An examination of vessel, gear and operational details useful for fishery-specific effort standardization, including FAD-related gear and fishing strategies

David G. Itano

Pelagic Fisheries Research Program, Honolulu, Hawaii, USA

1. INTRODUCTION

During the First Regular Session of the Scientific Committee (SC1)[1], the meeting charged the Fishing Technology SWG to:

> *identify and institute the collection of technical data on fishing gear and methods of special interest – particularly in relation to FADs*[2]

Addressing this task was a long-standing objective of the Standing Committee on Tuna and Billfish (SCTB) by way of the Fishing Technology Working Group (FTWG). The task has been inherited by the SC and incorporated into the SC structure by way of the FT SWG. However, it should be noted that the FT SWG can only promote, recommend and review studies and has no way to specifically institute programs.

Before going further in addressing this particular directive, it is useful to review and document previous research related to the subject of technical gear, fishing methods and FADs that are relevant to the Commission. Fortunately, this has already been done, making this working paper a review of a review, in reference to Itano (2005 – ***The transition and evolution of the Fishing Technology Working Group of the SCTB into the structure of the WCPFC Scientific Committee, including an annotated summary of FTWG research of relevance to the WCPFC***).

2. REVIEW OF RELEVANT INFORMATION

2.1 Summary of available papers

That paper (Itano 2005) summarizes and groups all of the papers and contributions to the FTWG (SCTB 14 – 17) as well as any written contributions to any SCTB meeting relevant to the Terms of Reference to the FTWG. The resulting 101 papers were listed by meeting and also within nine categories:

- **Effort standardization and estimation of effective fishing effort**
- **Fishing strategy and influences on effective fishing effort**
- **Vessel and gear attributes**
- **Documentation of fishing gear and technology**
- **Fish Aggregation Devices**
- **Training and information materials in support of improved catch and effort data**
- **Gear modifications for bycatch reduction and increased targeting**
- **Fleet characterization, recent developments and innovations**
- **Fishing capacity**

[2] Report of the First Regular Session of the Scientific Committee, page 44, para 7.20

Most of the papers are hyper-linked allowing them to be directly retrieved using any computer linked to the internet. The categories on fishing strategy, vessel/gear attributes, fishing gear and technology, FADs and fleet characterization are particularly relevant. Each paper is listed by:

Working Group acronym – Working Paper # (SCTB #)

An example of documents listed in Itano (2005) related to vessel, gear and operational aspects of fisheries in relation to effort standardization include:

RG–7 (13) RG–7 Matsumoto, T., M. Ogura, N. Miyabe & H. Shono. **Creation of a database to identify factors affecting CPUE of the Japanese equatorial purse seine fishery.** National Research Institute of Far Seas Fisheries. Japan.

WP 8 (11). Park, Y.C., D.Y. Moon & S.J. Hwang. **Review of changes for the Korean tuna purse seine fleet and fishing methods.** National Research and Development Institute,
Pusan, Korea. 7 pp.

WP 48 (11). Itano, D. **Notes on the improvement of fishing power and efficiency in the western tropical Pacific tuna purse seine fishery**. Pelagic Fisheries Research Program, Joint Institute of Marine and Atmospheric Research, University of Hawaii at Manoa,
Honolulu, Hawaii, United States of America. 8 pp.

FTWG-10 (14) Beverly, Steve. **Longline Fishing Perspectives: Techniques, Gear, Boats, Bait and Recent Trends**. Coastal Fisheries Programme, Secretariat of the Pacific Community.

FTWG–5 (16) Coan Jr., A. , Crone, P. **Fishery-related attributes associated with FAD and log fishing practices conducted by the U.S. purse seine fleet in the central-western Pacific Ocean, 1997–2002.** (533k)

FTWG–2 (17) Itano, D.G. **Vessel and gear attributes useful for the long-term monitoring and management of WCPO tropical tuna fisheries**. Pelagic Fisheries Research Program. JIMAR. University of Hawaii. USA. (150kb)

FTWG-10 (14) Beverly, Steve. **Longline Fishing Perspectives: Techniques, Gear, Boats, Bait and Recent Trends**. Coastal Fisheries Programme, Secretariat of the Pacific Community.

FTWG-11 (14) Morón,, J., J. Areso, and P. Pallarés. **Statistics and Technical Information about the Spanish Purse-Seine Fleet in the Pacific**. APAGAC, Madrid, Spain, Spanish Fisheries Office in Seychelles, Mahé, Seychelles and Instituto Español de Oceanoggrafia (IEO), Madrid, Spain.

FTWG-10 (15). Itano, D.G. **Super Superseiner**. Joint Institute for Marine and Atmospheric Research, University of Hawaii

FTWG-11 (15) Beverly, S. **State of the Art Longliner.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia

FTWG–3 (16) Itano, D. G. **Documentation and classification of fishing gear and technology on board tuna purse seine vessels**. (4,993k)

FTWG–5 (16) Coan Jr., A. , Crone, P. **Fishery-related attributes associated with FAD and log fishing practices conducted by the U.S. purse seine fleet in the central-western Pacific Ocean, 1997–2002.** (533k)

FTWG–4 (17) Langley, A. **An analysis of the main factors influencing the catch of bigeye tuna in purse seine drifting FAD sets.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia. (637kb)

INF–FTWG–3 (17) INF–FTWG–3 (17) Itano, D., Fukofuka, S., and D. Brogan. **The development, design and current status of anchored and drifting FADs in the WCPO.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia. Pelagic Fisheries Research Program. JIMAR. University of Hawaii. USA. (2,186 kb)

GEN–2 (17) Molony, B.W. **Review of fleet capacity, catch and effort of the purse-seine fleets in the Western Central Pacific Ocean, with emphasis on the use of FADs.** Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia. (2,203kb)

SWG-11 (14) Millar, C & P. Williams**. Taiwanese distant-water longline catch characteristics with regard to albacore targeting**. Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia

++++++++++

One paper from SCTB 17, **Vessel and gear attributes useful for the long-term monitoring and management of WCPO tropical tuna fisheries** (Itano 2004) reviews in detail the above listed SCTB contributions. This paper reviewed papers on gear and vessel attributes, data repositories of vessel attributes, previous efforts to collect these data (i.e. ESTHER project), papers on vessel efficiency, and provided recommendations on vessel and gear attributes that may be "not useful" vs "useful" towards the long-term monitoring of effective effort in WCPO fisheries. A summary of recommendations from this paper is provided below

2.2 ESTHER Program

The European Union funded[3] research project ESTHER (*Efficiency of the Tuna Purse Seiners and Effective Effort*) examined vessel and gear attributes of the EU purse seine fleets and conducted analyses and modeling to gauge the impact of various factors to fishing efficiency (Gaertner and Pallares 2002).. These factors were considered key technical improvements adopted by EU purse seiners that significantly increased vessel efficiency:

1. opening style roller purse rings;
2. use of drifting, instrumented FADs;
3. use of auxiliary FAD support and supply vessels;
4. installation and use of bird radar;
5. increasing familiarity with and more powerful sonar;
6. increased power of purse winch and power block;
7. increased vessel speed when competing in areas of high school density.

[3]*Institut de Recherche pour le Développement (IRD France); Instituto Español de Oceanoggrafia (IEO Spain)*

The ESTHER program also noted the following issues that tend to complicate the measurement of effective effort or generally confound these efforts. These points may not appear novel but bear listing here as a reminder of the difficulties involved.

1. The collection of technical data from vessels was made difficult due to limited cooperation from industry and very few boats voluntarily accepted scientific observers;
2. technological innovations occurred continuously making it difficult to tease out discrete influences;
3. the need to examine factors on a fleet by fleet basis. For example the age of vessel may be a negative factor for one fleet but be positive or of no consequence for another that regularly improves and upgrades vessels;
4. the fact that many innovations in gear have a positive combined effect, making the influence of single pieces of equipment difficult to discern and measure;
5. that some items may replace others, so the loss of one item may be compensated or improved by another, i.e. helicopters replaced by bird radar;
6. that personal preferences of the captain or navigator may have more influence on gear use and efficiency, i.e. having a bird radar and a helicopter may not double efficiency as only one may be favored by the captain, however having both may increase overall efficiency in case one is disabled.

2.3 Longline vessels and gear

Beverly (2001, 2002) reported on the status and improvements to tuna longline technology. The following technical improvements or recent developments in regional longline fisheries were considered especially significant:

1. improved monofilament longline reels (more power, higher capacity, less wear, lighter);
2. electric fishing lights to replace chemical light sticks;
3. use of temperature/depth recorders during sets;
4. electronic chart plotting software integrated with bridge electronics;
5. use of remote sensing data (SST, altimetry, chlorophyll);
6. rapid expansion of longline effort by vessels from Peoples Republic of China;
7. development of onboard processing of tuna to loins; combination of freezing and chilling capability on the same vessel; diversification of markets.

2.4 Purse seine vessels and gear

In review of papers on purse seine gear and technology, the author proposed that purse seine efficiency can be defined by an increasing ability to land a given quantity of tuna in less time, or an increased catch potential in a given time period (one year). This increasing efficiency consists of increasing actual fishing time, minimizing in port turnarounds, increasing the speed with which tuna can be caught, loaded and frozen onboard and decreasing overhead costs. It was proposed that purse seine efficiency can be achieved by:

1. Adequate fishing power
    a. large deep net designed for fast pursing
    b. full complement of electronics for tuna school assessment (high and low frequency sonar, scientific grade echo sounders, remote telesounder in skiff)
    c. adequate hydraulic power to quickly purse large net closed

2. Minimizing time to load catch
    a. rapid net hauling, stacking and sacking up with large capacity hydraulics
    b. installation of rubberized rail roller to speed sacking up process
    c. use of "Spanish style" sacking and brailing of catch to holds (see Itano 2003)

3. Advances in refrigeration and processing
    a. ability to load and preserve very large sets and maintain quality in warm waters, i.e. improved freezing capacity per hour

4. Increase of actual fishing effort during trips via:
    a. use of remotely monitored drifting FADs to maximize fishing time with sophisticated radio buoy technology (see Itano 2003)
    b. use of supply or tender vessels for FAD deployments and retrieval to monitor FAD aggregations and protect productive FADs from poaching (see Arrizabalanga et al. 2001)
    c. use of bird radar to remotely assess unassociated schools and plan movements between schools (see Gaertner, D., and P. Pallares 2002)

5. Decrease of down-time between fishing trips
    a. modifying fish well unloading system to "float" the catch to conveyor belts on the wet deck (see Itano 2003)
    b. design vessel layout to allow simultaneous unloading from several different fish wells
    c. configure fish wells and refrigeration system to allow sorting of catch at sea to market categories to speed unloading or transhipment
    d. transhipment of catch at sea or in port close to fishing grounds

6. Adoption of innovative new technology and methods that enhance any of these main areas of increased efficiency.

3. RECOMMNENDATIONS FOR DATA COLLECTION

Long lists of vessel and gear attributes considered "not useful" or "useful" to collect for various reasons was provided. These lists generated considerable discussion by the meeting, highlighting the strength of collaborative efforts over individual when designing data collection procedures. Suggestions of data to collect or data collection considerations that were generally agreeable to the meeting included the following, many of which have or will be adopted by existing programs.

1. Adopt and verify a standardized measurement system, preferably metric.

2. Agree upon a standardized definition of vessel length, i.e. length overall or waterline length, etc.

3. Abandon GRT as the primary definition of vessel "size" and adopt volume of fish hold capacity, i.e. cubic meters (m^3)

4. Data forms specific to each vessel gear type may be more efficient than a single form for all gears. However, sections like vessel characteristics, vessel electronics or remote sensing are general to all vessels and can be standardized to all forms.

5. Categorize vessel and gear attributes into categories of data that are relatively stable vs those that are more dynamic, and update dynamic data more often and perhaps by different means.

6. Develop criteria to define “significant” changes to a vessel or operational strategy and mechanism to report and update these changes soon after they are implemented.

7. Collect detailed information on the fish storage method including well plan with volume and chilling or freezing process

8. Collect information on the strategy and process of fish loading (i.e. brailing method), onboard processing, onboard sorting/discarding, fish storage and catch offloading; particularly if transshipment is involved.

9. The presence or absence of specialized gear should be qualified in some way to indicate degree of use, possibly by observer programs.

10. Consider abandoning the collection of highly detailed information on the make and model of items like marine electronics in favor of some general, easily noted quantifiable attribute that defines the power of the item in question along a standardized scale, i.e. maximum range of bird radar unit, frequency and maximum detection range of a sonar unit, etc.

11. Concentrate on the collection of data on new or innovative gear or methods, or those with highest potential impact to resources, like FADs. Collect detailed data on FAD configurations.

12. Develop data collection for longline vessels that clearly define target depth and target species, including shark targeting vessels, however a solution for vessels that change target frequently will have to be found.

13. For pole and line vessels, collect data on the number of real live fishermen as well as the number of automated poling stations to better define fishing power.

14. Avoid data ambiguity and subsequent recording difficulty by indicating if an attribute was present/absent/not noted.

4. FAD RELATED INFORMATION

Due to their size-related impact on tuna stocks and higher non-target CPUE, improved information on FADs and FAD fishing strategies is a current priority of the Commission. Unfortunately, detailed information of this kind is generally not available and difficult to obtain from the industry. Another paper from SCTB 17: **The development, design and current status of anchored and drifting FADs in the WCPO (**Itano, et al. 2004) summarizes available information on anchored and drifting FAD design and use within the Convention Area. FAD topics discussed included:

- anchored FAD types (Philippine payao, Indonesian);
- purse seine ventures and fisheries based on anchored FADs (Fiji, FSM, Solomon Islands, PNG);
- drifting FAD development;
- drifting FAD types and design (US, Japanese, Taiwanese, Korean, European Union);
- use of supply and FAD tender vessels;
- radio buoy technology and use; and
- new developments in drifting FAD technology.

The paper concluded that:

"*This review of available information on anchored and drifting FADs has highlighted the scarcity of documented information on technical parameters of FADs that are used in the WCPO fishery. Another conclusion may be that specific technical information on FADs that may influence their efficacy and aggregative characteristics needs to be defined to facilitate coordinated data collection efforts. Before this is done, it seems counterproductive to conduct analyses on the possible differences or similarities between "log" and "FAD" catches. First of all, it will be necessary to define useful parameters to collect in a standardized manner and more basically, to define the difference between the two. Currently, the characteristics of main interest to SCTB and the WCPO Commission will likely be related to the aggregative characteristics of FADs in relation to juvenile bigeye tuna, undersize market tuna in general and bycatch species".*

Unfortunately, little in the way of defining or collecting technical details on FADs has been accomplished in the intervening years. It is still not known what makes one FAD more productive than another or how FAD design may influence the species and size of aggregated schools. Itano et al. (2004) noted these problems, stating:

"Even though we can not say what makes one FAD more "effective" than another at this stage, the experience of fishermen and their comments should be noted and investigated. For anchored FADs, the use of sub-surface aggregators is a fundamental part of the Philippine payao design. However, the most important aspect of their anchored FAD fisheries seems to favor FAD density and large numbers of FADs over other considerations.

The drifting FAD designs appear to have converged to a common type, which is not surprising considering the degree of poaching that occurs between different vessels and fleets. The most common feature is that all drifting FADs seem to use a long panel of weighted netting that hangs down below the FAD"

Writing on WCPO purse seine vessels and gear, Itano (1998) noted:

"This generalized design varies from vessel to vessel, but there is a consensus among fishermen that a significant amount of subsurface area is important to a successful (drifting) FAD. ……. The reason for the apparent success of FADs with large sub-surface structure is not clear but the fishermen believe this to be true and fashion their drifting FADs accordingly. The predictable drift of FADs that hold well in the prevailing current is an additional benefit as one vessel may be tracking and monitoring more than 10 FADs at the same time."

Other factors that fishermen suggest contribute to the aggregative success of drifting FADs include having a large school of non-tuna finfish aggregated to the FAD (triggerfish, rainbow runner, mackerel scad, etc.), the use of artificial lights and light boats on the FAD, attaching chum containers or attachment of fish oil dispensers. These observations and views of fishermen support the potential importance of collecting technical data on these factors, but their true importance to aggregation remains unknown.

5. SUMMARY

Developing a list of technical parameters related to fishing gear, vessels, FADs and fishing strategies useful for effort standardization will require a collaborative effort. Input from researchers and the industry experienced with observer programs, gear technology and the fisheries needs to be combined with recommendations and requests from those who will use the data for effort standardization studies.

Verification of the data and a mechanism to regularly update technical details will be essential. Without a fishery independent means to verify technical data and maintain their accuracy over time, this type of data quickly becomes of little use. With limited resources available, every effort should be made to focus data collection efforts on critical data needs, such as technical data necessary to estimate fishing capacity, gear performance (i.e. hook depth, pursing depth), FAD aggregation characteristics and size/species-specific targeting.

It should be noted that the FT SWG, like all SWGs, remains an ad hoc research group without specific funding that relies on volunteer contributions from the research community. These SWGs struggle to address research tasks, accomplishing many by chance when regional or national research and management organizations coincidentally have related programs or when NGOs wish to promote agendas that parallel SWG objectives.

Timely addressing of critical research needs will often require specific contracting of services. This suggests that a priority task of the Commission is to promote and develop the means to fund necessary research or programs, while it is the priority task of the subsidiary bodies to clearly communicate the critical issues facing the region.

6. REFERENCES

Arrizabalaga, H., J. Ariz, X. Mina, A. Delgado de Molina, I. Aretxe, P. Pillares, and A. Iriondo. 2001. Analysis of the activities of supply vessels in the Indian Ocean from observer data. Indian Ocean Tuna Commission. Third Meeting of the Working Party on Tropical Tunas, 19 – 27 June 2001, Victoria, Seychelles. WPTT-01-11. 12 pp.

Beverly, S. 2001. Longline fishing perspectives: techniques, gear, boats, bait, and recent trends. 14th Meeting of the Standing Committee on Tuna and Billfish, Noumea, New Caledonia, 9 – 16 August 2001. FTWG-10. 11 pp.

Beverly, S. 2002. State of the Art Longliner. 15th Meeting of the Standing Committee on Tuna and Billfish. Honolulu, Hawaii, USA. 22 – 27 July 2002. FTWG-11. 3 pp.

Gaertner, D., and P. Pallares. 2002. The European Union Research Project « Efficiency of Tuna Purse-Seiners and Effective Effort » (ESTHER), Scientific Report of Project *(English translation of selected sections of the Scientific Report)* 15th Meeting of the Standing Committee on Tuna and Billfish. Honolulu, Hawaii, USA. 22 – 27 July 2002. FTWG-3. 12 pp.

Itano, D.G. 1998. Notes on the improvement of fishing power and efficiency by western Pacific tuna purse seine vessels. 11th Meeting of the Standing Committee on Tuna and Billfish, Honolulu, Hawaii, USA 28 May – 6 June 1998. Working Paper 48. 8 pp.

Itano, D.G. 2003. **Documentation and classification of fishing gear and technology on board tuna purse seine vessels**. 16th Sixteenth Meeting of the Standing Committee on Tuna and Billfish (SCTB16), held in Mooloolaba, Queensland, Australia. 9–16 July 2003. FTWG-3. 30 pp

Itano, D. 2004. **Vessel and gear attributes useful for the long-term monitoring and management of WCPO tropical tuna fisheries.** 17th Meeting of the Standing Committee on Tuna and Billfish. Majuro, Marshall Islands. 9-18 August 2004. FTWG WP-2.

Itano, D., Fukofuka, S., and D. Brogan. 2004. **The development, design and current status of anchored and drifting FADs in the WCPO**. 17th Meeting of the Standing Committee on Tuna and Billfish. Majuro, Marshall Islands. 9-18 August 2004. FTWG INF-3.

Itano, D.G. 2005. The transition and evolution of the Fishing Technology Working Group of the SCTB into the structure of the WCPFC Scientific Committee, including an annotated summary of FTWG research of relevance to the WCPFC. First Regular Session of the Scientific Committee, Noumea, New Caledonia 8-19 August, 2005. WP FT-4. 24 pp.