of reported catches. Professor Arai stated that illegal catches made their way to port by means of transhipment to cargo vessels which prepared the legal documentation that allowed the crab to be traded through legal channels. In a comment on this situation, a Japan Customs official from the Hakodate regional office stated that if the products were accompanied by the legally required documentation, it would not be possible for Japanese inspectors to know whether the origin of the product was actually legal or not (Asahi Shinbun, 2006).

Therefore IUU catches may comprise an additional 40–60% above reported catches

Although these cases relate to total seafood and crab respectively, they suggest that illegal catches in the Russian Far East may comprise an additional 40–60% above catches represented in official statistics. They also indicate that large quantities of illegally caught seafood are exported. It must now be examined whether an analysis of salmon fisheries and trade provides any indication of IUU fishing activity.

Preliminary identification of catch and trade quantity discrepancies

Japanese imports alone exceed total reported Russian exports of Sockeye

As an initial scoping exercise, information on catch quantities, total allowable catches (TACs), Russian exports, and East Asian imports was compiled for Sockeye and "other" (assumed to include Pink Salmon and Chum) salmon for comparison (**Table 10**). Sockeye catches exceeded the TACs in 2002–2003 but were within the TACs during 2004–2006. As expected, total Russian exports of Sockeye in all years are not greater than catches. Chinese and South Korean imports of Sockeye are only minor components of the total quantities, but Japanese imports alone exceeded total Russian exports in all years. In three of five years, Japanese imports also exceeded Russian catch figures.

The situation for Pink Salmon and Chum is markedly different. First, the combined catch for the two species never exceeds the combined TAC. Second, imports by East Asian countries are mostly concentrated in China, especially in the latter years, but total only a fraction, at most 22%, of catches. This result, *per se*, suggests that there is a much higher domestic consumption of Pink Salmon and Chum resources, than of Sockeye. Russian export data also suggest that most of the Pink Salmon and Chum catch remains within the Russian Federation, but there are some indications of a lack of reliability in the Russian export data. For example, East Asian imports from the Russian Federation vary from 56% to 312% of reported Russian exports (**Table 10**).

A large proportion of Pink and Chum catches appear to remain in the Russian Federation

Table 10

Reported quantities of Total Allowable Catch (TAC), catch and total exports from the Russian Federation, and imports from the Russian Federation as reported by Japan, China and South Korea for Sockeye and "other" (Pink Salmon and Chum) salmon, 2002–2006

	2002	2003	2004	2005	2006
Sockeye					
TAC	9275	15 390	20 295	20 548	29 525
Catch	24 797	17 630	16 342	19 818	24 730
Total Russian exports	22 335	17 336	14 388	18 190	20 087*
Russian exports to Japan, China & S. Korea	22 034	16 944	14 257	17 598	19 786
Japan imports from Russian Federation	24 562	20 892	18 827	24 759	24 649
China imports from Russian Federation	16	3	1227	601	860
South Korea imports from Russian Federation	62	13	52	0	0
Combined Imports (preceding 3 lines)	**24 640**	**20 908**	**20 106**	**25 360**	**25 509**
"Other" salmon					
Pink TAC	103 543	140 257	194 288	187 602	194 902
Chum TAC	24 730	28 952	36 842	33 756	54 786
Combined TAC (preceding 2 lines)	**142 782**	**213 780**	**142 820**	**240 346**	**248 411**
Pink Catch	108 109	180 062	113 260	205 791	199 303
Chum Catch	32 406	32 076	27 723	33 110	46 903
Combined Catch (preceding 2 lines)	**140 515**	**212 138**	**140 984**	**238 901**	**246 206**
Total Russian Exports ("other")	25 511	16 756	8946	37 801	50 282
Russian exports to Japan, China & S. Korea ("other")	24 042	15 859	8514	35 294	48 793
Japan Imports from RF ("other")	6434	5277	5430	6143	5658
China Imports from RF ("other")	5464	18 688	21 139	40 380	48 939
South Korea Imports from RF ("other")	1709	111	27	0	66
Combined Imports (preceding three lines)	**13 607**	**24 076**	**26 596**	**46 523**	**54 663**

Sources: TRAFFIC Europe staff (Russian office), *in litt*., March 2007; Japan Customs, 2007a; GCBI, 2003–2007; KITA, 2007.

Notes: RF = Russian Federation. All quantities are tonnes. Asterisk indicates cumulative tally to December 2006 only.

Russian export statistics may be unreliable due to transhipment issues

In addition to the discrepancies highlighted in **Table 10**, Russian Customs statistics have also been declared unreliable for fisheries products which are often transhipped at sea (Eurofish, 2005). While in theory fish transhipped to, and exported by, cargo vessels should be recorded in Customs statistics systems, there are administrative reasons why such products are not always recorded (Eurofish, 2005), as well as doubts about the accuracy of documentation produced by some cargo vessels (Asahi Shinbun, 2006). For these reasons, this study will focus on Russian catch data, rather than export statistics, as the basis of comparison. Results based on comparisons to catch data have the additional benefit of a direct link to assumptions made about salmon population exploitation levels when calculating future TACs.

This analysis will focus on Sockeye only

This preliminary analysis has documented that comparison of quantities of Pink Salmon and Chum in East Asian markets to catches of these species in the Russian Federation will not provide any useful information about the potential magnitude of IUU fishing activities. Instead, the modelling exercise will focus on Sockeye for which quantities in Japan, China and South Korea appear to exceed catches, as well as TACs, in several of the past years.

Uncertainties in catch and trade figures must be accounted for before drawing conclusions

Although this preliminary comparison appears to indicate IUU activity for sockeye, in some cases discrepancies between figures are small. Given that both catch and trade figures have inherent uncertainties, these uncertainties must be taken into account before drawing conclusions. Probabilistic models which allow uncertain parameters to vary across a range of likely values are applied below to estimate catch and trade quantities and draw a more reasoned conclusion regarding potential IUU fishing.

Probabilistic models of Sockeye catch and trade

Probabilistic models explicitly incorporate uncertainty through parameter ranges

Probabilistic, or Bayesian, models offer two key benefits in an analysis of this type. First, they allow parameters to be treated as random variables from any known statistical distribution rather than as fixed values. Bayesian methods thus explicitly account for uncertainty in each step of the statistical modelling (Ellison, 1996). Second, the resulting parameter distribution, called a posterior probability density (or posterior), represents the probability that the value of the parameter is true rather than the probability of observing data given a specific value for a parameter, as in frequentist statistics (Wade, 2000). Despite these advantages, probabilistic models, like other models, cannot fully compensate for weaknesses arising from poor quality or sparse data. Also, when uncertainty is high, the resulting probability intervals may be wide. Such results, while honestly representing the true range of values, may not provide a clear basis for action by decision-makers. Please refer to **Methods** for additional information on Bayesian methods.

This study uses models of catch (Input 1 and 2) to represent Sockeye leaving the Russian Federation

Two types of probabilistic models were formulated on the basis of either catch or trade data (**Figure 22**). The **Input model** is a representation of the catch data and produces two estimates of the amount of Russian Sockeye that is "input" to the East Asian system each year. One estimate (**Input 1**) represents all Sockeye caught in Russian waters by Russian fisheries (i.e. it excludes the Japanese driftnet fishery within the

Russian EEZ). The other estimate represents all Sockeye caught in Russian waters regardless of fishery (**Input 2**).

The second type of model is based on trade data. One trade model (**Imports**) estimates the amount of Sockeye imported by Japan, China and South Korea. Although all three countries' data are included, the vast majority of Sockeye is imported by Japan. Since the Japanese driftnet-caught Russian Sockeye are not imported by Japan (i.e. they are landed) the results of the **Import Model** must be compared to the results of **Input 1**. The other trade model is the **Market Model**. This model estimates the catch weight of Russian Sockeye (either Russian—or Japanese-caught) represented by the quantities of Sockeye sold in the markets of Japan. The results of the **Market Model** are compared to the results of **Input 2**.

Models of trade (Import and Market) are used to estimate the amount of Russian Sockeye in East Asia

Input model

Of the three models, the Input model is supported by the least amount of data. The estimation algorithm is based on three sources of information about total Russian Far East Sockeye catches, and one source of Japanese Sockeye catch in Russian waters for each year 2000–2006 (**Table 11**), as well as conversion factors estimated from interview information.

The Input model is based on reported catch data

The degree of independence in the Russian catch figures is unknown. While the annual catches reported by the three Russian sources differ slightly, these differences are small and may merely be due to different factors used in converting processed catch weights to whole fish equivalents. Information on the amount of Japanese catch in

Data on catches in Russian waters are limited

Figure 22

Schematic representation of the relationships between the catch (Input 1 and 2) and trade (Import and Market) models. The blue boxes represent models; the yellow boxes represent estimates.

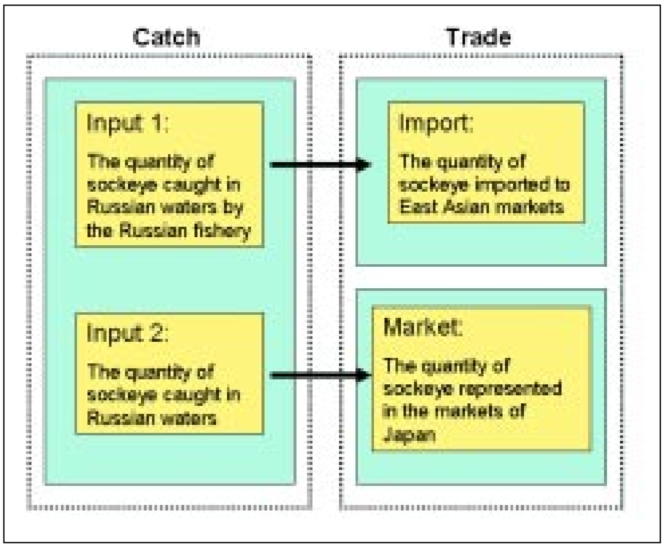


Table 11

Annual Sockeye catch data (t) in the Russian EEZ for the Input Models

	2000	2001	2002	2003	2004	2005	2006
Russian Catches							
TRAFFIC (2007)	15 127	17 962	24 797	17 630	16 342	19 818	24 730
Sinyakov (2006)	15 127	18 102	24 805	17 692	16 342	na	na
NPAFC (2007a); TINRO (2006)	15 107	18 124	24 796	17 704	16 343	19 503	24 247
Japanese Catches							
NPAFC (2007a); TINRO (2006)	2091	2715	3200	2018	2616	2738	na
Nemuro City (2007)	na	na	na	na	na	na	2990

Sources: TRAFFIC Europe staff (Russian office), *in litt.*, March 2007; Sinyakov, 2006; NPAFC, 2007a; TINRO, 2006; Nemuro City, 2007.

Russian waters is highly sensitive as it can affect the quota level awarded in the following year. For this reason there is only one official figure for Japanese Sockeye catch in each year.

Annual catch reporting error is estimated from Russian catch data

The model is based on estimating annual Russian catch (R_a) as a normal random variable (RV) from the three Russian data sources with error (σ^2):

$$R_a \sim N(\mu_{a,R}, \sigma^2) \qquad \text{Eq. 1}$$

Each year is assumed to have its own mean ($\mu_{a,R}$), which is initially assigned a relatively uninformative prior in the form of a normal distribution. This prior is then updated using the available data points to form a posterior (n=2 or 3 per year). The error term (σ^2) is initially assigned an uninformative prior in the form of a gamma distribution with shape and scale parameters set to 0.01. This error term is assumed to represent the catch reporting error, based on the observed error between each data point and the mean for that year, pooled and estimated across all years (n=19; **Table 11**). The posterior estimates of the annual means and the pooled variance are used to estimate the annual Russian catch (R_a, Eq.1).

This catch reporting error is then applied to Japanese catch data

An estimate of the Japanese catch in Russian waters in each year J_a is produced using an annual mean ($\mu_{a,J}$) and the Russian catch reporting error, σ^2:

$$J_a \sim N(\mu_{a,J}, \sigma^2) \qquad \text{Eq. 2}$$

As for the estimate of Russian catches above, the annual mean Japanese catch ($\mu_{a,J}$) is initially assigned a relatively uninformative prior in the form of a normal distribution. This prior is updated using the available data point for that year (n=1). The posterior estimates of the annual means and the pooled variance from the Russian catch estimates are used to estimate the annual Japanese catch (J_a, Eq. 2).

Both the Russian and Japanese catch estimates are adjusted for primary processing, i.e. dressed (headed and gutted) or semi-dressed (gilled and gutted), which occurs on board before the fish is exported to any country. The percentage of catch that is dressed (and semi-dressed) is allowed to vary by year according to interview information which suggests that while semi-dressed forms have dominated and continue to dominate, in recent years more fish are dressed (see section **Japan, Distribution and location of consumption**). This is achieved by setting separate Bernoulli variables (q, representing the proportion which is semi-dressed) for the periods 2002–2004 (q=0.99) and 2005–2006 (q=0.70).

Catches are adjusted to their weight after primary processing

In addition, the yield for dressed and semi-dressed salmon is allowed to vary within a specified range, a to b. These ranges, which were set based on interview information, were formulated as uniform random variables D for dressed, where a=0.7 and b=0.8, and S for semi-dressed a=0.8 and b=0.9. The annual Russian and Japanese catches after primary processing ($P_{R,a}$ and $P_{J,a}$) are thus determined by:

Yields for different types of primary processing are applied

$$P_{R,a} = R_a \times [(q \times D) + ((1-q) \times S)] \qquad \text{Eq. 3}$$

$$P_{J,a} = J_a \times [(q \times D) + ((1-q) \times S)] \qquad \text{Eq. 4}$$

The estimates of annual Russian catches after primary processing ($P_{R,a}$) require one further adjustment to account for the proportion of Sockeye which is exported by the Russian Federation to countries other than Japan, China and South Korea. Based on data reported in Russian national export statistics for 2002–2006 the proportion exported to East Asia is very large and the proportion to other countries is very small (**Table 12**).

An adjustment for the percentage exported is applied based on Customs data

Although the proportions in **Table 12** are based on the exports to other countries, the percentage of the total Russian Sockeye catch potentially available for East Asian markets would be lower if a portion of that catch is consumed within the Russian Federation. However, as there is currently no means of estimating the extent of this domestic consumption, out of necessity it is assumed that all Sockeye are exported. This assumption is conservative in that the results from the Input models are thus higher than might be expected if domestic consumption occurs. This, in effect, tends to minimize potential differences between Input estimates and comparative quantities

Domestic (Russian) consumption may reduce the amount of catch exported but this cannot be quantified with available data

Table 12

Russian exports of Sockeye (t) to Japan, China and South Korea versus other countries, 2002–2006

	2002	2003	2004	2005	2006
Exports to Japan, China and S. Korea	22 034	16 944	14 257	17 598	19 786
Exports to other countries	302	392	131	592	301
Percent of exports to East Asia	0.99	0.98	0.99	0.97	0.99

Source: TRAFFIC Europe staff (Russian office), *in litt.*, 2007.

from Import or Market Models, and thus renders it less likely to conclude that IUU activities are taking place.

The adjustment parameter for exports, O, was defined for all years as a uniform RV with a=0.97 and b=0.99. The estimate resulting from this final adjustment represents the total quantity of Sockeye product that could be imported from the Russian Federation by Japan, China and South Korea in each year ($E_{R,a}$).

$$E_{R,a} = P_{R,a} \times O \qquad \text{Eq. 5}$$

Resulting estimates are tightly constrained due to lack of data

The distributions, i.e. median and 95% probability intervals, for the annual values of $E_{R,a}$ represent the results for Input 1. The Input 2 results are the distributions produced by the stochastic sum of the annual values of $E_{R,a}$ and $P_{J,a}$. A diagram of the Input model is shown in **Figure 23** and the code for the model is provided in **Appendix 7**.

The results for the Input model are shown in **Figure 24**. Probability intervals are noticeably wider (3700–5200 mt) in 2005 and 2006 due to assumptions regarding the proportion of semi-dressed product. In previous years, the range of the annual catch estimates varied by as little as 1700 mt. The tightly constrained intervals are due in large part to the lack of available data to estimate parameters relevant to catch and

Figure 23

Schematic representation of the methodology for Input model. Probabilistic variables are shown in shaded ovals. Logical (calculated) variables are shown in shaded rectangles. Data are represented by unshaded rectangles. For simplicity, uninformative priors are not shown.

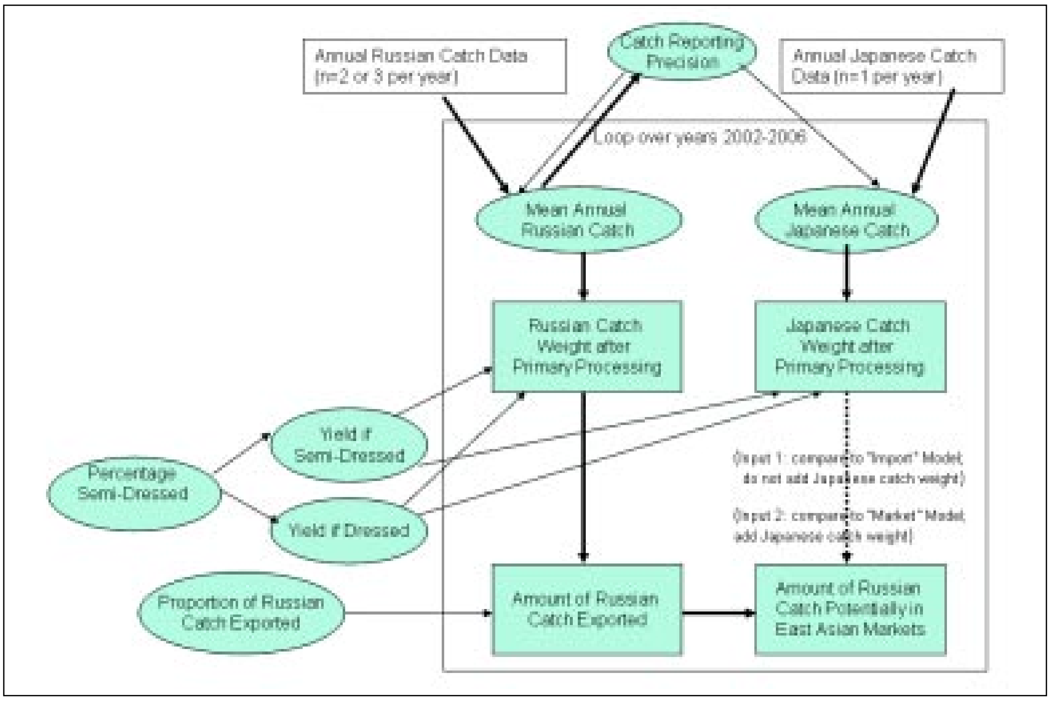
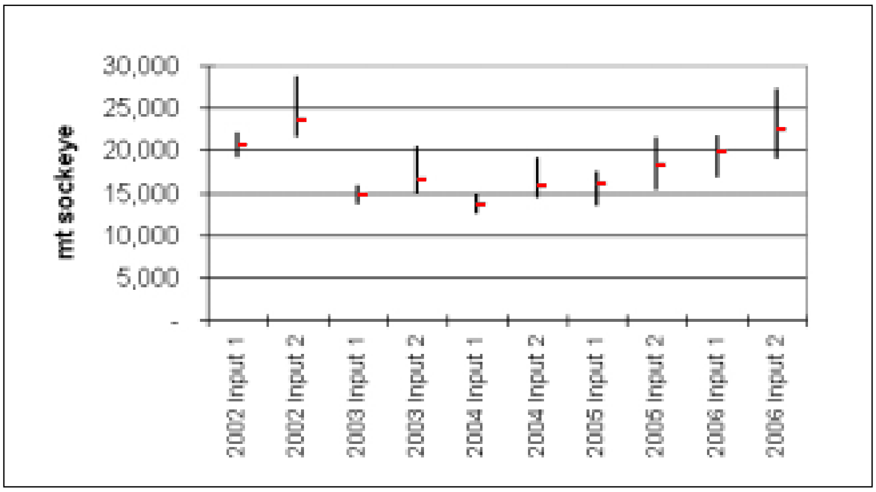


Figure 24

Input 1 (Russian fishery catch in Russian waters) and Input 2 (total catch in Russian waters) estimates for Sockeye, 2002–2006. Medians are shown with red bars, and black vertical lines represent 95% probability intervals.



export in the Russian Federation. This result is not surprising given that the scope of this study did not include data collection in the Russian Federation. Studies of IUU fishing for Russian salmon and related issues are being conducted by a separate team within the Russian Federation and may uncover information that is useful for this model. If so, these data can be incorporated into the Input models in the future.

Sensitivity analysis for changes in primary processing revealed only small differences in results

Sensitivity analysis was conducted for all parameters in the Input model which were specified on the basis of expert judgment alone. The only parameters which were so specified were the distributions for the percentage of Sockeye which were semi-dressed, rather than dressed, in the early and late estimation periods. Semi-dressed Sockeye have been the standard form for many years in the Russian and Japanese Sockeye fisheries and it is only in the past two years that some sources suggested the percentage of dressed salmon had increased. When the default values of p were lowered from 0.99 to 0.90 in the early period and from 0.70 to 0.50 in the late period, median catch values in both Input estimates were lowered by only 1–3%. Therefore, the default values, in addition to being the most likely values based on interview information, do not unduly bias the results.

Other parameters would benefit from better data

Other parameters, including Russian and Japanese catch estimates, processing yield, and proportion exported were data-based but may in fact be more variable than available data indicate. These parameters should also be subject to further exploration should new data become available.

Import Model

This model is based on the national Customs statistics of Japan, China and South Korea for imports of Sockeye from the Russian Federation. In addition to potential

A measure of variability for Customs data was derived from pairwise comparisons between East Asian countries and the USA

biases associated with Customs data such as under-declaration, mis-declaration and non-declaration (Clarke, 2004a), one of the major difficulties in using Customs data for estimation is that each value is a point estimate and no measure of variability is available. In this model it was decided to derive a measure of variability through pairwise comparison of recorded annual import and export quantities of Sockeye by trading partners. Given concerns regarding the accuracy of Russian export statistics (see section **Preliminary identification of catch and trade quantity discrepancies**), and the high level of observed discrepancies between Russian exports and imports from the Russian Federation recorded by Japan, China and South Korea (**Table 10**), US Sockeye exports were used to derive the measure of variability. There is no assumption that the Customs statistics from the USA are more accurate than any of the East Asian countries. Rather, the USA was selected for convenience because of its voluminous and frequent trade in Sockeye with all of the East Asian countries of interest to this study.

There are several reasons why trading partners' import-export statistics may not match exactly

As shown in **Table 13**, trade in Sockeye between the USA and Japan, and between the USA and China, was recorded in all years from 2002 to 2006. Trade in Sockeye between the USA and South Korea was recorded by both countries only in 2002, 2003 and 2005. Ideally, exports and imports of the same product in the same year should match closely. However, there are several reason why this may not be realized. For example, the ability to store frozen Sockeye in bonded warehouses might create year-on-year discrepancies if the holding period spans the end of the year. Systemic biases towards under-reporting of imports may be expected when tariffs are levied. Mis-matches in the way in which commodities are coded by the exporting and importing parties (e.g. Sockeye recorded on export as "sockeye" and on import as "other Pacific salmon") may also lead to discrepancies.

Each pair of countries is given its own variance

The model began by specifying relatively uninformative priors based on normal distributions for the mean quantity of exports traded between the USA and Japan,

Table 13

Trade between the USA and Japan, China and South Korea in frozen Sockeye (t), 2002–2006

	2002	2003	2004	2005	2006
USA Exports to Japan	18 719	21 185	28 342	35 594	13 477
Japan Imports from the USA	26 366	24 885	30 980	30 212	18 158
USA Exports to China	148	185	2135	2775	4113
China Imports from the USA	59	42	297	1317	3339
US Exports to South Korea	82	121	96	76	237
South Korea Imports from the USA	1	1	0	29	0

Sources: NMFS, 2007; Japan Customs, 2007a; GCBI, 2003–2007; and KITA, 2007.

China and South Korea, respectively, in each year (a) 2002–2006 ($\mu_{UJ,a}$, $\mu_{UC,a}$, $\mu_{UK,a}$). In addition to this prior on the mean, an uninformative prior for the variance, in the form of a gamma distribution with shape and scale parameters set to 0.001, was specified for each country pooled over all years ($\sigma_J^2, \sigma_C^2, \sigma_K^2$). Quantities of Sockeye exported by the USA to each country and imported from the USA by each country in each year (i=10, i=10, and i=6, for Japan, China and South Korea respectively; see **Table 13**) were then fit to these distributions to update the mean and variance terms:

$$UJ_{a,i} \sim N(\mu_{UJa}, \sigma_J^2) \quad \text{Eq. 6}$$

$$UC_{a,i} \sim N(\mu_{UCa}, \sigma_C^2) \quad \text{Eq. 7}$$

$$UK_{a,i} \sim N(\mu_{UKa}, \sigma_K^2) \quad \text{Eq. 8}$$

The posterior variances ($\sigma_J^2, \sigma_C^2, \sigma_K^2$) represent the error in reporting the quantity of imported Sockeye in each country. The next step was to define relatively uninformative priors based on normal distributions for the mean quantity of Sockeye imported by each country from the Russian Federation in each year 2002–2006 ($\mu_{RJ,a}$, $\mu_{RC,a}$, $\mu_{RK,a}$). These priors were used as the mean of normal distributions, with country-specific variances based on the posteriors above ($\sigma_J^2, \sigma_C^2, \sigma_K^2$). Available data for Japan's, China's and South Korea's imports of Russian Sockeye in each year (n=1; see **Tables 1**, **5** and **7**) are used to update the priors to form posteriors. Once the posteriors were obtained, they were applied to another set of normal distributions (Eqs. 9, 10, 11) to estimate the quantity of Sockeye imported by each country from the Russian Federation in each year (J_a, C_a, K_a).

This variance is then applied to each East Asian's country's point estimate from Customs data

$$J_a \sim N(\mu_{RJa_a}, \sigma_J^2) \quad \text{Eq. 9}$$

$$C_a \sim N(\mu_{RCa}, \sigma_C^2) \quad \text{Eq. 10}$$

$$K_a \sim N(\mu_{RKa}, \sigma_K^2) \quad \text{Eq. 11}$$

To obtain results comparable to the Input 1 estimate (i.e. Russian fishery catches of Sockeye in Russian waters, adjusted for primary processing and percentage exported), it was necessary to sum the estimates of imports for Japan, China and South Korea in each year (J_a, C_a, K_a). However, it was also necessary to consider the possibility of third-party trade. Specifically, as noted in the section **Third-party trade issues**, in some years China imports a considerable quantity (nearly 4000 t in 2006) of Sockeye from Japan. There are also very small quantities of Sockeye imported by China from South Korea (**Table 14**).

In some years China imports Sockeye, possibly Russian, from Japan

Regarding the import of Sockeye to China from Japan, there are several possibilities:

- These fish are Sockeye caught by the Japanese driftnet fishery in the Russian EEZ, landed in Japan and re-exported;

- These fish are Chum or Pink Salmon caught in Japanese waters, mis-declared as Sockeye and exported;
- These fish are Russian-caught Sockeye traded through Japan but not counted as Japanese imports; or
- These fish are Russian-caught Sockeye imported by Japan and then re-exported.

Table 14

Imports of frozen Sockeye (t) recorded by China from Japan and South Korea (both non-producers) 2002–2006

	2002	2003	2004	2005	2006
Imported by China from Japan	537	1392	1466	3605	3958
Imported by China from South Korea	0	0	75	42	0
Total	**537**	**1392**	**1541**	**3647**	**3958**

Source: GCBI 2003–2007

Japan's driftnet-caught Sockeye is unlikely to be sent to China

The first possibility is considered unlikely. Given the value of Russian Sockeye in the Japanese market (see section **Japan**), and the difficulties inherent in processing salmon in China for re-export to Japan (see section **China**) it is nearly certain that all of Japan's driftnet caught Sockeye is consumed within Japan. It should be noted that if these fish were Sockeye from the Japanese driftnet fishery, they should be excluded from the model since the results will be compared to Input 1 which does not include the Japanese driftnet catch (**Figure 22**).

China's imports of Sockeye from Japan might be mis-declared

Regarding the second possibility, there are no available data to estimate the incidence of mis-declaration of salmon species. Although such incidents undoubtedly occur, given the value of Sockeye relative to other species, and the fact that traders can easily distinguish Sockeye from other species, for the purposes of this study it is assumed that all salmon species are the species they are declared to be.

It is more likely that these Sockeye are Russian, imported to China through bonded areas in Japan

Of the remaining two possibilities, the former would indicate that the Sockeye imports to China from Japan should be accounted for separately since they were not enumerated by Japan. In the latter case, the Sockeye imported by China would have been recorded by Japan and if counted again in this analysis would be double counted. Interviews proved uninformative on this issue. The author's own judgment suggests that these fish were shipped through Japan to China without being imported and re-exported. The rationale for this conclusion is based on:

- Japan's *hozei* (bonded storage) system allows goods to be held without subject to tariff for up to two years pending a decision by the trader to import or re-export. It would be unprofitable for a trader to import and then re-export if there was a chance that the goods would not be needed in Japan;

- China's import statistics confirm that Japan serves as a routing country for Russian salmon (see the section China). It is thus possible that some portion of the Sockeye reported as originating in Japan is actually Russian Sockeye being shipped through Japan;
- The lack of correspondence between reported imports of Sockeye by China from Japan, and reported exports of Sockeye from Japan, suggests that these fish were not re-exported by Japan (and were thus not imported by Japan);

A further factor to consider is whether these Sockeye originated in Russian or North American waters. Given that the third-party trade is more likely to occur when handling Russian salmon than North American salmon for reasons explained in the section **Korea's role in the third-party trade**, the presumption is that these are Russian fish.

China's imports of Sockeye from Japan might also be of US origin mis-declared

Similar information for South Korea is lacking but it appears reasonable also to include China's imports of Sockeye from South Korea in the analysis for consistency. These quantities are of less concern simply because of their low volume (**Table 14**).

There is a similar issue for South Korea

As there is still a degree of uncertainty regarding these quantities, China's imports of Sockeye constitute a special case within the Import Model. In addition to the distributions used to estimate Japanese, Chinese and South Korean imports (Eqs. 9–11), another parameter (T_a) is used to represent the third-party trade involving the Russian Federation and China via either Japan or South Korea. This parameter is estimated in the same way as the national totals in Eqs. 9–11, i.e. with a relatively uninformative prior on the mean (μ_{CTa}) and the China import reporting variance (σ_C^2), updated with the data on quantities of Sockeye imported by China from Japan and South Korea in each year (**Table 14**). Once the posteriors are obtained, the quantity of Sockeye contained in the third-party trade involving the Russian Federation (T_a) is estimated as:

The uncertainty associated with these Sockeye is handled by a parameter which includes them in the analysis 80% of the time

$$T_a \sim N(\mu_{CTa}, \sigma_C^2) \qquad \text{Eq. 12}$$

A variable representing the likelihood that these fish should be included in the model is specified as a Bernoulli variable (L) with p=0.8:

$$T_{a_{adj}} = T_a \times L(p) \qquad \text{Eq. 13}$$

The value of p was set to reflect the high likelihood that these fish should be included in the model. With these four parameters estimated (Eqs. 9–11 and 13), the model stochastically sums the four terms to produce a result. A diagram of the Import Model is shown in **Figure 25** and the code is presented in **Appendix 8**.

The results of the Import Model are compared with the results of the Input 2 model in **Figure 26**. The Import Model estimates of the amount of Sockeye imported by East Asian countries from the Russian Federation in each year 2002–2006 extend over wide probability intervals spanning approximately 25 000 mt. This range reflects the underlying uncertainty in the import data. The median Import Model estimates are

Estimates of East Asia imports are considerably higher than catches but the difference is not statistically significant

Figure 25

Comparison of Input 1 (Russian fishery catch in Russian waters) and Import estimates for Sockeye, 2002–2006. Medians are shown with red bars, and black vertical lines represent 95% probability intervals.

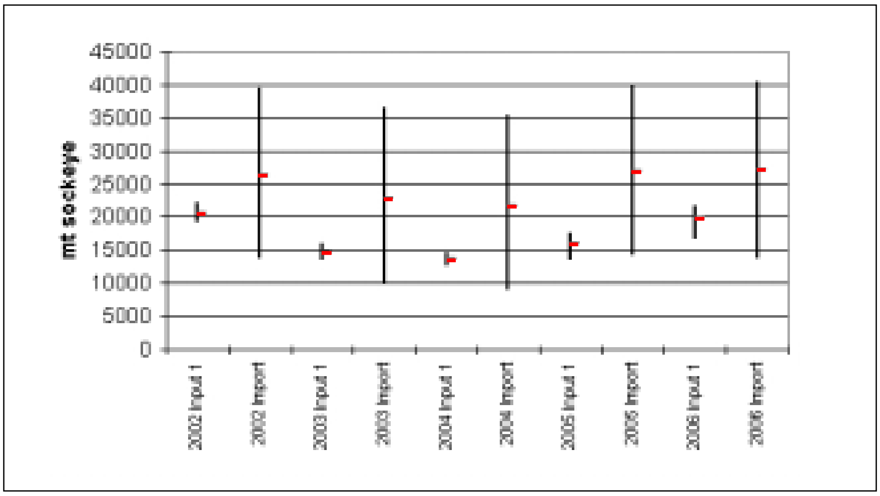
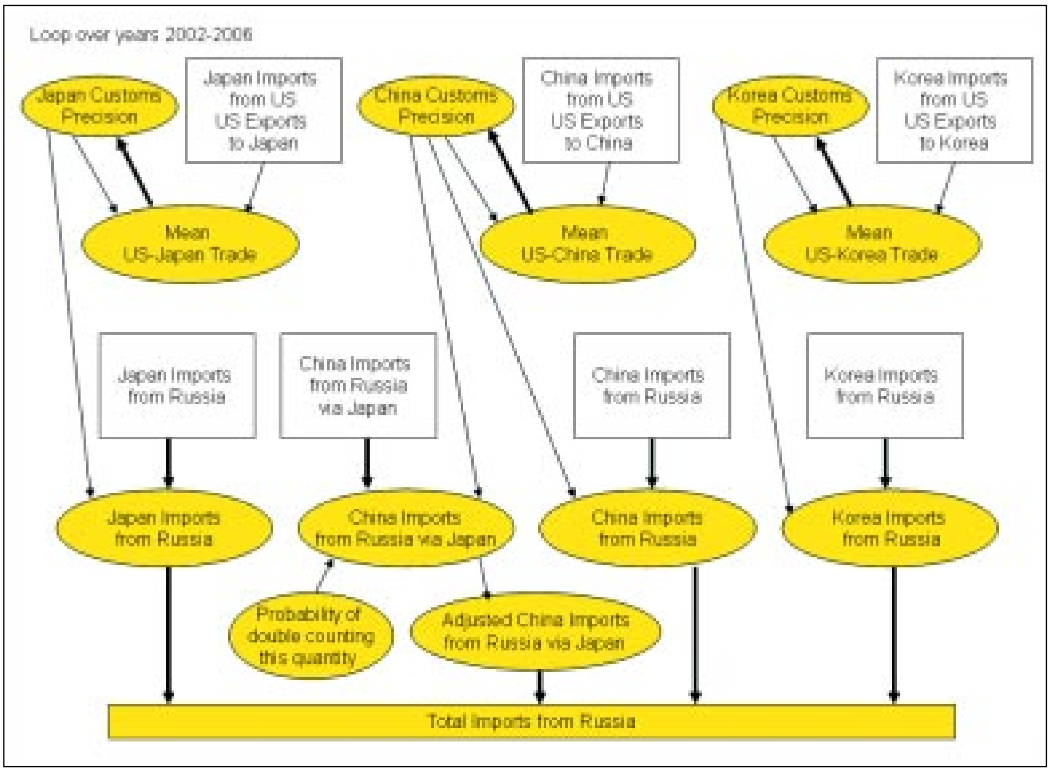


Figure 26

Schematic representation of the methodology for Import Model. Probabilistic variables are shown in shaded ovals. Logical (calculated) variables are shown in shaded rectangles. Data are represented by unshaded rectangles. For simplicity, uninformative priors are not shown.



always higher than the median Input estimates, sometimes by as much as 10 000 t (e.g. in 2005) but there is always an overlap in the probability intervals indicating there is no statistically significant difference between the two estimates. Nevertheless it is noted that in some years (2003–2005) the extent of this overlap is small. This indicates that while the probability that both estimates could be derived from the same state of nature cannot be dismissed, it is low.

Sensitivity analysis showed that the results were not particularly sensitive to the specification of the parameter for third-party trade only in 2003

The only parameter in the Import Model which was based on expert judgement was the factor for third-party imports of Sockeye to China. Based on several types of evidence, this factor was set to 0.8 so that third-party trade would be included in 80% of the model iterations. To test the sensitivity of the results to this assumption, the factor was set to 0.2. This resulted in estimates for the Imports model which were lower by 2–5% with the greatest difference in 2004. Since the amount of potential third-party trade was usually small relative to the total annual traded amount, this factor did not have a particularly strong influence on the result. However, if this type of trade were to increase in volume this factor should be further investigated.

Uncertainty in Customs reporting was accounted for but other biases may also exist

Other model parameters were data-based and were relatively well-informed by the data. A longer time series of data would assist in strengthening the estimates of variance in national Customs statistics. The potential exists for biases arising from mis-declaration by species or consistent under-declaration to avoid duty, but such biases could not be addressed by the data available to this study.

Market Model

The Market Model is based on Japan only due to lack of market data for China and South Korea

A large number of datasets available for salmon product sales in the Japanese market form the basis of this model. The scope of this model does not include the Chinese market because there are no available data on domestic consumption of salmon nor on the quantity of salmon fillets exported, after processing in Chinese factories, for consumption elsewhere. The South Korean market cannot be incorporated either, owing to lack of available market data. The exclusion of China and South Korea mean that the Market Model is expected to under-estimate somewhat the true quantity of Russian Sockeye sold in East Asian marketplaces, but this is mitigated by the fact that the major market is in Japan and quantities of Russian Sockeye sold in China and South Korea are likely to be very small.

There are inherently more uncertainties in the Market Model

Although there are copious data available for fisheries products in Japan, many of the datasets are not species-specific with regard to salmon (see section **Japan**). There are also numerous difficulties associated with back-calculating to primary processing equivalents (the basis of the Input models) from market data in which the product form is not clearly specified. Furthermore, in this model, more than in the others, there is considerable potential for double-counting products recorded at more than one stage in the distribution chain. For these reasons, the Market Model incorporates a greater degree of uncertainty and would be expected to produce wider probability intervals. As some key data were not yet available for 2006, the Market Model was run for 2002 to 2005 only.

Table 15

Amounts of frozen and salted Sockeye, and frozen *kirimi* (t) sold at Tsukiji market, 2002–2006. Calculations were carried out in kilograms but have been rounded to the nearest t

	2002	2003	2004	2005	2006
Frozen Sockeye B_{a_f}	2613	1888	2320	1748	2271
Salted Sockeye B_{a_s}	3796	3881	3534	3251	3755
Frozen *kirimi*	337	323	336	331	312
Total Frozen Salmon	37 759	36 885	34 768	28 092	35 086
Fraction of frozen salmon that is Sockeye	0.07	0.05	0.07	0.06	0.06
Assumed Sockeye *kirimi* (K_a)	23	16	22	21	20

Source: Tokyo Central Wholesale Market, 2007

Data on frozen and salted Sockeye in Tsukiji form the foundation of the model

The model begins with the source of the most detailed data on salmon sales in East Asia, Tsukiji, which also handles a large share of Japan's national seafood distribution. As described in the section **Japan**, Sockeye products at Tsukiji are recorded in frozen (B_{a_f}) and salted (B_{a_s}) forms, and some of the frozen *kirimi* recorded is expected to include Sockeye. As an initial assumption, the proportion of frozen *kirimi* that is Sockeye was calculated, outside the model, by assuming this proportion is the same as the proportion of frozen salmon that was Sockeye. These proportions are applied separately for each year based on observed proportions in that year (**Table 15**, bottom half).

Kirimi* *quantities were converted to primary processed equivalents and adjusted for double counting

The first step in the model converts the amount of Sockeye *kirimi* sold in each year (K_a) to a primary processed equivalent which can then be combined with the sales data for frozen and salted Sockeye (**Table 15**, lines 1 and 2). This conversion is implemented by applying a factor of 0.8, based on interview information which stated that the yield of *kirimi* from primary processed salmon is 80%. Since the yield may be expected to vary slightly, the factor is formulated as a uniformly distributed RV (Y) with range a=0.75 and b=0.85. The product is then adjusted for the situation in which *kirimi* may be double counted, i.e. sold in the central markets as a primary processed product (e.g. headed and gutted) and then re-sold as *kirimi*. For this conversion another uniformly distributed RV, M, was specified with range a=0.2 and b=0.5. This distribution derives from interview information which suggests that between 50–80% of the *kirimi* sold in central markets would have been recorded in sales data as a primary processed product. These two adjustments produce the primary-processed equivalent weight of frozen *kirimi* sold in Tsukiji which was not recorded in sales data at the primary processing stage ($K_{a_{adj}}$):

$$K_{a_{adj}} = K_a \times Y \times M \qquad \text{Eq. 14}$$

Tsukiji's sales are believed to be similar to all of the other nine major central wholesale markets in Japan with the exception of Osaka which has a higher demand for Sockeye (see the **East Asian salmon trade and the role of Russian salmon, Japan**). The proportion of Sockeye in the Osaka main market is unpublished but was obtained for Osaka's main market (Honjo) from private sources during interviews (see **Table 3**). Since the Honjo market is grouped with the east market (Toujo) as a single Osaka market in the national market statistics, the proportion of Sockeye in the Honjo was applied to the total frozen and salted quantities recorded by both the Honjo and Toujo markets in the national statistics (**Table 16**). This was accomplished within the model by using

Sockeye proportions for one Osaka market were applied to the other Osaka market

Table 16

Quantities of frozen and salted salmon (all species, t) sold in the Osaka main market (Honjo) and east market (Toujo), 2002–2005. Data for 2006 were not available

	2002	2003	2004	2005
Osaka (Honjo)				
Frozen salmon	4897	2713	2767	2517
Salted salmon	2944	2620	2570	3109
Osaka (Toujo)				
Frozen salmon	3403	2082	1878	1914
Salted salmon	2045	1897	1911	1704

Source: Osaka City, 2006

Osaka Honjo proportion data from **Table 3** for 2002–2005 to create a distribution of values for the proportion of frozen and salted Sockeye in the Toujo. This was achieved by using uninformative beta distributions as priors for the probabilities p_f *and* p_s in binomial distributions with sample size set to 100:

$$H_{a_f} \sim binomial(p_f, 100) \quad \text{Eq. 15}$$

$$H_{a_s} \sim binomial(p_s, 100) \quad \text{Eq. 16}$$

For each distribution, the prior was updated using the available data (n=4) from the Honjo proportions to estimate posterior values for H_{a_f} and H_{a_s}. Values drawn from these distributions (H_a) were applied to the Toujo data shown in **Table 16**, and added to the observed values of Sockeye in the Honjo. The resulting sums, O_{a_f} and O_{a_s}, represent the amounts of frozen and salted Sockeye sold in the Osaka market (combined for Honjo and Toujo markets) in each year, 2002–2005.

Both markets were summed to obtain the quantity of Sockeye sold in Osaka each year

For the remaining major central wholesale markets in Japan, although total quantities of frozen and salted salmon were published, no information on the proportion of Sockeye was available. To obtain the quantities of Sockeye sold in these eight markets, observed total quantities of frozen and salted salmon in these eight markets (Q_{a_f} and Q_{a_s}) were factored by distributions representing the proportion of Sockeye. These distributions were specified as ranges (r) using log normal distributions with means set at the proportion observed at Tsukiji and a variance which allowed the proportion to vary as high as the proportion at Osaka. The Tsukiji, Osaka and other eight markets

Other major wholesale markets were estimated from Tokyo and Osaka data, and summed to produce a total for all major wholesale markets

were summed to produce an estimate of the quantities of frozen and salted Sockeye sold through Japan's ten major central wholesale markets (C_{a_f} and C_{a_s}) as follows:

$$C_{a_f} = B_{a_f} + K_{a_{adj}} + O_{a_f} + \left(Q_{a_f} \times r_f\right) \qquad \text{Eq. 17}$$

$$C_{a_s} = B_{a_s} + O_{a_s} + \left(Q_{a_s} \times r_s\right) \qquad \text{Eq. 18}$$

The estimated quantity was then adjusted for amount sold outside of the wholesale market system

The sum of C_{a_f} and C_{a_s} as set equal to C_a. While many fisheries products are still traded through the central wholesale markets, a large and growing proportion of products are distributed outside these channels, e.g. from importers and processors directly to supermarkets (see section **Distribution and location of consumption**). Based on interview information cited in this section, the proportion of Sockeye traded inside the market was specified as a uniform distribution (X) with a range of a=0.3 and b=0.45 in 2002 decreasing annually in even increments to a range of a=0.2 and b=0.3 in 2005. The product of this distribution and C_a represents the total quantity of Sockeye in the Japanese market each year ($C_{a_{adj}}$):

$$C_{a_{adj}} = C_a \times \frac{1}{X} \qquad \text{Eq. 19}$$

Once this was estimated, it was necessary to partition this total supply into the portions corresponding to the Russian fisheries. For this purpose, the total annual supply to Japan was calculated from Sockeye imports to Japan from all supply countries according to Japanese import records, plus an allowance for landed Sockeye from the Japanese driftnet fleet (**Table 17**). The Russian share (s_a) was considered to be all Russian fish regardless of fishery and thus calculated as a ratio with Russian imports and Japanese driftnet landings as the numerator and total supply as the denominator.

Total Sockeye in the Japanese market was partitioned by the observed share of Russian supply based on imports and landings

Although the Market Model makes use of Customs data in this step, it uses only the proportional share of Russian sockeye, and not actual imported quantities as in the Import Model. As long as whatever biases in the import data apply to all three countries, these data should provide a fair representation of proportional supply.

Table 17

Imports of Sockeye (t) by Japan from the Russian Federation, Canada and the USA, Japanese driftnet landings (t) and proportion from the Russian Federation, 2002–2005

	2002	2003	2004	2005
Imports from Russian Federation	24 562	20 892	18 827	24 759
Imports from Canada	3920	1644	1691	510
Imports from USA	26 366	24 885	30 980	30 212
Japanese driftnet landings	3200	2018	2616	2738
Proportion of imports from Russian Federation	0.4783	0.4634	0.3963	0.4723

Source: Japan Customs, 2007; NPAFC, 2007a.

Alternative methods involving national Sockeye catch data were considered but these data would not account for domestic consumption, e.g. of Alaskan salmon in the USA, and thus could not be used to represent shares in the Japanese market.

The calculated proportions were used to factor the Japanese market estimate into a Russian Federation-specific estimate (Z_a).

$$Z_a = C_{a_{adj}} \times S_a \quad \text{where} \quad s_a \sim uniform\ (\ j, k\ ) \qquad \text{Eq. 20}$$

To account for uncertainty in s_a, a uniform distribution was formed using the lowest Russian share from **Table 17** as *j* and the highest Russian share from **Table 17** as *k*. Values of s_a were drawn and applied to the estimated quantity of Sockeye in the Japanese market, $C_{a_{adj}}$. The Russian Federation-specific estimate (Z_a) is thus the product of the quantity of Sockeye in the Japanese market and the share of the supply that is Russian, regardless of whether it is Russian or Japanese caught. A diagram of the Market Model is shown in **Figure 27** and the code for the Market Model is presented in **Appendix 9**.

Figure 27

Schematic representation of the methodology for the Market Model. Probabilistic variables are shown in shaded ovals. Logical (calculated) variables are shown in shaded rectangles. Data are represented by unshaded rectangles. For simplicity, uninformative priors are not shown.

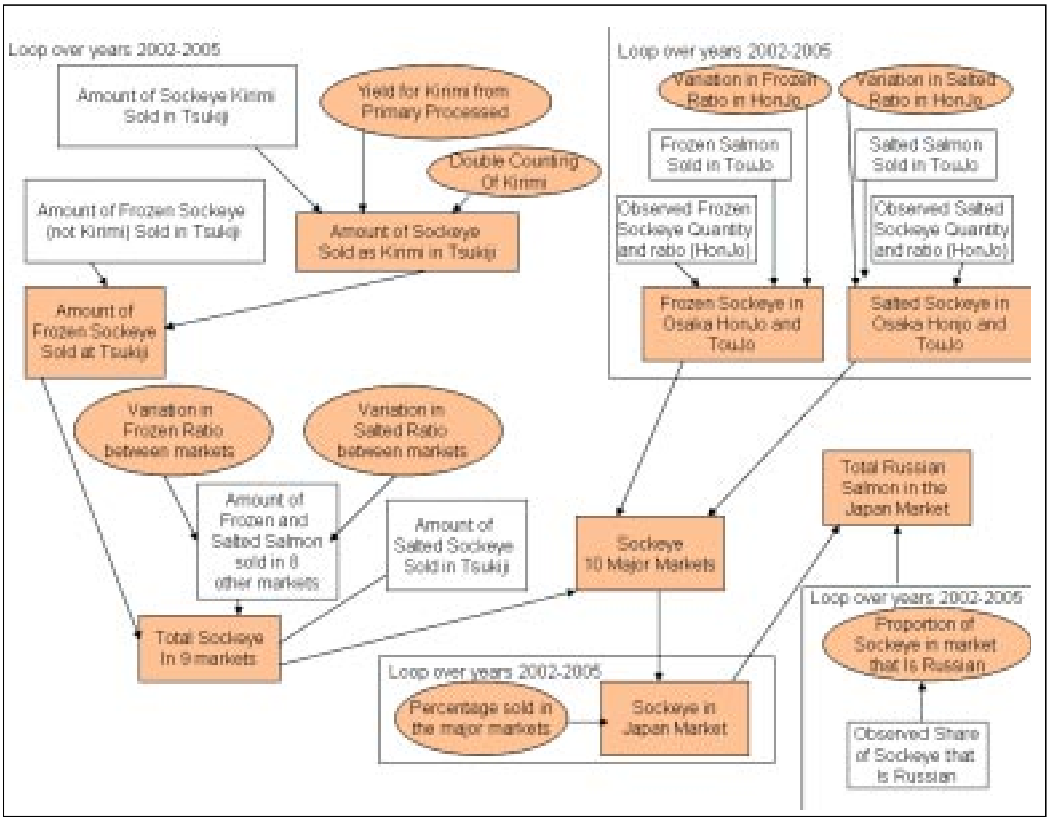
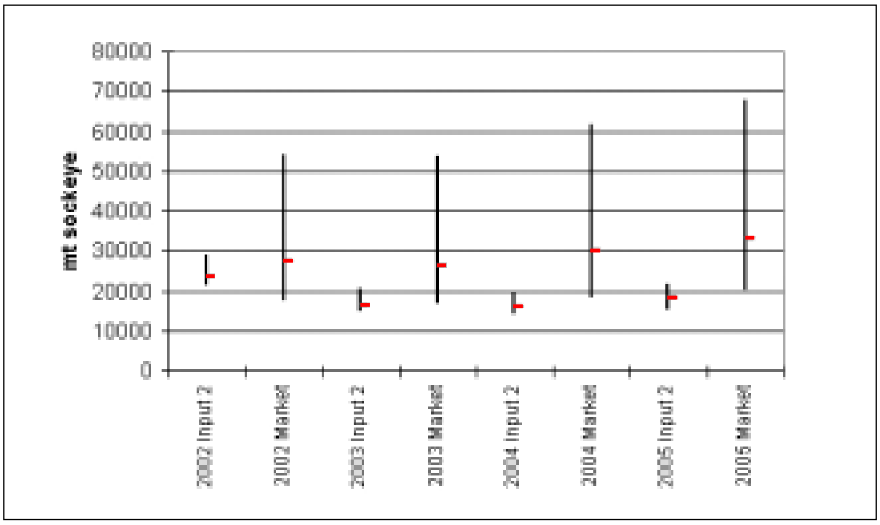


Figure 28

Input 2 (total catch in Russian waters) and Market Model estimates for Sockeye, 2002–2005. Medians are shown with red bars, and black vertical lines represent 95% probability intervals.



Market Model results are similar to Import Model results, but higher

The Market Model estimates when compared to the Input 2 (**Figure 28**) estimates are similar to the Import versus Input 1 comparison described above. Median Market-based estimates are always higher than Input model results, sometimes by as much as 15 000 t (e.g. in 2005). The estimates of catches are again near the bottom of the trade-estimated probability intervals but, just as in the Import Model, there is overlap in the probability intervals in every year, indicating that statistically the estimates are not significantly different.

Market Model results are highly sensitive to assumptions regarding the proportion of trade outside of wholesale markets

The two judgment-based parameters in the Market Model are the percentage of *kirimi* that is double counted, and the percentage of Sockeye traded outside the central wholesale market system. The default range of double-counted *kirimi* was set at 0.5 to 0.8. If less *kirimi* was double-counted, the model result would be higher and thus the difference between the Market and Input 2 results would be greater. As a sensitivity test, the range of double-counted *kirimi* was set at 0.8 to 1.0, implying that even less of the *kirimi* should be included in the model. This change in parameter specification resulted in <1% change in model. However, when the percentage of Sockeye traded outside the central wholesale market was decreased from 55–85% to match the range observed for Bigeye Tuna, Skipjack and Common (Flying) Squid *Todarodes pacificus*, i.e. 45–60% (see the section **Distribution and consumption of salmon products within Japan**), there was a large effect on the Market Model results. Median estimates decreased by 30–50%. Of the two parameters, the double counting of *kirimi* is much more speculative but much less influential. The model is highly sensitive to assumptions made regarding the percentage of Sockeye traded outside central wholesale markets. While the parameter used in the model is judgment- rather than data-based, it derives from the independent, but consistent opinion of representatives of two of Japan's largest marine products companies. Other parameters are primarily data-based. Although their estimation would certainly be improved with better data, existing data were taken at face value and appear to provide reasonable model inputs.

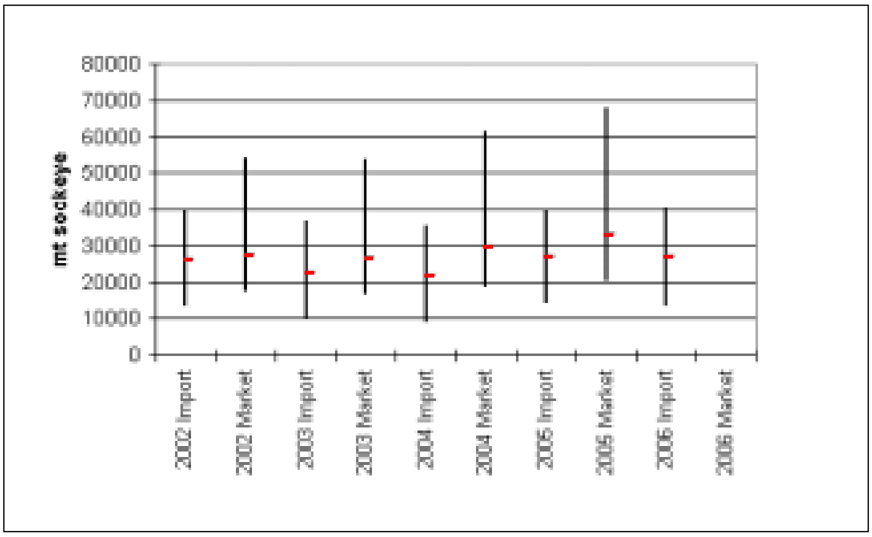
Comparisons between Import and Market Models

When the Import and Market Model results are compared side-by-side (**Figure 29**), the median results of the Market Model show a consistent upward bias ranging from just over 1300 t in 2002 to slightly over 8400 t in 2005. Given that the Market Model includes the Japanese driftnet-caught salmon and the Import Model does not, one would expect the Market Model to produce slightly higher estimates. This explains, in part, why median Market Model estimates are higher than Import Model median estimates. In addition, the higher degree of uncertainty in the Market Model, as discussed in the previous section, results in larger probability intervals, and thus higher maximum (97.5th percentile) estimates which compound the upper bias. Another difference is that the Import Model estimates are rooted in the reported Sockeye imports from the Russian Federation, whereas the Market Model performs many steps to calculate a total market quantity and only in the final step partitions this quantity into a Russian share. In this way, the Market Model is more likely to be influenced by factors that affect the overall Sockeye market but do not necessarily reflect the situation in the Russian Federation. For these reasons, a slightly higher credibility is attached to the Import Model results, but the higher estimates from the Market Model serve to warn that values above the median Import Model results should not be discounted.

The Market Model results are consistently higher than the Import Model results

Figure 29

Comparison of Import and Market Model results for Sockeye, 2002–2006. Medians are shown with red bars, and black vertical lines represent 95% probability intervals. Market results are not available for 2006.



Excess catch is defined as the amount by which traded quantities exceed catch

The results of the catch and trade models in terms of the 95% probability intervals and medians illustrated in **Figures 24**, **25** and **28** are given in **Table 18** (lines one to four). These probability intervals are two-tailed and address the issue of whether the trade estimates are higher or lower than the catch estimates. However, since the trade estimates have been shown to be higher than the catch estimates in all cases, we now directly address the hypothesis that the traded quantities are higher than the catch quantities. For this purpose, the 95th percentile (the upper endpoint of the 90% probability interval) is used as the threshold of statistical significance in a one-tailed test with $\alpha = 0.05$. Measures of excess catch, i.e. the amount by which traded quantities exceed reported catch, were calculated by subtracting the catch estimate (Input1 or Input2) from the trade estimate (Import or Market Model). It should be noted that negative numbers may result (i.e. if the catch estimate is larger than the trade estimate). A ratio of excess catch to reported catch, calculated by dividing the traded quantity by the catch quantity, was also prepared.

Excess catch is statistically confirmed by both models in 2005 and strongly suggested in 2003 and 2004

The statistical significance of the excess catch calculations can be determined by assessing the probability that the ratio of excess catch is greater than one. If the ratio exceeds one then excess catch was present in that year and the excess catch figures given in **Table 18** are statistically significant. **Figure 30** presents histograms showing the probabilities relative to one for each year and each model. The cumulative probability that the ratio is less than one is printed on each plot. For the Import Model the probabilities range from 0.031 to 0.177 and the only significant value (probability <0.05) is in 2005. This indicates that only in 2005 was there a greater than 95% probability that the excess catch ratio was greater than one. For the Market Model, the cumulative probability that the excess catch ratio is less than one range from 0.001 to 0.283 and results for 2003, 2004 and 2005 are statistically significant ($p=0.027$, 0.001 and 0.007, respectively). Therefore, the statistically significant presence of excess catch is confirmed by both models for 2005. The presence of excess catch for 2003 and 2004 is also strongly suggested since it is confirmed by the Market comparison ($0.027<0.05$ and $0.001<0.05$) and low though non-significant probabilities ($0.096>0.05$ and $0.086>0.05$) are indicated for these years in the Import comparison (**Figure 30**). Another factor to bear in mind is the conservative assumption in the Input (catch) model that none of the Sockeye is consumed domestically in the Russian Federation. If any Sockeye is consumed in the Russian Federation, the Input estimates would be lower making it more likely that a statistically significant difference between catch and trade estimates would be observed.

Excess catch in 2003–2005 is estimated as an additional catch 50–90% above reported catches

In the years of confirmed or suggested significant excess catch (2003–2005) medians of annual excess catch ranged from eight to 11 t for the Import Model and 10 to 15 t in the Market Model (**Table 18**, lines five to six). In the same years, medians for the ratio of excess catch to catch ranged from 1.5 to 1.7 for the Import Model and 1.6 to 1.9 for the Market Model (**Table 18**, lines seven to eight). These results indicate that an amount equal to 50–90% above the reported catch is present in East Asian trade. This is consistent with media reports of previous studies which suggested that IUU catches in the Russian Federation may comprise an additional 40–60% above catches represented in official statistics (i.e. excess catch ratio of 1.4–1.6).

Figure 30

Histograms of values of the ratio of excess catch to reported catch for Import Model vs. Input 1 (top five panels) and Market Model vs. Input 2 (bottom four panels). A line is drawn at 1 to illustrate the threshold value for the presence of excess catch. P-values indicating the proportion of values lying below 1 are shown on each plot.

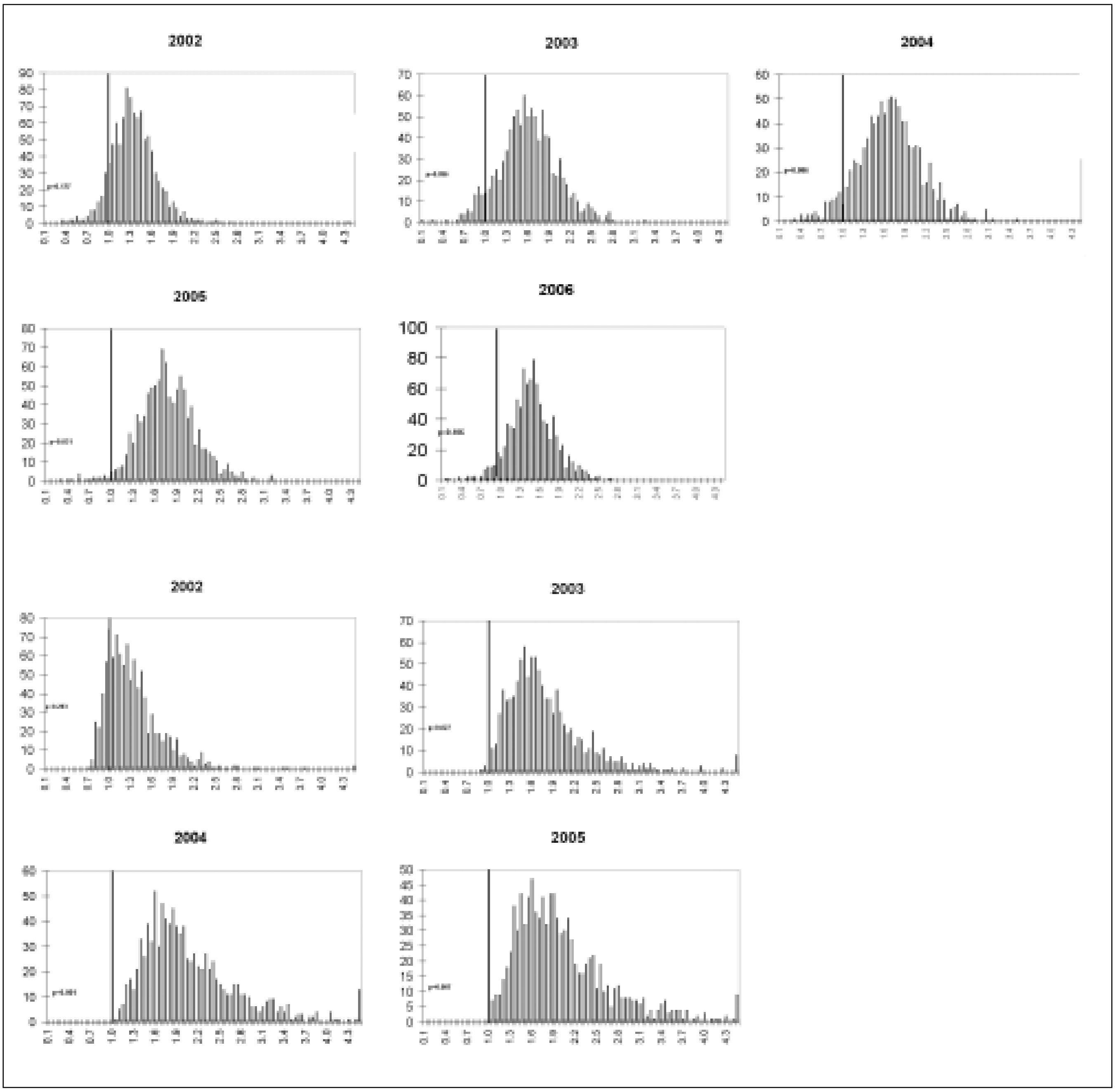


Table 18

Summary of model results in thousand t. Input 1 and Input 2 results are estimates of primary-processed, exported Russian Sockeye caught by the Russian fleet only, and by the Japanese and Russian fleets, respectively. Import and Market results are estimates of Russian Sockeye in East Asian markets. Values given in these rows are the 95% probability intervals and medians from Figures 24, 25 and 28. Excess catch and excess catch ratio are calculated as shown and 90% probability intervals are presented (one-tailed tests). The median dollar value of annual excess catch is given in units of million US dollars.

Model	2002	2003	2004	2005	2006
Input 1	19.4–21.9 (20.7)	13.8–15.6 (14.7)	12.7–14.5 (13.6)	13.6–17.3 (16.0)	17.0–21.6 (19.9)
Input 2	21.8–28.5 (23.5)	15.1–20.2 (16.5)	14.6–18.9 (15.9)	15.5–21.3 (18.3)	19.1–27.0 (22.5)
Import	13.8–39.4 (26.3)	10.3–36.3 (22.8)	9.2–35.1 (21.8)	14.4–39.6 (26.9)	13.9–40.1 (27.1)
Market	17.9–53.9 (27.6)	17.0–53.4 (26.5)	18.8–61.2 (30.1)	20.6–67.3 (33.0)	na
Excess Catch (Import minus Input 1)	-4.4–16.2 (5.7)	-2.1–18.3 (8.0)	-1.6–18.7 (8.1)	0.6–21.7 (11.1)	-3.0–18.2 (7.4)
Excess Catch (Market minus Input 2)	-4.5–23.6 (4.4)	1.4–30.0	4.1—37.8 (14.4)	3.9–40.1 (15.1)	na
Excess Catch Ratio (Import / Input 1)	0.79–1.8 (1.3)	0.85–2.3 (1.5)	0.88–2.4 (1.6)	1.0–2.4 (1.7)	0.8–2.0 (1.4)
Excess Catch Ratio (Market / Input 2)	0.8–2.0 (1.2)	1.1–2.8 (1.6)	1.2–3.4 (1.9)	1.2–3.3 (1.8)	na
Dollar Value of Excess Catch (Import / Input 1)	0 to 67.3 (28.4)	0–78.5 (39.8)	0–80.0 (40.7)	3.0–95.2 (55.6)	0–77.3 (37.1)
Dollar Value of Excess Catch (Market / Input 1)	0–89.6 (22.1)	6.8–118.8 (50.1)	20.7–151.7 (72.2)	19.3–162.5 (75.5)	na

The dollar value of annual excess catch ranges from 22 to 76 USD million

To calculate the value of the excess catch, a unit value of JPY600 (USD5) per kilogramme was assumed for primary processed Sockeye in the Japanese market (see **Figure 6**). Medians for the value of excess catch in 2003–2005 range from USD40 to 56 million for the Import Model and USD50 to 76 million for the Market Model.

Discussion

There are many uncertainties in estimates such as these. To the extent possible, given available data, allowances were made for variance due to reporting errors, uncertain processing yields, poor data coverage and differing expert opinions. Although the model results provide a realistic, preliminary estimate of the magnitude of IUU fishing, the model should be seen as an algorithm to which further data and knowledge can be added rather than a static, final product. Data, particularly those relating to processes in the Russian Federation, were scarce and as a consequence produced highly constrained estimates of catch. In addition, there were several potential biases, notably the incidence of mis-declaration of salmon species; the third-party trade involving the Russian Federation, Japan and China; and the amount of Sockeye consumed in the Russian Federation, which were acknowledged in the trade models but could not be robustly addressed by this study.

The model represents an algorithm to which further data and knowledge can be added

This modelling analysis was performed only for Sockeye, a high-value species which is preferentially exported from the Russian Federation to the Japanese market. Given the multi-species nature of the driftnet fishery for salmon in the Russian Federation, it is unlikely that Sockeye are targeted to the exclusion of other species. Therefore it is possible that the rates of IUU activity estimated for Sockeye are similar to those for other Russian salmon species. However, since available data suggest that other species, such as Pink Salmon and Chum, are predominantly consumed within the Russian Federation, it is not likely that import and Market Models such as those used for Sockeye can directly assess IUU fishing issues for these species.

Estimates for Sockeye may apply to other species but this cannot be confirmed using trade data

Owing to the trade-based nature of this study, no specifics are available on the type of IUU fishing occurring for Russian salmon. In particular, this analysis only explores whether trade figures exceeded reported catch, thus the issue of whether the excess catch derived from illegal or simply unreported operations cannot be addressed. Further clarification of this issue will require specific studies of fishing activities within the Russian Federation.

Trade data cannot identify whether excess catch is illegally caught or simply unreported

Although both Russian and Japanese fisheries target salmon in the Russian EEZ, model results suggest the excess quantities of Sockeye are not primarily originating from Japanese operations which fish in Russian waters but land their catches in Japan. Japanese landings would be suspected as the route for IUU Sockeye if the Market Model, which accounts for Japanese landings, always showed significant results while the Import Model, which does not account for these landings, did not. Instead, despite higher estimates in the Market Model, perhaps owing to higher uncertainties, the results of the Import and Market Models are generally consistent: both models document excess catch in 2005 and suggest excess catch in 2003 and 2004. This indicates that the excess catch is entering trade through a route that is accounted for in both the Import and Market Models, and is therefore not primarily based on landings.

Excess catch appears to enter trade through routes accounted for in both Import and Market Models, i.e. not primarily driftnet landings

Imports via cargo vessels are a likely route by which this excess catch enters trade. While these cargo vessels may be flagged by the Russian Federation, Japan, China, South Korea or even another country, as will be discussed in the section **Import control systems**, the pre-clearance procedures in effect for Russian cargo vessels landing in Japan may make it unlikely that Russian flagged vessels are used. Information on the flag State registration of the vessels delivering Sockeye imports from the Russian Federation, which is recorded by Customs authorities (e.g. Japan) but is not publicly available, would be necessary to pursue this line of inquiry. While the information

Excess catch appears to be reaching the market via imports from cargo vessels presented in this study suggests that excess catch reaches the market via cargo vessels delivering goods to registered Customs checkpoints (i.e. as represented in the Import Model results), the possibility that unreported landings and/or undocumented cargo shipments also contribute small amounts (i.e. as represented in the Market Model) cannot be dismissed.

Summary

In summary, this analysis has shown that:

- An initial, rudimentary comparison of catches and Customs data indicated that Japanese imports of Russian Sockeye exceeded Russian exports in all years, and exceeded reported Russian catches in three of five years examined;
- Models of the quantity of Russian Sockeye in the East Asia trade were designed to capture uncertainty and despite different methodologies and data sources, consistently indicated that traded quantities are large compared to reported catches;
- Statistical comparisons of modelled catch and trade quantities showed significant quantities of excess catch (traded quantities in excess of reported catches) in 2005 in both models, and a strong suggestion of excess catch in 2003–2004;
- In 2003–2005 the median quantities of annual excess catch were estimated to range from 8000 to 15 000 t representing a value of USD40 to 76 million;
- Model results for 2003–2005 indicate that traded amounts are 150% to 190% of reported catches reinforcing previous estimates that IUU activities in the Russian Far East represent an additional 40–60% above officially reported values;
- Since this analysis was focused on trade only, specific studies of the Russian fisheries will be necessary to determine whether the excess catch represents illegal or merely unreported catch;
- Consistency between the results for the Import Model and the Market Model suggests that excess catch reaches the market via a channel accounted for in both models, therefore pointing to a route involving cargo vessels rather than landings via fishing vessels.

STAKEHOLDER ACTIONS RELEVANT TO IUU FISHING FOR RUSSIAN SALMON

Even the most effective East Asian trade measures will not provide a complete solution

This section describes ongoing and potential actions by governments, the seafood industry, and consumers and which can act to curb illegal fishing activities in the Russian Federation. Since this study is limited to East Asian markets for Russian salmon, this discussion does not include actions which could be taken by Russian authorities to better control fishing operations or exports. It is acknowledged that even the most effective trade measures by East Asian countries will not be capable of providing a complete solution to the problem of IUU fishing in the Russian Federation. It is therefore essential that recommendations provided by this study be combined with those from a forthcoming study of IUU salmon fishery and trade issues in the Russian Federation to provide a holistic, multilateral response to the issue.

Stakeholders include government, industry, and consumers

The following discussion is organized by stakeholder group, i.e. government, industry, and consumers, and describes both current initiatives and recommendations for suggested activities. If the objective is to curtail IUU fishing activities, government bears the primary responsibility because only government can regulate fishing grounds, and control port landings and Customs borders. Industry and consumers can supplement government efforts by ensuring that particular supply chains (e.g. certain retailers) exclude IUU fishing products. However, in the absence of strict government controls, as long as a portion of the market remains open to the infiltration of IUU fishing products, IUU fishing can continue. For this reason, emphasis is placed on government activities which can control IUU fishing or importation of its products, rather than on industry or consumer actions which are limited to particular supply chains. Similar to the situation for market information presented in the chapter on East Asian salmon trade and the role of Russian salmon, the situation in Japan, relative to China and South Korea, is well-documented and seemingly advanced. Examples are drawn from China and South Korea where possible, but lack of available information in some cases prevents a comprehensive characterization of relevant seafood market measures.

Government

Government actions include import control, labelling requirements and IUU policies

Governments play perhaps the most critical role in stemming the flow of products derived from IUU fishing activities to East Asian markets. Relevant government actions may take one of several forms. First, all countries operate systems to control imports of products, but the extent to which these systems seek to detect and deter IUU fisheries products varies. Import documentation systems were investigated in some detail for Japan and to a lesser extent for China. Since Russian salmon are not imported in substantial quantities to South Korea, this country's import control system is less relevant than its bonded warehousing policy. Second, government may establish food labelling requirements that can assist in tracing the provenance of fish. While such programmes may not be designed with IUU fishing issues in mind, they document country of origin and the supply chain and thus can help identify the products of IUU fishing. A recently established labelling programme for Japan, which appears to be the most advanced in the region, is described as an example. Third, East Asian governments' policy responses to IUU issues are reviewed. These responses span the range from explicit National Plans of Action to less well documented intergovernmental co-operative programmes. A specific case from South Korea is presented as an example of a national response to international obligations regarding IUU fishing issues.

Import control systems

Certificates of Origin and Health Certificates are important import control documents

Customs clearance procedures, administrated by national Customs authorities, represent the most obvious form of interdiction exercised by governments towards IUU fishing products. Two of the most important documents in evaluating the legality of fisheries product imports are the Certificate of Origin and the Inspection and Quarantine Certificate (or health certificate). The Certificate of Origin is typically issued by the national authorities of the country which licences the fishing operations. Its possession serves to confirm that the fish were caught in a legal manner. The Inspection and Quarantine Certificate is issued by the exporting country which may or may not be the country issuing the Certificate of Origin. These certificates require a variety of information, in particular, the scientific name of the fish, the production country or region, the fishing region, the processing method, the production and processing enterprise name, and its registration number, as well as the institution that issued the certificates.

Control fails when documents are not carefully checked or are forged

Despite their detail and standardized usage, these documentation systems are not foolproof. In some cases, particularly when the volume of goods passing through the checkpoint is high (e.g. Clarke, 2004b), documents may not be checked thoroughly or carefully. Also, as cited in the section **Existing estimates of IUU fishing in the Russian Far East**, Customs inspectors sometimes claim that if all legally required paperwork appears valid, it is impossible for them to know whether the goods were legally or illegally sourced. This highlights the fact that import control systems may fail not only through ineffective implementation (e.g. failing to inspect documents) but also due to forgery and counterfeiting. The following discussion describes how each East Asian country manages its import control systems with specific reference to documentation issues.

Japan

Japanese Customs officials do not verify that contents match declaration unless contraband is suspected

The Japan Customs Administration is responsible for cargo clearance and thus takes the lead on most import issues. While Customs inspectors fastidiously re-weigh every incoming shipment to check the quantity, it appears that the contents of shipments will only be searched if information in the national intelligence database suggests problems with the import documentation. Information regarding this intelligence database is not publicly available but appears to focus primarily on weapons and illicit drugs, and secondarily on counterfeit goods and species listed under CITES. Most interview respondents admitted the contents would not be checked against the description on the manifest. One Customs official stated that seafood shipments would only be checked if it was suspected that fish were mixed with illicit drugs or other contraband. There appears to be no formal mechanism through which Customs officials can request support from Japan Fisheries Agency (JFA) personnel for inspection of fisheries product imports. Since the contents of the vast majority of containers of fisheries products are not checked against their manifest, the reliability of Customs data in accurately recording quantities by product type cannot be verified.

Although the Japan Customs Administration is thus solely responsible for inspecting imports, there is one formal mechanism through which it works with JFA. This liaison is driven solely by enforcement of a Japanese law which proscribes fishing by foreign vessels in Japanese waters and landings by foreign vessels in Japanese ports (Anon., 2006a). Whenever a cargo vessel enters a Japanese port and files documents indicating an intention to offload fisheries products, JFA is asked to verify whether the vessel is a cargo vessel or a fishing vessel. If the vessel is Russian-flagged, JFA will access a database provided by the Russian government which lists authorized fishing and cargo vessels and appears to be a form of "white list" (Roheim and Sutinen, 2006). JFA is not informed of, and does not take an interest in, what information the Russian Federation uses to place vessels on its "white" list. In interviews for this study JFA claimed its responsibility is limited to verifying whether the vessel is indeed a registered cargo ship, and apparently it does not, or cannot, use the system to confirm the authenticity of Certificates of Origin. In this way Japan, seemingly as a matter of policy, remains detached from the issue of detecting and identifying IUU products from another country's fishing grounds despite repeated reports in the media of co-operation between Japanese and Russian officials in combating the illegal seafood trade (Interfax, 2003 and 2005). Although it could not be confirmed from Japanese sources, it is likely that the Russian Federation uses or could use the system to proscribe vessels which have transhipped IUU products or otherwise violated Russian export procedures. This system appears to be conscientiously maintained and used by both governments, and despite the fact that the objectives of each government differ, it may be effective in preventing some shipments of IUU fish.

The only role of the Japan Fisheries Agency in import control is to verify that the importing vessel is not a fishing vessel

As a counterpoint to its apparently passive attitude towards controlling IUU fishing products from the Russian Federation, Japan implements strict trade controls on salmon imports from China, Taiwan and North Korea. JFA and the Ministry of Economy, Trade and Industry (METI) administer a special pre-approval process for any processed or unprocessed salmon imported from these three countries (see section **China**, **Box 1**). The onerous documentation requirements seem to be designed to discourage such imports but there is no evidence that these imports have any particular connection to IUU fishing. In fact, it seems almost none of China's salmon processing raw materials are caught by Chinese, Taiwanese or North Korea fisheries. Instead, most of these materials derive from Japanese or Russian fisheries (see **China**), presumably legal and possibly illegal operations. Japan's stated rationale for the policy is to prevent China, Taiwan and North Korea, which are not members of the North Pacific Anadromous Fisheries Commission (NPAFC), from benefiting from North Pacific salmon resources. However, by impeding the import of processed products from China the policy may be damaging the market, i.e. by disadvantaging low-cost processing in China, for legal products from NPAFC members, including Japan.

Japan requires special documentation for salmon imports from China, Taiwan and North Korea

Japan strictly prohibits imports from North Korea

In addition to the strict requirements for salmon imports from China, new regulations with regard to North Korea demonstrate Japan's capability to control imports of seafood when circumstances warrant. A ban on receiving exports from North Korea, of which 26% were seafood in 2005 (Johnston, 2006), was imposed shortly after the North Korean nuclear missile test on 9 October 2006. In the ensuing six months, Japan has assiduously enforced this ban including arresting eight shellfish traders for violations in April 2007 (Japan Times, 2007). This situation suggests that when political priorities are sufficiently high, Japan's legal and surveillance systems can be effective in stopping illegal seafood imports.

China

Chinese processors using Russian raw materials were interviewed

The Chinese Government's import control system for seafood products was assessed through interviews with Chinese fish processors. These processors require a thorough knowledge of import and export procedures to operate in this industry. Both interviewed companies supply the European and/or US seafood markets and are required to demonstrate complete chain-of-custody documentation in accordance with their clients' corporate policies. In addition, both have experience with sourcing raw materials from the Russian Federation.

Procedures whereby western Russian vessels can obtain Certificates of Origin in foreign ports appear not to apply in the Russian Far East

Imports of fish products to China require several accompanying documents including a Certificate of Origin and an Inspection and Quarantine Certificate. Information from Chinese traders indicated that in the case of the Russian Far East salmon fisheries, the Certificate of Origin is either issued when the fish are landed in a Russian port, or prepared by the cargo ship which offloads the fish from the fishing vessel (see **Existing estimates of IUU fishing in the Russian Far East**). A somewhat different system is operating for vessels in the fishing grounds off the western Russian Federation in that Certificates of Origin can be requested when the fishing vessel wishes to land fish in a foreign (e.g. European) port. In this case, the national authorities in the landing country will liaise with Russian authorities to verify that the fish were caught legally. Confirmation is required within 72 hours of landing; if not received, the fish cannot be sold or otherwise transferred. Although this issue cannot be conclusively addressed with the information available, it appears that there are no standing procedures in the Russian Far East by which Certificates of Origin are issued co-operatively by foreign authorities in receiving ports. Furthermore, regarding inspection of Certificates of Origin in China, as in Japan, it appears that authorities do not confirm the authenticity of these certificates through liaison with Russian officials. Though not relating directly to Certificates of Origin, cases of forged import paperwork implicating Customs officials have been reported in China (Shipowners, 2003).

Due to its relationship with EU and US markets, China may have a stronger interest in chain-of-custody issues

It has been reported for several years that the Russian Federation has begun partnerships with several countries including China to combat seafood smuggling (IntraFish Media, 2006). No details of these arrangements could be obtained. In addition to co-operation with source countries such as the Russian Federation, China also interacts with consumer countries, such as those in Europe and the USA, which receive its processed fish products. As such, it is possible that China's need to respond to chain-of-custody documentation requirements imposed by European and US clients may drive improvements in national import control, and co-operation with Russian authorities, at a faster rate in China than in the other East Asian countries.

South Korea

The South Korean Government, similar to the governments described above, requires Certificates of Origin for all imported seafood products (Kim, 2004). However, as described in the section **South Korea**, the quantity of Russian salmon formally imported to South Korea is very small. Instead, for South Korea, it is more useful to examine, to the extent possible, the bonded warehousing system. Bonded areas, in general and thus presumably also in South Korea, are technically under the control of national Customs authorities, but are either not subject to detailed record-keeping or these records are not publicly available.

Bonded warehouses are, in theory, subject to Customs control but the actual level of scrutiny is unknown

Bonded warehouse areas, particularly in Pusan, appear to be where Russian salmon are transferred to the ownership of brokers (see the section **South Korea**). At this point, in theory, Certificates of Origin should be produced. If the fish were to be imported to South Korea, government inspectors would be responsible for reviewing the Certificates of Origin for authenticity, but in the case of transfer of ownership within bonded areas, the role of government authorities is not clear. Nevertheless, if the salmon are shipped out of South Korea without being either imported or exported, traders state there would be no official paperwork from the South Korean Government. When these fish reach the destination country, all of the documents relating to the source of the product, e.g. the Certificate of Origin, should be identical to those for shipments coming directly from the Russian Federation. It would be only the shipping documents that would indicate that the salmon passed through Pusan. If this scenario is generally correct, the responsibility for verifying that the Certificate of Origin is authentic ultimately lies with the importing country's officials regardless of whether the shipment passed through a bonded area in South Korea.

Regardless of whether shipments pass through a bonded area, at the ultimate destination, import authorities must verify the authenticity of the Certificate of Origin

Labelling requirements

National regulations for food labelling are usually motivated by food safety concerns. While such labelling is primarily designed to allow consumers to select and avoid foods based on ingredients, and to document processing or storage conditions for health reasons, some schemes provide information that can be relevant to IUU fishing issues. For example, detailed seafood labelling systems could allow consumers to refuse products from species or fishing grounds with known IUU fishing problems, or avoid traders or processors implicated in past IUU fishing incidents. In this way, government-mandated labelling in combination with consumer choice can result in a coarse tool for distinguishing IUU-derived products and undermining their market. The following sections describe the sophisticated labelling requirements in Japan and the more basic systems in China and South Korea.

Labelling could allow consumers to avoid products from species or fishing grounds with known IUU fishing problems

Japan

Japan's traceability systems are designed primarily to promote food safety

Japan advocates labelling and traceability systems for certain food products to expand information available to consumers, foster consumer confidence in food safety and allow rapid containment of any contamination incidents (MAFF, 2004). Labelling requirements for food products in Japan are jointly set by the Ministry of Health, Welfare and Labour and the Ministry of Agriculture, Forestry and Fisheries (MAFF). Ultimately, Japan has ambitious plans to implement a traceability system in which labels provide the first link in a fully documented supply chain which stretches all the way from the consumer to the raw materials. Labels may take many forms, including bar codes and electronic tags, but simple paper labels with defined content are still the most widely used (>80%) form (MAFF, 2006c).

Fresh and frozen seafood must be labelled with source country and fishing ground

Labelling standards for fresh or frozen domestic products include a requirement for the name of the prefecture where the fishing or production (for aquaculture) ground lies to be listed. In cases where the area is offshore and the name unwieldy, the name of the landing port can be listed. For imports, both the source country and the fishing ground must be annotated. Products which are cultured must be denoted as such, and those which are frozen or thawed should also be specified. The label must also show the processor's and the trader's name, the species name (or common name), and the type of product (e.g. "for use as a fillet"). Finally, the expiry date and required storage method must be listed (MHWL, 2006).

Processed seafood must also be labelled with country of production

Labelling standards required for processed products have recently changed to become more similar to the requirements for fresh and frozen products, but there are still some differences. Domestically produced processed products must be annotated with the product name, the ingredient list, the weight of the contents, the "best eaten by" date, the preservation method to be used by the consumer, and the name of the processor. Imported processed products must comply with these requirements as well as listing the species producing the ingredients, and the country of production. This longer list of labelling requirements applies not only to those products which are imported in a form that can be immediately sold, but also to those which are imported already processed but are re-packed (into smaller containers) or re-wrapped in Japan (MHWL, 2006).

Implementation of Japan's traceability system is currently ~ 50%

A traceability system for seafood operates in parallel with labelling requirements and is evaluated annually (MAFF, 2006c). In the most recent survey, of nearly 2000 shops, between 40 and 50% could trace their stocks of salmon and trout, and nine other fisheries products, back to their origin. A minority of shops surveyed (36%) could access traceability information for salmon or trout within 24 hours, but more than half (51%) could not access it at all (MAFF, 2006c). The traceability system, like a branding system, provides assurance to consumers that the source of their food is known and that should any contamination issues arise, there can be rapid response and containment. However, unlike a brand, a traceability system is designed to work retroactively, rather than provide up-front assurance to the consumer regarding quality. For the purposes of this study, the main strength of Japan's labelling standards and traceability systems is that they provide information to the consumer about fishing ground and species name, and thus promote consumer choice.

China and South Korea

The issue of labelling as it potentially relates to Russian salmon is arguably less important in China and South Korea since this study has been unable to document consumption in these countries. For the sake of completeness, food labelling requirements in China and South Korea are briefly reviewed below.

According to import regulations implemented in 2003, China requires that the species name, country of origin and fishing ground be listed for all imports of aquatic products caught at sea (Canadian Food Inspection Agency, 2003; Anon., 2007). However, seafood labelling requirements at the retail level require only an ingredient list and the country of origin (Aden, 2003).

China requires an ingredient list and country of origin labelling

According to South Korean labelling standards, most imported food products must be labelled with an ingredient list but "fishery items, such as whole frozen fish" are exempt from this requirement. Most imported food products must also be labelled with the country of origin (Phillips and Chung, 2005) It is not clear whether fisheries product are also exempted from this requirement.

South Korea does not require an ingredient list and may not require country of origin labels

Other Policy Responses to IUU Fishing Issues

This section describes policies implemented, or actions taken, by governments which are relevant to IUU fishing issues outside domestic waters but do not involve import controls or product labelling.

Japan

Japan's main avenue for addressing IUU fishing issues is through intergovernmental organizations. It has been a strong proponent of the United Nation's Food and Agriculture Organization's International Plan of Action (IPOA) to Prevent, Deter, and Eliminate Illegal, Unreported and Unregulated Fishing (FAO, 2003). Japan's Organization for Promotion of Responsible Tuna Fisheries (OPRT) is particularly active with regard to IUU issues, maintaining a "positive list" of vessels complying with RMFO regulations and leading efforts to decommission Taiwanese vessels after detection of IUU fishing activities in the Atlantic (OPRT, 2007). Given Japan's strong stance against IUU activities it is surprising that it has not published a National Plan of Action (NPOA)-IUU as have Australia, New Zealand, Chile, Canada, South Korea, the USA and the EU (FAO, 2007b).

Japan supports several anti-IUU measures but has not published an NPOA-IUU

With regard to salmon issues specifically, Japan is a member of the NPAFC and active participant in enforcement activities under the NPAFC's Committee on Enforcement. This committee is responsible for ensuring that anadromous fish are not caught within the Convention Area, i.e. in the North Pacific outside the EEZs of

Japan, in co-operation with the NPAFC, patrols for IUU fishing activities on the high seas east of Hokkaido

the member countries. Japan patrols the Convention Area east of Hokkaido by ship and aircraft. After several years of almost no observations of IUU fishing activities in the area (NPAFC, 2007b) there was a sharp rise in sighted vessels, most of which were believed to be Chinese-flagged but also some Korean and Taiwanese vessels, in the latter half of 2006 (Low, 2006, Kitagawa, 2007). The NPAFC is said to be considering the application of port State control measures to deal with this issue (Low, 2006). It should be noted the main issue of concern to this study, IUU fishing of Russian salmon in the Russian EEZ, is likely to be considered by the NPAFC as beyond the scope of its remit.

Japan is heavily involved in transhipment and has admitted unreported tuna catch

Japan is not considered to be one of the main countries which flags vessels engaging in IUU fishing activities (MRAG, 2005). Nevertheless, Japanese vessels are heavily involved in transhipment (Gianni and Simpson, 2005) and admitted unreported catches of Southern Bluefin Tuna *Thunnus maccoyii* in the areas of the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) in 2006 (Associated Press, 2006b).

China

China reported several actions to control IUU activities by its own vessels

It was reported several years ago that China was acting to control IUU fishing activities by:

- requiring bilingual, thus more difficult to counterfeit, fishing licences to be onboard at all times;
- requiring vessels to be licensed before they left the shipyard;
- preventing Mainland fishing interests from working with Taiwanese fishing interests which have been involved in IUU fishing activities; and
- strengthening documentation for China's distant water tuna vessels (Anon., 2003).

No more recent description of actions on IUU issues by China was found.

Chinese vessels are reportedly involved in IUU fishing and transhipment around the world

In the past few years Chinese vessels have been heavily implicated in IUU fishing activities around the world (MRAG, 2005). Chinese vessels are also known to be actively involved in fish transhipment operations in the Atlantic and Pacific. While these activities may not be illegal *per se*, transhipment is known to be a key component of the infrastructure supporting both legal and illegal fishing operations (Gianni and Simpson, 2005).

South Korea

South Korea has published an NPOA-IUU

South Korea is the only country of interest to this study which has published an NPOA under the FAO IPOA to Prevent, Deter, and Eliminate Illegal, Unreported and Unregulated Fishing (MMAF, undated). In its NPOA South Korea commits to a number of measures to control IUU activities by vessels flying its flag and vessels within its own EEZ. Of greater interest to this study, however, are the other measures, including port State, market-related, and RFMO controls to which it commits. Specific items promised under the NPOA include:

- implementing measures in accordance with the provisions of the FAO Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas to which South Korea became a signatory in 2003 (port State measure);
- reporting information on IUU activities to the flag State when the South Korean government has clear and sound evidence of such activities and the vessel is voluntarily at anchor in a South Korean port (port State measure);
- intervening in the transhipment of fisheries products in Korean waters when such transhipment is in violation of fisheries or Customs regulations (port State measure);
- implementing catch documentation schemes by RMFOs and refusing importation of fish which are in breach of RMFO regulations (market-related measure); implementing a fishery traceability scheme for three stocks on a trial basis in early 2005 (market-related measure);
- including measures to minimize IUU fishing and trade of IUU fishing products when concluding bilateral or multilateral fishing agreements (market-related measure);
- joining RFMOs or if not a contracting party implementing the conservation and management measures of these organizations where practicable (RFMO measure);
- implementing a variety of monitoring, control and surveillance measures developed by RFMOs (see NPOA for list; RFMO measure); and
- codifying relevant RFMO regulations as national law (RFMO measure).

These commitments provide a solid framework for action against IUU fishing activities on a number of fronts. One practical example of an action taken by South Korea in response to a potential violation of an RFMO trade measure is presented in **Box 2**.

Box 2. Example of South Korean Government action in response to potential IUU fishing activity

A Russian fishing vessel, Hammer, in CCAMLR (Commission for the Conservation of Antarctic Marine Living Resources) waters was reported to the Australian government on the suspicion of illegal fishing for Patagonian Toothfish Dissostichus eleginoides *in December 2005. The catch was sold to the Uruguayan firm, Coast Line, and transhipped off the Hammer by the Panamanian-owned, Togo-flagged reefer, Sea Drift. When the Sea Drift entered Pusan in February 2006 it was detained by the South Korean Government which had been informed of the situation by CCAMLR. Coast Line brought suit against the South Korean Government claiming that since the reefer was registered to Togo, and Togo is not a party to CCAMLR, the vessel could not be legally detained. In July 2006, a South Korean court dismissed the case, finding that "South Korea is a member country of the convention and responsible [to] fulfil the duties of the convention under international law. Domestic laws apply to a boat which enters a South Korean port, thus the ban is legal regardless of the nationality of the boat". At the time of writing, the South Korean Government was in talks with Coastline and the Panamanian owners of the Sea Drift regarding potential options of returning the frozen fish to the owners or confiscating and disposing of them (Park, 2006).*

South Korean vessels have been implicated in IUU fishing around the world

Despite South Korea's recent international commitment to fight IUU fishing, its vessels have been implicated in numerous IUU fish activities both on the high seas and in EEZs (MRAG, 2005) including the NPAFC high seas Convention Area in 2006 (Kitagawa, 2007). South Korea is also ranked as one of the top ten countries of residence of owners/operators of vessels operating under flags of convenience, mainly Panamanian -registered (Gianni and Simpson, 2005).

Other

Initiatives funded by the government of the UK, including the IUU monitoring network and a programme of activities based at Chatham House, are encouraging research on IUU fishing issues around the world, including northeast Asia. It is expected that as part of the growing interest in IUU topics, other studies, funded by government or the private sector, will further explore issues of IUU fishing and trade in IUU fishing products involving the Russian Federation.

Seafood industry

Industry stakeholders who wish to avoid IUU fish will benefit from import control and labelling measures

The second type of stakeholder which could take action towards curbing IUU fishing of Russian salmon is the seafood industry. These stakeholders will comprise a heterogeneous group of traders, processors, distributors, wholesalers and retailers. Within this group there will be a subset who either currently wish to avoid trading in IUU-derived products, or can be prompted to avoid trading in IUU-derived products for reasons of reputation, concern for stock status, or desire for legitimate sourcing channels. This subgroup may be seeking to avoid IUU products at present but simply not have enough information to distinguish legal from illegal. In this sense, the aspirations of this subset will be served by some of the government actions described above. For example, improved import control systems will reject IUU products at the border making it less likely that they penetrate the East Asian market in the first place. Also, the implementation of government-sponsored traceability schemes will promote transparency at all stages of the supply chain.

Industry initiatives could include codes of conduct, branding or certification

There are also actions that such stakeholders may wish to initiate on their own that could increase transparency and potentially create a market advantage for the products in which they choose to trade. Such actions could take various forms, such as branding, certification or voluntary codes of conduct.

Certification requires third-party involvement, branding does not

Branding of a product usually refers to creating a distinct identity for that product, often associated with particular characteristics which act as selling points. Brands can be at the discretion of the company itself and may change considerably over time without any loss of reputation. In contrast, certification of a product implies that it has met standards formulated and administered by an independent third party. Certification schemes may vary considerably in their rigour, but all imply a greater guarantee of quality, at least in the aspect to which they are certified (e.g. "organic" ingredients) than is implied by an uncertified, branded product. Issues of certification and branding will be discussed below for Russian salmon primarily using the Japanese market as an example.

A number of certification schemes for food products exist in Japan. One of the largest, the Japan Organic and Natural Foods Association certifies food products put forward by various producers against the Japan Agricultural Standard (JAS) but does not appear to include capture fishery products. No domestic Japanese ecologically-based labelling schemes for fish products were identified during the course of this study. The London-based Marine Stewardship Council (MSC) fisheries certification programme, a global system already certifying 450 products in 25 countries, has recently begun to penetrate the Japanese market. A Japanese fishery, the Kyoto Danish seine fishery for Snow Crab *Chionoecetes opilio* and Flathead Flounder *Hippoglossoides dubius*, is currently undergoing certification and if successful will become East Asia's first MSC-certified fishery. MSC-certified products currently sold in Japan through MSC chain of custody-certified suppliers include Alaskan salmon, Alaskan Black Cod *Anoplopoma fimbria*, Alaskan Pollock *Theragra chalcogramma*, Pacific Cod *Gadus macrocephalus* and New Zealand Hoki *Macruronus novaezelandiae* (MSC, 2007).

In Japan, currently the only certification scheme for fisheries addressing sustainability issues is the MSC

One of Japan's largest retailers, Aeon, which operates 660 outlets including Jusco and MaxValu supermarkets, introduced several MSC-labelled products at the end of November 2006 (**Figure 31**). These products are now part of Aeon's own TOPVALU Green Eye line of environmentally-conscious products established in 1994. Information from 2001 states that Aeon's sales of products from the TOPVALU Green Eye line, plus two other of its own environmentally-conscious product lines, represented 1.4% of total sales (Anon., 2006b). Since that time the TOPVALU line has been expanded to include apparel, household items and leisure goods and now TOPVALU sales comprise 5% of net sales (Aeon, 2006). Aeon promotes MSC products through a website which is listed on the placard on the supermarket shelf (Aeon, 2007). Interview respondents stated that Aeon has recently echoed major retailer Wal-Mart's intention, announced in February 2006, to source all fresh and frozen fish from MSC-labelled supplies within three to five years.

As of November 2006, MSC products are distributed through a major Japanese supermarket

While the appearance of MSC-labelled products on the Japanese market is a positive sign, the impact on consumer awareness and preference is yet to be determined. The current activities of Aeon and other retailers to offer MSC-labelled products is believed by some of the experts interviewed for this study to reflect a commitment to corporate social responsibility (CSR) policies. Some believe these policies originate from a desire to promote investment and improve shareholder value, rather than in response to consumer demand for eco-friendly products.

CSR policies in Japan do not necessarily reflect or influence consumer demand

Interview respondents also believed that many Japanese companies are likely to resist eco-labelling for fear of showing susceptibility to environmental campaigns. One reported that fishermen's co-operatives, which represent the vast majority of Japanese fishermen, are responding to suppliers like Aeon's call for MSC-certified products by demanding that the Japan Fisheries Association create their own certification system or brand. Since seafood industry personnel stated during interviews that Japan is already a brand-crowded marketplace, there may be diminishing returns for new brands as consumer choice becomes more and more complicated. In the face of increasing competition, particularly from farmed salmon and trout, many salmon

Figure 31

Credit: S. Clarke.

Marine Stewardship Council certified Alaska salmon was launched by Aeon, a major Japanese supermarket chain, in November 2006.

In the long run, branding and certification costs may be similar

producers have already established their own labels and brands as a means of distinguishing their products in the marketplace. For example, the Hokkaido Federation of Fisheries, also known as Gyoren, which provides most of Aeon's national supply of scallops and *akisake* ("fall"-run Chum) has developed its own brands for these products which are advertised as far away as Hong Kong. The Hokkaido government has also recently started its own brand (*Hokkaido Ninsho*) to promote locally produced salted salmon. In order to use the new brand name certain processing standards including salt content, temperature and other traditional methods must be maintained. While there is rush to develop new brands for fisheries products, and Japanese consumers are reported to prefer to buy branded goods, the extent to which the effort invested in brand creation results in increased sales is not clear. Current sentiment among fishermen seems to suggest a preference for branding over certification, such as MSC, due to fears regarding the high cost of certification. Although branding is seen as a cheaper alternative, the cost of developing a strong and effective brand may be less explicit than the cost of certification, but in the end just as high.

Voluntary chain-of-custody control schemes could be developed for East Asian end-markets and third-party processors

Another type of initiative by the seafood industry could involve voluntary codes of conduct. For example, the European Seafood Processors Association (AIPCE) has recently implemented a "control document" for purchase of Barents Sea cod. Under the new scheme, AIPCE members throughout Europe agree to abide by procedures to ensure the legal provenance of supplies of Barents Sea cod. According to industry sources, one of the stimuli for the programme was the now common practice of using a third-party processor, often in China, as an intermediary between the fishery and the distributor, thus heightening the need to validate the entire supply chain (Fishupdate, 2007). A similar scheme for Russian salmon could be initiated by East Asian industry stakeholders supplying local markets (e.g. Japan) or by processors of Russian salmon serving foreign markets with an interest in chain-of-custody control (e.g. China serving the EU).

Consumers

Like the seafood industry, consumers can respond to government actions which provide more information about product provenance by making more informed choices. Consumer choice with respect to Russian salmon will be likely to be a factor of the extent to which consumers distinguish between salmon products, and the extent to which issues such as IUU fishing and sustainability influence their choices. The following sections describe what is known about current consumer sentiments in Japan, China and South Korea.

Consumer action on IUU fishing requires both an ability and a desire to exercise choice

Japan

Long-term trends in Japanese consumer preferences for salmon are characterized by Knapp *et al.* (2007) which states that consumption doubled between the mid-1980s and 1996, declined in 1996–2000, and has fluctuated but only partially recovered since then. According to Japanese sources, the major trend in consumer preferences in Japan in the past decade is a growing demand for farmed salmon and trout (Coho, Atlantic Salmon and Sea Trout). World farmed salmon production has nearly tripled in the past decade and in 2005 composed 63% (1.6 million t) of the total global supply of salmon (Hokkaido Economic News, 2005). Of this amount roughly 150 000 t were imported to Japan comprising approximately 70% of Japan's salmon imports and contributing 50% of Japan's total supply (Gyoren, 2006). The rate of growth in consumption of farmed salmon would have led to much higher levels of total salmon consumption in Japan if not for a concomitant decrease in wild salmon consumption (Shimizu, 2005; Knapp *et al.*, 2007).

There is a growing market for farmed salmon in Japan which has led to a decline in demand for wild salmon

Interview sources consulted in this study stated that consumers are turning to farmed salmon for reasons of price, availability and the higher fat content, and thus richer taste, of the flesh. Japanese consumers also choose farmed salmon because wild salmon contains macroparasites which must be killed before consumption. This can be achieved through cooking or freezing, but if salmon is desired for consumption as sushi or sashimi, the quality will be reduced during the freezing process. Farmed salmon do not contain macroparasites and thus can be consumed fresh without having been frozen. In addition, farmed salmon's higher fat content gives it a more attractive appearance and taste for sushi and sashimi products. Therefore, most of the salmon sushi and sashimi market is now said to be supplied by farmed salmon.

Farmed salmon is particularly preferred for sushi and sashimi

While the trend has been towards greater consumption of farmed salmon, there is still a sector of the Japanese market which prefers the traditional, usually salted forms of salmon. Sockeye is considered the best quality species for salted products which

Japan's traditional salmon products are salted forms

include *yakisakana* (grilled fish), often sold as *kirimi* or the more traditional *yamadzuke* (fermented form; see the section **Japan**). Although traditional forms persist, many have lowered their salt content to appeal to a growing health consciousness among older consumers. Products are often labelled with the species name (e.g. *benizake* for Sockeye), prefaced by *karashio* (high salt), *chuushio* (moderate salt) or *amashio* (low salt). As described in the section **Japan**, some consumers rank Sockeye based on fat content and prefer fish from certain regions.

Japan is the world's largest market for salmon roe

Japan is the world's largest market for salmon roe (Knapp *et al.*, 2007) but consumer tastes are not well understood. Consumers are said to prefer *ikura* products with large egg diameter which have never been frozen. *Ikura* may be flavoured with soy sauce, salt or *kombu* (kelp). *Sujiko* is considered a more traditional, but less popular, form which is only consumed in Japan. Japanese consumers in general do not prefer canned salmon roe or meat.

The market for Russian salmon in Japan appears limited

Overall, the Japanese salmon market is characterized as "mature", meaning that per capita consumption is high, there is a well-distributed supply and a knowledgeable consumer base (Knapp *et al.*, 2007). Therefore, in contrast to other major salmon markets in Europe and the USA, salmon demand in Japan is unlikely to grow (Knapp *et al.*, 2007). It is possible that the market could shift towards a more pronounced preference for wild Russian salmon, but this seems unlikely given the strength of demand for farmed salmon, the abundant domestic supply of lower-value species like Chum, alternative supplies of Russian species from the USA and Canada, and the aging of the market sector which prefers wild species like Sockeye. Furthermore, interview information indicated that while Russian waters are known to contain good quality resources, due to handling and processing quality issues, the prevailing perception of Russian products in Japan is poor. This perception may perhaps be perpetuated by those who fear competition from expanding Russian fisheries. Many industry respondents stated their belief that consumers are motivated primarily by price, and to a lesser extent by food safety and environmental issues. Even major food contamination or additive scandals were said to have had only small and temporary effects on Japanese purchasing behaviour.

WWF-Japan promotes MSC products to Japanese consumers

WWF-Japan hosts a detailed website introducing MSC products to Japanese consumers under news, where-to-buy, and MSC certification topics. WWF-Japan has also supported the launch of MSC products in Japan in 2006 and the nomination of the Kyoto Danish Seine Fishery Federation for fishery certification assessment. These efforts are increasingly complemented by media reports about MSC products in popular forms such as serials (e.g. *manga*) and television programmes.

China

Chinese seafood consumption has grown rapidly in the last decade

Consumer demand for salmon in China must be considered in the context of China's rapidly increasing fish consumption rates. Per capita consumption of fish in China rose from 49g per capita per day in 1994 to 68 g per capita per day in 2004. While this rate is still low compared to Japan (178 g per capita per day), it is now, despite the recent trend towards greater seafood consumption in western markets, higher than consumption in the USA (stable at between 56–59g per capita per day during the 1994–2004 period). Furthermore, China's rate of growth in consumption during the last decade (39%) outstrips rates in other developing Asian economies such as Thailand (-1%), Malaysia (2%), Viet Nam (12%) and Indonesia (18%) by a wide margin (FAO, 2007c).

In a Chinese supermarket survey, most respondents preferred salmon in sushi form and did not realize it came from Norway

A supermarket survey conducted in three major Chinese cities (Beijing, Shanghai and Guangzhou) in 2002 specifically addressed consumer preferences for salmon (Wang, 2003). A high proportion of respondents (approximately 80–90%) between the ages of 15 and 49 had consumed salmon. The proportion was slightly lower (74%) for the 50–64 year old group. Of those who had consumed salmon, roughly two-thirds had had their last salmon meal at home versus one-third who had eaten it in a restaurant. Given frequencies of salmon consumption ranging from "once per week" to "less than twice per year", the modal response (28%) was "once per month". Those purchasing the highest amounts of salmon were characterized as young consumers with high incomes (CNY5000 or about USD650 per month) who have a tendency to buy fresh foods and seafood. Two-thirds of the respondents were only familiar with salmon in *sushi* or *sashimi* form and this was believed to be the reason why most replied that the best salmon was from Japan. Ironically, these same consumers usually purchased farmed Norwegian salmon, rather than Japanese salmon, because it was more commonly available in fresh form as *sushi*. The study did not address the issue of provenance labelling, but it is inferred that salmon products in the surveyed supermarkets were not labelled with country of origin, species or method of production.

Chinese consumer preferences for Japanese-style seafood are fuelling sales of salmon rather than tuna

More recent observations of the salmon market in Shanghai by Japanese researchers (Shimizu, 2007) suggested that rising popularity of *sushi*, particularly among 20–30 year olds, and also *kirimi* style fish products, was boosting sales of salmon, rather than tuna. Norwegian salmon is preferred over Japanese salmon (i.e. mainly Chum), both for *sushi* and for grilled forms, most likely because it is fresh. Except for breaded forms of Norwegian salmon, prices for Norwegian salmon were always higher than for Japanese salmon. In fact, prices for hand-rolled (*nigiri*) Norwegian salmon *sushi* exceeded those for tuna, eel and shrimp. The surveyors concluded that the market for lower-priced salmon, such as Japanese Chum, could expand with the growth of the working class in China.

All salmon observed in Hong Kong was farmed, though labelling sometimes claimed it was wild

In April 2007, a survey of seafood outlets in Hong Kong was conducted with the objective of gauging awareness of salmon provenance issues. Hong Kong, as a developed city within China, may serve as an advance model for distributor and consumer awareness in China as a whole. As this study is focused on Russian salmon, which is usually distributed in frozen form, the survey targeted western seafood restaurants rather than Japanese restaurants serving *sushi* and *sashimi*, which might be expected to use fresh, therefore farmed, supplies. Of the eleven restaurants visited, two did not offer salmon on their menu. Of the remaining nine restaurants, four listed the country of origin of the salmon on the menu and five did not. If the country of origin was not listed it was clarified through querying the wait staff, who passed the question on to the chef if they did not know. In total, three restaurants offered Scottish salmon, three offered Australian salmon and five offered Norwegian salmon. Only one restaurant declared on the menu whether the salmon was wild or farmed but the information given was dubious (salmon described as "wild" but originating in Norway[10]). Of the other eight restaurants which did not specify wild or farmed sources on the menu, a majority were able to provide correct information regarding production methods. However, in addition to the probable menu labelling error described above, at one of the outlets Scottish salmon was said to be wild; at one the staff did not understand the difference between wild and farmed salmon; and at one the staff said the salmon was farmed (which was true) because it was large and de-boned. At one of Hong Kong's premier supermarkets, Australian fillets were labelled as wild salmon but when queried the store removed this information pending clarification of the production method from their distributor. It appears that some Australian distributors are marketing Tasmanian pen-reared salmon as "wild".

WWF-Hong Kong's seafood guide lists wild salmon as recommended

In an attempt to inform consumers, WWF-Hong Kong released a Seafood Guide in March 2007 listing 66 species in three categories: "recommended", "think twice" or "avoid". The country of origin, production method (wild caught or farmed), and MSC certification status were also shown. MSC-certified Pacific salmon from Alaska was listed in the "recommended" category whereas Atlantic salmon from "Norway" was listed in the "think twice" category. Russian salmon was not listed.

South Korea

Salmon is not popular and costly, thus consumption is low in South Korea

Salmon consumption in South Korea appears to be limited by a number of factors. It has not been a traditionally popular food, costs are high and there are still many Koreans who have never tasted it (Canadian Government, 2003). When salmon is purchased, frozen forms are not preferred unless it is thawed and then smoked (Kim, 2005). Price, rather than quality, is considered the main driver and farmed Norwegian and Chilean salmon comprise most of the supply (Canadian Government, 2003).

10. In 2001, Norway produced approximately 1,500 t of wild Atlantic salmon and nearly 420,000 t of farmed salmon (WWF-Norway, 2005).

Summary of stakeholder actions and recommendations

Context for recommendations

The East Asia situation is unique and complex

A recently published report focused on North American salmon fisheries and markets states that "nothing is simple about salmon, salmon fisheries or salmon markets" (Knapp *et al.*, 2007). This study further underscores that statement. Within the four countries covered by this study are found:

- the world's most natural and bio-diverse salmonid assemblage, as well as arguably the most rapidly developing fishing industry (Russian Federation);
- the world's largest and most product-diversified national salmon market and the top global producer of Chum (Japan);
- the world's leading fish processing industry (China); and
- a country home to one of the world's largest container ports (AAPA, 2006) with an historical and continuing major role in distant water fishing and reefer operations (South Korea).

Each country is unique in its language, governance system, degree of public information disclosure, and stage of development. Within the region there are significant, long-standing political tensions over many issues including fishing and other maritime rights.

Anti-IUU measures in East Asia must be complemented by actions in Russia

At issue in this study is the threat caused by potential overfishing to the salmon resources of the Russian Far East. The analysis presented here examines this issue from one angle only: using market data from Japan, China and South Korea, it estimates the actual catch quantity for one, high-value species. The degree to which this species, or any of the other Russian salmon stocks, are threatened by this actual, total catch would require stock assessment analysis beyond the scope of this study. Instead, the purpose of this assessment was to identify the role that East Asian markets occupy in the distribution chain for IUU Russian salmon catches. An additional objective was to highlight what actions are being, or could be, taken by these markets to deter such IUU fishing activity. However, by definition, all of these actions would be implemented outside the Russian Federation. Therefore, while they could, if effective, close East Asian markets to IUU salmon, they would not necessarily deter IUU fishing if other markets, and channels to those markets, could be found. It is thus critical to view the recommendations of this study as part of a package of measures which must be supplemented by corresponding actions within the Russian Federation.

East Asian fisheries and their trade are characterized by a number of difficult issues which compete with Russian IUU fishing issues for attention

At the same time, it would be unhelpful to analyse East Asian salmon markets merely as recipients or conduits for Russian supplies. Concerns about Russian IUU salmon supplies entering East Asian markets exist within a framework of market forces and resource management issues which are continuously shaping East Asian fisheries and their trade. For example, Japan is highly sensitive about its driftnet fishery in the Russian EEZ given the recent expansion of Russian fisheries and Japan's continually shrinking quota. Japan is also currently struggling with its somewhat contradictory policy regarding salmon processing in China. On one hand, Japan enforces a strict, almost punitive, pre-approval process for all imports of salmon from China, yet on the other hand, China's proximate and low-cost processing of Japanese salmon for western markets is instrumental in supporting Japan's domestic Chum fisheries in the facing of declining local demand. Chinese interests are in turn concerned with rising costs and associated labour shortages in the processing industry which could ultimately result in loss of business to Southeast Asian competitors. The Chinese processing industry is also increasingly being held responsible by western purchasers for documenting chains of custody which extend over long and complex supply channels. As for South Korea, it would seem recent government actions in publishing a National Plan of Action-IUU and moving towards acceding to various other intergovernmental agreements signals a commitment to responsible engagement on international fisheries management issues. Paradoxically, reputational benefits accruing from such actions will be eroded if South Korean vessels continue to be involved in suspected IUU activities and flag of convenience operations.

Specific recommendations will be presented

With this context in mind, and following a stakeholder-based structure, the following discussion presents a number of suggestions to improve the transparency of East Asian salmon markets and where possible deter IUU fishing for salmon in the Russian Federation. Specific recommendations are highlighted in a final summary. As argued previously, while industry and consumers can discourage the sale of IUU fishing products within particular supply chains, without strong government action, fish rejected due to IUU fishing concerns will simply percolate into other products and markets. Therefore, the following recommendations heavily emphasize government import control, labelling and anti-IUU fishing measures.

Government actions on import control

East Asian import control could be improved

Several key points emerged from the preceding discussion of import control. While recognizing that import control is necessarily connected to export control, there are several points upon which East Asian import control authorities' performance could be improved.

The extent of current co-operation between Russian and East Asian import control authorities should be expanded

East Asian authorities appear to rely either on Russian officials to notify them of any problems with incoming shipments, or *prima facie* document inspection. In the first case, this somewhat passive approach to import control will be effective only if Russian authorities are diligent and communications networks between the Russian Federation and the receiving country are clear and immediate. Japan and the Russian Federation have an apparently functioning system yet somehow imported quantities of Russian salmon are much larger than reported catches. It is not known whether similar systems are operating for China and South Korea. Detailed information regarding the operation of the Japan–Russian Federation system is confidential but it may be based on cargo vessel records (i.e. whether each vessel is licensed or has been involved in any violations) rather than on shipment-by-shipment authorization. If so, this invites the possibility of vessels operating legally on some occasions and not others, and should be strengthened. It also appears that the system only applies to Russian cargo vessels thereby leaving open the possibility that imports of IUU fish are arriving on non-Russian flagged vessels. A proposal by Governor Darkin of Primorye to prohibit transhipment in the EEZ of the Russian Far East and require export clearance in port (Eurofish, 2005) would likely lead to considerable progress in reducing the number of counterfeit Certificates of Origin and should be supported. At a minimum, the procedures under which authorities in the eastern Russian Federation issue Certificates of Origin should be investigated and clarified by separate studies being conducted within the Russian Federation.

Banning transhipment in the Russian EEZ would improve accountability

In cases where the Certificate of Origin alone is used to judge the legality of the shipment, there should be formal mechanisms by which Russian, Japanese, Chinese and South Korean authorities share intelligence on incidents of counterfeiting or other irregularities. Since document inspection and enforcement is most rigorous at the point of import, and may not take place at all when goods are placed in bonded storage, efforts would be best targeted at importing countries, i.e. Japan and China rather than South Korea. In addition, if national laws do not provide sufficient scope for validating Certificates of Origin in bonded warehouse areas, these should be strengthened to prevent such areas being used as a means to facilitate IUU fish trade.

Greater efforts are needed for Certificate of Origin validation

Japan's import control system is the best documented of the systems assessed in this study and may be the most stringent. Nevertheless, it does not appear to exercise any method to verify whether the contents of a shipment matches its declaration. Limited, random inspection of containers, as well as a formal mechanism through which Japan Fisheries Agency staff can be consulted if any queries arise should be implemented. Hong Kong Customs Authority procedures would serve as a useful model in both cases (Clarke, 2004b). Chinese and South Korean authorities should consider similar measures if not already implemented.

Random inspection of contents against declarations should be implemented

Government actions on labelling

Japan is already implementing strict labelling and traceability systems for seafood and other products. This system sets a high standard and promotes food safety assurance and containment of any contamination incidents. Although not designed for identifying potential IUU fish, if used effectively, it can provide consumers with information about fishing grounds and species names which can aid in identifying areas and fish populations with IUU fishing problems. China requires that country of origin be listed on seafood products, but it is not clear whether South Korea requires this. Neither country requires species name or fishing ground information to be annotated. If China and South Korea were to implement a system like Japan's, the additional information generated would benefit both food safety and consumer choice.

China and South Korea should consider a system like Japan's on labelling and traceability

Government actions on IUU fishing

The preceding section described several measures being taken by Japan, China and South Korea to discourage IUU fishing activities. However, it is very important to

Most anti-IUU fishing policies relate to national waters, national vessels or the high seas

note that these and almost all other national anti-IUU fishing measures are targeted towards either:

- activities on the high seas;
- activities within the EEZ of the country taking the action; or
- activities undertaken by vessels flagged or otherwise controlled by interests within the country taking the action.

In the case of IUU salmon fishing off the Russian Federation, the activity is within Russian waters and aside from scattered interception incidents involving various types of South Korean vessels (Associated Press, 2006a), there is no clear evidence that Japanese, Chinese or South Koreans vessels are responsible for the majority of the IUU salmon catch. It thus likely that most countries would consider this a domestic issue to be resolved by the Russian Federation.

NPAFC should follow through on consideration of port State controls

One opportunity for co-operation lies with the NPAFC which until now has confined its attention to IUU fishing in the waters of its Convention Area (i.e. outside all national EEZs). Recent reports indicate that the NPAFC is considering applying port State measures to eliminate IUU fishing activities reportedly involving Chinese and South Korean flagged vessels in the area east of Hokkaido. Under the IPOA-IUU a port State should forbid landing or transhipment of products when it has clear evidence that the vessel was engaged in IUU fishing activities. Recent action by the Northeast Atlantic Fisheries Commission (NEAFC) may have set a new precedent for strict port State controls by implementing tighter landings regulations for fishing and cargo vessels, as well as vessel "blacklists" (NEAFC, 2007). In the case of IUU activities in the NPAFC Convention Area by Chinese and South Korean vessels, a clear case for port State action could be made to South Korea since it has committed to the principles of the IPOA-IUU by publishing its own NPOA-IUU. The likelihood of action by China is less clear given that it does not have an NPOA-IUU nor it is member of the NPAFC.

The Russian Federation may also request port State controls directly

With regard to IUU fishing for salmon in the Russian EEZ, the Russian Federation could request port States measures of any of the three East Asian countries without the involvement of the NPAFC. Trade-related measures are also an option, but according to the IPOA-IUU are to be used only under exception circumstances and when other measures have failed (Roheim and Sutinen, 2006). However, since Japan does not allow foreign fishing vessels to land in its ports, nor has it produced an NPOA-IUU, there may be little opportunity for co-operation on this particular front. As discussed above for high-sea violations, given their policy platforms, South Korea might be most likely to respond to a request from the Russian Federation, and China somewhat less likely to respond.

Trade-related measures are also possible but less likely to be applied

Trade-related measures tend to be more controversial, due to potential conflicts with the Generalized Agreement on Tariffs and Trade (GATT) and the WTO, but such concerns are not necessarily as restrictive as it might appear (Le Gallic, 2004). Nevertheless, it is unlikely that the Russian Federation would request trade measures to be imposed against itself, and also unlikely that East Asian countries would invoke trade measures for resources which are mainly in Russian waters.

Given the symbiotic nature of these four countries with regard to salmon fisheries, and the purpose of the NPAFC to promote the conservation of anadromous stocks in the North Pacific, it would be highly beneficial to use the NPAFC as a forum for discussing traditional monitoring, control and surveillance measures, as well as potential port State and trade-related measures among all four parties. For this to occur, China would have to join the NPAFC, and though it has been encouraged in the past to do so, its policy appears to be one of co-operation rather than membership (Anon., 2005). Since China is not officially fishing for salmon in the North Pacific, it may previously have seen no need to join the NPAFC. With the recent expansion of its salmon processing industry, which as of 2006 imported nearly 150 000 t of Pacific salmon, China now has a major stake in management of the stocks, as well as a critical role in port State or trade measurements to support management. It would seem another major benefit to China in joining the NPAFC would be the lifting of Japan's burdensome pre-approval system for salmon imports.

China now has a major stake in North Pacific salmon resources through processing and should join the NPAFC

Industry actions

The seafood industry can take steps to eliminate IUU fishing products from its supply chain by careful checking of chain-of-custody documentation, potentially encouraged by voluntary codes of conduct. However, if national import control systems are effective, IUU fishing products should, in theory, be prevented from entering the market in the first place. National labelling and traceability systems, such as those in Japan, also promote provenance transparency. To assist with governmental efforts, industry should comply with all relevant labelling and traceability regulations, and consider providing country of origin, species name and fishing information on consumer labels whether or not it is required by law. Engaging in code of conduct programmes could provide a market advantage, particularly in the case of China, when supplying foreign markets placing a high priority on legally-documented, sustainable supplies.

Voluntary labelling and chain of custody protocols can confer a market advantage

East Asian salmon producers, i.e. those in Japan, may also act to distinguish their legally-sourced domestic products from Russian products through certification, branding or other measures. Japanese producers are eager to gain a market advantage particularly since domestic consumption of local salmon is dropping (Shimizu, 2005). Several brands have already been launched for salmon in Japan, and MSC-certified Alaska salmon is being promoted through a major supermarket chain. If, in the future, Russian salmon obtains MSC certification, East Asian suppliers could apply for MSC chain of custody-certification to distribute the product in their markets. In the meantime, local producers should consider MSC certification or other branding featuring environmental or sustainability issues. While a market advantage has yet to be demonstrated for MSC-certified products (Knapp *et al.*, 2007), it appears that some retailers in Japan have a strong interest in stocking eco-friendly products.

Products supported by certification, such as MSC or other eco-friendly brands, may have a market advantage

Consumer and public sector actions

Consumers should take an active role in understanding salmon supplies and shaping demand

The three markets assessed in this study have widely different levels of knowledge regarding salmon products. Some Japanese consumers are said to be able to distinguish Sockeye products from Kamchatka versus the Kuriles, whereas most consumers in China do not have the knowledge or information to distinguish Norwegian farmed salmon from wild Japanese salmon. To some extent the recommendations for better product labelling will allow consumers to understand and distinguish between the different products on offer. However, as observed in the Hong Kong survey, it may be necessary for consumers to raise specific questions about provenance and production methods in order to receive complete and correct information. Therefore, in addition to being passive recipients of product information through labelling and promotional materials, consumers should take an active role in understanding locally-offered supplies, expressing preferences and shaping demand.

Research and consumer education initiatives should continue

Further research on fisheries sustainability topics, and IUU fishing in particular, will be necessary to develop clear messages to policy decision-makers and the general public. Academics, independent researchers and environmental groups should partner through existing fora such as the IUU Monitoring Network and the Chatham House initiative to co-ordinate information and heighten awareness. Fisheries management fora, such as the NPAFC, should be made aware of the findings of this study to ensure that stock assessment models reflect realistic estimates of total Russian salmon catches. Continued efforts by environmental groups within East Asia will be necessary to bring sustainable fishing issues to the attention of the general public and perhaps modify western-based initiatives to better target East Asian consumers.

Summary of recommendations

The key recommendations, summarized from the discussion above, are as follows:

- Russian control of export documentation would be considerably strengthened if transhipment at sea were prohibited and intelligence formulated on a shipment-by-shipment basis. East Asian import control officials should lend their support to such proposals when co-ordinating with their Russian counterparts.
- Co-operation between the Russian government and port State control authorities should be expanded to include not only Russian flagged vessels but non-Russian flagged vessels operating in the Russian EEZ or adjacent high-sea areas.
- A co-ordinating group should be formed involving Russian, Japanese, Chinese and South Korean import control officials, to share information on counterfeiting and other import documentation irregularities for North Pacific fisheries products.
- Where the scope of national legislation is insufficient for validating Certificates of Origin in bonded warehouse areas, authority should be strengthened to prevent such areas being used as a means to facilitate IUU fish trade.
- Import control authorities should begin a programme of random inspections as a step towards confirming the accuracy of declared contents. In conjunction

with this, a formal mechanism through which fisheries personnel can be consulted for specialist knowledge by Customs authorities should be implemented.

- China and South Korea should consider enhancing seafood labelling and traceability systems to incorporate information on species, fishing ground and country of origin where not already required.
- Japan and China should produce a National Plan of Action under the International Plan of Action to Prevent, Deter and Eliminate IUU Fishing.
- China should be urged to join the NPAFC because of its major stake, as the world's leading fish processor, in managing Pacific salmon stocks and its important role in potential port State or trade measures to support such management.
- The NPAFC should expand the remit of its Enforcement Committee to consider port State and trade-related measures. Co-ordinated discussion of port State and trade-related measures can assist in curbing IUU fishing activities on the high seas and assist members with domestic EEZ issues, as well as support better estimation of actual catches and improved stock assessment.
- Seafood processors, distributors, wholesalers and retailers should comply with all national labelling and product traceability requirements, and when not already required, consider labelling all products with country of origin, species name and fishing ground.
- East Asian salmon producers who wish to gain a market advantage for their products should consider implementing voluntary codes of conduct to validate legal provenance. Certification schemes, such as the Marine Stewardship Council certification, can assist with chain-of-custody documentation as well as heighten public awareness of responsible fishing issues and serve to suppress demand for the products of IUU fishing.
- Consumers should take an active, rather than passive role in obtaining complete and correct information regarding the provenance and production methods of locally-offered supplies.
- Academics, independent researchers and environmental groups should continue to co-operate through existing fora such as the IUU Monitoring Network and the Chatham House initiative to advance research, influence policy and educate consumers, specifically in East Asia.

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APPENDIX 1. IMPORT AND EXPORT COMMODITY CODES USED IN JAPAN FOR SALMON PRODUCTS (2000–2006). QUANTITIES ARE GIVEN IN KG AND VALUES ARE IN UNITS OF JPY1000

Live

0301.99-290	Fish (excluding ornamental fish, fry for culture and 0301.99-210), live (import)
0301.99-900	Other live fish (export)

Fresh or chilled

0302.11-000	"Masu" (*Salmo trutta*, *Oncorhynchus mykiss*, *O. clarki*, *O. aguabonita*, *O. gilae*, *O. apache* and *O. chrysogaster*) (import and export)
0302.12-000	Pacific, Atlantic or Danube *sake* (export only)
0302.12-011	"Benizake", red salmon *O. nerka* (import only)
0302.12-012	"Ginzake", silver salmon *O. kisutch* (import only)
0302.12-019	Pacific salmon excluding *O. nerka* and *O. kisutch* (import only)
0302.12-020	Atlantic or Danube Salmon (import only)
0302.70-000	Livers, eggs and soft roe of fishes (export only)
0302.70-090	Livers, eggs and soft roe of fishes (not *Clupea*, *Gadus* or *Merluccius* spp.) (Fish livers and roes nes) (import only)

Frozen

0303.10-000	Pacific sake (prior to 2002) (export only)
0303.11-000	"Benizake" Sockeye salmon or red salmon *O. nerka* 2002 onward (imports and exports)—prior to 2002, code 0303.10-010 was used for imports and 0303.10-000 was used for exports)
0303.19.000	Other Pacific "sake" 2002 onward (export only)
0303.19-010	"Ginzake" silver salmon *O. kisutch* 2002 onward—previously 0303.10-020 (prior to 2002) (import only)
0303.19-090	Pacific salmon excluding *Oncorhynchus nerka* and *O. kisutch* (believed to be mainly *O. keta*)—previously 0303.10-090 (prior to 2002) (import only)
0303.21-000	*Masu* (trout) (import and export)
0303.22-000	Atlantic Salmon, Danube Salmon (import and export)
0303.29-000	Other salmonidae (import and export)
0303.80-000	Livers, eggs and soft roe of fishes (export only)
0303.80-090	Other livers, eggs and soft roe of fishes (not *Clupea*, *Gadus* or *Merluccius* spp.) (Other livers and roes) (import only)

Fillets and other meat

0304.10-199	Other fish fillets, fresh or chilled (imports)
0304.10-299	Other fresh or chilled fish meat (imports)
0304.10-900	Other fish fillets, fresh or chilled (exports)
0304.20-099	Other frozen fish fillets (imports)
0304.20-900	Other frozen fish fillets (exports)

0304.90-099	Other fish meat frozen (imports)
0304.90-900	Other fish meat (exports)

Dried, salted, in brine, smoked, flour, meal or pellet for human consumption

0305.20-000	Fish livers, eggs and soft roe (export only)
0305.20-030	"Sake" eggs (salmon roes dried smoked salted or in brine (import only)
0305.30-000	Dried, salted or in brine fillets (export)
0305.30-010	Dried "sake" fillets (Salmon and trout fillets, dried, salted or in brine) (import only)
0305.41-000	Smoked Pacific, Atlantic and Danube "sake" (Salmon smoked) (import and export)
0305.69-010	Salted "sake" (salmon and trout, salted or in brine) (import only)
0305.69-000	Salted fish (export only)

Prepared or preserved fish; caviar and caviar substitutes prepared from fish eggs

1604.11-000	"Sake" (export only)
1604.11-010	"Sake" (salmon prepared or preserved, not in airtight containers) (import only)
1604.11-090	Other "sake" (salmon in airtight containers) (import only)
1604.30-010	"Ikura" (import only)
1604.30-090	Other caviar (Caviar and caviar substitutes) (import only)

Note: all codes applicable from 2000–2006 except where noted; separate codes for imports and exports may apply

Note: "masu" is defined as *Salmo trutta; Oncorhynchus mykiss; O. clarkii; O. aguabonita; O.gilae; O. apache and O. klingaster*

Note: "sake" is defined as *Oncorhynchus nerka; O. gorbuscha; O. keta; O. tshawytscha; O. kisutch; O. masou and O. rhodurus*

Note: Atlantic "sake" is defined as *Salmo salar* and *Hucho hucho*

Source: Japan Customs, 2007b and 2007c.

APPENDIX 2. COMMODITY CODES USED IN CHINA FOR SALMON PRODUCTS (2000–2006). QUANTITIES ARE GIVEN IN KG AND VALUES ARE IN UNITS OF USD1000

Live

0301-9990	Live fish not elsewhere specified, excluding fry (2000–2001)
0301-9999	Live fish not elsewhere specified, excluding fry (2002–)

Fresh or chilled

0302-1100	Trout (2000–2004)
0302-1200	Pacific, Atlantic and Danube salmon (2000–2001)
0302-1210	Atlantic salmon (2002–2004)
0302-1220	Pacific and Danube salmon (2002–2004)
0302-1900	Other salmonidae excluding 0302.11 and 0302.12 (2000–2004)
0302-7000	Fish livers & roes (2000–2004)

Frozen

0303-1000	Pacific salmon (2000–2001)
0303-1100	Sockeye (2002–2004)
0303-1900	Other Pacific salmon (2002–2004)
0303-2100	Trout (2000–2004)
0303-2200	Atlantic and Danube salmon (2000–2001)
0303-2210	Atlantic salmon (2002–2004)
0303-2220	Danube salmon (2002–2004)
0303-2900	Salmonidae (2000–2004)
0303-8000	Fish livers & roes (2000–2004)

Fillets

0304-1000	Fresh or chilled fish fillets (2000–2004)
0304-2000	Frozen fish fillets (2000–2001)
0304-2090	Fresh or chilled fillets, nes (stet; probably should read "frozen") (2002–2004)
0304-9000	Frozen fish meat (excl. fillets) (2000–2004)

Dried, salted, in brine, smoked, flour, meal or pellet for human consumption

0305-2000	Fish livers and roes (2000–2004)
0305-3000	Fish fillets dried, salted or in brine, but not smoked (2000–2004)
0305-4100	Smoked Pacific, Atlantic or Danube salmon (incl. fillets) (2000–2001)
0305-4110	Atlantic salmon, dried or salted or in brine but not smoked (2002–2004) (probably smoked)
0305-4120	Pacific or Danube salmon, dried or salted or in brine but not smoked (2002–2004) (probably smoked)
0305-6990	Other fish salted or in brine but not dried or smoked, not elsewhere specified

Prepared or preserved fish; caviar and caviar substitutes prepared from fish eggs

1604-1100	Prepared or preserved salmon (excl. minced) (2000–2001)
1604-1190	Prepared or preserved salmon (nes) (2002–2004)
1604-2010	Prepared or preserved fish in airtight containers
1604-3000	Caviar & caviar substitutes

Note: codes and their definitions vary according to year and the likelihood of misclassification is increased by inconsistent definitions
Note: prior to 2002 smoked salmon was classified under an 0305 code; subsequently, smoked salmon seems to be excluded from 0305 codes but there is no code specifically for smoked salmon from 2002 onward

Source: GCBI, 2002–2007.

APPENDIX 3. COMMODITY CODES USED IN HONG KONG FOR SALMON PRODUCTS (2000–2006). QUANTITIES ARE GIVEN IN KILOGRAMMES AND VALUES ARE IN UNITS OF 1000 HKD WHERE USD1 = HKD7.8.

Live

0301-9999	Other marine fish

Fresh or chilled excluding fish fillets and other fish meat of heading 0304

0302-1100	Trout (*Salmo trutta*, *Oncorhynchus mykiss*, *O. clarki*, *O. aguabonita*, *O. gilae*, *O. apache* and *O. chrysogaster*)
0302-1200	Pacific salmon (*Oncorhynchus nerka*, *O. gorbuscha*, *O. keta*, *O. tschawytscha*, *O. kisutch*, *O. masou* and *O. rhodurus*), Atlantic Salmon *Salmo salar* and Danube Salmon *Hucho hucho*
0302-1900	Other salmonids
0302-7000	Fish livers and roes

Fish, frozen, excluding fish fillets and other fish meat of heading 0304

0303-1000	Pacific salmon (prior to 2002; i.e. replaced by 0303-1100 and 0303-1900 in 2002)
0303-1100	Sockeye Salmon (red salmon) *Oncorhynchus nerka* excluding livers and roes
0303-1900	Other Pacific salmon (*Oncorhynchus gorbuscha*, *O. keta*, *O. tschawytscha*, *O. kisutch*, *O. masou* and *O. rhodurus*), excluding livers and roes
0303-2100	Trout (*Salmo trutta*, *Oncorhynchus mykiss*, *O. clarki*, *O. aguabonita*, *O. gilae*, *O. apache* and *O. chrysogaster*)
0303-2200	Atlantic Salmon *Salmo salar* and Danube Salmon *Hucho hucho*
0303-2900	Other salmonids
0303-8000	Fish livers and roes

Fillets and meat

0304-1010	Fresh or chilled fillet (2000–2002)
0304-1019	Fresh or chilled fillet other than toothfish (2003–)
0304-2000	Frozen fillet
0304-2090	Frozen fillet other than toothfish (2003–)

Dried, salted, in brine, smoked, flour, meal or pellet for human consumption

0305-2000	Livers and roes of fish, dried, smoked, salted or in brine
0305-3000	Dried [fish] fillet, dried, salted or in brine but not smoked
0305-4100	Smoked salmon, including fillets of Pacific salmon (*Oncorhynchus gorbuscha*, *O. keta*, *O. tschawytscha*, *O. kisutch*, *O. masou* and *O. rhodurus*), Atlantic Salmon *Salmo salar* and Danube Salmon *Hucho hucho*
0305-6990	Other fish, salted or in brine, but not dried or smoked

Prepared or preserved fish; caviar and caviar substitutes prepared from fish eggs

1604-1100	Salmon, whole or in pieces, but not minced
1604-2000	Other prepared or preserved fish
1604-3000	[Fish] Caviar and caviar substitutes

Source: Hong Kong Government, 2007.

APPENDIX 4. COMMODITY CODES USED IN SOUTH KOREA FOR SALMON PRODUCTS (AS OF 2006). QUANTITIES ARE GIVEN IN KILOGRAMMES AND VALUES ARE IN UNITS OF USD1000

Live

030199-9099	Other live fish

Fresh or chilled

030211-1000	*Salmo trutta*, *Oncorhynchus mykiss*, *O. clarki*, *O. aquabonita*, *O. gilae*
030211-2000	*O. apache* and *O. chrysogaster*
030212-0000	Pacific salmon (*Oncorhynchus nerka*, *O. gorbuscha*, *O. keta*, *O. tschawytscha*, *O. kisutch*, *O. masou* and *O. rhodurus*)
030219-0000	Other salmon fresh or chilled
030270-2000	Fish roes

Frozen

030311-0000	Sockeye Salmon (red salmon) *O. nerka*
030319-0000	Other (probably “Other Pacific salmon, frozen, nei”)
030321-0000	Trout (*Salmo trutta*, *Oncorhynchus mykiss*, *O. clarki*, *O. aguabonita*, *O. gilae*, *O. apache* and *O. chrysogaster*)
030322-0000	Atlantic Salmon *Salmo salar* and Danube Salmon *Hucho hucho*
030329-0000	Other (probably “Other Salmonids, frozen”)
030380-2090	Fish roes other than from Alaska Pollock

Fillets and Meat

030410-9000	Fresh or chilled fillets of other fish
030420-9000	Frozen fillets of other fish

Dried, salted, in brine, smoked, flour, meal or pellet for human consumption

030530-1000	Dried fish
030530-2000	Salted or in brine fish
030541-0000	Pacific salmon (*Oncorhynchus nerka*, *O. gorbuscha*, *O. keta*, *O. tschawytscha*, *O. kisutch*, *O. masou* and *O. rhodurus*), Atlantic Salmon *Salmo salar* and Danube Salmon *Hucho hucho* (probably smoked)
030520-2000	Dried fish roes
030520-3000	Smoked fish roes
030520-4090	Other fish roes

Prepared or preserved fish; caviar and caviar substitutes prepared from fish eggs

160411-1000	Salmon in airtight containers
160411-9000	Salmon in other forms
160430-1000	Caviar

Source: KITA, 2007.

APPENDIX 5. LIST OF INTERVIEW RESPONDENTS CONSULTED DURING THE COURSE OF THIS STUDY

- A representative of one of Japan's largest marine product companies;
- The managing director of a foreign fish trading company in Tokyo;
- A Russian Customs official;
- A New Zealand fish trader operating in China;
- A Japanese government scientist researching salmon markets;
- A linguistics specialist who has lived for many years in Kamchatka;
- A Japanese journalist who has published a book on illegal fishing in Russia;
- The managing director of a major salmon fisheries co-operative in Hokkaido;
- A salmon fisherman in Hokkaido;
- A journalist covering fisheries issues in eastern Hokkaido;
- President of a large salmon and other fish processing facility in eastern Hokkaido;
- Branch chief of a government Customs inspectorate in eastern Hokkaido;
- A representative of a Russian information centre in eastern Hokkaido;
- The vice-director of a group advocating return of the four islands (Habomai, Shikotan, Etorofu and Kunashiri) from the Russian Federation to Japan;
- Chief of the fisheries section of a city office in eastern Hokkaido;
- A representative of the fisheries section of a Hokkaido prefectural office in eastern Hokkaido;
- A representative of the Korea Trade-Investment Promotion Agency in Tokyo;
- The director and vice-director of the head office (Sapporo) of the largest fisheries co-operative in Hokkaido;
- Another representative of the same fisheries co-operative based in eastern Hokkaido;
- Another representative of the same fisheries co-operative based in southern Hokkaido;
- A fisheries scientist based in Kamchatka;
- General manager of a salmon processing company in eastern Hokkaido;
- A salmon trader in Tsukiji (Tokyo);
- Chief of the salmon group of one of the largest trading houses in Tsukiji;
- A representative of the Japan Statistical Association, Shinjuku (Tokyo);
- Several representatives of the Statistical Section, Japan Fisheries Agency;
- A journalist with one of the largest fisheries industry newspapers in Japan;
- A representative of one of the largest marine products companies in Japan based in Osaka;
- Representatives of the Russia section of the Japan Fisheries Agency;
- Representatives of the Resource Management Regulations section of the Japan Fisheries Agency;
- Representatives of the Tokyo Customs Authority;
- A senior staff member of one of Japan's largest marine product companies;
- Senior representatives of one of China's largest fish processing factories in Qingdao, China;

- Managing Director of a major Chinese factory processing whitefish from Russia in Qingdao, China;
- Representative of a fish processor in Shiogama, Japan;
- Representatives of the assessment team preparing the documentation for Japan's first Marine Stewardship Council application for certification by a Japanese fishery;
- Director of a Japanese non-governmental organization encouraging sustainable fisheries; and
- Section Chief of the Distribution Section for one of Japan's largest fishing and fish trading companies.

APPENDIX 6. PROCESSING OF SALMON IN QINGDAO, CHINA

Credit: S. Clarke

Factory Entrance: There are two workshops for salmon: one which specializes in Chum and one which specializes in Pink. This workshop specializes in Chum but sometimes handles Pink Salmon as well. Entrance procedures involve donning a hair net, face mask, sock covers, boots and lab coat with hood, removing all watches and jewellery, washing hands thoroughly, soaking hands in a bleach solution, and having lab coat rolled for loose hair.

Credits: S. Clarke

Pre-Processing: Thawing. Russian Pink Salmon (left) and Alaskan Chum (right) were thawing in separate areas in advance of separate processing runs. The Chum was being processed at the time of the visit and is shown in the following photographs

Credit: S. Clarke

Station 1. Filleting dressed (headed and gutted) salmon. Fish are cut in half lengthwise and the vertebrae removed.

Credit: S. Clarke

Station 2. Fillet trimming and pin bone removal. Pin bone removal is done with the use of tweezers.

Credit: S. Clarke

Station 3. Trimming of the fat line. Depending on the specification, some of the fat line may be left intact for flavour.

Credit: S. Clarke

Station 4. Parasite removal under ultraviolet (UV) light. About 20 people were working with tweezers to remove parasites visible from the surface, mostly in the belly area. UV light is necessary to spot parasites when working with salmon. Chum are said to have a particularly high number of parasites.

Credit: S. Clarke

Station 5. Cutting into individual portions for freezing. Fillets are cut and weighed according to client specifications. They are then placed on trays for freezing in a plate freezer.

Credit: S. Clarke

Station 6. Post-freezer trimming. Any ice pieces attached to the frozen fillet are tapped off with a knife to improve appearance. These fillets will be passed through a metal detector and then packaged according to client specifications.

APPENDIX 7. WINBUGS CODE FOR INPUT 1 AND INPUT 2 MODELS

```
model {

#Set Prior for generating uninformative mean distributions
priortau<- 1/(100000*100000)

#Set Uninformative Prior for Russian Catch Reporting Variance
	tau_RUS~dgamma(0.01,0.01)
	tau_JAP~dgamma(0.01,0.01)

#Set Uninformative Priors for Expected Mean Catch in each year
for (i in 1:7)
{
	RC[i] ~ dnorm(20000,priortau) I(1,)
	JC[i] ~ dnorm(3000,priortau) I(1,)
	}

#Read in Russian catch data to inform mean and variance terms

for (k in 1:5)
{
	for (i in 1:3)
	{
	RusCatch[k,i]~dnorm(RC[k],tau_RUS) I(1,)
			}
}

for (k in 6:7)
{
	for (i in 1:2)
	{
	RusCatch[k,i]~dnorm(RC[k],tau_RUS) I(1,)
		}
}

#Read in Japanese catch data to inform mean
for (k in 1:7)
{
	JapCatch[k]~dnorm(JC[k],tau_JAP) I(1,)
	}


#Simulate annual catch values from informed means and updated precision
for (i in 1:7)
```

```
{
        EstRusC[i]~dnorm(RC[i],tau_RUS) I(1,)
        EstJapC[i]~dnorm(JC[i],tau_RUS) I(1,)
        }

#Primary Processing Conversion
early~dbern(0.99)
late~dbern(0.70)

GandG~dunif(0.8,0.9)
HandG~dunif(0.7,0.8)

for (i in 1:5)
{
        RusCPP[i]<-EstRusC[i] * ((early*GandG) + ((1-early)*HandG))
        JapCPP[i]<-EstJapC[i] * ((early*GandG) + ((1-early)*HandG))
        }
for (i in 6:7)
{
        RusCPP[i]<-EstRusC[i] * ((late*GandG) + ((1-late)*HandG))
        JapCPP[i]<-EstJapC[i] * ((late*GandG) + ((1-late)*HandG))
        }

#Adjust for non-Asian consumption of Russian catches
AsiaExp~dunif(0.97,0.99)
for (i in 1:7)
{
        RusExp[i]<-RusCPP[i]*AsiaExp
        }
#Sum Adjusted Russian and Japanese Amounts
for (i in 1:7)
{
        TotCatch[i]<-RusExp[i]+JapCPP[i]
        }


}
#DATA
list(
RusCatch = structure(.Data = c(
15127,15127,15107,
17962,18102,18124,
24797,24805,24796,
17630,17692,17704,
16342,16342,16343,
```

```
19818,19503,NA,
24730,24247,NA
), .Dim=c(7,3)),
JapCatch = c(2091,2715,3200,2018,2616,2738,2990)


#INITS
#CHAIN 1
list(
tau_RUS=0.000001,
tau_JAP=0.0002,
RC=c(22000,18000,15000,25000,20500,19000,24000),
JC=c(2000,3000,1500,2000,4000,2000,1000))

#CHAIN 2
list(
tau_RUS=0.000005,
tau_JAP=0.0005,
RC=c(18000,15000,24000,22000,20000,14000,26000),
JC=c(1000,1000,2000,2000,3000,3000,4000))
```

APPENDIX 8. WINBUGS CODE FOR IMPORT MODEL

```
model
{

#set variance for prior

priortau<- 1/(100000*100000)

#set the uninformative priors for the estimated import quantities

for (i in 1:5) {
        USJP[i] ~ dnorm(25000,priortau) I(1,)
        USCN[i]~dnorm(1000, priortau) I(1,)
        USKO[i]~dnorm(30,priortau) I(1,)
        RUJP[i] ~ dnorm(18000,priortau) I(1,)
        RUCN[i] ~ dnorm(200,priortau) I(1,)
        RUKO[i] ~ dnorm(25,priortau) I(1,)
        CNJP[i] ~ dnorm(2000,priortau) I(1,)
        }

#set variance for the distribution that reads the data (this is the "target" variance to be estimated)

tau_USJP~dgamma(0.001,0.001)
tau_USCN~dgamma(0.001,0.001)
tau_USKO~dgamma(0.001,0.001)

#read in the data (and adjust variance for Japan-US and China-US pairs

for (i in 1:5)  {
        UJ[i]~dnorm(USJP[i],tau_USJP)
        JU[i]~dnorm(USJP[i],tau_USJP)
        UC[i]~dnorm(USCN[i],tau_USCN)
        CU[i]~dnorm(USCN[i],tau_USCN)
}

#read in the data (and adjust variance) for Korea-US pairs

for (i in 1:3) {        #Korea only has three paired data points (unfortunately): 2002, 2003 and
2005 for U.S. comparison
         UK[i]~dnorm(USKO[i],tau_USKO)
         KU[i]~dnorm(USKO[i],tau_USKO)
        }

#estimate China's Sockeye imports from Japan with additional uncertainty of whether these are
```

```
Russian Sockeye to be counted
Double~dbern(0.8)

#update the uninformative prior for each country's imports from the Russian Federation for each
year 2000–2006
for (i in 1:5)
{
	JapImBen[i]~dnorm(RUJP[i],tau_USJP)
	CnImBen[i]~dnorm(RUCN[i],tau_USCN)
	KoImBen[i]~dnorm(RUKO[i],tau_USKO)
	CnImJPBe[i]~dnorm(CNJP[i],tau_USCN)

#re-estimate and sum nodes
	RJest[i] ~ dnorm(RUJP[i], tau_USJP)
	RCest[i] ~ dnorm(RUCN[i], tau_USCN)
	RKest[i] ~ dnorm(RUKO[i], tau_USKO)
	CJest[i]<-RCest[i]*Double
	TotRusIm[i]<-RJest[i]+RCest[i]+RKest[i] +CJest[i]
	}
}

#DATA
list(

JapImBen=c(24561.852,20892.052,18827.434,24759.018,24648.688),
CnImBen=c(15.777,2.964,1227.480,601.255,860.302),
KoImBen=c(61.847,13.383,52.345,0,0),

CnImJPBe=c( 537.120, 1392.098, 1541.634, 3647.814, 3958.273),

UJ=c(18719.004,21185.199,28342.639,35593.902,13477.387),

JU=c(26365.818,24885.139,30979.576,30212.559,18158.523),

UC=c(147.726, 185.216,2135.055,2774.933,4112.744),

CU=c(59.256,42.403,297.363,1316.741,3339.228),

UK = c(82.165,120.954,76.560),

KU= c( 1.089,1.315,28.700))

#INITS
list(
tau_USJP=0.0000003,
```

```
tau_USCN=0.0000001,
tau_USKO=0.0000005,
USJP=c(20000,30000,9000,14000,23000),
USCN=c(800,1200,1000,1600,500),
USKO=c(100,20,80,50,70),
RUJP= c(15000, 25000,13000,10000,28000),
RUCN = c(150,200,400,100,250),
RUKO = c(50,100,20,40,60),
CNJP = c(1200,800,500, 1500,200)
)

list(
tau_USJP=0.0000004,
tau_USCN=0.0000004,
tau_USKO=0.0000002,
USJP=c(30000,23000,19000,24000,3000),
USCN=c(1800,700,5000,1100,1500),
USKO=c(10,200,180,115,110),
RUJP= c(1500, 12500,3000,20000,11000),
RUCN = c(300,500,500,700,50),
RUKO = c(20,80,120,25,160),
CNJP = c(120,1800,1500, 230,120)
```

APPENDIX 9. WINBUGS CODE FOR MARKET MODEL

```
model
{

PrimSale~dunif(1.176,1.333)
Kirimi2x~dunif(0.2,0.5)
TsuRatF~dlnorm(-2.813,0.9)
TsuRatS~dlnorm(-1.427,2.5)      #
b1~dbeta(1,1)
b2~dbeta(1,1)

for (k in 1:4) {
        FrBeProp[k]~dbin(b1,100)
        ShBeProp[k]~dbin(b2,100)
        }

OsakaFr~dbin(b1,100)
OsakaSh~dbin(b2,100)
RusShare~dunif(0.3963,0.4783)


for (i in 1:4) {

        TSUkakirW[i] <- TSUkakir[i] * PrimSale
        KirimiAd[i] <- TSUkakirW[i] * Kirimi2x
        TSUtofr[i] <- TSUfrben[i] + KirimiAd[i]

        OsakaTFr[i] <- OsaHfrbe[i]*OSfrfrbe[i] + (OsaTfrbe[i]*(OsakaFr/100))
        TO9fr[i] <- TSUtofr[i] + (EightFr[i]* TsuRatF)
TO9sh[i] <- TSUshben[i] + (EightSh[i]*TsuRatS)
        TempSum[i] <- TO9fr[i]+TO9sh[i]

        All10[i] <- TempSum[i]+OsakaTFr[i]+OsakaTSh[i]

        PercIn[i]~dunif(low[i],high[i])
        AllMarkt[i] <- All10[i] * (1/PercIn[i])
        TotRUsoc[i] <- AllMarkt[i] *RusShare

        inMT[i]<-TotRUsoc[i]/1000
}

}
```

#DATA

```
list(
TSUfrben=c(2612615,1888453,2319838,1747624),
TSUshben=c(3796388,3881005,3534275,3250662),
TSUkakir=c(23304,16541,22451,20618),
EightFr=c(27087000,25396000,26857000,25130657),
EightSh=c(30083000,26930000,27215000,25655803),

OsaHfrbe=c(4897000,2713212, 2766767, 2517295),
OsaTfrbe=c(3403000,2082068,1878493,1914204),
OsaHshbe=c(2944000,2620490, 2570459, 3109346),
OsaTshbe=c(2045000,1897364,1911461,1704580),
OSfrfrbe=c(0.39,0.48,0.40,0.29),
OSshshbe=c(0.81,0.69,0.57,0.74),
FrBeProp=c(39,48,40,29),
ShBeProp=c(81,69,57,74),
low=c(0.30,0.27,0.23,0.20),
high=c(0.45,0.40,0.35,0.30))
```

TRAFFIC, the wildlife trade monitoring network, works to ensure that trade in wild plants and animals is not a threat to the conservation of nature. It has offices covering most parts of the world and works in close co-operation with the Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

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