February 2007

Report of a Survey to Establish the Capacity of Longline and Pole-and-Line Fleets in the Western and Central Pacific Ocean

Prepared by

Gillett, Preston and Associates
Vanuatu

ADMINISTRATIVE REPORT AR-PIR-07-01

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Pacific Island Region

PACIFIC ISLANDS REGIONAL OFFICE

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Explanatory Note

The control of fishing capacity continues to be one of the most significant challenges facing national fishery managers and administrators, as well the various tuna regional fisheries management organizations (RFMOs) around the globe. In some fora the level of analysis that has been undertaken to develop capacity controls is relatively involved and complete. In others the data are not yet available from all the required sources for quantitative assessment of national and regional capacities of the relevant fishing fleets. Highly migratory species (HMS) fisheries in the western and central Pacific Ocean (WCPO) fall into the later category.

This study compliments a 2003 report on purse seine capacity in the WCPO. We believe that effort was instrumental in encouraging more detailed subsequent analysis that suggested purse seine capacity in the WCPO was excessive (depending on the metric chosen as the appropriate standard).

Several recent studies have indicated a similar situation for other gear types or fleets fishing for HMS in the WCPO. However, to date there have been no published reports documenting the number, much less the fishing capacity, of longline or pole-and-line fleets in the WCPO. This study was commissioned to obtain a reliable estimate of the number of longline and pole-and-line vessels greater than 14 meters in length that are currently operating in the WCPO. We believe this is a necessary first step for a more rigorous analysis that will provide a factual basis for future discussions related to fishing capacity in the WCPO.

The modest goal of quantifying the number of vessels participating in the WCPO longline and pole-and-line fisheries proved relatively difficult to achieve. Not all of the important fishing nations in the region agreed to provide data for this survey. We are thankful to those that did cooperate in providing information for this survey. However, until all fishing nations cooperate fully in such studies, reliable estimates will not be available to fishery managers and RFMOs, with obvious policy and management implications for both industry and the affected resources.

This report is an initial step in the process of conducting a rigorous capacity analysis of WCPO longline and pole-and-line fleets. Similar efforts need to now be completed for other gear types so that a comprehensive assessment of fishing capacity being directed at the tuna resources in the WCPO can be undertaken.

William L. Robinson
NMFS Pacific Islands Regional Administrator

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GILLETT, PRESTON AND ASSOCIATES INC.

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Robert Gillett and Mike A. McCoy

November 2006

National Oceanic and Atmospheric Administration
Contract # AB133F-06-CN-0131

GILLETT, PRESTON AND ASSOCIATES INC.

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Executive Summary

The objective of the study

The objective of the study was to estimate the number of longline and pole-and-line vessels in the Western and Central Pacific Fisheries Commission area in 2005 and explore the considerations involved in obtaining an output-type estimate of capacity.

Fishing capacity

A relatively simple input measure of fishing capacity is initially used in the study: the number of vessels in the various fleets. More specifically, capacity is defined as the number vessels having at least some participation in tuna longline or tuna pole-and-line fishing in the WCPFC area in the year 2005. Latter sections of this report deal with the considerations associated with going beyond fleet sizes to obtain an output-type estimate of fishing capacity (i.e. catch per year).

Scope of the study

The study is confined to:

- Longline and pole-and-line vessels 14 meters and above.
- Those vessels that carried out at least some fishing in calendar year 2005.
- The area of the Western and Central Pacific Fisheries Commission.

Major constraint

The lack of detailed vessel information from Japan and Taiwan was the study's greatest constraint to obtaining an accurate assessment of fishing capacity in the region.

Fleet activity

According to data collected during this study, the longline and pole-and-line vessels of at least 29 nations were active in the WCPFC area in 2005. The largest longline fleets were those of Japan and Taiwan. The largest pole-and-line fleets were those of Japan and Indonesia.

The study databases

Two Microsoft Excel® databases were constructed. The Forum Fisheries Agency Regional Register is the basis of the study's longline vessel list, which is subsequently enhanced by

- 23 national lists of vessels known to be active and/or licensed in the WCPFC area in 2005,
- Lists of vessels visiting five important ports in the region,
- A list of vessel names from Secretariat of the Pacific Community's Oceanic Fisheries Programme that, according to logsheet information, conducted fishing in 2005, and
- A list from the Organization for the Promotion of Responsible Tuna Fisheries of vessels that transshipped tuna in the WCPO in 2005.

A similar process was followed to create a database for pole-and-line vessels.

Estimate of the number of longline vessels

Taking the national longline fleets for which the study's database has good coverage (25 countries, 1,021 vessels) and adding to it the estimates from other sources for the vessels of Japan, Taiwan, Indonesia, and Vietnam (3,493 vessels) results in the study's best estimate of the number of longliners 14 meters and above: 4,514 vessels.

Estimate of the number of pole-and-line vessels

Taking the national pole-and-line fleets for which the study's database has good coverage (7 countries; 138 vessels) and adding to it the estimates from other sources for the vessels of Japan (215 vessels) results in the study's best estimate of the number of pole-and-line 14 meters and above: 353 vessels.

Limitations and gaps of the databases

Numerous limitations and gaps in the data must be acknowledged. Vessel size, transliteration of the Chinese language in Taiwan, and the FFA Regional Register are particularly important and require special attention.

Improving the estimates of vessel numbers

Estimates of vessel numbers could be improved considerably by obtaining the full cooperation of Japan and Taiwan, gaining a greater understanding of longliners based in Indonesia and Vietnam, and altering the WCPFC vessel reporting requirements.

Obtaining an output-oriented estimate of fishing capacity

Going beyond fleet sizes to obtain an output-oriented estimate of fishing capacity (potential annual catch) appears possible. More information on vessel characteristics and catch rates are required, but this could be obtained, or at least estimated, through a combination of available data and fleet experience.

1.0 Background of the Study

1.1 Origin of the Study

The issue of fishing capacity has been the subject of discussions at several meetings associated with the management of highly migratory species in the Western and Central Pacific Ocean (WCPO). There has been considerable debate as to both the optimal level of fishing capacity, as well as the amount of current fishing capacity. Many uncertainties have surrounded these discussions due to the rapid expansion of tuna fisheries in the WCPFC area during the past few decades and the lack of comprehensive records of regional tuna fleets.

In most oceans of the world, tuna fleets are larger than needed to take the available harvest. In many areas where tuna stocks are fully exploited, the same amount of fish could be harvested with smaller fleets, resulting in lower costs of production, greater economic returns, and on occasion, lower prices for the consumer. Joseph (2003) reviews the need for information on fishing capacity in tuna fisheries and some implications for fisheries management (Box 1). Before a workable scheme to limit tuna fishing capacity can be developed, a considerable amount of information is required, key of which is information on the numbers and characteristics of vessels currently operating. There are a variety of methods that can be employed to obtain these important data elements in capacity analysis –direct census, random surveys or use of vessels lists maintained by various authorities both domestic and international.

Several organizations maintain vessel participation lists for the tuna fisheries in the Pacific Ocean, including the Western and Central Fisheries Commission (WCPFC), the Forum Fisheries Agency (FFA), and the Inter-American Tropical Tuna Commission (IATTC). To varying degrees, however, these lists are inadequate for determining tuna fishing capacity in the WCPFC area:

- The WCPFC list contains for several key nations *all* vessels that are authorized by the various member states to fish in the convention area beyond areas of national jurisdiction. It does not contain vessels fishing exclusively in domestic waters, but does include vessels that may not actually fish in the WCPFC area.
- The FFA Regional Register is limited to foreign fishing vessels in “good standing” with the FFA member countries.
- The IATTC vessel list is a record of vessels that have been authorized to fish in the IATTC convention area for species under the purview of the Commission. That list is not relevant for WCPFC area fishing capacity because the area of concern is in the eastern Pacific and the list (like the WCPFC list) contains all vessels that are authorized by the various member states to fish, rather than those actually fishing.

Box 1: Why Worry about Capacity in Tuna Fisheries ?

In the past the problem in tuna fisheries of too much fishing capacity, fishing effort, or fishing mortality has been addressed mostly through the application of catch quotas, closed areas and seasons, gear restrictions, etc. Some management schemes for tuna employ all of these methods, and more, to control fishing mortality for a single species. This sort of micro-management is often confusing, complex, and difficult for fishermen to comply with, not to mention the heavy implicit and explicit costs of management, and is not always effective in achieving the desired conservation objectives. Such management approaches can frequently end up reducing vessel efficiency and productivity per vessel. These sorts of events cause conservation programmes to fail. Setting fishing capacity limits would mitigate many of these problems, but could introduce others, such as allocating fleet capacity among participants, and measuring and monitoring vessel efficiency.

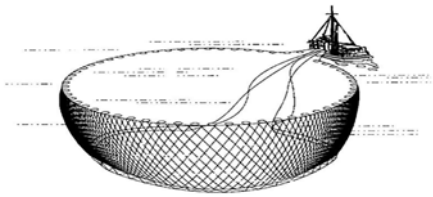
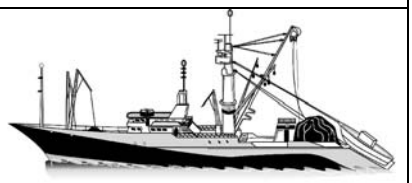
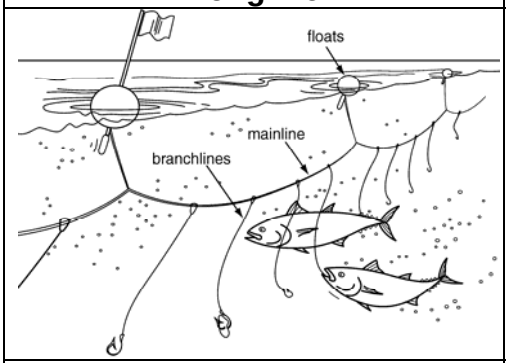
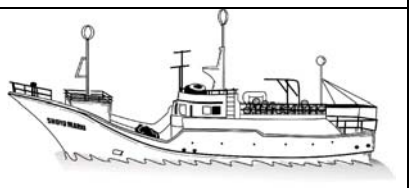
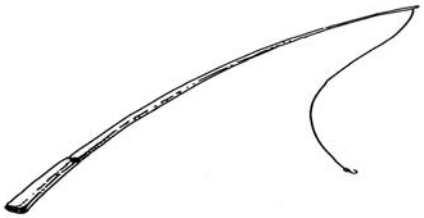
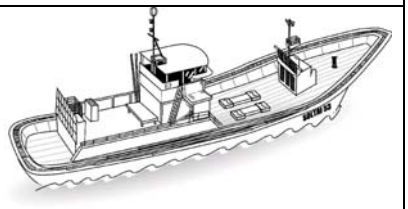
Source: Joseph (2003)

The three main tuna fleets as delineated by gear type operating in the WCPFC area are the purse seiners, the longliners, and the pole-and-line vessels (Figure 1). Purse seine fishing capacity in the region was reviewed in late 2003. To augment that previous study the fishing capacity of the longline and pole-and-line fleets, the consultancy firm Gillett, Preston and Associates (GPA) was contracted in June 2006 to review the fishing capacity of these two fleets. More specifically, GPA was charged with determining the individual and aggregate capacity of the longline, and pole-and-line fleets operating in the western and central Pacific Ocean that fish for yellowfin, albacore, skipjack or bigeye tunas and swordfish. The firm was charged with providing:

- An estimate of WCPFC area longline and pole-and-line vessel fleet sizes
- A capacity-oriented classification system for longline and pole-and-line vessels
- National fleet profiles, including documentation of past and present participation of the various fleets in the WCPFC area
- Identification of significant constraints in obtaining a more precise estimate of longline and pole-and-line fishing capacity in the region

Work on the review began in early July 2006 and was completed four months later. In the course of the study 60 documents were consulted and 148 individuals were contacted. These are listed in Section 10 and Appendix 1, respectively.

Figure 1: The Three Main Gear Types Used in the Tuna Fisheries of the WCPFC area

Gear Type	Catch	Typical Vessel that Uses Gear
Purse seine		
	Mainly skipjack and small yellowfin are caught by purse seine gear. Most catch is for canning. Bigeye tuna may occur as a by-catch.	
Longline		
	Most tuna caught are large size yellowfin, bigeye, and albacore. The prime yellowfin and bigeye often are exported fresh to overseas markets. Most of the albacore is for canning.	
Pole-and-line		
	Mainly skipjack and small yellowfin are caught by pole-and-line gear. Most catch is for canning or producing a dried product.	

Source: Gillett (2004)

1.2 Fishing Capacity

The term "fishing capacity" should be clarified. It is recognized that there are various interpretations of the term (See Box 2).

Box 2: Fishing Capacity

Different groups of people generally have a different understanding of capacity. Fishing technologists often consider fishing capacity as the technological and practical feasibility of a vessel achieving a certain level of activity – be it days fishing, catch or processed products. Fisheries scientists often think of fishing capacity in terms of fishing effort, and the resultant rate of fishing mortality (the proportion of the fish stock killed through fishing). Fisheries managers generally have a similar view of fishing capacity, but often link the concept directly with the number of vessels operating in the fishery. Many managers express fishing capacity in measures such as gross tonnage or as total effort (e.g. standard fishing days available). Most of these ideas reflect an understanding of capacity primarily in terms of inputs (an input perspective). In contrast, economists tend to consider capacity as the potential catch that could be produced if the boat were to be operating at maximum profit or benefit (an output perspective). To reflect these different views of fishing capacity, an FAO technical consultation developed a definition of fishing capacity that is both input (e.g. effort, boat numbers, etc.) and output (catch) based:

> ***Fishing capacity is the amount of fish (or fishing effort) that can be produced over a period of time (e.g. a year or a fishing season) by a vessel or a fleet if fully utilized and for a given resource condition.*** **(FAO 2004)**

The difficulties of measuring fishing capacity should not be under-estimated. In a review of global longline fishing capacity, Miyake (2004) states it is "very hard to define and furthermore, almost impossible to quantify at present".

Because the present survey is an initial attempt to estimate a fairly elusive subject in the WCPFC area, a relatively simple input measure of capacity is used: the number of vessels in the various fleets. More specifically, capacity is defined as the number of vessels having at least some participation in tuna longline or tuna pole-and-line fishing in the WCPFC area in the year 2005. Section 8.5 of this report deals with the considerations associated with going beyond fleet sizes to obtain more precise output-oriented estimate of fishing capacity.

1.3 Similar Work on Purse Seine Fishing Capacity

In 2003, The NOAA Fisheries Service Pacific Island Regional Office contracted for a similar study on purse seine fishing capacity in the WCPO. The major results of the study were reported in Gillett and Lewis (2003) and can be summarized as:

- The basic method used in calculating the carrying capacity of the various fleets operating in the WCPFC area consisted of transforming the FFA regional vessel registers[1] into purse

[1] Prior to September, 2005 the FFA compiled two registers: the Regional Register and the FFA VMS register. These were combined in 2005 to form the FFA Vessel Register.

seiner capacity inventories by eliminating non-seiners, correcting obvious mistakes, estimating missing information, and cross-checking with as many sources as possible.

- The total carrying capacity of purse seine vessels participating in the fishery during 1988, 1995, and 2003 was about 140,000, 200,000, and 233,000 cubic meters, respectively. This represents an increase of about 43% during the 1988-1995 period, an increase of about 16% during the 1995-2003 period, and an increase of about 67% during the entire 1988 to 2003 period.
- The numbers of purse seine vessels participating in the fishery in 1988, 1995, and 2003 were 136, 175, and 191, respectively.
- The most important reservation concerning the estimate of carrying capacity is that the calculation relies heavily on unverified information in the Regional Register. Although it was possible to cross check vessel numbers for the three years with Secretariat of the Pacific Community (SPC) data, there was much less opportunity for verification of the data on carrying capacity.
- For both improving the estimate of carrying capacity and for developing any alternative proxy to carrying capacity, the key is to upgrade the accuracy of the data in the Regional Register. Independent verification of vessel-supplied information is essential.

2.0 Scope of the Study

For practical and logistical reasons, this current was limited with respect to vessel size, time period, and geographic area.

Only longline and pole-and-line vessels 14 meters (45.9 feet) or greater are included. This must qualified by:

- The case of Indonesia where, due to the availability of information at the national level, only vessels greater than 30 gross registered tonnes (GRT)[2] are considered in the present survey. According to data from Indonesian fisheries officials the relationship between GRT, as measured in Indonesia, and length is variable but 14 meters often corresponds to a vessel of about 24 GRT (D. Retnowati, personal communication).
- The *bonitier* vessels of French Polynesia (about 45 vessels) have sometimes been categorized in reports as being pole-and-line vessels, but are not considered so in this survey because (a) the fishing technique (trolling pearl shell lures from poles) is much closer to trolling than pole-and-line fishing which characteristically uses live bait, and (b) *bonitier* vessels are typically 10 to 12 meters in length, considerably below the minimum limit for inclusion in this study.

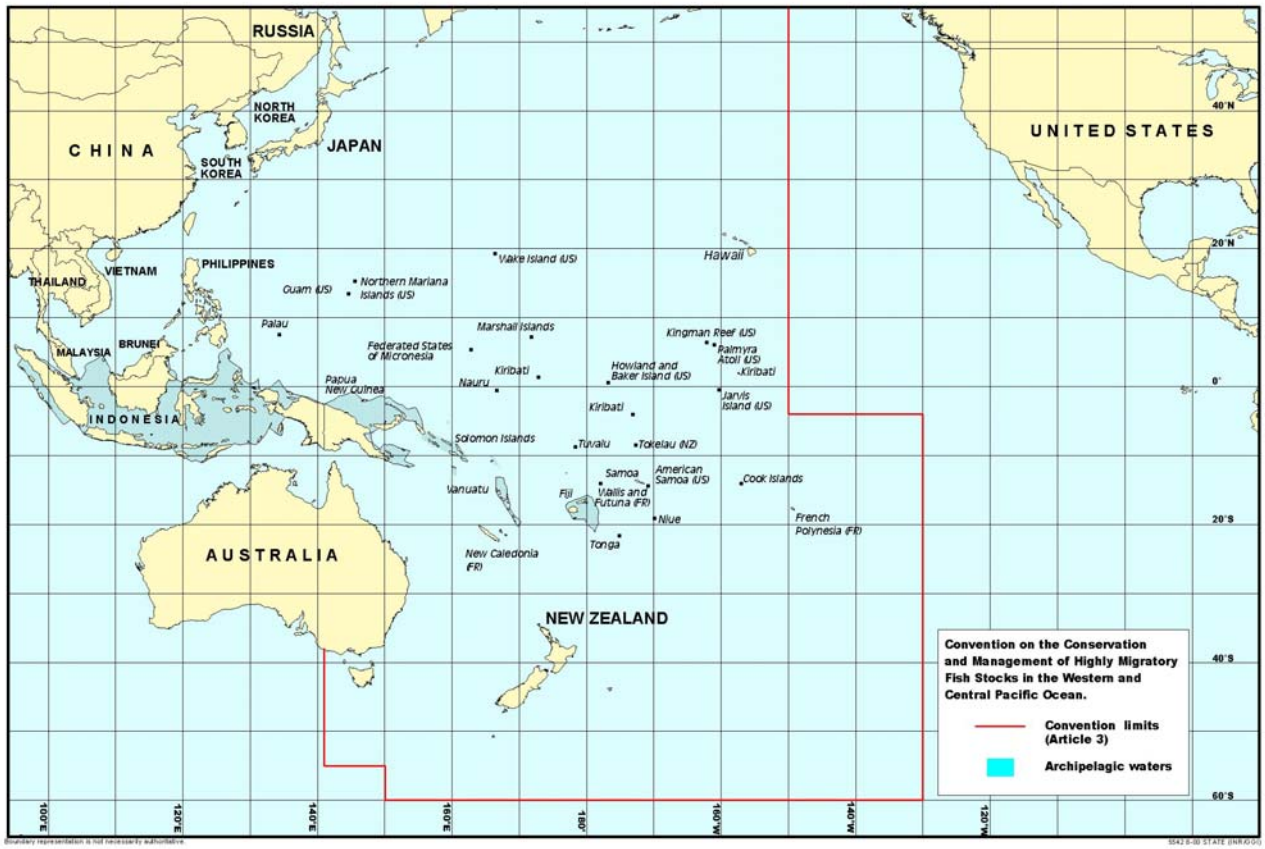
The present survey considers only those vessels that carried out at least some fishing in calendar year 2005. Some difficulty is created by the fact that calendar year 2005, spans two different one-year periods of the FFA Regional Register (September 1 to August 31), one of the principal sources of information for the survey. In addition, many national governments have annual licensing periods that are not based on the calendar year.

In the terms of reference associated with this study, the geographic scope is specified to be both the “WCPFC area” and the WCPO”. The complication of using the “WCPFC area” is that there is no western boundary. The problem with using the “Western and Central Pacific Ocean” is that the eastern boundary results in the exclusion of much of French Polynesia and important tuna fishing grounds to the north, while the western boundary includes some southeast Asian areas that are

[2] In Indonesia the central licensing system covers only those vessels fishing vessels above 30 GRT or having engines greater than 90 HP. The original data from Indonesia included 10 pole-and-line vessels below 30 GRT but with engines greater than 90 HP. Those 10 vessels were eliminated and are not considered in this study.

more closely related to Indian Ocean tuna fishing. In view of the geo-political make-up of the two established areas and various study requirements, it is considered appropriate that the area of the present study is the WCFPC area (Figure 2) with the provision that in Asia the study area includes only Vietnam, Philippines, China, Taiwan[3], Japan, Korea, and the northeast portion of Indonesia. Northeast Indonesia is defined as the three Indonesian fisheries management areas of Banda Sea, Seram Sea/Halmahera Sea/Tomini Bay; and Sulawesi/Pacific.

Figure 2: The WCPFC Area



3.0 Sources of Information

3.1 Sources for the Vessel Databases

Various sources of information were used for the fleet overviews and for development of the longline and pole-and-line vessel databases. The general fleet information and sources of information are given in Section 4 below. The main sources of data for the vessel database (*and the associated limitations*) are:

> The FFA Regional Register of Foreign Fishing Vessels. The Regional Register is a listing of vessels in "good standing" with the FFA member countries. Important characteristics are that the register period is from September 1 to August 31, the registration fee per vessel is

[3] Although Taiwan is often referred to in the context of Regional Fishery Management Organizations as "Chinese Taipei", the more familiar label of Taiwan is used in this report.

US$2253,[4] and approximately 1200 vessels were on the register in mid-2006. The present study used two modifications of the Regional Register. *The limitation of the Regional Register is that it does not identify vessels that actually fished in the WCPFC in 2005, but rather foreign fishing vessels that were eligible to fish in FFA member country waters. It therefore does not include vessels registered in an FFA member country that fish only domestically, vessels operating in countries that are not FFA members, and vessels that fish exclusively on the high seas. The previous purse seine capacity study (Gillett and Lewis, 2003) indicated that for fishing capacity purposes, the register required accuracy upgrading and independent verification of vessel-supplied information.*

Lists from Pacific Island countries and territories. Pacific Island countries and territories provided various lists of longline and pole-and-line vessels to the present study. These included (a) domestic and/or foreign vessels which were confirmed active in 2005, or failing that, (b) domestic and/or foreign vessels which were licensed in 2005 and therefore were eligible to fish. *The countries for which license information (rather than participation information) was supplied were Fiji, Solomon Islands, FSM, Kiribati, and Tuvalu. In a few cases a vessel could have paid licensing fees for 2005 (often and order of magnitude greater than Regional Register fees) without actually fishing during the year*.

Lists of participation in the fisheries. Australia, New Zealand, USA, Korea, China, Philippines, Belize, Indonesia, and Spain provided lists of longline and pole-and-line vessels that participated in tuna fishing in the WCPFC area in 2005. Similar information was requested from Japan and Taiwan but for reasons given in Section 3.2 below, those countries chose not to provide information. *Some information on these lists conflicted with other data sources, especially SPC logsheet data and port visits. Considerable follow-up correspondence with some countries was required to reconcile inconsistencies. Longline data from one country was disregarded as vessels numbers were much greater than that obtained from several other sources. Some of the lists could include vessels that target species other than those included in the scope of the study, such as shark longliners.*

Port entry information. Information was obtained from several ports in the region known to host tuna transshipment or servicing. This consisted of data from calendar year 2005 for Davao. Philippines (foreign longline vessels visiting the port), Guam (longliner transshipments), Suva and Levuka, Fiji (entry/departure of all fishing vessels), Pago Pago, American Samoa (entry/departure of all longline fishing vessels) and Papeete, French Polynesia (entry/departure of all foreign fishing vessels). *There was some difficulty distinguishing longliners from other fishing vessels in information from some ports. Problems were also experienced with some vessel names: spelling errors and difficulties with Chinese to Latin (English) transliteration. It was also sometimes difficult to determine if certain vessels that were not found on any other source of information were in fact bonafide longline or pole-and-line vessels. Potential errors in spelling or gear type further added further confusion to this problem.*

SPC logsheet information: SPC receives fishing vessel logsheets from a wide variety of sources. The present study received from SPC the names of those longline and pole-and-line fishing vessels that, according to logsheet information, conducted fishing in 2005. *As only vessel names were supplied, it was difficult to cross-check the information for any misspelling or transliteration of vessel names. Some vessels were eventually determined to have a length less than 14 meters.*

At-sea transshipment information: The Organization for the Promotion of Responsible Tuna Fisheries (OPRT) in Japan supplied a listing of OPRT-member longline vessels that had

[4] The fee given is for the Vessel Register combined in 2005.

transshipped in the WCPFC area in 2005. The list included vessels from China, Korea, Philippines, Taiwan, and Vanuatu. *No Japanese vessels were included in the listing. Only those vessels greater than 24 meters are affiliated with OPRT and appear on the list.*

RFMO lists: The regional tuna management bodies maintain various lists of tuna vessels, and FAO maintains the High Seas Vessels Authorization Record. The chief value of the RFMO lists was (a) another source of specifications on some vessels, and (b) a possible source of information on vessels identified from the monitoring of ports, for which no other information was available. *Because these lists contain vessels which were authorized to fish, rather than actually fishing, they were mostly consulted during the study to obtain characteristics on vessels identified by other sources as having fished in the WCPFC area.*

WCPFC meeting information: Many of the country papers presented at the Second Regular Session of the WCPFC Scientific Committee (7 - 18 August 2006, Manila, Philippines) contained summary information on national tuna fleets. *The vessel numbers in many of the papers were different from that of the databases supplied to the study directly from countries.*

WCPFC record of vessels[5]: This information contains all vessels that are authorized by the various member states to fish in the convention area beyond areas of national jurisdiction. The Commission gave the present study full access to the various databases. *The study's assessment of the utility of these records is similar to that contained in the report of the Second Session of the WCPFC Technical and Compliance Committee (28 September-3 October 2006, Brisbane, Australia): "The Committee noted that there were a large number of vessels on the Record that had been authorised to fish on the high seas but that many of these vessels operated in other oceans and did not engage in fishing activities in the WCPO. Without knowledge of vessels that were active in the Convention Area it is difficult to use the Record as a benchmark of capacity in WCPO". The present study used the list primarily for confirming vessel data obtained from other sources and for estimating relationships between tonnage to length in some instances where no length data were available.*

Prior studies: For Vietnam, information on the longline fleet is from a report by one of the investigators of the present study (Lewis 2005). *The report appears to be the only credible source of information on tuna vessels in Vietnam and therefore cannot be cross-checked against other sources. It also lacks data on specific vessels.*

The FAO High Seas Vessels Authorization Record (HSVAR) and Commission for the Conservation of Southern Bluefin Tuna authorized list were not extremely useful as they contained vessels which had been authorized to fish, rather than actually fishing.

3.2 Lack of Vessel Data from Two Countries

In general, all countries in the WCPFC region cooperated with the study and provided detailed vessel information to the extent possible. The exceptions to this were the Governments of Japan and Taiwan. The lack of detailed information from these countries is without doubt the study's greatest constraint to obtaining a more accurate assessment of fishing capacity in the region.

As was done for other key countries with large fleets operating in the WCPFC area, NOAA Fisheries Service directly sought the cooperation of the relevant government agencies in Japan and Taiwan prior to the data collection phase.

[5] This is actually a collection of many national lists that had not been complied into one list during the study period.

Japanese authorities declined to provide information on the activities of individual vessels, and explained their position on the matter to one of the authors at a meeting in Tokyo in mid-August, 2006. At that and a subsequent meeting, senior officials of the Japan Fisheries Agency's International Affairs Division confirmed that:

- Data such as were being requested is considered an important commodity by Japan and were not available for release to researchers undertaking this study.
- Japan is willing to provide such data, but is not willing to provide the information unilaterally to a study commissioned by the U.S.
- Japan considers the data on fishing vessel activity as very important, and if provided should be done on a multi-lateral basis subject to specific conditions and in a manner agreed.
- Japan considered that work in the capacity field requires "a clear standard and a workable program for obtaining information on missing areas".

Taiwanese authorities also declined to provide information on the activities of individual vessels, citing confidentiality and along with other concerns. Officials of the Taiwan Fisheries Agency in Taipei explained at a meeting with one of the authors in early September, 2006 that:

- Taiwan has been working diligently on improving their standing as a responsible fishing nation, including obtaining more data on longline activity and
- Taiwan is currently tackling the problems posed by the operation of the large number of smaller (under 100 gross ton) longliners whose activities are overseen by government at the county or city level rather than by the national fisheries administration in Taiwan.

The Taiwanese officials described the domestic situation surrounding the operation of these smaller vessels, as well as larger vessels, as "delicate" and stated that regretfully, no information could be provided to this study which might identify individual vessels.

Although the study was not given access to detailed vessel data from Japan and Taiwan, summary information for 2005 appeared in the papers prepared by those countries for the Second Regular Session of the WCPFC Scientific Committee. For Taiwan, information relevant to the WCPFC area was also available from recent submissions to the International Commission for the Conservation of Atlantic Tunas (ICCAT).

3.3 Site Visits

To "ground truth" data from a variety of sources, considerable travel was undertaken in order to collect information on national and licensed foreign fleets. Trips were made to Honolulu, Pohnpei, Palau, Manila, Taipei, Kaohsiung, Tokyo, Seoul, Shanghai, Noumea, Suva[6], Tongatapu, Honiara, Jakarta, Denpassar, and to the biennial INFOFISH Tuna Trade Conference held in Bangkok.

Individuals were subcontracted to obtain extra information in Indonesia, Marshall Islands, Philippines, Tuvalu, and French Polynesia. The collection of data from Guam and American Samoa was facilitated by cooperation of government agencies in those locations.

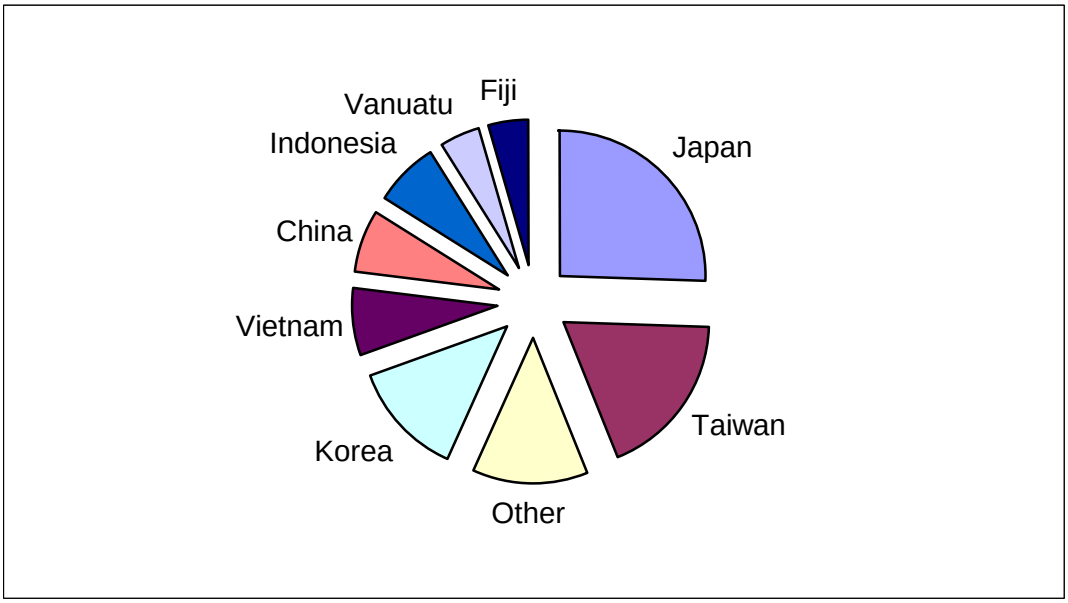
One of the investigators of the present study travelled to Vietnam in 2005 to study tuna fisheries of that country. The report of that trip (Lewis 2005) is perhaps the only available synopsis of Vietnam tuna fisheries.

[6] Residence of one of the study investigators.

4.0 Overview of the Major Longline and Pole-and-Line Fleets

According to data collected during this study, the longline and pole-and-line vessels of at least 29 nations were active in the WCPFC area in 2005. The various national longline fleets employ different types of vessels, operational strategies, and fishing areas. Consequently, their contribution to the total longline catch varies considerably. Figure 3 partitions the 2005 tuna catch by longline gear in the WCPFC area identified by nationality of vessel.

Figure 3: The 2005 Longline Catch[7]



Sources: P.Williams (SPC) and Lewis (2005)

Pole-and-line vessels from seven nations were active in the WCPFC area in 2005**.** A partitioning of catches for the pole-and-line fleets similar to that in Figure 3 above is not possible due to the lack of catch data for the two major fleets. It is clear, however, that over 99% of the pole-and-line catch in the WCPF area comes from Japanese and Indonesian vessels.

In the sections below, important features of the major longline and pole-and-line fleets are presented. As detailed vessel-specific information is available for most national fleets in the WCPFC area in the study's database, proportionally more attention in the following sections is on the fleets of Japan and Taiwan in areas where vessel-specific information available to the study is poor or non-existent. The fleets of Indonesia and Vietnam are also given significant coverage below due to conflicting information and a lack of documentation, respectively. The emphasis in the following sections is on fleet dynamics and vessel characteristics; fleet sizes are covered in Section 6.2.

[7] Shown are the countries whose longline fleets (all sizes of vessels) captured more then 10,000 mt of albacore, bigeye, yellowfin and skipjack in 2005. Information is courtesy of SPC, except for Vietnam where the amount is estimated from Lewis (2005). The Vietnam data is not an official government estimate, and the species composition is only given as "tuna". The amount for Indonesia is carried over from the 2004 catch estimate and is based on a larger number of vessels than estimated during the present study.

4.1 Japan Fleets

Longline

Japan began longlining for tuna and billfish using engine-powered vessels in the early 20th century. During the period between the two World Wars, vessels became larger, fishing areas expanded offshore and in high seas areas, overseas bases were established, and innovations such as the line hauler were introduced.

The history of post-World War II tuna and billfish longline fishing in Japan is one of expansion, adaptation, and more recently, contraction. Longline fishing had been the major supplier of fresh sashimi-grade fish in Japan since before the Second World War. Rapid expansion beyond coastal and offshore waters accelerated after 1952 with the lifting of post-war restrictions on fishing grounds available to Japanese vessels. While coastal and offshore vessels continued to land fresh fish in Japan, Japanese distant-water vessels producing mostly cannery-grade frozen tuna for export expanded in the Pacific. Operations reportedly began in the Indian Ocean in 1954 and in the Atlantic Ocean in 1957 (Takase 2004).

In the mid 1960s during a period of falling profitability and the entry of Korea and Taiwan into the cannery-grade tuna longline fishery, the Japanese economy expanded rapidly, along with personal income and there was in increase in the demand for sashimi-quality tuna. Refrigeration technology was developed that enabled sashimi-grade tuna to be retained frozen for long periods at sea using ultra-low temperatures (ULT) and the distant-water fleet adapted their activities to satisfy that market.

By the early 1990s the cumulative effects of adverse economic conditions and declining fish stocks took their toll on both the offshore and distant water fleets. Continued attrition in offshore vessel numbers continued throughout the 1990s, and a government-sponsored 20 percent reduction to the number of large scale distant water longliners occurred in 1999.

Tuna fisheries in Japan are operationally divided into three categories: coastal, offshore and distant water. The Japan fishery authorization system has traditionally operated so as to minimize interaction between these classes on a geographic basis.

Coastal longline vessels are those under 20 tons that use ice or refrigerated seawater to preserve the catch. Vessels of this size were based exclusively in Japan during the 1970s and through the mid 1980s, operating in coastal Japanese waters as well as into the FSM, Palau and some high-seas areas of the western Pacific. Although some vessels are based in or deliver to Guam for air transshipment of fresh sashimi-grade fish to Japan (c.f. McCoy and Ishihara 1999), it is believed the majority are still based in Japan. Albacore are the main target north of 15 deg. N latitude, bigeye are targeted between 30 deg. N and 40 deg. N latitude, and bigeye and yellowfin are the targets to the south of 15 deg. N. Vessels in this category operate within and to the east of the Japan EEZ as well as south to areas of Micronesia and north of Papua New Guinea and east to around 160 degrees E. longitude. Many of these vessels are from Okinawa and the large southern Japanese island of Kyushu. Hull material is fiberglass, and refrigeration is typically refrigerated seawater (RSW) or ice for the smaller vessels. Vessels offloading in Guam typically have RSW systems for preserving the catch in a fresh state. These vessels tend to remain in the western Pacific region for up to 2 years or more, returning to Japan only for periodic major refits and drydocking (McCoy and Ishihara, 1999).

Offshore longliners are described as those between 20 and 120 GRT (Miyake 2004). According to the information contained in the Japan country report to WCPFC SC2 (Matsunaga et al. 2006) these vessels operate outside coastal waters in primarily two general areas: to the east of Japan in sub-tropical waters, and in tropical waters from east of the Philippines to approximately the dateline.

This segment of the fleet utilizes predominantly RSW to preserve the catch, which is landed fresh in Japan or occasionally to offshore bases in the western part of the Pacific such as Guam.

Distant water longline vessels are categorized as those over 120 GRT. Vessels in this category fish globally where authorized (Miyahara personal communication), although there are also other restrictions placed on their operation (Miyake 2004). Information shown in Matsunaga et al. (2006) indicates that the distant water fishery in the WCPFC area operates in the high seas areas and in the 200-mile zones of other countries to the east, south, and southeast of the Hawaiian Islands. Vessels in this class target bigeye and employ ultra-low temperature freezing and storage methods, typically transshipping their catch to refrigerated fish carriers for delivery to the Japan market.

Provisional 2005 data for catches within the WCPFC area provided by Japan to the WCPFC SC2 meeting indicated that coastal vessels caught 8,084 mt of bigeye and 5,445 mt of yellowfin. Catches for offshore vessels were reported with those for distant water vessels; the combined categories caught 22,284 mt of bigeye, and 15,677 mt of yellowfin (Matsunaga, et al. 2006).

Information on the methodology of estimating the size of the longline fleet of Japan in the WCPFC area is given in Appendix 3. The conclusion is that 568 is the best estimate of the number of Japanese longline vessels 14 meters and above in length active in the WCPFC area during 2005.

Pole-and-Line

The pole-and-line fishing method as practiced in Japan relies on supplies of live bait, typically anchovies or similar-sized species that can withstand handling and transportation in bait wells onboard with minimal mortality. Target species are primarily skipjack and albacore, the latter seasonally targeted by larger sizes of vessels.

A pole-and-line fishery in the Japan home islands existed before World War II, and was complimented by bases in the Japanese mandated islands of the Mariana, Caroline and Marshall Islands. After the Second World War, fishing was limited to Japanese coastal waters, but in the mid-1960s the Japan-based skipjack fleet began a rapid expansion. Larger vessels were built and fishing expanded southward of the more traditional fishing grounds near Japan. Live bait for these vessels continued to be procured in Japan and transported to the fishing grounds. The expansion southward continued into the mid-1970s when the number of distant-water vessels fishing outside coastal waters exceeded around 300 vessels. Fishing also expanded to the southeast down the Emperor seamount chain as far as the Northwest Hawaiian Islands (Boggs and Kikkawa 2003). The fleet began to decline in the late 1970s as a result of high fuel prices, the introduction of 200 mile EEZs covering many of their traditional fishing grounds, and the emergence of purse seining as a more cost-effective method of production of cannery-grade skipjack. Stabilization of the large-scale fleet occurred when the use of new refrigeration and handling techniques were adopted, resulting in the production of higher value products for different markets.

During the 1960s fleets of smaller, coastal and offshore vessels were based in Palau, Solomon Islands, Indonesia, Philippines and Papua New Guinea where local bait sources were plentiful (Shomura 1974). These bases declined in importance during the 1970s, and were eventually either closed or taken over by national fleets from other countries. Vessels within these smaller size classes using RSW or ice as a storage method continue to operate, based exclusively in Japan.

A general characteristic of pole-and-line vessels in Japan irrespective of size is the carriage of large volumes of live bait in tanks built integral with the hull. All but the smallest vessels utilize pumps to circulate seawater within the tanks. To minimize bait mortality, larger vessels fishing distant waters, particularly in tropical areas, carry fish feed for the bait and have refrigeration coils to maintain constant seawater temperatures in the tanks that are cooler than ambient temperatures in which fishing is taking place.

A unique feature of pole-and-line vessels is a water spray system to help attract fish to the vessel. The system is affixed to the portions of the bow and stern where fishermen are situated to pole aboard fish using jigs with barbless hooks. Large vessels are often equipped with mechanical poling devices to reduce the number of crew onboard.

Skipjack is the main target for tuna pole-and-line vessels, with albacore sought as a secondary target during summer months east of Japan. Fishing locations and seasons differ by size of vessel. Distant water vessels fish in tropical areas from late in the 4th quarter to early in the 2nd quarter of the calendar year. They then move northward east of Japan to target albacore from June to around October. Offshore vessels target skipjack in sub-tropical areas eastward of the Northern Mariana Islands in the first quarter, moving northward in accordance with fish movements as far north as northern Japan. The smaller offshore and some coastal vessels operate almost year-round in the Okinawa and Ryukuyu areas, primarily on anchored Fish Aggregation Devices, FADs, and near the Izu Islands south of Tokyo (Matsunaga et al. 2006).

Skipjack catches by Japan pole-and-line vessels over 20 GRT in the WCPFC area have averaged about 110,000 mt during the three-year period 2003-2005. All the catches from these vessels, regardless of vessel size, are offloaded in Japan.

Information on the methodology of estimating the size of the pole-and-line fleet of Japan in the WCPFC area is given in Appendix 3. The conclusion is that 215 is the best estimate of the number of Japanese pole-and-line vessels 14 meters and above in length active in the WCPFC area during 2005.

4.2 Taiwan Fleet

Tuna longlining was introduced to Taiwan by the Japanese during the period of Japan's rule of the island that occurred from 1895 to 1945. In 1928-1929 a fishing base was established in Kaohsiung, a port in the southern portion of the island. By 1937 about 200 vessels of a size described as "14-15 gross tons" were based in Kaohsiung and operating up to 1,000 miles from that port (Miyake 2004). After World War II these vessels resumed fishing as a "small scale" tuna fleet that has continued to expand both in numbers and fishing grounds, driven by technological advances in vessels and gear and the introduction of the use of air freight for fresh tuna to Japan.

A "large scale" fleet of vessels capable of staying at sea for extended periods developed during the 1960s, fishing more distant waters as well as being deployed to bases overseas where the target was mainly albacore for canning. During the 1990s a significant number of vessels in this fleet followed the earlier lead of Japanese and Korean longliners in targeting sashimi markets by adopting technology to freeze and maintain their bigeye and yellowfin catch at ultra-low temperatures of around minus 50 degrees Celsius (Lightfoot and Friberg 1998).

The government administration system for fishing vessels in Taiwan and the collection of government statistics relevant to capacity characteristics are based on gross tonnage. Vessels are classified according to a system sometimes referred to in English as the "CT" system. Each vessel is issued a unique number, with the prefix denoting size class and a suffix the number assigned a specific vessel. Vessel statistics are published annually by the Taiwan Fisheries Agency in the Taiwan Fisheries Yearbook. Using data supplied in the 2005 Yearbook, the numbers of all tuna longline vessels in Taiwan, average gross tonnage, average horsepower and hull material distributed across relevant size classes are shown in Table 1[8].

[8] There are also 173 vessels listed as under 10 gross tons (CT1) fishing in coastal areas of Taiwan which are multi-purpose vessels that may employ the longline method from time to time but which are said not to be full-time longline vessels and are believed to be under 14 meters in length.

Table 1: Summary of Taiwan Tuna Longline Vessels by Size Class

Size Class (gross tons)	CT Designation	Number of Vessels	Average Gross Tonnage	Average Horsepower	Hull Material		
					Wood	Steel	FRP
10 to below 20	CT2	196	16	221	124	--	72
20 to below 50	CT3	753	40	406	138	11	604
50 to below 100	CT4	593	74	606	1	2	590
100 to below 200	CT5	17	174	324	--	16	1
200 to below 500	CT6	341	388	925	--	340	1
500 to below 1,000	CT7	247	686	1,319	--	247	--
1,000 tons and over	CT8	0			--	--	--
TOTAL		**2,147**			**263**	**616**	**1268**

Source: 2005 Taiwan Fisheries Yearbook

It is interesting that the Taiwan Fisheries Yearbook specifies tuna longline as a vessel category in its enumeration. In response to a query about these figures possibly including shark targeting longliners as well as those targeting tuna, officials of the Taiwan Fisheries Agency indicated that Taiwan vessels are authorized to fish as "longliners", without reference to these target species (Lin, personal communication)[9].

There are essentially three categories of Taiwanese tuna longline vessels that operate in the WCPFC area:

- Coastal: small, usually wooden or FRP-hulled vessels that fish within or close to the Taiwan EEZ and deliver exclusively to ports in Taiwan
- Offshore: small to medium size FRP longliners that target the fresh sashimi markets and typically deliver to either Taiwan or ports in the WCPFC area such as Bitung, Davao, Guam, Palau, and Suva.
- Distant water: larger, steel-hulled vessels that stay at sea for extended periods and have the ability to fish a wide area of the WCPFC area while producing either frozen albacore for canning or frozen bigeye and yellowfin for sashimi markets. The vessels targeting albacore deliver to ports with processing facilities, while those targeting bigeye typically transship at sea[10].

A unique feature of coastal and many of the offshore vessels is the ability to carry some live bait (usually milkfish procured from fish farms in certain ports). Offshore vessels also have significant freezer hold space to store the bycatch of billfish, wahoo, most species of sharks and other species with a significant enough market value to justify retention.

For comparative purposes, Table 2 provides some general characteristics of vessels in the three categories.

[9] A separate category in the Taiwan Fisheries Yearbook enumerates vessels under a separate category of "Misc. Fish Long Line" which could refer to longline fisheries other than tuna, e.g. demersal snapper, or black cod.

[10] Some vessels have dual capabilities and switch targets depending on market conditions and other factors.

Table 2: General Characteristics of Three Categories of Taiwan Longliners

	COASTAL	OFFSHORE	DISTANT WATER
CT Designations	CT1, CT2	CT3, CT4,	CT5, CT6, CT7
Hull material	Wood or FRP	Predominantly FRP	Steel
Longline Mainline Material	Monofilament	Monofilament	Monofilament or tarred nylon
Number of hooks	600-1,000	1,500-2,000	2,500-3,500
Catch Preservation	Ice	RSW (tuna) Frozen (billfish, sharks and other bycatch)	Frozen
Fish Hold Capacity	4-8 tons	RSW: 18-30 mt Frozen: 12-20 mt	250-400 mt
Total Crew	4-6	6-10	20-26
Nationality of Officers	Taiwan	Taiwan	
Nationality of Crew	Taiwan, Mainland China	Mainland China, Indonesia, Fiji, Philippines	Mainland China, Indonesia, Vanuatu, Vietnam

Sources: McCoy and Ishihara (1999), Lightfoot and Friberg (1998) and authors' estimates

Taiwanese longliners are present in all major tuna longline fisheries of the world. In addition to the WCPFC area, the larger vessels are deployed to the Indian and Atlantic Oceans as well as the Eastern Pacific. The main emphasis for large longliners is reported to be in the Indian Ocean (Fisheries Agency Chinese Taipei 2006b).

Large vessels over 24 meters in length that operate in the WCPFC area can be divided by target tuna species into two main groups, with some vessels present in each group:

- those that operate in tropical areas, between 15 deg. N and 15 deg. S latitude targeting bigeye tuna, and
- those that operate in subtropical and temperate waters targeting albacore

The albacore-targeting vessels usually enter into port two times per year for landing of their catch. Transshipment and re-supply can also take place on the high seas for these vessels. Vessels targeting bigeye transship and typically obtain supplies and fuel on the high seas as well (Chinese Taipei 2006).

The smaller under 24 meter length offshore vessels are primarily active in the WCPFC area. Only three such vessels fished in the Atlantic, targeting albacore. In the Eastern Pacific Ocean, eight vessels were present in 2005 targeting shark and marlin on a seasonal basis. From 170 to 190 operated in the Indian Ocean and the vast majority, somewhere between 910-1030 operated in the WCPO (Fisheries Agency Chinese Taipei 2006a).

The under 24 meter vessels operating in the WCPFC area rely on the air freighting to Japan of the sashimi-quality portion of their catch and are based in or deliver to ports in Taiwan, Philippines, Guam, Indonesia, Federated States of Micronesia, Papua New Guinea, Marshall Islands, and Fiji.

Taiwan preliminary estimates of catches (metric tons) by the large tuna longliners in 2005 were reported to the WCPFC in August, 2006 as follows: northern Pacific albacore (4,210 mt), southern Pacific albacore (9,248 mt), bigeye (9,855 mt), yellowfin (6,354 mt), and swordfish (1,009 mt). In the corresponding catches for the small tuna longliners in 2005 the albacore catch was not divided into northern and southern but reported as 2,177 mt in total. Other species included bigeye (5,415 mt), yellowfin (13,816 mt) and swordfish (5,722 mt).

Information on the methodology of estimating the size of the longline fleet of Taiwan in the WCPFC area is given in Appendix 3. The conclusion is that 1,180 is the best estimate of the number of Taiwanese longline vessels 14 meters and above active in the WCPFC area during 2005.

4.3 Korea Fleet

South Korea began experimenting with longline fishing during the mid-1950s in the Indian Ocean (Moon, et al. 2006). During the 1960s a fleet of mid-sized (up to 100 GRT) longline vessels targeting albacore were based in American Samoa to supply the canneries there. The Korean industry was subsequently fairly quick to follow Japan into fishing for sashimi-grade bigeye utilizing ULT freezing systems. Through a combination of buying second-hand vessels in Japan and building new vessels in Korea, a substantial fleet was developed, so that by 1990 all but a few very old vessels were fishing for frozen sashimi (Lightfoot and Friberg 1998).

The total number of Korean longline vessels has been decreasing since the mid-1970s from a high of over 500 mostly albacore-targeting vessels to about 200 vessels targeting bigeye for sashimi markets in 2005. According to Miyake (2004b), Korea began limiting its total licenses during the 1980s.

Unlike the Taiwanese or Japanese, the Korean longline fleet is fairly homogenous. It consists solely of vessels that are classified as distant water with none under 24 meters in length. The dominant sizes range from 300 to 500 GRT, figures that have remained unchanged for the past 10 years (Moon, et al. 2006).

The Korean longline fleet fishes primarily in the Pacific Ocean, but vessels can and do migrate between the Pacific and Indian Ocean, depending on the conditions of each fishing ground. In 2005, effort by the fleet in the WCPFC area was distributed from about 160 deg. E. longitude to around 140 deg. W longitude, between 20 N. latitude and 20 S. latitude (Moon et al. 2006). According to Lightfoot and Friberg (1998) the Korean fleet is less likely to work in extreme latitudes because the prices they receive for catches in those areas are not sufficient to offset the lower catch rates and the higher risks in those areas.

The fleet targets bigeye and yellowfin tuna, with minor catches of albacore. Total annual catches in the WCPFC area have ranged from 33,000 mt to 54,000 mt during the past 5 years. There has been a decrease in bigeye catch from over 20,000 mt in 2001 and 2002 to about 15,000 mt in 2005. The 2005 total catch of the three major tuna species, bigeye, yellowfin and albacore was 32,870 mt (Moon et al. 2005).

Longline catches are typically transshipped on the high seas. Vessels stay at sea for extended periods (up to a year), relying on refrigerated carriers and tankers for fuel and other supplies. Destination of much of the catch is Japan, with export percentages fluctuating from 64 to 82 percent of the total during the past 5 years. The remainder is sent to Korea where it is consumed domestically (Moon et al. 2006).

4.4 Vietnam Fleet

Modern longlining appears to have started in Vietnam only in the early 1990s, with a Japan-sponsored project carried out from 1992-94 in Central Vietnam waters. That project involved extensive survey work, technology transfer and provision of second hand vessels, and was the start of the offshore longline fishery in Vietnam. The State Company ESFICO (East Sea Fisheries Corporation) was initially involved, but several other companies are now operating in the fishery. Most vessels are ex- Japanese, Korean or Taiwanese, but three of the present ESFICO fleet of around 15 vessels were reportedly built in Vietnam to Japanese design in composite (FRP, fiberglass reinforced plastic) material. FRP vessels are now regularly constructed at various

locations in the country. There are now at least 3 companies operating a number of larger vessels (reportedly 6-15 vessels per company, 350 horsepower and up) for offshore tuna longlining, targeting bigeye and yellowfin tuna for export. Smaller wooden vessels continue to operate from ports in south central Vietnam, using handline but increasingly, short longlines in conjunction with line haulers and even line shooters.

Table 3 below summarizes much of the available information on the two longline vessel types which target large tunas in the offshore fishery.

Table 3: Summary of Characteristics of Small and Large Longline Tuna Vessels in Vietnam

	Small vessels	Larger vessels
Ownership	Family/cooperative	Corporate- state and private
Vessel size	15-18m LOA, and smaller 90-150 HP main engine	> 20m LOA 350-600 HP main engine
Number of Vessels	Binh Dinh – 500 vessels; Phu Yen – 500; Khanh Hoa – 300 (500 plus?) Smaller numbers in other provinces Total ~ 1500 – 1800?	Main companies: • Esfico (12 vessels); Dai Doung (15); • VietTan (10); • Ocean Joint Stock (6); • Hai Vuong ? Total ~ 45
Fishing area	Up to 400 km from shore	6^{o} to 20^{0} N; 110^{0} to 120^{0}E
Trip length	5-15 days	30-40 days, but transship every 5 days at sea (carrier vessels)
Hooks	Mostly 300-500, but some 800; smaller vessels still use handline or short longline	1,500 - 2,000
Catch per year	8-10 mt (some larger)	50 – 100 mt; much more from some vessels
Operating ports	Qui Nhon, Tam Quan, Tuy Hoa, NhaTrang, many smaller ports	Nha Trang, Vung Tau, Ho Chi Minh City
Season	Nov to March, some all year	All year
Estimated annual tuna catch	12,000 – 18,000 mt	4,000 mt

Source: Lewis (2005)

Lewis (2005) also estimates the total tuna catch in Vietnam by longline and other gear types:

- Purse seine (650 vessels @ 100t/vessel) 6,500
- Small longline (1500 vessels @ 10 mt/vessel) 15,000
- Large longline (40 vessels @ 100t/vessel) 4,000
- Gillnet (1400 vessels @ 50t/vessel) 7,000
- Other coastal provinces with fewer data, various gears ~ 10,000
- Total ~ 42,500 mt

An important point in the above information is the part-time nature of most of the small longline vessels. Although there are some 1,500 small longline vessels, most of them are not engaged in tuna longlining full time. Duong (2002) reports that the tuna longline fishing season is from November to March.

The total catch for the "small" component of the longline fleet (12,000 to 18,000 mt) is only about twice the 2005 catch of the 52 vessels in the Fiji longline fleet. However, the fishing capacity (expressed as potential production) of the very large number of small Vietnamese vessels is obviously great.

4.5 China Fleet

China is one of the later Asian entrants into the WCPFC area tuna longline fishery. Early activities included the building of one wooden longliner of 24.5 meters in length in 1954-1955 that carried out experimental fishing in the South China Sea. Later, Guangdong Province obtained two larger used

longliners from Japan during the early 1970s for fishing in the South China Sea. A few years later, in 1977-1978 further experimental fishing was conducted in the South China Sea that resulted in catches that were 88 percent yellowfin (JETRO 1995).

The first commercial attempts at tuna fishing outside of China reportedly took place in 1987-1988. In one case, a provincial enterprise formed in Liaoning Province purchased a used, ultra-low temperature longliner from Japan in 1983, but it was not until 1988 that the vessel began overseas operations at Mauritius in the Indian Ocean. That same year, seven trawlers refitted as tuna longliners arrived in WCPFC area waters to fish for tuna in what were described as “trial fishing experiments” (Xu 2002).

The number of Chinese longline vessels fishing in the WCPFC area increased rapidly during the early 1990s peaking at 457 vessels in 1994 with the deployment of vessels to bases in Palau, FSM and Marshall Islands. (Song et al. 2004). Without a long history in tuna longlining, China adapted utilitarian designs used in other fisheries in coastal China to tuna longlining in the WCPFC area.

Two distinct Chinese longline fleets operated in the WCPFC area in 2005: those that are based in the Pacific Islands and those generally larger distant water vessels (over about 40 meters in length) that target bigeye in high seas areas of the eastern portion of the WCPFC area. The larger vessels follow patterns of other Asian longliners by transshipping and re-supplying on the high seas. The major market for the catch is Japan.

The Pacific Islands-based vessels either target bigeye (Palau, Pohnpei, and Majuro) or primarily albacore (Fiji). The main fishing grounds for island-based vessels include FSM, Palau, Marshall Islands, Fiji, and Vanuatu. Catches are landed in those island areas for air shipment to Japan and other markets, except that in Fiji albacore is offloaded for cannery use there.

Most of the older large vessels in the Chinese fleet over 30 meters in length are former Japanese or Taiwanese longliners built in those countries. All vessels under 30 meters and most of those over 30 meters 8 years old or less were built in China. Vessels based in Pacific Island ports north of the equator are of mostly steel or fiberglass reinforced plastic (FRP) construction. Some older vessels have hulls made of ferro-concrete with wooden bulwarks above the water line.

Most of the vessels based in the Pacific Islands utilize monofilament reel systems, including hydraulically operated line setters. Older vessels based in Pacific Islands north of the Equator used ice for catch preservation, while newer vessels and those built in Japan or Taiwan utilized RSW. Most of the vessels based in Fiji but which are not licensed to fish in Fiji are larger vessels of at least 100 gross tons and carry ice but also have refrigeration. They are thus capable of longer trips than the vessels fishing exclusively in Fiji that just carry ice without refrigeration (McCoy and Gillett 2005).

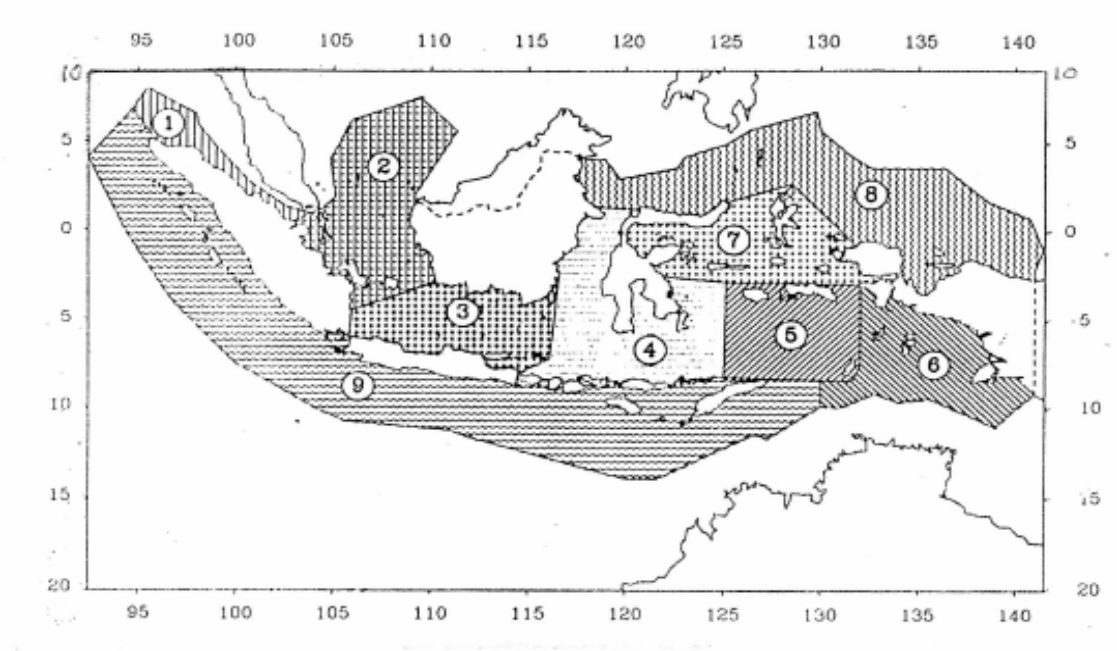
According to SPC, the 2005 catch of tuna (bigeye, yellowfin and albacore) in the WCPFC area in 2005 was estimated to be 18,545 mt (P. Williams, personal communication).

4.6 Indonesia Fleets

Simorangkir (2002) indicates that the Indonesian tuna longline industry began on an industrial scale in 1972 with the establishment of some state-owned pioneer companies. Longline fishing was developed in Benoa (Bali) and Sabang (Aceh) while pole-and-line fishing began in Bitung (North Sulawesi), Sorong (Papua), and Ambon. Development has been rapid and today Indonesia leads the world in producing tuna from home waters.

Indonesia is divided into 9 areas for fisheries management purposes as shown in Figure 4. In this report "northeast Indonesia" is defined as being three of those nine Indonesia fisheries management areas: Area 5 (Banda Sea) and Areas 7 and 8 (Pacific/Sulawesi),

Figure 4: Fisheries Management Areas in Indonesia



The important aspects of tuna fishing vessels operating in northeast Indonesia are:

- Indonesian pole-and-line vessels can be categorized as either small artisanal craft of less than 10 GRT that usually sell fresh product for local consumption, or larger vessels ranging up to 100 GRT that supply domestic canneries and export markets. A typical catch (average) for the latter category is in the neighborhood of 1.3 mt/day although catches of 3 mt per day or more are common during the better seasons. The catch is held in ice slurry in wooden fish holds that are often not insulated (Itano 1993).
- The longliners that operate in NE Indonesia are characteristically 40 to 60 GRT, have a fiberglass hull, and employ the classic "Taiwanese-style" shallow-set longline basket gear, with just 5 hooks per basket (between floats) and 1,200 to 1,500 hooks per set. (M. McCoy and C. Proctor, personal communication). Another observer (Takandengan 2005) reports that long -line fishing vessels in Bitung average 20-25 m in length, although several of them are of 80 m. Gross tonnage (GT) of the vessels were >100 GT (40%) and < 100 GT (60%)[11].

An investigation of the number of longline and pole-and-line vessels operating in northeast Indonesia in 2005 was carried out as part of the present study. In summary, it is concluded that there were 132 pole-and-line vessels greater than 30 GRT[12] operating in that area in 2005. With respect to longliners, there appears to be a large discrepancy between the various sources in the number greater than 30 GT based/fishing in northeast Indonesia. Estimates by industry and consultants range from zero to about 65, but the central licensing system indicates almost one thousand. Based on selective use of available information, it is concluded that it is likely that about 50 longliners operated in northeast Indonesia in 2005.

[11] Although it is inconsistent and confusing, tonnage and length were both used. Because no conversion information is supplied and because the report is one of the few documents available on the subject, it is necessary to use the information in whatever units are supplied.

[12] The Indonesia central licensing system covers only those vessels fishing vessels above 30 GRT or having engines greater than 90 HP. Some ten vessels included are below 30 GRT but have engines greater than 90 HP.

Important ports in NE Indonesia for pole-and-line vessels are Sorong (about 31 pole-line vessels in mid-2006), Bitung (75), Ternate (20 to 30), Bone (20), and Kendari (22). Almost all of the longline vessels in NE Indonesia appear to be based in Bitung.

Gillett (2005) examines tuna catches in Indonesia. Due to a belief in the inaccuracy of Indonesia's official tuna statistics, attempts were made to obtain additional information on tuna production from individuals/agencies familiar with Indonesia's tuna fisheries, including knowledgeable people from government agencies (9 individuals), the tuna fishing/processing industry (7), and other organizations (4). The report states that conclusions (summarized in Table 4 below) should be considered as a contribution to the "educated guesswork" on Indonesia tuna fisheries.

Table 4: Estimates of Indonesia Tuna Catches

	Industrial Tuna Fishing	Small-Scale Tuna Fishing
Indian Ocean area (Area lying within FAO area 57)	Longlining, mainly from the three industrial ports of Muara Baru (North Jakarta), Benoa (South Bali) and Cilacap (south coast Central Java); Best estimate appears to be from Herrera (2002) – about 54,000 mt of principal market species in 2000.	Trolling, small purse seining (especially in the north of Sumatra) and drift gill-netting. Best estimate appears to be from Herrera (2002) – about 50,000 mt of principal market species in 2000
Arch/Pacific area (Area lying within FAO area 71)	Purse seining, and pole/line fishing from vessels greater than 15 GT – about 40% of the 370,000 mt of tuna from this area (given above), or 148,000 mt	Pole/line fishing from vessels less than 15 GT, handlining - about 60% of the 370,000 mt of tuna from this area, or 222,000 mt

Source: Gillett (2005)

4.7 Vanuatu Fleet

Vanuatu has had longline fishing taking place within what became its EEZ since long before independence in 1980. A longline base was operated by a Japanese company at Palekula in the north of the country from 1957 until the late 1980s. The facility stored and transshipped cannery-grade albacore caught by Korean and Taiwanese longliners that were contracted to the base. After its closure, Taiwanese vessels continued to operate within the EEZ for some time under bilateral licensing arrangements.

Vanuatu is unique amongst Pacific Island countries in that it has an international shipping registry that is highly active in the tuna fishing industry[13]. The country became independent in 1980 and a Maritime Act passed soon after independence established an open registry system. Thus many of the Vanuatu-flagged vessels active in the WCPFC area do not operate from Vanuatu[14].

Under the Vanuatu open registry, it is reported that 48 of its large-scale tuna longliners (those over 24 meters) are linked in some manner to Taiwan and may fish in the Pacific and Indian Oceans (Taiwan Fisheries Agency 2006). This number of vessels represents 77% of the total number of Vanuatu-flagged vessels over 24 meters on the study database.

Generally, the Vanuatu fleet consists of large, fairly new longline vessels. Only around a quarter are below 40 meters in length, while almost half are from 40 to 50 meters. Another quarter of the vessels are above 50 meters up to 61 meters in length. Only 14 percent were built before 1995.

[13] The Marshall Islands has a very large international shipping registry, however a relatively small number of fishing vessels are registered and most of those are purse seiners. Federated States of Micronesia also has a form of open registry, but the number of vessels registered are less than 10.

[14] As a result, Vanuatu is a member of or contracting party to IATTC, IOTC, and ICCAT as well as WCPFC.

According to the Vanuatu WCPFC SC2 report, only 11 Vanuatu-flagged vessels were licensed to fish in the Vanuatu EEZ during 2005 (Naviti and Taleo 2006)[15]. Other fishing grounds indicated in the report for the entire fleet included the high seas between Vanuatu and Fiji, and high seas areas to the south of Vanuatu as well as north to the west of Hawaii. Vessels fishing in the Vanuatu-Fiji area likely offloaded in Suva or Levuka, Fiji. Vessels fishing elsewhere may have transshipped on the high seas.

In 2005 the reported unraised and provisional combined catch of bigeye, yellowfin and albacore was 11,833 mt (Naviti and Taleo 2006). Albacore represented 79 percent of the catch, with bigeye 13 percent and yellowfin 8 percent.

Three Vanuatu pole-and-line vessels were on the FFA Regional Register for 2005, with one licensed in Solomon Islands for fishing in 2005. Information on catches of these vessels is not readily available from neither Solomons nor Vanuatu.

4.8 Fiji Fleets

Foreign longliners from Japan were based in Fiji beginning in the mid-1950s, with albacore tuna the main target species. At the time, the catch was shipped to canneries outside Fiji. A local cannery began operating at Levuka in 1976, supplied primarily by Taiwanese and Korean vessels at about the same time the Japanese closed their base to concentrate in the distant-water sashimi-grade fishery. (Chapman 2004)

The first Fiji-based local longline vessel began operating in 1988. By 1990 there were 30 licensed tuna longliners in Fiji. Due to limited infrastructure and other problems, only 8 to 10 actually operated during that year. With steady improvements in local conditions, vessel numbers and catch increased steadily from 1992 to 1995, however not all vessels based in Fiji were domestic flag. This continues to be the case, with a mixture of domestic and foreign flag vessels based in Fiji.

All but one of the vessels in the current fleet were built outside Fiji. About 40 percent were built in Japan (9 with FRP hulls, 13 with steel hulls), and 36 percent were built in China (all steel hulled). The remainder of the vessels are a mixture of FRP and steel, originating from Australia, Taiwan, Korea, and the U.S. Above 24 meters the predominant length classes are 24-30 meters (20 vessels) and 31 to 40 meters (also 20 vessels). There are just three vessels above 40 meters, with the largest 47 meters.

Vessels less than 24 meters in length use ice for catch preservation; as previously noted some also use refrigeration coils in conjunction with ice. For vessels over 24 meters, RSW is used for vessels in the lower end of the range and freezer coils for larger vessels.

According to Fiji's report to WCPFC SC2, the distribution of fishing effort in 2005 for the domestic fleet centered on the Fiji EEZ and to a lesser extent in the neighboring EEZ of Vanuatu and the enclosed high seas between the two EEZs. A total of 28 longline vessels from Fiji were permitted to fish in the Vanuatu EEZ during 2005 (Naviti and Taleo 2006). A small amount of activity took place in adjacent high seas areas to the northwest and south of the Fiji EEZ (Anon. 2006).

The total catch of bigeye, yellowfin and albacore for the domestic Fiji fleet in 2005 was 11,313 mt. The catch was predominantly albacore, 78.7 percent, with just 3.7 percent bigeye and 17.6 percent yellowfin (Anon. 2006). Most of the albacore is sold to the cannery or exported to canneries elsewhere. Sashimi-grade albacore, yellowfin and bigeye are exported to Japan, U.S. and Australia.

[15] An additional 116 longline vessels from six countries were licensed to fish in Vanuatu's EEZ in 2005. Most were Chinese, Taiwanese, Korean and Fijian, many of which were based in Fiji.

As the single pole-and-line vessel operating in 2005 fished only sporadically, it catches were likely to be minimal, certainly less than 200 mt.

4.9 Other Fleets

Longline fleets that caught less than 10,000 mt of albacore, bigeye, yellowfin, and skipjack in 2005 in aggregate represent about 13 percent of the total catch. The more significant fleets in this category (vessels over 14 meters) are very briefly described by nationality in Table 5.

Table 5:
Overview of Significant Longline Fleets Catching Less than 10,000 mt in the WCPFC Area in 2005

State	Fleet Characteristics
USA	Vessels are based in Hawaii, California, and American Samoa and range from 14 to 30 meters in length. Among the three fleets, the Hawaii-based fleet consistently had the highest number of active vessels during 2001-2005 (NOAA 2006). Most catch in Hawaii is landed fresh for sashimi markets; American Samoa vessels predominantly target albacore and sell to the local canneries.
Australia	Domestic longliners are generally 15-25 meters in length, with several larger vessels. Almost all (96 percent) effort was within the eastern Australian Fishing Zone. Ice or RSW is used to preserve catches (Hender and Ward 2006).
French Polynesia	Almost the entire fleet is based in Papeete, and comprises fresh fish longliners 13-20 meters in length, mixed longliners of 21 meters that can either deliver fresh or frozen loins processed onboard, and freezer longliners 24-26 meters (Ponsonnet 2006)
New Zealand	Vessels are mostly 15 to 25 meters, only a few larger. Some of the vessels can switch between troll and longline gear. Total number of vessels has been declining in each of 5 years, 2001-2005 (New Zealand 2006).
Belize	An open registry like Vanuatu. Vessels range from 15 to 59 meters in length. Almost all were built in China, Japan, Taiwan, or Korea.
Cook Islands	Nearly all fishing takes place within the Cook Islands EEZ (Cook Islands 2006). Vessels are 14-34 meters in length, built in a mixture of countries including U.S., New Zealand, Australia, Korea and others.
Papua New Guinea	The fleet, composed of vessels from 14 to 33 meters, is based in Port Moresby. Fishing takes place predominantly in the Coral Sea within the PNG EEZ (Kumoru and Koren 2006). Most vessels were built in Asia, but a few were built in the U.S. and Australia.
Federated States of Micronesia	The fleet, based in Pohnpei and Majuro, Marshall Islands is comprised of vessels from 14 to 29 meters in length. Most are equipped with RSW and were built in Japan, Taiwan, or China.
New Caledonia	The fleet is comprised of vessels from 18 to 29 meters. Albacore is the primary species caught by the fleet in a fishery affected by varying seasonality (New Caledonia 2006).
Samoa	All vessels in the Samoan fleet are less than 22 meters, and target albacore within the Samoa EEZ.
Spain	Spanish vessels in the WCPFC area range from 31 to 50 meters. Most are reportedly able to process and freeze the catch onboard.
Tonga	The fleet consists of vessels from 18 to 40 meters fishing within domestic waters.

5.0 The Databases of Longline and Pole/Line vessels

The longline database construction began with modifying an MS Excel® version of the FFA Regional Register. The 2004/2005 register was combined with those vessels entered on the 2005/2006 register before December 31, 2005 – this was to identify those vessels eligible to fish in calendar year 2005. All vessels except longline vessels were eliminated. Next, all available records from previous register years were obtained in order to have characteristics for some of the vessels not on the register in 2005 that were identified from other sources (e.g. port visits).

The above two datasets were then imported as worksheets in an MS Excel® workbook. Data from other sources were also imported after pre-processing to normalize fields and testing against the complete Regional Register list. Normalizing the data included establishing a consistent vessel naming convention, removal of unnecessary white space, setting dates to YYYYMMDD, converting feet into meters, and other standardizations.

Any non-duplicate vessel over 14 meters was added, provided that the vessel was found in at least one other source. This last provision was to eliminate the possibility of including misspelled vessels and/or vessels that might not be longliners. If a vessel from a non-FFA register source was not identified from another source, it was placed in the “IUU and/or Mis-identification” category (Section 6.2).

Using Visual Basic® scripts, the various sources of data were brought together, compared, and used to create a dynamic worksheet in the workbook. Through an iterative process using automated comparisons and updating together with visual inspections, the inconsistencies, duplications, and data conflicts were flagged for additional scrutiny and modification. Vessels under 14 meters were deleted. Table 6 shows the 42 worksheets of the longline vessel database.

Table 6: The Worksheets in the Longline Database

Source Data Worksheets	Description		Other Worksheets	Description
AU	Australia		INTRO	This worksheet with instructions
BZ	Belize		XA	Update missing GRT/LOA in GP
CK	Cook Islands		RR	FFA Regional Register 2005
CN	China		RRALL	Regional Register complete
ES	Spain		REF1	Update reference
FJ	Fiji Islands		REF2	Append reference
FM	FSM		SUMMARY	Summary Log
KI	Kiribati		LOG	Update detail Log
KR	Korea		CHANGE	Change info
NC	New Caledonia		ANOMALIES	Checks for anomalies
MH	Marshall Islands		INPUT	Pre-process datasets
NU	Niue		SCRATCH	Temporary calculations
NZ	New Zealand			
PG	Papua New Guinea		**GP**	Output – the final result
PF	French Polynesia			
PH	Philippines			
PW	Palau			
SB	Solomon Islands			
TO	Tonga			
TV	Tuvalu			
US	USA			
VU	Vanuatu			
Port Data				
P-AS	Port - Pago Pago			
P-FJ	Port – Suva/Levuka			
P-GU	Port – Guam			
P-PF	Port – Papeete			
P-PH	Port – Davao			
Other				
OP	OPRT transshipments			
SP	SPC logsheet data			

A total of 49 fields are available for each longline vessel (Table 7), but several data sources have fewer fields. For example, information from some countries includes just length, tonnage, and a registration number.

Table 7: Longline Vessel Information in the Excel Workbook

POP ORDER	VSL_SM_AIR_YN
VID	VSL_STORAGE_CAPACITY
NAME	VSL_CHANGE_DETECTED_YN
IRCS	VSL_NOTES
CTY_FLAG_CODE	CREATEDBY_USER_ID
VSL_FLAG_REG_NUM	CREATEDON_DATETIME
VTY_ID	LAST_UPDATEDBY_USER_ID
VSL_HULL_MATERIAL_CODE	LAST_UPDATEDON_DATETIME
VSL_GRT	VSL_CONTACTS_FAX
VSL_LENGTH	VSL_CONTACTS_EMAIL
CTY_BUILT_CODE	VSL_APPROVED_ALC_YN
VSL_SPEED	VSL_INMARSAT_NUMBER
VSL_BUILTIN_YEAR	VSL_RL_LENGTH
VSL_CREW_COUNT	VSL_LP_LENGTH
VSL_ENGINE_POWER	VSL_ENGINE_MODEL
VSL_POWER_UNITS_CODE	VSL_STORAGE_CAP_UNITS_CODE
VSL_FUEL_CAPACITY	VTY_TEXT
VSL_SATELLITE_COMMS_YN	CTY_NAME
VSL_DFM_BRINE_YN	LLV_MAINLINE_MATERIAL_TEXT
VSL_DFM_BLAST_YN	LLV_MAINLINE_LENGTH
VSL_DFM_COILS_YN	LLV_BASKET_COUNT
VSL_DAILY_CAPACITY	LLV_HOOK_COUNT
VSL_SM_ICE_YN	LLV_LINE_SHOOTER_YN
VSL_SM_SEA_YN	SOURCES OF INFORMATION
VSL_SM_BRINE_YN	

In summary, the FFA Regional Register is the basis of the study's longline vessel list. This is essentially for two reasons. The first is that all vessels on the FFA Register were considered real vessels that were fishing (most other sources required confirmation from another source/list). The second reason is that information from the FFA Register (vessel characteristics) is much more complete (more fields) than any other source and, in cases of data inconsistency, it usually is given more credibility than from other sources.

The study's list compiled from the FFA Register is subsequently enhanced by (a) 23 national lists of vessels known to be active and/or licensed in the WCPFC area in 2005, (b) five lists of vessels visiting or transshipping in five important ports in the region[16], (c) a list of vessel names from SPC that, according to logsheet information, conducted fishing in 2005, and (d) a list from the Organization for the Promotion of Responsible Tuna Fisheries of vessels that transshipped tuna in the WCPO in 2005.

The longline workbook does not include any vessel data from Japan or Taiwan. Vessels from those countries are included only if they were on the FFA Regional Register, were licensed in a Pacific Island country, or visited one of the five ports in 2005.

A similar process was followed to create a database for pole-and-line vessels. The sources of data were limited to participation or license lists from Fiji, FSM, Indonesia, Kiribati, Marshall Islands, New Zealand, the Solomon Islands, and the USA. SPC logsheet data was also incorporated. In the pole-and-line database a total of 48 fields are available for each vessel. The information in the fields is similar to that of the longline database, except the specialized longline information (mainline

[16] During interviews with officials and vessel operators in the major Asian fishing nations it was confirmed that their vessels calling at these ports would be considered engaged in fishing in the study area, and hence presence in those ports was considered indicative of fishing activities.

material, line shooter, et cetera) is replaced by auto-poler, bait storage capacity, and bird radar information.

The final results are two worksheets (named GP): one for longline vessels and another for pole-and-line vessels. Each worksheet contains a list of discrete vessels that, by virtue of appearing on one or more of the lists described above, have a high probability of having fished in the WCPFC area during 2005.

6.0 Results

6.1 Summary of the Databases

Table 8 summarizes the information in the longline database. Figure 5 shows the relative sizes of the major longline fleets, with the information for the Japanese and Taiwanese fleet sizes coming largely from summary information presented at the Second Meeting of the Scientific Committee of the WCPFC (SC2) as interpreted by this study[17].

[17] Details of that interpretation and the results are given in Appendix 3.

Table 8: A Summary of the Information on National Longline Fleets

Data Source	Flag State	Total # Vessels ≥ 14 m	# Vessels 14-24 m	# Vessels >24 m	Notes
From Vessel Database	China	184	20	164	
	Korea	162	0	162	
	USA	140	100	40	
	Australia	99	91	8	
	Vanuatu	73	11	62	
	Fr.Polynesia	63	55	8	
	Fiji	55	14	41	
	NZ	43	40	3	Only includes longliners that target YFT ALB, BET or SWO
	Belize	37	9	28	Vessel w/o length allocated to > 24 m on basis of tonnage;
	Cook Is.	31	13	18	Some reflagging to/from other countries; numbers adjusted
	PNG	29	18	11	
	FSM	23	11	12	
	New Caled.	23	17	6	
	Samoa	15	15	0	Some reflagging to/from other countries; numbers adjusted
	Spain	14	0	14	
	Tonga	11	7	4	
	Unknown flag	7	0	7	One vessel without length, but assumed large vessel
	Niue	5	4	1	Some reflagging to/from other countries; numbers adjusted
	Eq.Guinea	1	0	1	
	Honduras	1	1	0	
	Cambodia	1	0	1	
	Panama	1	0	1	
	Philippines	1	0	1	
	Senegal	1	0	1	
	Tuvalu	1	0	1	One vessel without length
	Sub-Total	**1021**	**426**	**595**	
	Japan	*185*	*76*	*109*	Consists of only those vessels that were licensed in a Pacific Island country, made a call to a monitored port, or had logsheets received by SPC
	Taiwan	*421*	*270*	*150*	Consists of only those vessels that were licensed in a Pacific Island country, made a call to a monitored port, had logsheets submitted to SPC, or made an OPRT recorded transshipment. One vessel had no length data.
	Indonesia	*6*	*0*	*6*	Consists of only those vessels that were licensed in a Pacific Island country, made a call to a monitored port, or had logsheets received by SPC
	IUU and/or mis-identification	*42*	*N/A*	*N/A*	Comprised mostly of vessels that appeared only on port lists and nowhere else; Could be IUU vessels, or inadvertent misspelling of names, or vessels other than longliners.
Data Source	**Country**	**Total # Vessels ≥ 14 m**	**# Vessels 14-24 m**	**# Vessels >24 m**	**Notes**
	Japan	568	282	286	The methodology for estimating the number of small longliners is given in Appendix 3.
Other Sources	Taiwan	1180	1030	150	The methodology for estimating the number of small longliners is given in Appendix 3. The estimate of vessels > 24 m taken from study database and should be considered a minimum.
	Indonesia	50	40	10	Estimate from Gillett (2006); Estimate is for the three fisheries management areas in NE Indonesia; Assumed that 80% of the vessels are 14-24 meters.
	Vietnam	1695	(1650)	45	Estimate from Lewis (2005); Size division occurs at 20 m; Estimate for small longliners is mid-point of a large range. (Most small vessels are engaged in tuna fishing part-time)
	Sub-Total	**3493**	**3002**	**491**	

Figure 5: The Major WCPFC area Longline Fleets[18]

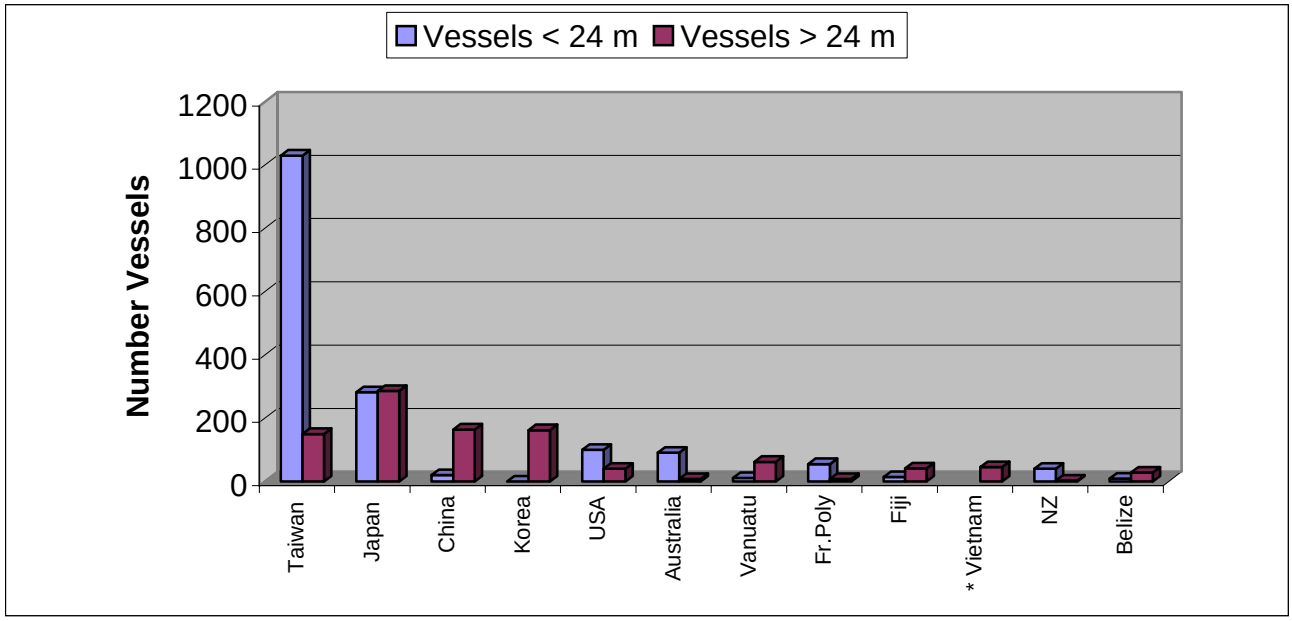


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Table 9 summarizes the information in the pole-and-line database.

Figure 6 shows the relative sizes of these major longline fleets. Due to the varying availability of data, size information in the table is a mixture of length and tonnage. National systems for measuring tonnage vary, and therefore the various national fleet size categories are not strictly comparable.

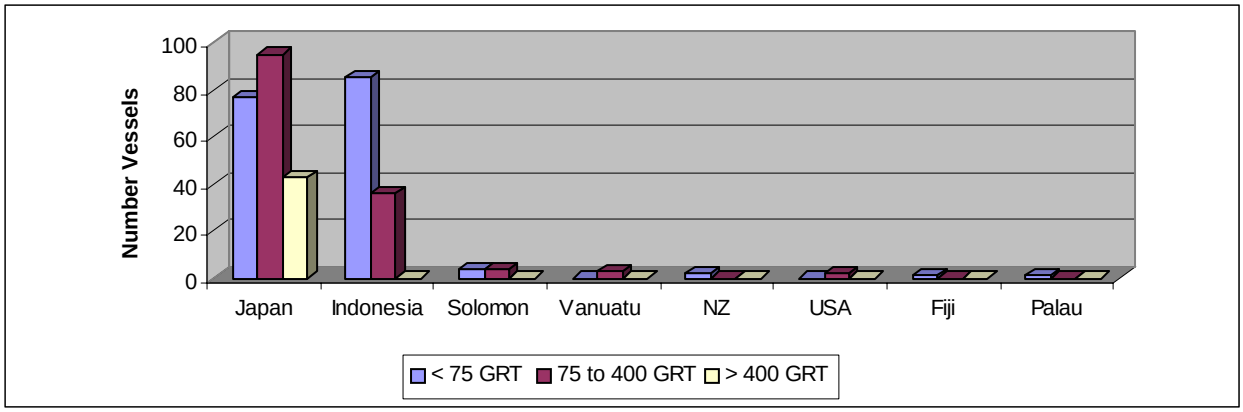
[18] As many/most of the small longliners in Vietnam operate only part-time, only the large Vietnamese longliners are shown here.

Table 9: A Summary of Information on National Pole-and-Line Fleets

Data Source	Flag State	Total # Vessels ≥ 14 m or (for Indonesia) ≥ 30 GRT	# Vessels ≤ 75 GRT	# Vessels 75 to 400 GRT	# Vessels > 400 GRT	Notes
From Vessel Database	Fiji	1	1	0	0	
	Palau	1	1	0	0	
	Indonesia	121	85	36	0	Misses vessels > 14 but less than 30 GRT
	New Zealand	2	2	0	0	
	Solomon	8	4	4	0	
	USA	2	0	2	0	
	Vanuatu	3	0	3	0	
	Sub-Total	138	93	45	0	
	Japan	*39*	*0*	*5*	*34*	Consists of only those vessels that were licensed in a Pacific Island country, made a call to a monitored port, or had logsheets received by SPC

Data Source	Flag State	Total # Vessels ≥ 10 GRT	# Vessels 10 to 50 GRT	# Vessels 50 to 200 GRT	# Vessels > 200 GRT	Notes
Other source	Japan	215	77	95	43	From the Japan report to WCPFC SC2 (Matsunaga et al., 2006).

Figure 6: Pole-and-Line Vessels over 14 Meters



6.2 The "IUU and/or Mis-Identification" Category

The category "IUU and/or mis-identification" on Table 8 requires some additional explanation. Altogether 42 vessels have been placed in this "too hard basket". Most of the vessels in this category entered one of the five monitored ports in the WCPFC area. When subsequently checked, no other information could be found on (a) FFA Regional Register (present and previous years), (b), vessel participation/license lists from Pacific Island countries, (c) national lists of vessels authorized

to fish in the WCPFC area, (d) the SPC list of vessels that had submitted logsheets, or (e) the OPRT WCPO transshipment list. As an example of such a vessel, Box 3 gives the case of the *Orion 101*.

Box 3: The Case of the *Orion 101*

Fiji Fisheries Department documentation indicates that the Korean longline vessel Orion 101 entered Suva harbor on August 19 2005 and discharged 3.5 mt of shark fins. Although not licensed to fish in Fiji waters, the operators of the vessel indicated that the vessel was licensed to fish in Tuvalu and in Kiribati. A check on list of vessels supplied by the flag state to the WCPFC did not reveal the *Orion 101,* nor was the vessel on Kiribati or Tuvalu lists of licensed vessels.

For about half of the 42 vessels it was not possible to do additional clarifying in the short study period. However, some speculation was possible on several vessels:

- For six vessels, when some additional identification information was available (national registration number, IRCS) and checked, this was associated with a vessel that was apparently completely different as in the case described above.
- For nine vessels, when some additional identification was checked, the information was not associated with any vessel.
- Six vessels with Taiwanese registration numbers appeared on a port list with Indonesian names, an indication that they may also be registered in Indonesia.
- Five of the vessels are flagged in countries not normally associated with WCPFC area tuna fishing, including Georgia, Cambodia, and Madagascar.

For these 42 vessels identified from information obtained through port calls, various reasons ranging from innocent to potentially sinister could be advanced for the inability to acquire more information. One possibility is that the vessel names were wrongly recorded by port officials, by either misspelling or problems with transliteration from Chinese (Section 6.3). It is also possible that, because in some ports the only information obtained for each vessel was “fishing vessel”, the vessel in question was not a longline vessel but some other type of vessel (troll, squid, etc.). Other possible explanations are that a vessel could have made a port call while making innocent passage to fishing grounds outside the WCPFC area, or that a name/flag change occurred that would negate available information. Lastly, the vessel could be engaged in fishing in the WCPFC area without the authorization of the flag state.

For the purpose of estimating the number of longliners in the WCPFC area, it is assumed that these 42 do not represent operational longliners. If, however, all of the 42 vessels were indeed longliners fishing in the WCPFC area in 2005, that would represent only about an additional one-tenth of a percent to the total number of longliners.

6.3 Limitations and Gaps of the Databases

In this present attempt to estimate fleet sizes, numerous limitations and gaps in the data must be acknowledged. Many of these limitations that are applicable to a particular source of data are given in Section 3.1 above. Those that are especially troublesome or that apply to more than one source of data deserve further mention.

Vessel Size

All pole-and-line vessels and 97.5% of the longliners in the study database have tonnage information. In theory, tonnage can be a good indicator of fishing capacity (Appendix 2), but there are many practical difficulties involved. A major limitation of the present study was that tonnage information supplied by some sources was expressed in GT, while other sources gave GRT, or did

not specify the units, or gave apparently wrong units. Across the study countries there are several different national systems of tonnage and multiple systems can be used within a single country. Conversion between systems is not straightforward, there is often considerable difficulty in determining which tonnage system is actually being used and/or reported. In some countries there are incentives to mis-report. These have resulted in difficulties of using vessel tonnage in the study. Consequently, the less informative measurement of length has been used in this study for longliners as an indicator of vessel size and as a proxy for fishing capacity.

In addressing longliners in the study, length measurements suffer from numerous difficulties, although not as seriously as tonnage. Turner (1998) states that in Asia alone there are six definitions of the length of a vessel in use. It is believed, however, that some of the more common length measurements: length between perpendiculars, length overall, and registered length, would not be expected to result in the magnitude of variations in measurement that could be found in different tonnage systems

The situation for measurement of pole-and-line vessels is even more difficult. In the study database, less than one-third of these vessels are associated with length, so tonnage is in many cases the *only* indicator of vessel size, and out of necessity must be used.

Vessel measurement can be quite complex, yet the subject is important to understand in the management of tuna fisheries. During the present study it became evident that some significant aspects of vessel measurement are not appreciated by many fisheries managers in the WCPFC area. To provide some insight into vessel measurement, Appendix 2 gives summary information on the topic.

Transliteration of the Chinese Language

Transliteration, the act of using the closest corresponding letters or characters of a different alphabet or language during translation, was recognized early in the study as a potential problem that could affect the identification of vessels in some Asian fleets. It was found that the high degree of standardization in the separate systems for writing Japanese, Korean and Simplified Chinese (for mainland China) characters using the Latin alphabet eliminated or greatly reduced such problems for those fleets. A lack of standardization to represent characters in Taiwanese did, however, pose problems for the construction of the database[19].

The construction of the database was affected by transliteration in several ways. As a result of different name spellings, duplicate vessels appeared with the same unique identifier such as registration number and required further cross-checking to validate. If a particular spelling was chosen from among two to represent the vessel on the database and a third spelling appeared during the research without the identifier, that vessel might be accepted as unique. Repeated cross-checking and validation was required in a number of such cases, some of which were never resolved.

The FFA Regional Register

The FFA Regional Register (adjusted for eligibility for fishing in 2005) formed the basis for the both the longline and pole-and-line databases of the study. It was assumed that fishing would be highly likely if a vessel operator went through registration process and paid the required fees. The study's longline database contained 83 vessels (5.1% of the database longliners) that were on the Regional Register but where there was a lack of other information (e.g. SPC logsheet list, country license list)

[19] There are at least three different systems of "Romanization" that could be used in Taiwan: an official system recently adopted by the national government, an alternative system used in some cities, notably Taipei, and an older system still used by some people.

demonstrating actual fishing in 2005. There were 3 pole-and-line vessels (1.7% of the pole-and-line database) in this category. A major unknown for estimating fleet sizes is whether these 86 vessels actually participated in tuna fishing in 2005. For various reasons (expense to be on the Register, little reason for vessels fishing other regions or vessels out of commission to be on the Register) it is assumed that they did, but some uncertainty remains.

Other Limitations and Constraints

There are other limitations and constraints of the study databases that should be acknowledged. These include:

- Reflagging and/or renaming of vessels commonly occurs, and seems to be most prevalent between Taiwan and Indonesia. This was detected in a number of cases where vessels calling at particular ports were identified as Indonesian but retained Taiwanese registration numbers. Although the magnitude of this problem was not detected, it is inevitable that at least some double counting occurred.
- The study was intended to cover all longline and pole-and-line vessels above 14 meters, but for Indonesia only information on vessels larger 30 GRT was available[20]. Consequently what is probably a substantial number of vessels of a size between 14 meters and 30 GRT were not included in the study's database. The official 2004 Indonesia fisheries statistics (the latest available) give an estimate of the total number of various types of vessels in northeast Indonesia. That information together with the 2005 information from the central licensing system (only vessels above 30 GRT) would suggest that the in northeast Indonesia in 2005 there were about 1,000 longliners below 30 GRT and about 3900 pole/line vessels less than 30 GT. There is, however, some possibility that the tuna longliner category includes some tuna handlining, hence the very large number of small-scale longline operations in the statistics.
- The only credible source of information on tuna fleets in Vietnam is Lewis (2005), who reports a huge fleet of small longliners (1500 to 1800 vessels of between 15 to 18 meters LOA). Because most are reported to fish only during a certain season, there is some uncertainty on how to deal with a part-time fleet. The approach in this study is to simply report the available information, noting that this represents both a considerable amount of latent capacity and a large range in vessel numbers.
- Agency fatigue produced gaps in the data. Although excellent cooperation was received from almost all countries with fleets in the WCPFC, some countries had problems extracting particular types of data (e.g. vessel participation rather than licensing) or responding to multiple requests to re-check possible errors/omissions.
- At least some illegal activity is occurring in the longline fisheries, some of which could affect estimates of fleet sizes. Allegations of this sort include several vessels sharing of a single license, vessels being used to ferry ashore longline fish from the Atlantic, and stateless vessels.
- Although high credibility was usually given to non-verified country-supplied data, this may not always be justified. There may be reasons to over-report, or the data may simply be inaccurate.

6.4 Estimate of WCPFC Area Fleet Sizes

Tables 8 and 9 give estimates of the sizes of the various longline and pole-and-line fleets that operated in the WCPFC area in 2005. The two sections above summarize the major reasons why the actual number of vessels may depart from what is considered the most reasonable estimate.

[20] In Indonesia, a fishing vessel of 14 meters often corresponds to about 24 GRT

Taking the national longline fleets for which the study's database has good coverage (25 countries at the top of Table 8; 1021 vessels) and adding to it the estimates from other sources for the vessels of Japan, Taiwan, Indonesia, and Vietnam (3493 vessels) results in the study's best estimate of the number of longliners above 14 meters: 4514 vessels.

Taking the national pole-and-line fleets for which the study's database has good coverage (7 countries at the top of Table 9; 138 vessels) and adding to it the estimates from other sources for the vessels of Japan (215 vessels) results in the study's best estimate of the number of pole-and-line above 14 meters: 353 vessels.

There are a number of reasons why these estimates could be either too low or too high. The various uncertainties are noted in the two sections above. The most likely factors that would result in the numbers of vessels actually fishing being greater than the study's estimate vessels involve:

(a) the 42 vessels in the "IUU and/or Mis-Identification" category (for longliners),
(b) vessels in the Indonesia "14 m to 30 GRT" category, and
(c) undetected vessels fishing on the high seas and transshipping to vessels that were included on the database.

The most likely factors that would result in the numbers of vessels actually fishing being less than the study's estimate vessels involve: (1) duplicate entry of re-flagged and/or re-named vessels, (2) vessels that were on the FFA Regional Register but did not fish, and (3) incentives for countries to over-report. The large range in numbers of longliners for Vietnam (1500 to 1800 vessels) could cause either an over- or under-estimate depending on the actual situation.

The probabilities and likely magnitudes of the above factors are unknown. Consequently, it is not possible to establish ranges or confidence limits around the estimates.

Williams and Reid (2006) make estimates of longliners in the WCPFC area. The report indicates that in 2005 slightly more than 5,000 vessels operated. This number is not strictly comparable to the present study's estimate because in the Williams/Reid study, Vietnamese longliners were not considered, longliners of all sizes were included (not only those over 14 m), and estimates for some fleets may have included vessels that did not fish in the WCPFC area in 2005.

The scope of the present study is limited to longline and pole-and-line vessels 14 meters (45.9 feet) or grater. Although there is no requirement to cover smaller vessels, some comments may be useful to place the number of small vessels in perspective. With respect to non-Asian vessels, it is likely that less than 35 longliners and 5 pole-and-line vessels operated in the WCPFC area in 2005. For the Asian vessels, the situation is more complicated. Section 6.3 of this report suggests that in northeast Indonesia in 2005 there were about 1,000 longliners below 30 GRT and about 3,900 pole-and-line vessels under 30 GT, but several caveats are associated with that estimate. For the other Asian vessels, a crude estimate of the number under 14 meters operating in the WCPFC area in 2005 is 600 longline vessels and 200 pole-and-line vessels.

7.0 Improving the Estimates of Fleet Sizes

Improving the estimates of longline and pole-and-line fleet sizes in the WCPFC area can be approached for the short-term and for the long term. In the near future vessel enumeration could be improved in a number of ways, including (in descending order of priority):

- Obtaining the cooperation of Japan and Taiwan.

- Supplementing the WCPFC reporting requirements. This would involve inclusion of "vessels fishing for highly migratory fish stocks in the Convention Area" in addition to supplying lists of "vessels authorized for fishing for highly migratory fish stocks in the Convention Area beyond areas of national jurisdiction".
- Gaining a greater understanding of the dynamics of the fleet of small Taiwanese longliners, including obtaining industry estimates, development of procedure to reduce transliteration and re-flagging difficulties, and better insight into the movement of vessels in/out of Indonesia.
- Better information on the Vietnam tuna fleet, especially the seasonal longline vessels.
- Resolving the difference between official Indonesia data on longline fleet size and unofficial estimates by industry and foreign specialists.
- Obtaining estimates of the number of Indonesian longline and pole-and-line vessel larger than 14 m but smaller than 30 GRT.
- Acquiring enough information on the various national systems of vessel measurement so that fleets can be partitioned at a minimum size (e.g. 14 meters).
- Improving the FFA Regional Register: elimination of obvious errors (e.g. longliner of 82 meters), cross checking with other information (e.g. lists of authorized vessels authorized to fish in WCPFC area), and requiring international tonnage certificates for verification.

For the longer-term, the ability to track fleet sizes in the WCPFC area will be strongly influenced by the requirements for the use of a vessel monitoring system (VMS) and logsheet reporting requirements. The present plans for the WCPFC VMS are that the Commission will receive vessel-specific data from those boats fishing in the high seas or in other countries' zone, either directly from the vessel or via FFA in Honiara. When operating as envisaged, the Commission's VMS system should result in a remarkable improvement in the ability to determine the number of vessels fishing externally of waters under flag state jurisdiction. The enumeration of domestic vessels that fish only in domestic waters, however, will not be affected.

New reporting requirements will also affect the ability to determine fleet sizes. The first meeting of the WCPFC Scientific Meeting (WCPFC 2005) made a recommendation (SC1–ST–1) to the subsequent Regular Commission Meeting for mandatory reporting of vessel numbers:

> The number of vessels active in the WCPFC Statistical Area during each calendar year shall be provided to the Commission for each gear type. For longliners, pole-and-line vessels and purse seiners, the number of vessels active shall be provided by gross registered tonnage (GRT) class. The GRT classes are defined as follows: (a) Longline: 0–50, 51–200, 201–500, 500+; (b) Pole-and-line: 0–50, 51–150, 150+; and (c) Purse seine: 0–500, 501–1000, 1001–1500, 1500+.

According to the WCPFC Executive Director, the report of the first meeting of the WCPFC Scientific Meeting was tabled and adopted, complete with all recommendations (including this recommendation on reporting vessel numbers) at the second regular session of the Commission in December 2005. The full implementation of vessel number reporting is, however, expected take a considerable amount of time. (A. Wright, personal communication).

8.0 Fishing Capacity Considerations

8.1 Concepts of Longline and Pole-and-line Fishing Capacity

Miyake (2004) presents a review of longline fleet capacity in the world. He states that estimation of fleet size is the first step in estimating fishing capacity of the fleet, and the paper is largely oriented towards determining numbers of various groups of longliners. In following this approach, the above

sections of the present report deal with estimation of the numbers in the national longline and pole-and-line fleets operating in the WCPFC area. This section deals with the considerations associated with going beyond fleet sizes to obtain an output-oriented estimate of fishing capacity; in other words making the jump from vessel numbers to potential catch. This is something that represents a considerable progression in computational complexity and data requirements.

All longline and pole-and-line vessels are not created equal. Some types of vessels are able to catch more fish because they can remain on the fishing grounds longer, set more hooks each day (for longline vessels), carry more bait (for pole-and-line vessels), store more catch, and a myriad of other reasons – some of which are intangible like the skill of captain/crew or efficiency of vessel management. None of these factors by itself entirely determines the potential catch, but some are better indicators than others. An ideal proxy for fishing capacity would be a vessel feature that has several characteristics, including those strongly related to potential catch, applicable across vessels sizes and nationalities, and be readily available and verifiable, but not easily altered so as to complicate monitoring.

Much has been written about measuring fishing capacity in general. Greboval (1999) states that there is still no generally agreed and standardized definition of how capacity should be quantified and measured, particularly for world-wide comparison. Kirkley and Squires (1999) in their discussion of fishing capacity state that the mostly widely used proxy variable is vessel size, which can be measured in length, tonnage, or engine power, but point out that they are all limited measures of fishing power. Turner (1998) indicates that gross tonnage is likely to be most important single variable influencing fishing capacity and states: “The measurement of gross tonnage is in many respects a good compromise between having no measure and a perfect one.”

8.2 Longline Vessels

With respect to longline vessels, the present study deals with vessels from 25 countries ranging in length from 14 to 75 meters. There are a wide variety of opinions on indicators of fishing capacity of these vessels. In discussions of longline fishing capacity with many fisheries specialists familiar with the longline fishery in the WCPFC area, a general consensus on two topics emerged:

- The number of hooks which can be set per day is likely to be the best indicator of fishing capacity, but as this feature is difficult to monitor and easily changeable. The next best would be vessel attributes (eg. length, tonnage) that affect the ability of a vessel to set hooks. In addition to affecting the number of hooks that can be set, larger vessels can have more autonomy at sea and can fish in rougher weather, both factors that result in more fishing days per year.
- For fishing capacity purposes, longliners above 14 meters can be placed into two categories depending on the type of product produced: (a) Those vessels that produce fresh fish and are required to return to port often (every one to three weeks or so); and (b) those that produce frozen fish and can stay at sea for much longer periods. These two fish storage methods have a strong affect on the need to return to port and hence number of fishing days per year. Another important aspect of these categories is space: a longliner using ice with 40 cu m of fish storage capacity may be able to carry around 13 to 15 mt of fish, while a similar size fish hold with a freezing system could carry almost twice as much fish.

Discussions with longline industry participants indicate a number of problems with some of the other candidates for longline fishing capacity proxies:

- The problems of using tonnage are noted in Section 6.3 of this report. One of the main problems is that gross registered tonnage (GRT) is the tonnage measurement often recorded for small longliners and it can vary considerably between countries.
- Crew numbers can be affected by gear type and national requirements. A longliner using a monofilament mainline system could use half the crew of a vessel using the more traditional

tarred nylon. Crew size can also be dictated by government manning requirements. In some countries (especially developing countries with unemployment problems) regulations can result in many more crew than actually needed.

- Vessel main engine power also has its problems. Some vessels such as the Chinese-built longliners used in Micronesia since the early 1990s that might have been built with specific economic conditions in mind, have engines half the size of similar length vessels from other countries that can set a similar number of hooks. Alternatively, vessels built with trawling in mind and converted to longlining may have engines that are well in excess of industry standards.
- Although overall length could be a good proxy, vessels from some countries (e.g. USA) are sometimes built with relatively wide beams. In recent years the soaring cost of fuel is affecting the length of longline vessels - some longline operators are changing from short/wide to long/narrow vessels which can reduce power requirements. Conversely, in some countries management regulations and/or fees are based on vessel length, creating incentives for short/wide vessels.
- Cubic meters of fish storage capacity is often used as a proxy for fishing capacity in the tuna purse seine fleet, but it is far less appropriate for tuna longliners. Filling all fish holds on a seiner usually completes a fishing trip, but not necessary so for longliners, as they often transship at sea or return to port when the ice supply is exhausted.

The above discussion suggests that a capacity-oriented classification system for longliners should utilize information on both vessel length and on fish storage method. A proposed system is outlined in Table 10.

Table 10: Capacity-Oriented Longline Classification System

	Number Fresh Vessels	Number Freezer Vessels	Total Number Vessels
14 m to 20 m			
> 20 m; ≤ 24 m			
> 24 m; ≤ 44 m			
> 44 m			

Information from such a table, together with catch data on these vessel categories, would enable an output-type estimate (i.e. tonnes per year) of longline fishing capacity in the WCPFC area.

8.3 Pole-and-line Vessels

For pole-and-line vessels, many of the capacity considerations are similar to that for longline vessels mentioned above. All pole-and-line boats included in the scope of this study (Section 2.0) use live bait, and the amount of bait and type of bait has a large effect on fishing capacity.

In relation to fishing capacity, the number of poles utilized during a fishing operation is analogous to the number of hooks used on a longliner – and may be a good indicator of fishing capacity. But it will be hard to monitor and easy to change. As with longliners, the next best would be vessel size – something that greatly influences the number of poles which could be used, as well as the amount of bait which could be carried.

With longlining there is a large distinction between those vessels that produce fresh fish and those that produce a frozen product. For pole-and-line vessels a similar division for does exist but it is over-shadowed by bait type. Bait supplies often have a large influence on total tuna production. Key determinants are how much bait can be taken aboard a vessel and how long the bait lasts. In the

tropics the important bait species are characteristically less plentiful than in the temperate countries, require low-density storage, and suffer relatively high daily mortality. Bait captured in Japan (often carried in temperature controlled and filtered tanks) can be sufficient for weeks of fishing, whereas most pole-and-line boats in the tropics characteristically terminate tuna fishing each day when the bait supplies are exhausted.

The above discussion suggests that a capacity-oriented classification system for pole-and-line vessels should utilize information on both vessel size and region of bait procurement (tropical/temperate). The latter can be identified by vessel registry, with all temperate based boats of the present study being registered in Japan or New Zealand. Such a system is outlined in Table 11.

Table 11: Capacity-Oriented Pole-and-Line Classification System

	Number Vessels Tropic-Based	Number Vessels Temperate Based	Total Number Vessels
14 m to 20 m			
> 20 m; ≤ 24 m			
> 24 m; ≤ 44 m			
> 44 m			

As with the longlining above, information from such a table, together with catch data on these vessel categories, would enable an output-type estimate (i.e. mt per year) of pole-and-line fishing capacity in the WCPFC area.

8.4 Using the Study Databases to Measure Capacity

Despite the ideal capacity-oriented classification systems described above, the reality is that much of the required information is presently not available for incorporation into the study's database. In addition, some of the information that is collected is inconsistent, wrongly recorded, or has problems/confusion with the units.

Of the information on longline vessel characteristics that could conceivably be used for fishing capacity purposes, length is the most commonly included in the study's database – 1629 vessels have length information (99.8% of 1633 vessels on the list). Fewer vessels have tonnage information (1592 vessels, 97.5%), age (1303 vessels, 79.8%), engine power (1298 vessels, 79.5%), crew size (1238 vessels, 79.5%), and catch storage capacity (1103 vessels, 67.5%). Although mainline length could be an indicator of longline fishing capacity, 67 vessels record zero and 1005 vessels (61.5%) record values which range from 3 to 180,000 indicating some confusion over units used. For the basket count, 257 vessels record zero and 809 vessels (49.5%) record values which range from 3 to 4,000. For the hook count, 67 vessels record zero, 1005 vessels (61.5%) have values which range from 25 to 25,000.

In general, vessel characteristic data availability is considerably poorer for those vessels not required to submit information for the FFA regional register and those vessels not required to be on the WCPFC list of authorized vessels. Registration on those lists requires fairly comprehensive data. Vessels that are not on either of the two lists consist mainly of vessels only fishing domestically (e.g. only in PNG or French Polynesia). It should be noted that the fact that such data is not on the study's database, does not necessarily mean that it could not be made available. With more persistence, a longer time-frame for data collection, or collective endorsement of data collection by WCPFC countries, it is likely that more vessel characteristic data could be obtained.

The identification of which longliners produce fresh or frozen fish would seem to be possible by examining the detailed vessel information on the various vessel lists held by regional fisheries agencies. But this is not the case. Four types of "storage methods" are given in the FFA Regional

Register and vessels on the register are required to indicate they use particular storage methods. Out of necessity, the study's database is based on the FFA scheme where vessels are required to state one of four storage methods: "ice", "refrigerated sea water", "brine (NaCl)", or air "(coils)". These translate into storage method types and numbers of vessels on the database as:

- Ice – 231 vessels indicated "Yes"
- Sea – 209 vessels indicated "Yes"
- Brine - 174 vessels indicated "Yes"
- Air – 469 vessels indicated "Yes"

It could be assumed that the first two categories produce fresh fish and the latter two produce frozen fish[21], but there are several complications with respect to the study's database. There is no storage method information for 654 vessels (40% of the vessels in the database), several vessels list multiple methods and consequently the primary method cannot be determined, and some of the information appears wrong (e.g. large Korean vessel using ice for storage). The conclusion is that it is not possible at this point to use the information in the study's database to partition the longliners into fresh vessels and freezer vessels. Similarly, the information presently collected by WCPFC ("freezer type: air (coils), brine, and other") does not lend itself to easy separation of the fleet into fresh and freezer operations. On the positive side, it seems like it would take only a simple modification of the longline information collected by the various agencies for registry purposes to be able to do the partitioning.

Of the information on pole-and-line vessel characteristics that could conceivably be used for fishing capacity purposes, tonnage is the most commonly included in the database - 100% of all vessels on the list have tonnage information, whereas only 50 vessels (28%) have length information, and only 44 vessels (25%) have engine power information. The paucity of pole-and-line vessel information is largely due to the fact that the details made available for Indonesian vessels (121 total, 69% of all pole-and-line vessels on list) are limited to name, flag, and tonnage. The cautions raised over the varying systems of national tonnage (Section 6.3) create problems for using this characteristic for comparing and combining the fishing capacity of the national fleets.

8.5 Considerations for Making an Output Estimate of Fishing Capacity

To make an output-type estimate of longline fishing capacity along the lines of the scheme mentioned above, three types information are required:

(1) The number of vessels by size category. The four size categories suggested in Section 8.2 above each represent about one-quarter of the fleet. The results of the present study provide this information.
(2) A division of all vessels into either fresh or freezer type
(3) Catch information for each size category and fish storage type. Four size categories and two storage types result in a requirement for catch data for eight cells.

Estimating fishing capacity could be done on two levels of rigor. One could be done immediately and would involve using the limited amount of catch data available and individuals with knowledge of the configurations, operations, and limitations of the various national fleets. The other is much longer-term and would require altering the type of data collected/reported by management agencies and subsequently would require a more precise analysis of register and logsheet information.

In the near future, a crude output estimate of fishing capacity could be obtained by using information on vessel numbers/sizes from the present study, in conjunction with catch information from SPC and a small number of individuals with enough knowledge on national longline fleets to make educated guesses on average/maximum annual catches and fish storage methods.

[21] This is the intention according to the former MCS Manager of FFA (A .Richards, personal communication)

SPC's present logsheet coverage of WCPFC area longline fleets is limited[22] and there is uncertainty whether the vessels for which they have data is representative of entire fleets (J.Hampton, SPC, personal communication). Similarly, the WCPFC is not currently in a position to provide processed information on logsheet data that they may be holding. On the other hand, there are many people with intimate knowledge of the longliners of the WCPFC area, including fishery scientists/managers, fishery observers, and masterfishermen. In addition, there is a substantial amount of regional and national longline observer data that countries could conceivably make available and which could give insights into specific topics relevant to vessel productivity.

A dialogue between individuals holding the available data and those with the extensive fleet knowledge would appear sufficient to produce at least a preliminary estimate for catches by vessel size category and catch storage method. Such a meeting could be small (perhaps six to eight people) and short in duration (perhaps two days). The cost would depend on any sponsorship by national/regional agency and location of the meeting, but an indicative figure would be around US$35,000.

In the longer term, through institutional and analytical means a more precise output estimate of longline fishing capacity in the WCPFC area could be obtained. National and regional management agencies would need to collect more refined vessel characteristics (Section 8.4 of this report). Catch reporting to fisheries management agencies would need to be vessel-specific and mechanisms would need to be developed for associating catch data to vessel characteristics. Several years would be required for this process, including that for obtaining country agreement, alteration of data forms, introduction of the forms to the fleet, and accumulation of catch histories. It is not possible to estimate costs involved in instituting such a system at this time. In another sense, such changes in information collection and analysis could be considered as part of their regular programme of work for the involved agencies, rather than as a separate initiative.

The discussed short-term and long-term approaches deal with longline capacity, but they could apply equally to pole-and-line capacity with some provisions. The most important of these concerns Indonesia. As a large portion of the WCPFC area pole-and-line fleet is made up of Indonesian vessels, some additional information or investigation would be required from that area.

A few comments should be made on the approaches described above. The end-product of either of the above would be information for input for a fisheries capacity analysis using such techniques as peak-to-peak or data envelopment analysis (Kirkley and Squires, 1999). The two approaches presented are not mutually exclusive – a "quick/dirty" estimate can be made while preparing for the more methodical longer-term approach.

With respect to the benefits of obtaining estimates of output fishing capacity, some of the reasons for tuna fishing capacity work in general are given by Joseph (2003) and are summarized in Section 1.1 above. With specific reference to the WCPFC area, the general topic of fishing capacity is being vigorously debated, albeit with little reference to optimal or appropriate levels and only for one gear type- purse seining. There was considerable discussion at the Second Regular Session of the WCPFC which resulted in a resolution dealing with capacity (Box 4). Any further moves towards capacity reduction in the tuna fleets of the region are expected to be contentious and, in order to be successful, thorough analysis will be required.

The continual improvements in longline technology, the participation and the adoption of that technology by fleets with production costs lower than those of traditional participants in the fishery are realities that cannot be ignored. They all lend a sense of urgency to undertake actions to

[22] According to WCPFC (2004), SPC's principle gaps in coverage by operational level catch and effort data (logsheet data) include the domestic fisheries of the Philippines and Indonesia, the distant-water longline fleets of Korea and Chinese Taipei, and the longline, pole-and-line and purse-seine fleets of Japan on the high seas.

develop a better understanding of capacity within all active fleets as well as the linking of that capacity to catches in the WCPFC area.

Box 4: Resolution-2005-02 of the WCPFC

Developed Commission Members, Cooperating Non-members and participating Territories (CCMs) whose nationals are beneficial owners of purse seine vessels that entered the WCPFC area after the MHLC and PrepCon resolutions and other concerned CCMs shall work together to ensure that the beneficial owners reduce by 31 December 2007, such overcapacity as created by those fishing vessels through reduction of equivalent fishing capacity of other fishing vessels operating in the Convention Area.

Source: WCFPC website

9.0 Concluding Remarks

The objective of the study was to estimate the number of longline and pole-and-line vessels in the WCPFC area in 2005 and explore the considerations involved in obtaining an output estimate of capacity. The report provided capacity estimates in terms of input (numbers of vessels in size classes), and also devised a concept for making output estimates based on vessel size and catch storage method.

The study's best estimate of the number of longliners above 14 meters is 4,514 vessels, and that for pole-and-line vessels is 353. Various uncertainties are associated with these estimates, the major ones involving the fleets of Japan, Taiwan, Indonesia and Vietnam and undetected vessels fishing on the high seas. Additional uncertainties and difficulties are created by re-flagged and/or re-named vessels. It should also be recognized that for reasons of practicality, the study placed great faith in the accuracy of unverified country-supplied vessel information.

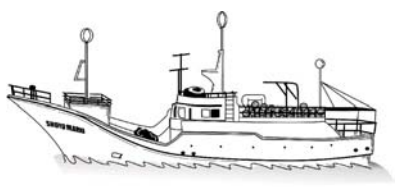
The estimates of vessel numbers could be improved considerably. One of the major mechanisms would involve obtaining the full cooperation of Japan and Taiwan so as to eliminate the myriad of assumptions researchers must make for fleets of these countries in the absence of hard data. A second key element would be gaining a greater understanding of longliners based in Indonesia and Vietnam. Altering the WCPFC vessel reporting requirements would be a major step towards providing the kinds of data necessary to improve estimates and verify other data sources. Another key vessel parameter to be obtained across all fleets would be conclusive identification of fish preservation methods and the resultant product form of the catch, i.e. fresh or frozen.

Moving beyond fleet sizes to obtain an output-oriented estimate of fishing capacity (i.e. potential annual catch) appears possible. More information on vessel characteristics and catch rates are required, but this could be obtained, or at least estimated, through a combination of the available data and practical fleet experience.

A report on the state of world fisheries and aquaculture recognized the problems of determining fishing capacity:

> "Attempts to control overfishing can be negated - at least partially - by the practical difficulties associated with the measurement of fishing capacity, whether expressed as inputs (fishing units) or output (potential catch)" (FAO 1998).

This statement is consistent with the experience gained during the present study which involved acquiring, compiling, and interpreting information on thousands of vessels in the fleets of 29 nations. Nevertheless, a rough estimate of input capacity has been made, and ways to improve the estimate have been identified. The quantification of output capacity for longline and pole-and-line vessels in the WCPFC area now seems to be within reach.



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Appendix 2: Some Information on Vessel Measurement

Tonnage

In theory, tonnage can be a good indicator of fishing capacity, however, there are many practical challenges involved. Across the countries covered by the present study, several different systems of measuring tonnage are employed, including multiple systems within a single country[23]. Conversion between systems is rarely straightforward, and there is often considerable difficulty in determining which tonnage system is actually being used and/or reported. This is further complicated by the fact that in some countries there are incentives to mis-report, such as when tonnage determines certain licensing or operational limitations or conditions.

An FAO report (Turner 1998) highlights the difficulties of measuring tonnage in a region which is encompassed by the present study:

> In Asia, several tonnage formulae are in use for vessels under 24 meters between perpendiculars and definitions of the parameters used vary widely. For example there are at least six definitions of length of the vessel, two definitions for the breadth and six definitions of depth. Some formulae include the length of the periphery around the section of the hull at mid-length. Coefficients used to derive tonnage vary widely according to hull shape, and furthermore, vary with hull material. Some include enclosed volume above the upper deck, while others ignore such spaces.

Tonnage is often confused with a measure of displacement, or weight, of the vessel. It is, however, a measurement of the spaces within a vessel that defines its size. Methods of measurement and the resultant tonnage is important not only for shipping and fishing regulatory purposes but also because it has historically been the basis of commercial charges such as harbour dues, tolls, and insurance. Of relevance to this study, are the definitions of and differences between gross tonnage, GT, and gross registered tonnage, GRT.

Box 5: Tonnage Measurement

The existence of conflicting tonnage measurements resulted in the International Convention on Tonnage Measurement of Ships, 1969. The Convention is commonly known as the 1969 International Tonnage Convention, London 1969, or simply the International Tonnage Convention (ITC). It entered into force on 18 July 1982, though existing ships were not required to comply with the Convention until 12 years after the date on which the Convention came into force on 18 July 1994. The Convention applies to ships over 24 meters engaged on international voyages (warships exempt) and defines gross tonnage (GT) as a measure of the volume of all enclosed spaces (below and above the upper deck) of the ship in cubic meters. It should be noted that in international law, as well as in practice, several systems of tonnage measurement existed side by side. For example, gross tonnage as defined by the International Tonnage Convention only became obligatory for all vessels (over 24 meters long and engaged on international voyages) after 18 July 1994. Prior to this time vessels could have tonnages measured under terms of an earlier convention (the Oslo Convention) that were referred to as gross registered tonnage (GRT). In addition, measuring units to arrive at GRT at the national level (sometimes using a simplified formula) can also be used to determine the tonnage of any vessel operating without an international tonnage certificate conforming to the 1969 Tonnage Convention. In terms of comparing different tonnage systems, GT is often double GRT, and sometimes as much as 4 times GRT (Turner, 1998).

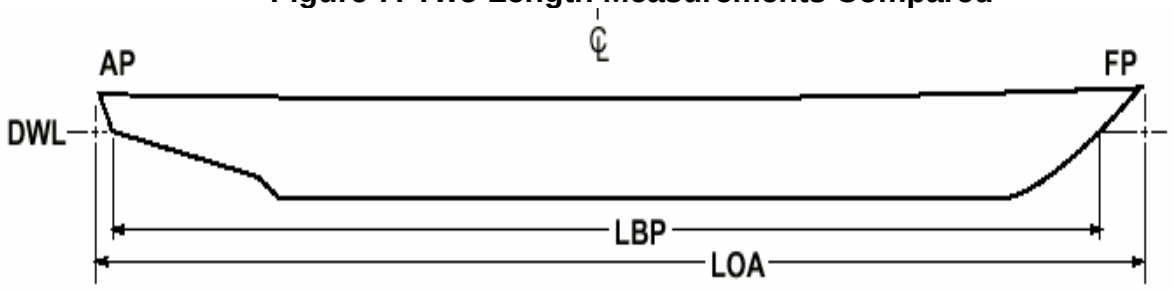
[23] An example of multiple systems of tonnage measurement can be found in the U.S. where any vessel over 79 feet (24 meters) in overall length must be measured under the International Tonnage Convention system. However, existing regulations for licensing, manning and vessel inspection are based on a different system called the “standard tonnage system”, U.S. vessels can be optionally measured under a second system for regulatory purposes. A vessel is assigned two tonnages under this scheme: a required “Convention” tonnage and an optional “regulatory” tonnage (Essex et al. 2003).

The most common tonnage labels encountered during the present study were GT (or as expressed in some countries, IGT or GT ITC) and GRT. The former is international, but GRT can vary considerably between countries. As an example, a particular longliner in Fiji originated in Japan where it was 352 GRT but in Fiji it measures 602 in the international system. According to maritime consultants familiar with the subject, there is no simple conversion between the two systems of GT and GRT (Essex et al. 2003).

Length

The use of vessel length presents a new set of challenges its own problems for identifying vessel size. As stated by Turner (1998) above, in one region there can be up to six definitions of the length of a vessel in use. It is believed, however, that some of the more common length measurements: length between perpendiculars, length overall, and registered length, would not be expected to result in the magnitude of variations in measurement that could be found in different tonnage systems. In Figure 7 below, the method of determining length overall (LOA) is compared with that of length between perpendiculars, where AP is the aft perpendicular, FP is the forward perpendicular, and DWL is the design waterline length.

Figure 7: Two Length Measurements Compared



The definition of length under the International Tonnage Convention 1969 is important because most countries with large fishing fleets are signatories to that Convention and would be expected to utilize its methods to determine the applicability of the Convention[24]. The ITC definition of length is given in the Convention as:

> "Length" means 96 per cent of the total length on a waterline at 85 per cent of the least moulded depth measured from the top of the keel, or the length from the fore side of the stem to the axis of the rudder stock on that waterline, if that be greater. In ships designed with a rake of keel, the waterline on which this length is measured shall be parallel to the designed waterline (ITC 1969).

This definition is close to LBP shown in Figure 7 and may appear convoluted to non-technicians, but the key point is that it would be expected to be a measurement method in wide use by countries that are signatories to ITC 1969. All countries that operate significant fleets of tuna vessels in the WCPFC area are signatories to the convention, except Taiwan, Solomon Islands and the Federated States of Micronesia (IMO 2006).

[24] The International Tonnage Certificate (1969) issued to certify tonnage by national authorities contains the main dimensions of the vessel (length, depth, breadth).

As for non-signatory countries, it is not known for certain what method is commonly used to determine vessel length in longline vessels registered in the Federated States of Micronesia and Solomon Islands. Comparing with the estimates in this study, FSM's longline vessels represent only 0.5 percent of the estimated 4,514 vessels 14 meters and above, and Solomon Islands' pole-and-line vessels represent just 2.2 percent of the 353 total.

According to an official of the China Corporation Register of Shipping in Taipei interviewed during the course of this study, Taiwan follows the same requirements as the relevant IMO conventions, including ITC 1969 (Chen, personal communication).

For reasons that remained unexplained, the length of longliners from China (a signatory of ITC 1969) were reported to the WCPFC Commission in their authorized list as "LOA", or length overall. LOA is not length as described in the ITC, but is the length measured along the vessel's centerline from the extreme point forward to the extreme point aft and is the measure by which length could be the longest out of several accepted measures of vessel length. It is therefore possible that some Chinese longliners (N=184 or 11 percent of the total in the database) reported as over 24 meters in length may in fact be less than 24 meters.

Appendix 3: Estimating the Sizes of Japanese and Taiwanese Fleets

Estimating the Size of the Taiwan Longline Fleet in the WCPFC area

In the absence of definitive information from Taiwan, determining the number of Taiwanese vessels active in the WCPFC area is difficult because information contained in public documents and reports is either incomplete, qualified, or in some cases contradictory.

Documents from Taiwan describing the fleets can refer to tonnage or length with the terms used almost interchangeably. For example, in the Chinese Taipei country report to the WCPFC 2nd Scientific Committee meeting in Manila (SC2) one section describes large tuna longliners, "LTLL" in terms of length: "*mostly* greater than 24 meters LOA" (emphasis added). Another section ignores length and refers to small tuna longliners ("STLL") as those under 100 gross registered tons.

In its most recent enumeration of its longline vessels, Taiwan has stated that in 2005 there were 604 longline vessels greater than 24 meters in their fleet worldwide (Fisheries Agency Chinese Taipei 2006b). The present study has determined that in 2005, 150 Taiwanese vessels 24 meters or greater were licensed in a Pacific Island country, made a call to a monitored port, had logsheets submitted to SPC, or made an OPRT recorded transshipment. Therefore 150 vessels represent very minimum estimate of the number of these vessels active at one time or another in the WCPFC area during 2005.

With respect to the small tuna longliners, the problem is identifying which of the "STLL" identified by Taiwan as operating in the WCPFC area fall in the range of 14 to 24 meters. In the Taiwan country report to SC2, it is stated that *about* 1,421 small tuna longliners (emphasis added) "operating actively in the WCPFC Convention Area" in 2005, but the number is qualified as preliminary (Chinese Taipei 2006).

A document provided by Taiwan to ICCAT in October, 2006 stated that Taiwan has a fleet of around 1,200 small-scale tuna longline fishing vessels ("LOA less than 24 meters") whose fishing areas include the WCPFC area including Taiwan's EEZ, and convention areas of IOTC, IATTC, and ICCAT. The document further states that from 910 to 1030 vessels operated in the WCPO (Fisheries Agency, Chinese Taipei 2006a).

In order to come up with an estimate of active vessels with lengths between 14 and 24 meters, some assumptions have to be made. The first is that the numbers given in the report to ICCAT are as accurate as possible at present and represent a refinement of the vessel numbers contained in the Taiwan country report to SC2. The second assumption is that due to the many unknowns surrounding the operations of these vessels and their administration in Taiwan, the uppermost number in the range given in the report to ICCAT,1,030 vessels, is the best indication of the number of active vessels under 24 meters in the WCPFC area.

In its report to ICCAT, Taiwan states that the names of all small-scale longline vessels actively fishing in the WCPFC area in 2005 "are included in the WCPFC Record of Fishing Vessels". Since there are no Taiwanese longline vessels on that list less than 14 meters in length, it can be assumed that all such active vessels were between 14 and 24 meters in length.

The conclusion is that 1,030 is the best estimate of the number of Taiwanese longline vessels between 14 and 24 meters in length active in the WCPFC area during 2005.

Estimating the Size of the Japanese Longline Fleet in the WCPFC area

The most recent information in the public domain available for estimating the number of vessels that operated in the WCPFC area is contained in Matsunaga et al. (2006). The information contained in that document is categorized by tonnage class rather than length[25]. A table in the report provides the provisional number of fishing vessels engaged in tuna fisheries in the WCPFC area by gear and size of vessel. Longline vessels (provisional number engaged in tuna fisheries in WCPFC Convention Area) are grouped according to the following tonnages:

- 0-10 (287)
- 10-50 (417)
- 50-200 (132)
- 200-500 (448)
- 500+ (7)

This information is of limited use for determining WCPFC area activity because all but two of the five longline tonnage classifications listed are noted in the report as including vessels that operated in areas other than the Pacific.

Since there is neither a definitive number of longline vessels active in the WCPFC area nor a list of such vessels available, information and clues from the SC2 report and the Japan authorization list submitted to the WCPFC Commission must be coupled with certain assumptions to arrive at an estimate of the number of active vessels in 2005. The following paragraphs describe the processes, admittedly imperfect, that are used to arrive at the numbers and length categories shown in Table 8.

The first category, "0-10 ton", represents vessels operating only in the WCPFC area. Vessels in this category are not considered as they fall below the 14 meter length criterion set for inclusion in this report[26].

For practical purposes in a discussion of WCPFC area capacity, the second category, 10-50 tons is essentially that for coastal vessels, 10-19.99 tons[27]. This is based on the list of vessels authorized to fish outside the Japan EEZ submitted to the WCPFC Commission in 2005. There are 271 longliners from 11 to 50 gross tons on that list, and only one (at 49 gross tons) is larger than 20 GT[28]. None are over 20 meters in length. It is assumed that the vessels 14 meters or greater on this list (257) represent all in that class. The difference between the 417 reported in the SC2 paper and 257 (160) is thus considered to represent vessels under 14 meters and are not to be included in this study.

The third category shown in the SC2 report, 50-200 tons, contains 132 vessels. Two statements in the SC2 report give some indication of how many in this category operated in the WCPFC area:

- "…almost of (sic) 100-199 GRT boats are operating in this area".
- "All other smaller size categories operated in the WCP-CA"

[25] Although government administration of fishing vessels in Japan is done by tonnage, the tonnage classifications in the SC2 paper do not correspond with those used administratively in Japan.

[26] Examination of the list of authorized vessels sent to the WCPFC Commission by Japan in 2005 indicates that vessels of 14 meter length are around 14-15 gross tons and 12 meter vessels are 13-14 gross tons (whether measured in the international tonnage system or Japanese GRT).

[27] The table uses 'ton' rather than gross ton or gross registered ton. This may be because the authorized list submitted to the Commission contains some vessels measured in GRT and others with their tonnage designated "IGT" or international gross ton. For purposes of this discussion, and since the referenced categories in this study are in length, the term 'ton' will be mostly used in this discussion.

[28] This tonnage may be a typographical error, as the vessel length, beam and depth are nearly the same as several 19 ton vessels.

Using the WCPFC Japan authorization list to determine the proportion of vessels in the 50-100 and 100-199 ranges of the third category, it is found that 43 percent are in the smaller range with 57 percent in the larger. Applying the percentage for the smaller vessel size range to the total number of vessels (132) gives 57 vessels that operated in the WCPFC area. That leaves 75 vessels to which the statement that almost all of the vessels applies. For the purpose of this study, almost all is assumed to be 95 percent or 72 vessels. This results in a total of 129 from this category having operated in the WCPFC area.

To determine how many of these vessels are 24 meters and over and how many are under 24 meters, the WCPFC Japan authorization list was again consulted. In that list, the apparent division for 24 meter length longline vessels appears at around 75 GRT. Thus all the 72 vessels in the 100-199 GRT range are over 24 meters. Not knowing the GRT distribution of the 57 vessels in the 50-100 ton range makes estimating their breakdown by length less certain. It is assumed that their GRT distribution follows that of the WCPFC list, where 57 percent are over 24 meters length and the remaining 43 percent are between 14 and 24 meters. Applying this proportion to the 57 vessels in the 50-100 ton range gives 25 below 24 meters. The 32 vessels above 24 meters in the 50-100 ton range are added to the 72 vessels in the 100-199 ton range for a total of 104.

The fourth and fifth categories of vessels 200-500 tons and 500+ tons represent the distant water vessels. The activities of these vessels are addressed in the text of the SC2 report referring to the WCPFC area: “most of the boats larger than 200 GRT are operating outside (of it)”. “Most” in this context could mean any number from a majority (51 percent) to nearly all (99 percent). This vagueness presents one of the larger problems in estimating active Japanese vessels from available information.

In the absence of further qualifying statements to the data provided, a mid-range of 75 percent (25 percent fishing within the CA) might be considered an appropriate guess. However, the wording used in the SC2 report does not discount the possibility that vessels might have fished in the WCPFC area at some point, and other factors might contribute to a larger percentage of vessels operating in the Convention Area than just 25 percent. These factors include the proximity of fishing grounds in the Eastern Pacific Ocean to the Convention Area, (including the overlap in the Convention Area and EPO to the north and east of French Polynesia), and the ability of larger vessels to fish as far west as the dateline under domestic regulation. For these reasons 60 percent is deemed an appropriate interpretation of “most”, resulting in 40 percent or a total of 182 estimated to have operated within the WCPFC area.

Table 12 summarizes the estimates of numbers of vessels operating in the WCPFC area from the discussion above, and includes for reference the provisional estimates as contained in the Japan country report to SC2.

Table 12: Estimates of the Number of Japan Longline Vessels Operating in the WCPFC area in 2005

SC2 Report Category	SC2 Report Number of Vessels (Provisional)	Revised Estimate of Number of Vessels ≥ 14 m	Number of vessels 14-24 m	Number of vessels >24 m
0-10 tons	(287)	--	--	--
10-50 tons	(417)	257	257	0
50-200 tons	(132)	129	25	104
200-500 tons	(448)	182	0	182
500 + tons	(7)	Combined with category above	--	--
TOTAL	**(1,291)**	**568**	**282**	**286**

Estimating the Size of the Japanese Pole-and-Line Fleet in the WCPFC area

Information on the pole-and-line vessels active in the WCPFC area is provided in the Japan report to SC2 by Matsunaga et al. (2006). There are no qualifications to operations in other ocean areas, and it is known that Japanese pole-and-line vessels all operate in the Pacific.
Vessels in the 0-10 ton category are not included, as with the longline vessels they are assumed to be under 14 meters in length. The data in the SC2 report giving the provisional numbers of vessels in 2005 is shown in Table 13.

Table 13: Provisional Number of Pole-and-Line Vessels Operating in WCPFC area, 2005

Category	Number of Vessels (Provisional)
10-50 ton	77
50-200 ton	95
200-500 ton	43
Total	**215**

Appendix 4: Acronyms and Abbreviations Used in this Document

CCM	Cooperating non-Members and participating territories
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
EPO	Eastern Pacific Ocean
EU	European Union
FFA	Forum Fisheries Agency
FRP	Fiberglass reinforced plastic
FSM	Federated States of Micronesia
GPA	Gillett, Preston and Associates
GRT	Gross Registered Tons
GT	Gross Tons
IATTC	Inter-American Tropical Tuna Commission
ICCAT	International Commission for the Conservation of Atlantic Tunas
IOTC	Indian Ocean Tuna Commission
IRCS	International Radio Call Sign
ITC	International Tonnage Convention
IUU	Illegal, Unregulated and Unreported
JFA	Japan Fisheries Agency
KDSFA	Korea Deep Sea Fisheries Association
MOMAF	Ministry of Maritime Affairs and Fisheries
mt	Metric tons
OFDC	Overseas Fisheries Development Council
OFP/SPC	Oceanic Fisheries Programme of the Secretariat of the Pacific Community
OPRT	Organization for Promoting Responsible Tuna Fishing
PNG	Papua New Guinea
WCPO	Western and Central Pacific Ocean
WCPFC	Western and Central Pacific Ocean Fisheries Commission
OPRT	Organization for the Promotion of Responsible Tuna Fisheries
RSW	Refrigerated seawater
SC2	Second Meeting of the Scientific Committee of the WCPFC
ULT	Ultra low temperature