The world tuna industry
-an analysis of imports, prices, and of their combined impact on tuna catches and fishing capacity-

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Aims of the paper

• To assess the influence of the tuna market on tuna catches

• To provide an input for the evaluation of the optimum tuna fishing capacity
Commercial tuna species

- Skipjack tuna *Katsuwonus pelamis*
- Albacore, longfin tuna *Thunnus alalunga*
- Yellowfin tuna *Thunnus albacares*
- Southern bluefin tuna *Thunnus maccoyii*
- Bigeye tuna *Thunnus obesus*
- Pacific bluefin tuna *Thunnus orientalis*
- Atlantic bluefin tuna *Thunnus thynnus*

The species utilized for canning are skipjack, yellowfin and albacore. Because of the colour of the meat, canned skipjack and yellowfin are also known as “light meat tuna”, while canned albacore is also known as “white meat” tuna. In turn, the main species utilized in the Japanese *sashimi* market are bigeye, yellowfin and the three bluefin species.
According to FAO data, global catches of commercial tuna species increased from 402,000 MT in 1950 to 3.8 million MT in 1999, to decline to 3.7 million MT in 2000 and 2001. Landings of commercial tuna species in 2001 represented 63 percent of the world capture of tunas, bonitos and billfishes. Skipjack tuna is the main species caught, followed by yellowfin tuna, bigeye tuna, albacore and the three bluefin species. According to FAO data, the main commercial tuna fishing nations are Japan, Taiwan Province of China and Spain. About 68 percent of captures of commercial tuna has been landed in the Pacific Ocean over the 1950-2001 period.
Analysis of the factors affecting tuna catches

- Human induced:
  - Trends in the demand of tuna commodities
  - Fishing technology
  - Regulatory framework

- Non-human induced:
  - Climatic (ENSO)

The general increase in tuna catches in the post-war period was driven by the growing demand for this cheap and protein-rich food. Over time, the growth of the tuna industry fostered the development of fishing technology in order to build powerful vessels able to catch larger quantities of fish. The bulk of tuna catches is taken by purse seine vessels, longliners and pole and line vessels.

Tuna species are mobile and caught beyond areas of national jurisdiction. Bilateral agreements between distant-water fishing nations and coastal states are implemented through the sale of fishing licenses to distant-water fishing nations. Mobility and distant fishing, combined with the necessity to strive for sustainability in the management of highly exploited resources, justified the set up of regional fishery bodies and arrangements (RFBAs) aimed at the management of tuna species in various oceans.

Tuna management bodies such as the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), the Inter-American Tropical Tuna Commission (IATTC), the International Commission for the Conservation of Atlantic Tunas (ICCAT) and the Indian Ocean Tuna Commission (IOTC) have the responsibility to ensure the conservation and optimum utilization of tuna resources through stock assessment, management and trade control measures.

The resolutions of other international bodies such as the World Tuna Purse Seine Organization (WTPO) have an impact on the catch of tuna and tuna-like species, for market rather than sustainability reasons. The WTPO, on 1 December 2000, decided for a drastic reduction in skipjack fishing, e.g. all participating countries decided to stop fishing for a minimum of 30 days, during the following 60 days, or to implement a reduction of 35 percent in fishing effort. The aim was to help the recovery of skipjack prices, which had fallen to a historical low of US$350 to 450/MT kg for frozen fish over 2000. Further to these measures, the market stabilized in 2001, but prices started to decline once again in 2002. In early 2003, WTPO recommended a reduction of skipjack catches by increasing the number of days in port, based on the different tonnage of boats.
The tuna processing chain
Tuna for *sashimi*

- Originates from fresh/chilled or sea-frozen tuna
- Graded according to:
  - Species
  - Capture method
  - Fat contents
  - Aesthetic characteristics
- Cut in small slices and served raw

*Sashimi* originates from fresh raw tuna meat, or from tuna frozen at -40° immediately after harvest. The *sashimi* market requires the use of larger species, such as bluefins (ensuring the premium *sashimi*) bigeye and yellowfin. Generally, larger fish are preferred to smaller fish. In terms of capture methods, tuna for the premium *sashimi* market is generally caught by longlines, which ensure the best handling of the fish. In terms of processing methods, connoisseurs of the premium *sashimi* market favour fresh and chilled tuna. Tuna for the *sashimi* market is also graded on aesthetic characteristics, such as bright/clear appearance of the skin, clear and moist eyes, elastic skin and undamaged abdominal walls, and on the high fat contents of the fish. *Sashimi* is served in small slices, dipped in soy sauce or *wasabi* (Japanese horse radish) and consumed raw.
Different sashimi cuts from different species have various market values, depending on fat contents: the higher the fat content, the lighter the colour and the more valued the sashimi will be. The best sashimi comes from toro, the peripheral layer of lighter coloured tuna meat with a fat content of circa 25 percent. Toro is further divided into otoro, pink, which gives the prime sashimi, and chutoro, darker pink. Within otoro there is a smaller part called sunazari whose texture is marbled with thin lines of fat, with distinctive looks and flavour. The central block of red meat, with a lower fat content (around 15 percent) is called akami and fetches lower prices than toro.
Tuna for direct consumption

- Fresh and chilled
- Frozen
- Fresh/frozen loins, fillets, meat
After capture, there are different steps to process tuna for canning. When the fish are unloaded from the vessel they are thawed in running water or sprays of water. The fish are then quickly gilled, gutted, headed, and finally frozen. After cutting, the tunas are loaded into trays and taken to the pre-cooker. After pre-cooking and cooling, the cleaners remove the skin from the fish and separate the loins from the skeleton. After cutting the loins into solid pack or chunks, according to their firmness, the last step, canning, is a totally automated process. Canned tuna products are packed in oil, brine, spring water or sauce. Once the cans are sealed, they are cooked a second time (“retort cooking”), for two to four hours. After the retort cooking, the cans are cooled, labelled, and finally packed into cardboard cases for distribution.

It is a relatively common practice in the tuna industry to undertake all the processing stages up to tuna loining as close as possible to the landing areas in developing countries, to freeze the loins and to export the frozen semi-processed product (tuna loins) to canneries in developed countries.

The HACCP principle (Hazard Analysis and Critical Control Point) is generally applied to the tuna industry “from the sea to the fork”. HACCP implies food safety controls within the process rather than applied to the final product. It is extremely important to undertake all the processing at a temperature of 0°C at least, in order to avoid the likelihood of histamine poisoning.
Tuna raw material

- Whole, H&G, G&G, frozen
- Frozen pre-cooked loins
- Fresh and chilled
Canned tuna

- Solid pack, chunks, flakes
- Preserved in brine, oil, sauce
- Canned in tin, glass, pouch pack
Other tuna products

- Smoked, dried skipjack *fushi*
- Tuna spread
- Tuna roe and poutargue
- Tuna burgers
- Tuna jerky
- Tuna sausage
- Other by-products (heart, swimbladder etc.)
Benefits of tuna:

- Omega 3
- Phosphorus
- Iodine
- Proteins
- Vitamin B12

Tuna has numerous health benefits: it is rich in Omega-3, a polyunsaturated fat. The consumption of Omega-3 rich fish is associated with decreased risk of heart diseases, cholesterol reduction, regulation of high blood pressure, prevention of arteriosclerosis. Tuna also contains phosphorous, iodine, which favours a balanced growth, proteins and vitamin B12, helping the growth of cells, and niacin, which ensure correct metabolism of fatty acids and cholesterol.
...and concerns linked to its consumption...

- Health concerns:
  - Histamine
  - Methyl mercury
- Animal welfare (dolphins)

The most likely hazard when consuming inadequately handled *Scombroidei* is histamine poisoning. Histamine is produced in certain types of fish when microbes break down the amino acid histidine. High temperature and time abuse of harvested fish accelerate the growth of microorganisms normally present in the fish, increasing the breakdown of histidine into histamine. Human scombroid poisoning is caused from consuming fish with high levels of histamine. Symptoms may include rashes, a metallic taste in the mouth, nausea, vomiting, diarrhoea, hypotension, palpitations, tingling, muscle weakness and respiratory paralysis. Scombroid poisoning has sometimes resulted in human death.

Raw fish can be contaminated with fecal bacteria when gutted and if the fish is stored at temperatures above freezing, the bacteria grow. They produce an enzyme that dissolves the tissues of the fish, resulting in the production of histamine. The easiest way to prevent this type of food poisoning is to store the fish at freezing temperatures, 0°C. Every time the fish is manipulated, the temperature of the fish is likely to increase; therefore, it is essential to keep the fish at 0°C while handling it.

Another cause of concern thought to be linked to the consumption of *Scombroidei* is mercury poisoning. Mercury occurs naturally in the environment and can be released into the air through industrial pollution, thus also on water surfaces. Bacteria living in water convert inorganic mercury into methyl mercury, and fish absorb methyl mercury through water and by feeding on other aquatic organisms. Clearly, long-lived, larger predators such as sharks, swordfish and king mackerel tend to accumulate the highest levels of methyl mercury.

The primary danger of methyl mercury in fish is the harm it can cause to the development of the nervous system of unborn children and of children less than six years of age, hence the issuing by the United States Food and Drug Administration (FDA) and by the United States Environmental Protection Agency (EPA) of a series of advisories aimed at limiting consumption of fish by pregnant and nursing mothers and small children. As far as tuna is concerned, older and larger fish used for the preparation of steaks and *sashimi* seem to have the highest levels of methyl mercury, while raw material for canning, which comes from smaller and younger fish, seem to be less affected.

One of the highest-profiled crises of the world tuna industry, and still unresolved from 1990, was determined by the tuna-dolphin issue. In May 1990 the main North American canners decided not to process any more tuna caught through the practice of encircling dolphins, therefore leading most of the tuna fleets to move from the Eastern Pacific, where dolphins and yellowfin tuna form mixed schools, to the Western Pacific, also creating the conditions for an embargo to countries catching tuna by using the “encircling” dolphins practice, such as Mexico.

In 1991 Mexico complained under the GATT (General Agreement on Tariffs and Trade) dispute settlement procedure. The panel reported to GATT members in September 1991. It ended with the United States not being allowed to set an embargo on imports of tuna products from Mexico just because Mexican regulations on the way tuna was produced did not satisfy United States’ regulations. However, the United States could apply its regulations on the quality or content of the tuna imported. Furthermore, GATT rules did not allow a country to take measures to force other countries to implement its domestic legislation (extra-territoriality). However, the panel report was never adopted. Therefore, Mexico and the United States held their own bilateral consultations aimed at reaching an agreement outside GATT. The outcome of the consultations was the Agreement on the International Dolphin Conservation Program (AIDCP), entered into force in 1999.

By the end of December 2002, the Department of Commerce of the United States ruled that encircling dolphins with nets a mile wide to catch tuna would not significantly harm them, through the implementation of the measures set forth by the AIDCP. Should all encircled dolphins be safely rescued from the nets, the tuna could be marketed as dolphin-safe, as opposed to the previous definition of “dolphin-safe”, introduced by the Earth Island Institute (Eii), which excluded the labelling of “dolphin-safe” to any tuna caught by using the practice of encircling. Eii and other environmental NGOs immediately filed a lawsuit against the decision by the Department of Commerce.
World tuna trade
World imports of fresh, chilled and frozen tuna increased from 435 000 MT in 1976 to 1.6 million MT in 1998, to decline slightly to 1.4 million MT in 2000 and catch up to some 1.5 million MT in 2001 (Figure 6). In terms of value, world imports of fresh, chilled and frozen tuna increased from US$406 million in 1976 to US$3.4 billion in 1995, to decline to US$3 billion in 2000 and 2001, albeit with a slight reprise in the latter year.

Imports of frozen tuna increased from 421 000 MT in 1976, equivalent to US$368 million, to 1.4 million MT in 1998, equivalent to US$2.4 billion, to decline slightly to 1.3 million MT in 2001, equivalent to US$2.1 billion. World imports of fresh and chilled tuna increased from 14 278 MT in 1976, equivalent to US$38 million, to 160 177 MT in 2001, equivalent to US$935 million.
Skipjack is the most traded species in quantity terms, followed by yellowfin.
Yellowfin and bigeye are the main traded species in terms of value. It is worth noting a decline in the export values for all species (but bluefins) which has been particularly marked for skipjack during the nineties.
World imports of fresh and frozen tuna by main countries, quantity 1976-2001

- Thailand
- Japan
The main importers of fresh, chilled and frozen tuna commodities are Thailand (first in terms of volume and second in terms of value) which mainly imports frozen skipjack for its canneries, and Japan (first in terms of value and second in terms of volume), mainly importing frozen bigeye for the *sashimi* market.

It is worth highlighting the decline of Thailand’s imports in the nineties because of the mid-decade crisis and of the late-decade depreciation of Thailand’s main imported material, frozen skipjack.

Other importers are Spain, Côte d’Ivoire and the United States of America.
Production of canned tuna increased from 499 000 MT in 1976 to 1.4 million MT in the 1998 to 2001 period, albeit with a slight declining pattern as from the peak of 1998. The main producing countries are Thailand, the United States and Spain.
World imports of canned tuna (including declared loins) increased in terms of volume from 89 000 MT in 1976 to 836 000 MT in 2001. The main importers are the US, the UK and France.
Selection of key prices and price series analysis
The *sashimi* tuna market
High prices of Southern bluefin tuna peaked in 1996-1997 at average year quotations of ¥11,100/kg and ¥11,292/kg, respectively. In the years which followed, they declined to a low of ¥7,508/kg in 2000 and fluctuated around similar values over the 2000-2003 period. In 2003, high prices of Southern bluefin tuna totalled ¥7,651/kg. In turn, low prices of Southern bluefin tuna declined slightly from ¥887/kg in 1995 to ¥635/kg in 2003. The peak prices of Southern bluefin tuna reported in Japan in 1996 and 1997 were due to low supplies from imports against strong demand. In the years which followed, decline in Japanese prices was a reflection of the market penetration of cheaper *sashimi* preparations from farmed bluefins.
High prices of Atlantic and Pacific bluefin tuna increased from ¥6 917/kg in 1986 to ¥10 717/kg in 1991. In the years which followed, they declined to a low of ¥4 906/kg in 2003. In turn, low prices of Atlantic and Pacific bluefin tuna increased from ¥3 642/kg in 1986 to ¥3 881/kg in 1991 and declined in the years which followed until they reached ¥2 555/kg in 2003. As from 1999, ITN started to report quotations of farmed Atlantic and Pacific bluefins. Prices of farmed Atlantic and Pacific bluefin tuna decreased from ¥4 000 (low price) - ¥5000 (high price), origin Spain to ¥1 800-3 000 in December 2003. Over the past two years, these quotations have been lowering the average bluefin quotations on the Tsukiji market.
Since 1994, high prices of bigeye have been following the same declining pattern as Atlantic, Pacific and Southern bluefin prices. Declining bigeye prices are due to the continuing good world catches over the 1991-2000 period and the substitution of high quality bigeye with average quality bigeye, which is reflected in the relatively buoyant low prices of bigeye. The increase of high prices in 2003, however, seems to be largely due to low supply of the species, against high demand due to the preference allowed by consumers to the leaner meat of bigeye against farmed bluefins, which are reported to contain too much fat due to artificial feeding.
Average high prices of fresh/chilled and frozen yellowfin in Japan increased from ¥1,811/kg in 1990 to ¥2,663/kg in 1995, to decline to ¥1,354/MT in 2003. Average low prices of fresh/chilled and frozen yellowfin in Japan fluctuated around a value of ¥480/MT. High yellowfin prices seem to follow the same pattern of high bluefin and bigeye prices, with an increase followed by a drastic decline. Low yellowfin prices appear relatively stable over the period considered.
Decline of high sashimi tuna prices indicates a shift towards cheaper sashimi. Main reason: changing macro-economic conditions in Japan.
In Italy, the use of loins for canning has been estimated to average about 70 percent of total canned tuna production over the 1994-2001 timeframe. Prices of yellowfin loins have been averaging €3.40/kg up to 2002. However, good supplies in canneries led main yellowfin consuming countries, such as Italy, to slow down their demand for loins in 2002 and 2003; hence prices started to decline. In turn, prices of skipjack loins declined from €2.51/kg in January 1999 to €1.88/kg in January 2001. The restrictive measures on skipjack catches implemented between the end of 2000 and the beginning of 2001 generated an increase in prices of skipjack loins to €3.35/kg in August 2001. In the months which followed, prices of skipjack loins fluctuated between €3.15 and 3.20/kg until they reached US$3.41/kg (February to April 2002). However, between the end of 2002 and the beginning of 2003 prices of skipjack loins declined until they reached €2.28/kg in December 2002 to February 2003. Restrictive measures implemented by WTPO Members and reduced landings led prices of skipjack loins to increase to €2.53/kg in May 2003.
Average canned tuna prices declined from US$1,435/MT in 1989 to US$1,212/MT in 1992, mainly due to persisting oversupply of raw material. In the years which followed, average canned tuna prices caught up and peaked to US$1,599/MT in 1997 and US$1,578/MT in 1998. The oversupply of raw material in the years which followed pushed prices down to US$995/MT in 2000. WTPO measures aimed at restricting raw material supply helped canned tuna prices to catch up, as well as raw material prices. In fact, canned tuna prices increased to US$1,336/MT in 2001, but they continued to decline in the years which followed, until they reached US$1,120/MT in 2003.
The two price curves follow an almost identical pattern, leading to the 2000 depression and subsequent recover.
From 1990 to 1996, the price decrease was determined by increasing availability of supply from captures. As from 1997, despite buoyant international demand (imports) and declining catches, the development of tuna farming has made available increasing quantities of cheaper farmed bluefin in world markets since 1997, hence lowering the average bluefin tuna prices.
World imports of bigeye tuna have been steady over the whole 1990 to 2001 period, increasing from 96 000 MT in 1990 to 154 000 MT in 2001, with a peak of 161 000 MT in 1998. Catches also increased from 294 000 MT in 1990 to a peak of 411 000 MT in 2000, declining in 2001 to 372 000 MT as a result of declining catches in the Indian Ocean and in the Southeast Pacific. Prices of bigeye in the Japanese market increased from ¥2 947/MT in 1989 to ¥3 324/MT in 1994, to decline in the years which followed until they reached a low of ¥1 601/MT in 2001. The decline of bigeye prices in the nineties has been generated by both oversupply of bigeye in world markets (despite the buoyant demand) as well as by a reduction in the demand for top quality sashimi-grade fish in favour of average quality bigeye. In 2002, bigeye prices would have reached ¥1 399/MT, to catch up in 2003 to ¥1 663/MT as a result of lower supply and increasing demand.
From 1990 to 1998 steady international demand for canned tuna generated an increase in catches and imports of raw material. However, as the increase in catches was limited enough not to generate continuous oversupply, prices increased accordingly (with the exception of 1991 and 1992 due to an excess of raw material supply). The excess of supply of end decade, not compensated by an adequate increase in the demand for tuna commodities (both raw material and canned tuna), generated a depression in raw material and canned tuna prices. Such a depression reached its hypogeum in 2000. The supply restricting measures implemented by the WTPO limited catches in 2000 and 2001, improving prices, but, as far as skipjack was concerned, it only proved to be a temporary measure.

Processing of canned tuna (live weight equivalent) totalled an average of 85 percent of catches of skipjack and yellowfin. The trends in the processing of canned tuna and catches are almost parallel, as processing of canned tuna is influenced by the availability of raw material. The link between canned tuna processing and tuna prices is relatively weak due to the strong presence of producers who would buy at extremely high raw material prices to supply the buoyant demand from their traditional market. However, processing of canned tuna has been growing at a slower pace than catches, mainly because of the slower pace at which the tuna processing capacity has developed than tuna fishing capacity. In fact, tuna processing capacity is more linked to the technological input than to the abundance of natural resources and the ability to target the richest fishing grounds.
Concluding remarks

- Steady demand for canned tuna increases demand for raw material, catches (and capacity), processing and prices
- When demand cannot absorb supply anymore, prices go down (Bangkok bottleneck)
- In cases of continuous oversupply, equilibrium has to be re-instated through external operators (WTPO)
Sources

- Slides 4 and 17 to 23: FAO FISHSTAT +;
- Slides 26 to 29: ITN;
- Slide 31: estimate from skipjack price series on EPR (EU), INC (Africa), ITN (Asia) and NMFS/GLOBEFISH (US) and yellowfin prices on EPR;
- Slide 32: EPR;
- Slide 33: ITN;
- Slide 34: same as slides 31 and 33;
- Slides 35 and 36: ITN and FISHSTAT +;
- Slide 37: FISHSTAT + and same as slide 34.