Interim Advice to the Preparatory Conference for the Western and Central Pacific Fisheries Commission (WCPFC)

Review of Data Standards, Technical Capabilities and Data Sharing Policies for the Western and Central Pacific Region

Prepared for

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List of Acronyms

CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CECAF	Commission for the Eastern Central Atlantic Fisheries
CES	Catch and Effort Statistics
CPUE	Catch Per Unit Effort
CWP	Co-ordinating Working Party on Fishery Statistics
EEZ	Exclusive Economic Zone
EU	European Union
Eurostat	Statistical Office of the European Community (European Commission)
FAO	United Nations Food and Agriculture Organisation
FFA	Forum Fisheries Agency
FIDI	Fishery Information Data and Statistics Unit
FIGIS	Fisheries Global Information System
FTP	File Transfer Protocol
GAM	Generalised Additive Model
GFCM	General Fisheries Commission for the Mediterranean
GLM	Generalised Linear Model
HMS	Highly Migratory Species
IATTC	Inter-American Tropical Tuna Commission
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICES	International Council for the Exploration of the Sea
IOTC	Indian Ocean Tuna Commission
ISC	Interim Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean
ISCAAP	International Standard Statistical Classification of Aquatic Animals and Plants
IWC	International Whaling Commission
MCS	Monitoring Control and Surveillance
MHLC	Multilateral High Level Conference
NADS	Non-target, Associated and Dependent Species
NAFO	Northwest Atlantic Fisheries Organisation
NASCO	North Atlantic Salmon Conservation Organisation
OECD	Organisation for Economic Cooperation and Development
OFP	Oceanic Fisheries Programme
PrepCon	Preparatory Conference
RFMO	Regional Fisheries Management Organisation
SCTB	Standing Committee on Tuna and Billfish
SPC	Secretariat of the Pacific Community
STATWG	Statistics Working Group of the ISC
TAC	Total Allowable Catch
UNFSA	United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks
VMS	Vessel Monitoring System

VPA	Virtual Population Analysis
WCPO	Western Central Pacific Ocean
WG	Working Group

1 Introduction

1.1 Background

The Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean was concluded in July 2000. The Convention was opened for signature at Honolulu on 5 September 2000. The Conference that negotiated the Convention passed a resolution establishing a Preparatory Conference (PrepCon), which met for the first time in April 2001 in Christchurch, NZ.

During the meeting, the PrepCon established two open-ended working groups:

- Working Group I (WGI) on issues relating to the organisational structure of the Commission, its budget and financial contributions.

- Working Group II (WGII) on the scientific structure of the Commission and the provision of interim scientific advice.

During the second session of the Preparatory Conference (PrepCon2), WGII reviewed and gave preliminary consideration to the Commission's needs with respect to:

1. Data requirements, including current gaps in data coverage and standards for data collection and management;
2. Science, and in particular stock assessment and advice on stock status in the short term and ongoing;
3. Research priorities and research planning and co-ordination;
4. Review of assessments, analyses and other scientific work.

WGII established an ad-hoc task group to consider the future information needs to support discussions and progress on matters related to the scientific activities of the Commission. Drawing upon the material from the ad-hoc task group the working group agreed that the following matters, amongst others, should be addressed, as far as possible, prior to the next meeting of the working group:

1. An investigation of the technical capabilities, and security and data-sharing policies of existing organisations, including those of participants in the Preparatory Conference, with the view of possibly contracting out interim data services.

2. A compilation and review of standards for collection, verification and for the timely exchange and reporting of data on fisheries currently practised by existing arrangements (e.g. SCTB, ISC, IATTC, CCAMLR, CCSBT and ICCAT) and an assessment of their suitability for use by the Commission.

This report addresses these matters.

1.2 The requirement for data

The quality of fishery data required for fishery management cannot be determined in isolation. The purpose for which data are needed dictates the required resolution (see Section 1.2). For example, to close a fishery that reaches an overall TAC requires data of lower resolution that for a fishery where quota is allocated to individual vessels. Similarly, the time scale on which data are needed also varies depending on their intended use. For example, catch and effort data collected for use in an annual stock assessment analysis may be reported with several months delay between the catch event and the time of

recording in the database. However, catch data that are used to monitor progress during the season towards a catch limit must be reported with minimal delay to ensure that the fishery is closed when the limit is reached.

Fishery collection programs often develop during the initial phases of a fishery, and continue even as the fishery and exploitation patterns change. Periodic review of the fishery, its management objectives, and the data collection program assures that the data collection program remains compatible with current data needs.

The data requirements for the types of scientific analyses needed to manage WCPO tuna fisheries in accordance with the Convention text are essentially those specified by other tuna commissions. The most basic data are catch (by weight and/or numbers), effort, and length frequency data. If the fish can be aged, which in the case of tuna is very rare, then age sub-samples, along with other biological data are needed to develop estimates of the various biological relationships (growth, mortality, length-weight etc.). All these data should be collected on an ongoing routine basis. Ideally, they would be supplemented by other targeted data collection (surveys, tagging, etc.). Regarding fishing effort, it is important to collect vessel specific information, for example through a vessel register and observer programme.

One of the keys to reliable tuna assessments is the collection of representative data across the full range of the species being caught. First and foremost this provides good estimates of total removals. But, given the distribution of HMS is affected strongly by the environment, it is vital to cover the full area, especially when developing abundance indices. Unlike most other ocean areas with tuna fisheries, the WCPO contains many small islands, which affect oceanic processes and make interpretation and extrapolation of data much more difficult. Finally, many of the longliners work preferentially on the high seas, rather than within an EEZ, and data from them is vital. Longline effort data are usually considered easier to interpret than purse seine effort data.

Regarding the scale of data required for stock assessment, the characteristics of HMS and their fisheries make it very important to collect data at the finest scale possible. This points essentially to haul-by-haul data.

For most tuna species, especially tropical tunas, ageing is extremely difficult, and currently not possible for some species. In those species, good quality, comprehensive length frequency data (at as fine a geographical scale as possible) and growth curves are needed, with large enough sampling fractions and full area coverage. This is true whether one is using simple production models, age-structured production models, VPA-like assessments or integrated assessment methods.

The other vital element is catch per unit effort (CPUE) data. In many cases, these are the only data that might produce an index of abundance. It is now routine to analyse these data with complex statistical analytical tools such as generalised linear models (GLMs) and generalised additive models (GAMs). These models try to account for targeting changes over time, vessel changes, and spatial distribution. Commonly in these analyses every factor is significant, as usually is every interaction term. For these reasons, these analyses are most effective when undertaken on detailed haul-by-haul data (e.g. from logbooks) with exact positions, supplemented by observer data. However, this ideal is rarely met. Most tuna commissions do not have mandatory submission of data at such a fine scale. More commonly, catch and effort data are required on a scale of 1-degree squares by month, while length data may be required on a scale of 5-degree squares by month or quarter. It is sometimes possible to get access to more detailed haul-by-haul data, but the problem is that collection of data at this scale impinges on issues of commercial confidentiality, and unless fishers and flag states are convinced that confidentiality will be preserved, there will be a reluctance to submit the necessary information.

2 Data Standards

2.1 Introduction

In this section we have compiled and reviewed standards for collection, verification and for the timely exchange and reporting of data on fisheries currently promoted and/or practised by existing arrangements.

The Convention calls for the Commission to:

- Adopt standards for collection, verification and for the timely exchange and reporting of data on fisheries for highly migratory fish stocks in the Convention Area in accordance with Annex I of the Agreement, which shall form an integral part of this Convention (Article 10(1d)).

- Compile and disseminate accurate and complete statistical data to ensure that the best scientific information is available, while maintaining confidentiality, where appropriate (Article 10(1e)).

With regard to data collection, Annex I of the UNFSA explicitly requires fishery data collection at an operational level. Conversely, obligations relating to specifications for data reporting are not clearly defined. Nevertheless, given reference to the need for data collection and compilation enabling – *statistically meaningful analysis for the purposes of fishery resource conservation and management* – this too points to the need for catch and effort reporting at the finest stratum possible, at the operational level.

> *States should ensure from vessels flying their flag that data are collected on fishing activities according to the operational characteristics of each fishing method (e.g., each individual tow for trawl, each set for long-line and purse-seine, each school fished for pole-and-line and each day fished for troll) and in sufficient detail to facilitate effective stock assessment* (Article (2a))
>
> *States should agree, within the framework of subregional or regional fisheries management organizations or arrangements, or otherwise, on the specification of data and the format in which they are to be provided, in accordance with this Annex and taking into account the nature of the stocks and the fisheries for those stocks in the region* (Article (2d))

The management of HMS requires regional co-ordination through the development of common standards (guidelines) influencing collection, verification and reporting of data. Criteria need to be established which, when applied, permit data collected at a national level to be used as the source of regional data. The primary objective of standardisation, in this context, is therefore to facilitate the integration of data collected under different data collection systems through the application of common standards and classification codes. The application of common standards and codes has a particular influence on the extent to which data can be integrated within a central data repository. Significant benefits can be obtained in both the quality and value of data where standards are applied.

The use of data exchange standards, in addition to offering a framework of guidelines defining the format of submissions, provides ready means of integrating data from disparate sources, and in so doing enables Regional Fisheries Management Organisations (RFMOs) to offer information and services in improved ways.

Timely exchange (reporting) of data will rely to a large extent on the structure of national data collection systems. Significant benefits in timeliness of data reporting can result through ensuring that standard (compatible) exchange formats are generated; recent IT advances have been made in the development of methods of data exchange that are independent of proprietary software or hardware.

In the development of standards applicable within the region the Commission will need to consider the particular situations of developing countries as these countries may not be able readily to implement standards designed in the context of more developed fisheries. Specific regional examples include the Philippines and Indonesia where the capacity to monitor domestic fleets is limited.[1] On the other hand the national capabilities of the Island Nations in Convention Area are substantially augmented through their membership of FFA and SPC.[2]

Finally, it is essential that the initial system of standards and classifications is not only capable of meeting immediate data needs, but that it is also flexible enough to meet those needs which might evolve over time.

2.2 Standards for data collection and reporting

2.2.1 CWP

The FAO promotes various instruments, which present overarching guidelines for collection and exchange of fisheries data, including: 1995 United Nations Fish Stocks Agreement (UNFSA), the FAO Compliance Agreement, and the FAO Code of Conduct for Responsible Fisheries. Given clear reference to the UNFSA in the recommendations of the MHLC consultation of 1996 and subsequent Convention text, it is important for the Commission to be aware of FAO standards developed in support of statistical systems guided by these instruments. This includes internationally recognised definitions, classifications and codes, which the FAO recommends be used where possible and appropriate.

The FAO co-operates with regional fisheries bodies, particularly through the Co-ordinating Working Party on Fishery Statistics (CWP), to standardise reporting forms, procedures, definitions, classifications, and other related documentation.

The CWP has as its purpose to:

- Keep under continuous review the requirements for fishery statistics for research, policy-making and management,
- Agree standard concepts, definitions, classifications and methodologies for the collection and collation of fishery statistics, and
- Make proposals for the co-ordination and streamlining of statistical activities amongst relevant intergovernmental organisations.

Current Membership of the CWP includes CCAMLR, CCSBT, FAO, IATTC, ICCAT, ICES, IOTC, NASCO, NAFO, OECD, EU/Eurostat, SPC and the IWC. The OFP Fisheries Statistician is currently chairman of the CWP.

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[1] As noted in Williams (2002), Indonesia and the Philippines represent two of the largest domestic tuna fisheries in the world. The estimated tuna catch from the Indonesian and Philippine fisheries contribute 17% and 13% of the WCPO total catch, respectively, and 13% and 9% of the Pacific Ocean total catch, respectively. Appropriate data from these fisheries are therefore fundamental to regional tuna stock assessments.

[2] Commencing in 1988, tuna fishery databases have been developed and installed on computers in fisheries departments of fourteen SPC member countries. The systems are customised according to the needs of the member country, but typically allow the production of data summaries and maps of fishing activity within their EEZ. Some systems also include a logsheet data entry component and components for landings data, observer data and length-frequency data. In cases where data entry is carried out at SPC, regular data updates are sent via email or on CD-ROM with the CES data retrieval system. Countries that have received support for their fisheries databases include Federated States of Micronesia, Fiji, French Polynesia, Kiribati, Marshall Islands, Nauru, New Caledonia, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga and Tuvalu. In the past, the OFP has also provided support to Guam and the Northern Marianas; however, support for these systems has since been provided by the National Marine Fisheries Service (http://www.spc.org.nc/OceanFish/Html/Statistics/StatSysSCTB.htm).

It is strongly recommended that the Commission adopt standard codes and co-ordinate with FAO and the CWP in their development. Where it is necessary to adopt unstandardised codes very rapidly, databases can easily be configured to accept temporary codes for later replacement with standard codes.

2.2.1.1 Review of statistical requirements

A critical element to ensure that appropriate standards are maintained, whilst reflecting the changing needs and priorities of scientists, statisticians and fisheries managers, is the need for ongoing review and adaptation. Recent initiatives of the CWP, relevant to the Commission, include the recognition that a more integrated approach to fisheries management is needed; a consequence of this being the need for data outside the realm of traditional fishery statistics, including data relating to biological, environmental, social and economic aspects of fisheries. Concepts and definitions for the parameters necessary to address these additional aspects are under continued review, particularly as regards mechanisms for their assimilation into existing data collection programmes. An example is that, although not mandated to define social and economic indicators, in recognition of the increasing importance of social and economic data, the CWP recognises that there is a role to be played in addressing the data requirements necessary to quantify them (Inter-Sessional Meeting of the CWP, 2002).

2.2.1.2 Standard classification codes and definitions

The use of internationally agreed codes is an important element facilitating the collation of fishery statistics from disparate sources, at national, regional and at international levels. International classification codes agreed by the CWP include:

- International Standard Statistical Classification on Aquatic Animals and Plants (ISSCAAP)
- International Standard Statistical Classification of Fishing Vessels (ISSCFV)
- International Standard Statistical Classification of Fishing Gears (ISSCFG)

Standard classification codes drawn-up by the CWP have been widely accepted. Periodic reviews are undertaken in an effort to reflect changes in fisheries and the needs of scientists, statisticians and managers. Issues recently addressed by the CWP have included proposed revisions to ISSCAAP and ISSCFV (FAO, 2001).

Also with regard to standard classifications, a recommendation has recently been put forward by the SPC and IATTC proposing that once the Commission becomes operational, statistical areas be modified to reflect areas used for statistical purposes by the Commission, IATTC, and other RFBs in the region.

In addition, the CWP has recommended improvements to standard definitions. A recommendation was made by the CWP for an amendment to the definition relating to attribution of catch nationality; specifically with regard to flag state reporting obligations (FAO, 1999c). The recommendation was made in recognition of the complex situation surrounding DWF vessel reporting, particularly when fishing in territorial waters under access or joint venture arrangements. The updated definition has been implemented by the SPC-OFP when determining catch and effort reporting obligations (Lawson et al., 2002); this matter is discussed in more detail in Section 2.6.1.

2.2.1.3 Reporting methods

Recognising the importance of harmonised data reporting, the CWP has also addressed the issue of standardising format for data reporting. Traditionally, focus has orientated towards the standardisation of paper reporting formats such as the STATLANT questionnaires, to which the CWP made a major

contribution with regard to the specification of measures of fishing effort by gear type. The name itself betrays the origins of the CWP as a co-ordinating body for Atlantic statistics. STATLANT forms are dispatched (together with instructions for completion) by the FAO on behalf of RFMOs to the relevant national authorities.

- STATLANT A questionnaires are used for reporting annual nominal catch by species and by statistical sub-area, division or sub-division.
- STATLANT B questionnaires are used for reporting fishing effort by month, vessel size class, gear and statistical sub-area, division or subdivision and together with associated catch by species.

Statlant A and B questionnaires have been used by CCAMLR to collate statistics for major fishing areas 48, 58 and 88 (Southern Oceans), by NAFO for area 21 (Northwest Atlantic), by ICES for area 27 (Northeast Atlantic), by CECAF for area 34 (Eastern Central Atlantic), and by GFCM for area 37 (Mediterranean and Black Sea).

With the specification of finer and finer detail in catch reports (many organisations now require that haul by haul data are reported from defined fisheries), Statlant data are probably of less use to individual RFMOs than they were previously. If they are the only form of reporting on some fisheries, they are obviously essential, but in the case where there are better data available to the organisation, Statlant data still have a use in being public domain summaries of data on catch and effort.

FAO only collates the Statlant A questionnaires into its publication of global fisheries statistics, and the organisations listed above have generally found the Statlant B information to be more useful for their purposes. Thus, if the Commission wishes Statlant B data to be available publicly it will have to publish them itself. This should, however, be relatively inexpensive especially if web-based publication is envisaged.

More recent attention of the CWP has focused on the need for standards to be defined for reporting using electronic media. An example is the recognition of the CWP of the widespread implementation of VMS technology and the need for international reporting standards. The CWP agreed that there is an urgent need for an international standard format which accommodates the reporting of position, fishing activity, catch and other data through VMS. The CWP recommended that an international standard be developed and promoted, and that FAO consider facilitating this process as a matter of urgency (FAO, 1999c).

2.2.2 FIGIS

The Fishery Global Information System (FIGIS) is a global information system on fisheries developed by FAO aimed at providing policy makers with timely, reliable strategic information on fishery status and trends on a global scale. Designed as a policy-based information system, it provides a single entry point to strategic data, information, analyses and reviews of fisheries issues and trends. A key principle of FIGIS is that of ensuring that information is quality-controlled and maintained up-to-date. FIGIS' maintenance will rely upon a network of partners (initially RFMOs and National Centres of Excellence) contributing to the system according to their own mandate. As a corollary, the system's control is decentralised: contribution and maintenance rights are assigned to FIGIS partners who are the data owners, these partners having to share certain standards and adhere to certain rules aimed at ensuring the best possible quality of data and information. Being a distributed information system, FIGIS will allow states to fulfil their reporting obligations according to international requirements. In that respect, FAO has already agreed with SPC, ICCAT, ICES, and NAFO on the development of case studies.

For effective fisheries information management, FIGIS needs to promote and agree on standards: thesauri with agreed vocabularies and classifications for indexing, glossaries to ensure definitions of terms, and shared concepts. Norms for data sets content management are under development, including documentation of information quality assurance processes. FIGIS refers to the Dublin core XML Metadata standard to set up its own proposal for a Fisheries XML information standard.

2.2.3 ISO

The International Organisation for Standards (ISO – www.iso.org) produces internationally agreed standards for quality management systems (ISO9000) and for environmental management systems (ISO14000). Under the ISO format, standards developed must:

- Consider and organise the purpose of the standards,
- Define the problem areas that the standards must solve,
- Determine the "best practices" available, and
- Select the actual measures to assure that the standards are met.

The main attributes of best practice are based on the standards established by ISO 14000. In environmental management these standards require consensus planning and comprehensive stakeholder involvement, based on full information and equal empowerment. The ISO 14000 standards for environmental management are scale-independent: they apply to environmental management of regions, sectors, specific projects and individual operational activities.

The rigorous and time-consuming process to achieve full ISO certification for data collection management standards will not likely serve the purpose of the Commission. However, a less rigorous procedure that follows the ISO format will provide an opportunity for the PrepCon to fully evaluate the details of sampling requirements in the context of data quality needs, e.g. see Figure 2.1.

2.2.4 1996 MHLC Technical Consultation

The MHLC Technical Consultation of 1996 agreed several outline standards for collection, verification, and exchange and reporting of data. During the Technical Consultation, a drafting group, consisting of Representatives of Japan, Korea, New Zealand, Papua New Guinea and the United States, assisted by SPC and FFA staff drafted recommendations for co-operation in data collection and exchange and research co-operation under some future regional fisheries management organisation or arrangement. The resulting recommendations were as follows:

In recognition of the need to progress the development of scientific support for future conservation and management of highly migratory species in the WCPO, the Consultation affirmed its support for:

- *Collection by flag states of catch (target and non-target species), effort and other data at a vessel operation level, i.e. logbook data;*
- *Provision of such data for both waters under national jurisdiction and the high seas at a degree of detail and at a level of resolution to be agreed upon to enable effective stock assessment; and*
- *Co-operation in scientific programmes to generate other data required for effective stock assessment.*

Regarding the future data needs of WCPO fisheries, the Consultation recommended that any future co-operative scientific data collection in the WCPO be consistent with the guidelines and requirements of the UN Implementing Agreement, especially as set out in Annex I of that agreement, and be established pursuant to a regional fisheries management organisation or arrangement, taking into account the nature

of the stocks and the fisheries involved. Regarding the specification of agreed minimum requirements of any future scientific data collection programme, the Consultation also recommended that the following elements be included in any such future programme:

(1) Flag states should compile annual catch statistics by species, covering all fishing activities for each fleet.

(2) Flag states fishing for tuna in the WCPO should collect catch, effort and other data at the fishing operation level (i.e. logbook data in a format to be agreed upon) for all commercial tuna fishing activity, regardless of whether such activity takes place in waters under flag state jurisdiction, other national jurisdiction or on the high seas. The logbook data should be validated with landings or other information.

(3) Annual catch statistics should be made available as soon as possible to all parties involved in the arrangement. Agreement should be reached on how to consolidate logbook and other data for all fleets in a confidential database. Access to such data should be under conditions determined by international agreement.

(4) A data repository system for length-frequency and associated data should be established so that such data can be used under agreed conditions for stock assessment and other tuna research projects. A co-ordinated sampling plan for all major species should be developed and implemented through the co-operation of the parties involved in the arrangement.

(5) A scientific observer programme, based on a regionally co-ordinated sampling design, should be developed and implemented through an agreement among the parties involved in the arrangement. Observers should collect data on fishing operations, including bycatch and discards; they should also conduct biological sampling of both the target and non-target catch, and collect other operational data as appropriate.

(6) *All parties involved in the arrangement should co-operate in developing and implementing scientific research programmes of relevance to stock assessment of target and non-target species caught by tuna fisheries in the WCPO.*

Points (1) and (2) refer specifically to data types that are required for stock assessment analyses and should be collected by flag states. Point (4) also refers to another important data type - length frequency data - although in the context of data storage rather than data collection. Nevertheless this is another data type that is important for stock assessment. The following Section (Section 2.3) therefore presents a brief review of data types required by international regional fisheries organisations, such as the WCPFC, to meet their obligations of fishery management advice based on the best scientific evidence available. The importance of data quality and issues relating to the promotion of data quality and of validation of data resulting from several types of data collection (e.g. logbooks, observer programs) is stressed in the following section. Finally, we discuss expectations regarding timely data reporting to the organisation and standards for data exchange (point (3) of the Technical Consultation list).

Options available for collecting these data (e.g. observer programs mentioned in point (5), the sampling plan mentioned in point (4) and the scientific research programs mentioned in point (6) of the Technical Consultation list) are discussed in Section 3. This section also discusses regional capabilities for collecting and handling various types of data, including the data repository system mentioned in point (4) of the Technical Consultation list. In this context we discuss technical capabilities and particularly some of the specific hardware and software needs of organisations undertaking this type of data storage and processing.

2.3 Data types

As described in Section 2.2.4, a number of recommendations were presented in the 1996 MHLC Technical Consultation, specifically relating to data collection, reporting and associated standards,

including a discussion of the overarching data types needed. The data types and the bodies charged with their collection are summarised below:

Data type	Responsibility for collection
Annual catch statistics	Flag state
Catch and effort data	Flag state
Logbook validation data	Flag state
Length data and associated biological information	All parties to the Commission through a co-ordinated sampling plan
Operational data, data on bycatch and discards, biological sampling of target and non-target species	All parties to the Commission through a regionally co-ordinated observer or port sampling programme
Research programmes of relevance to stock assessment which could broadly be interpreted as collection of biological, environmental and ecological data	All parties to the Commission through co-operative research

In discussing the data usually required to undertake stock assessment and other related scientific analyses that underpin management advice, we consider four principal categories of data:

- Commercial fishery data including catch and effort statistics, landings and transhipment records (both aggregated and fine-scale) collected on the basis of flag state submissions;
- Biological and ecological data, including by-catch information, length frequency data, sex, maturity, age data, environmental data etc.;
- Environmental data, including meteorological and oceanographic information;
- Economic data, including market information, trade data, commodity, consumption, fisher information etc.

In addition to the above data categories, we also recognise the category of technical data. This comprises the type of data collected on vessels characteristics and operational history that would be collected as part of a vessel registration process for use in standardising fishing effort data (see Section 1.2) and for other Commission purposes.

2.3.1 Commercial fishery data

Commercial fishery data represent the most fundamental data type required to monitor a fishery. It can also contribute, once a sufficient time series has been collected, to the assessment of stock status and potential. Annual catch estimates and annual catch rates offer a baseline for monitoring long-term trends in a fishery, whilst for stock assessment and other population modelling, finer scale data are usually needed. Catch and discard data are required for both target and non-target species, although direct commercial sources are usually limited with respect to the latter.

Regarding standardised terminology for catch statistics, the following terms are suggested Alverson et al. (1994), proposed at a bycatch workshop in Newport, Oregon (U.S.A) in February 1992 (McCaughran 1992):

- Target Catch — The catch of a species or species assemblage that is primarily sought in a fishery, such as shrimp, flounders, cods;
- Incidental Catch — Retained catch of non-targeted species;
- Discarded Catch — That portion of the catch returned to the sea as a result of economic, legal, or personal considerations;
- Bycatch — Discarded Catch plus Incidental Catch.

Landings and transhipment records comprise an important source of information with which reported catch data can be verified and validated; both in terms of absolute volume of catch and reported species composition. Additional sources of data used to verify reported catches, include observer programmes and port sampling programmes. Observer programmes are a particularly important source of data with which catches can be adjusted to reflect actual catch (all species landed on deck) rather than the proportion of catch that is retained.

Basic effort data, such as number of vessels and days fished must be supported with detailed information regarding vessel and gear attributes to allow standardisation of effort indices; this may be critical for estimating indices of abundance and for use in stock assessment models (e.g. surplus production models and MULTIFAN-CL models). Commercial sources of effort data, including details of vessel and gear attributes include operational logsheet reporting, vessel registers and vessel activity reports.

The following list identifies some of the key commercial fishery data types in the context of scientific research and the monitoring of catch and effort:

Commercial fishery data collection	
Data type	**Description/Source**
Annual catch estimates	Estimates of annual catch by gear and species. Catch is defined as all species landed on deck; discard as all species caught and subsequently discarded. Based on verifiable logsheet, unloading, or other commercial catch data sources (trade statistics etc.)
Catch data	Landings /unloading data Data on volumes by species, origin of catch (e.g. statistical area) Mechanism for confirmation of reported landed catch volume and composition. Catch data are whole (green) weight only. If fish are processed on board, independent collection of data on conversion factors is highly recommended.
	Port sampling Landed catch composition – volume by species
	Transhipment data Data on volumes by species, origin of catch (e.g. statistical area)
	Scientific observer data Detailed records maintained of catch composition (catch and by-catch species) Recorded on a haul-by-haul basis / by statistical area / as trip summary information
	Trade statistics Including catch documentation and trade documentation schemes Mechanism to verify legality and identify unreported catches (respectively).
Effort data	Vessel registers and activity reports Catalogue of operator, vessel and gear attributes (standardising effort) Trends in vessel activity
	Observer data Operational data recorded on a haul-by-haul basis Gear and vessel attributes, including any modifications to gear and setting practices Recording of other vessels sighted
	Surveillance reports Patrol reports used to verify licensed vessel activity and a means of identifying and recording IUU fishing activity
	VMS data Mechanism for verifying licensed vessel activity and can act as an M & E mechanism ensuring complete catch and effort enumeration (means of identifying missing data sets and intelligence prompting requests for data)
Catch and effort data	Flag state reporting based on vessel records – catch and effort logsheets • haul by haul • Fine-scale (by vessel per fishing operation) • Aggregated catch and effort data by time, area and gear strata (e.g. monthly 5^o x 5^o for longline and 1^o x 1^o for surface gears) In some cases individual vessel catch and effort records transcribed at port in a prescribed format (IATTC).
	Observer data Usually detailed records of catch and bycatch recorded at an operational level (haul-by-haul).

2.3.2 Biological and ecological data

Biological and ecological data types supplement commercial fishery data and are collected either through targeted research initiatives or through monitoring programmes such as port sampling and observer programmes. Regular monitoring programmes, particularly observer programmes, provide a valuable source of supplementary data, which are not usually available from commercial catch and effort data. These include: catch composition, discards of target species, incidental catch and discard of non-target species, details of fishery interactions with species of special interest (e.g. marine mammals, seabirds and turtles) and changes in operational factors or gear. Of particular importance for observer programs in tuna fisheries is the recording of bycatch, especially in view of the increased emphasis on ecosystem approaches in modern fisheries management policy.

Data collected in support of age and growth studies include length data, otolith samples and tag and recapture data. Tag and recapture data together with genetic data also constitute an important source of information on stock structure. Tuna ecology studies are reliant on detailed ecosystem information with which food web structures may be modelled; data sources include samples of stomach contents and muscle / tissue biopsy samples.

Biological and ecological data collection	
Data type	**Description/Source**
Bycatch, discard and other data	Observer data Number and/or weight of discarded catch (target and non-target catch) Incidental mortality data of species of scientific interest (e.g. marine mammals, seabirds, turtles)
Length data	Observer sampling Information relating to unsorted catch according to defined sampling protocols (protocols differ based on scientific objectives (e.g. development of age length keys etc.).
	Port sampling Collect length frequency information based on samples of landed catch.
	In some cases crew record length frequency information of target species
Movement and growth data	Tagging programmes Supported by observer and crew records of recapture and sampling for ageing material
	Fishery independent research – aerial surveys (ICCAT/IOTC)
Morphometric data	Observer sampling Morphometric information, conversion factor information etc.
	Port sampling Additional information to length data collected on occasions
	Fishery independent research
Ecological data	Observer sampling Stomach contents, genetic data, etc Anecdotal information may provide qualitative data to inform future research.
	Fishery independent research Details of species interactions including predator prey relationships etc. Direct effects on non-target species and habitat. Details of species interactions including predator prey relationships etc. Direct effects on non-target species and habitat.

2.3.3 Environmental data

Tuna distribution and abundance have been shown to be sensitive to environmental variability. In particular, the El Niño Southern Oscillation (ENSO) appears to have important consequences both for spatial distributions and migrations of the tuna populations and for their level of recruitment and biomass. Environmental data are therefore important for the determination of effective effort, in longline and surface fisheries, and in monitoring the extent and the influence of, oceanographic and meteorological processes on tuna fishery stock dynamics, migrations and production.

2.3.4 Economic and sociological data

The Convention is very clear regarding the consideration of sociological and economic criteria in the application of management measures. This stems primarily from the need to take into account the special requirements of developing States in the Convention Area, particularly small island developing States (Article 5(b)), both in terms of the allocation of allowable levels of catch and effort (Article 10(3)), and inclusion in the scientific process (Article 30(3)).

In terms of scientific activities in support of these objectives, however, the Convention mentions only the collection and evaluation of economic and other fisheries-related data and information relevant to the work of the Commission (Article 10(1j)). To give effect to these objectives, the Commission will need to consider what specific information will be needed to support the application of the type of criteria listed in Article 10(3).

Fisheries managers and policy makers increasingly recognise the importance of social and economic information in fisheries management. The collection and evaluation of social and economic data, when integrated with fishery and biological data, can provide an important source of advice relating to optimal levels of fishing, from a bio-economic point of view. This is particularly important for small island developing States (SIDS), where the fishing industry is often regarded as the cornerstone of the economy contributing socially through employment and protein and directly to the economy through contribution to GDP and generation of foreign exchange.

This increasing trend in the demand for economic data has resulted in a number of organisations, most notably the CWP, stressing the need for collaboration between fishery statisticians, economists and managers towards determining the types of data necessary to quantify the social and economic contribution of fisheries.

2.3.5 Technical data

The concept of a vessel register is now widely accepted as a valuable means of collecting vital information on vessels technical details and capacities (important for analysis of catch per unit effort data) and also for tracking vessel ownership and standing in terms of compliance with national and international management regulations. Fishing operators seeking to access resources managed under a regional fisheries arrangement should be required to register with the regional organisation and provide the required information on their vessel, company, master and catches. In Part V, Article 24 of the Convention text, vessel register information and procedures are discussed. Information requirements set out in Annex IV of the Convention:

1. *Name of fishing vessel, registration number, previous names (if known), and port of registry;*
2. *Name and address of owner or owners;*
3. *Name and nationality of master;*
4. *Previous flag (if any);*
5. *International Radio Call Sign;*
6. *Vessel communication types and numbers (INMARSAT A, B and C numbers and satellite telephone number);*
7. *Colour photograph of vessel;*
8. *Where and when built;*
9. *Type of vessel;*
10. *Normal crew complement;*
11. *Type of fishing method or methods;*
12. *Length;*
13. *Moulded depth; Beam;*

14. *Gross register tonnage;*
15. *Power of main engine or engines;*
16. *The nature of the authorisation to fish granted by the flag State;*
17. *Carrying capacity, including freezer type, capacity and number and fish hold capacity.*

These data surpass FAO standards, but should nevertheless be regarded as an agreed framework upon which more specific information requirements can be established. It is crucial that standard units of measurement are agreed to facilitate harmonisation of data from different sources. This is particularly important, for example, with metrics that may be important for assessing fishing effort, such as Gross Registered Tonnage, which should be standardised to the international convention, not based on national conventions, which vary. Standard codes for potentially ambiguous data types are also an important component of vessel registers. These are particularly applicable with regard to vessel type and where operational details are required describing gear, processing facilities etc.

In addition to the information included in the list above detailed information is commonly submitted regarding: fishing gear attributes, including details of power blocks, winches, net type and configuration, hook size etc.; vessel technology in addition to communications equipment such as navigational equipment, fish finding equipment, EPRBs, transceivers (VMS) etc.; and, fishing vessel support, which may take the form of support vessels, helicopters etc.

2.4 Data quality

Data quality control is applied at two points in the data capture and handling process. Firstly there is verification of data submissions prior to insertion into the database. Secondly there are internal mechanisms to ensure the integrity of data in the database is maintained.

2.4.1 Data verification

The verification of data is essential to ensure that data are accurate, complete and give a true indication of the state or value of the factors under consideration. The problems associated with the collection of fisheries data mean that the risks of collecting erroneous or inappropriate data are very high without careful and statistically valid design and monitoring.

Standard data import routines can facilitate traditional manual crosschecks of reported data with independent sources and ensure data integrity during data entry. Different types of data will need to be verified in different ways. Some examples of methods to verify data include:

- Checking logbooks against landings data (e.g. sales notes);
- Sampling catches for species or grade composition;
- Comparing landings statistics with certificates of origin, trade and commodity production statistics (e.g. processed fish) and similar sources of information;
- Inspecting data collection methods by statistical staff;
- Interviews with fishers;
- Observer schemes or inspections;
- Reporting from sea on retained catch on entering and leaving the fishing zones;

- Using vessel monitoring systems, such as transponders, to monitor the position, catch and activities of vessels;

- Instituting airborne and shipboard surveillance, together with the boarding of vessels.

In cases where fishery-independent data, such as stock abundance indices from research surveys, are available, it is possible to use these as an independent check on CPUE indices based on commercial fishery catch and effort data. In cases of suspected serious misreporting of catches, it is even possible to use such fishery-independent data to obtain estimates of the commercial catches.

At the macro-level (typically national), food balance sheets can be used as an overall check of the consistency between production, utilisation, trade and consumption statistics. For such an exercise, it is necessary to convert all figures into live-weight equivalent units using appropriate conversion factors. Total fish production from capture fisheries and aquaculture, less quantities used for non-food purposes (e.g. fishmeal production) plus imports minus exports should correspond to the domestic food fish supply. It is usually expressed in per capita terms by dividing by the population size. The average per capita fish supply can then be compared with fish consumption estimates derived from food surveys. Large deviations from food survey results or large fluctuations from year to year suggest that there are problems with some of the statistics used in the calculations (FAO, 1998).

2.4.2 Data Quality Control

2.4.2.1 Overview

Data quality control is a key element of ensuring adherence to data quality standards. In this context, we consider data quality control in terms of its utility to managers, scientists and other interested parties. The data collected must be rational in order to form the basis of standard report summaries (weight of catch, location of catch, CPUE, etc.) against which progress of the fisheries is monitored or managed (output control, stock assessment, etc.).

The main issue to be addressed in data quality control is the identification of 'outliers' in the input data; e.g.: are catches / effort reported by any one vessel consistent with other reports coming in from vessels operating within the same fishery, at the same time, general location, with the same gear? How consistent are these data with historical pictures of how data have accumulated within any particular fishery? (See also discussion of the types of error types.) This requires some detailed level of understanding about 'average' expected conditions within any one particular fishery, under a given set of circumstances. For example, distributions of previous years' catch and effort data may be used to establish 'thresholds' above or below which input data are flagged (say, 95th and 5th percentiles - effectively, 'zero tolerance') as possibly suspect. Alternatively, depending on how data are assembled, individual input data sheets can be compared against current data accumulating from the fishery. 'Outliers' may also appear on position reports associated with catch records compared with detailed management measures, including conditions of licence, gear restrictions, area restrictions etc. which may be in force. These can be identified at the time of data entry in the same way as the genuine outliers described above.

It is also important to consider the 'completeness' of the data. On the assumption that any one vessel must submit a fishing report or a non-fishing report, the time series of accumulated data should be checked at the level of the individual vessel in order to identify any unaccounted gaps in the date sequence. This requires, for example, information on fishing plans and license periods for individual vessels.

The primary tool of monitoring data quality within a database is through database integrity constraints. Three mechanisms exist for implementing database integrity constraints dependent on the volume of data being processed. These are real-time, transaction and batch.

Real-time error trapping has become much easier in the last few years with the increase in speed of PC-based applications and their increased complexity. Single fields can now be checked within the data entry application against a set of possible values or that an entered value is within a defined range. Fields can also be checked relatively simply against each other as they are entered. For example take the latitude and longitude entered for the start and end of a haul. It is now quite a simple process to take the two positions, calculate the distance between the two (using the Great Circle functions) and check that this is within an appropriate range. For a wide variety of fields, pull-down menus of appropriate values can be added, e.g. only "N" or "S" can be entered for the latitude hemisphere field of a position.

Transaction processing occurs at the end of a single unit of data entry, i.e. a logsheet. Here error trapping can be implemented for a wide variety of fields. For instance, it is common to run a quick check to see that the values entered for a particular entry add up correctly to match an entered total. If they don't, the row is not submitted to the database and the user is prompted to check the data before proceeding to the next row. Another mechanism used for transaction processing is that of double entry or double keying of data. Normal practice for the double entry of data is to enter the data twice, i.e. a set of logbooks will be entered once by the first data entry person and then the entire set will be re-entered by a second independent data entry person. The two datasets will then be compared at the end of the entry of the second data record and any inconsistencies resolved by reference to the original paper record. This has been found to reduce substantially simple errors caused by e.g., operator's inability to read data on a data sheet, transposition of numbers, missing decimal points etc.

The double entry method is expensive, however, and requires a number of personnel to be available to enter one single dataset, it also doubles the size of the database. The compromise solution is double typing where each field in a data set is typed twice during entry before the user is passed onto the next record. The previous typing is obscured and any differences are highlighted at the end of the second row and resolved against the paper record. Only one correct set of data is retained in the database and one data entry clerk is needed. Probably the simplest mechanism at this level of data checking is to make the data entry clerk do a simple visual check of the data entered at the end of each record. Batch processing is similar to transaction processing, but occurs after a number of rows have been entered into the database. During batch error processing a series of complex analytical routines are run automatically, usually overnight or at weekends when data are not being entered. Data are then flagged as having passed or failed the checks. Data having passed the test are available for analysis immediately. Data having failed one or more of the error checks are flagged and will need to be checked by the user. It is possible to implement a system of data flags that allow a number of flags to be applied to a particular data record, to track where in the record errors have occurred. For example, data can be checked for a large array of potential problems including CPUE within a particular range, species average weights within ranges, and species composition not skewed towards by-catch species that may in fact be targeted against regulations. Each of these is allocated a unique flag, which is applied to the data error flag field for the record. In this way multiple errors can be traced for each record. It is quite common for errors to cascade through a record; once one field is wrong, the user continues to enter data incorrectly until the row is completed. This mechanism easily highlights these occurrences.

2.4.2.2 Types of errors

There are four types of data errors that commonly occur in database systems. These are completeness, consistency, currency, and accuracy. Completeness is a simple Boolean description of whether a datum has been filled or not. A datum is consistent if its value satisfies a set of constraints such as formal rules, logical requirements, or relational requirements, vis-à-vis other variables. A datum is non-current or out-of-date if its recorded value was true in the past but no longer agrees with the present true value. Finally a datum is accurate if its recorded value agrees with its true value.

In the case of the majority of fisheries data being collected, currency is not an issue as these are single entries recorded and stored that are not modified after storing (unless other types of errors are found). Completeness and consistency can both be trapped very easily by the mechanisms described above. Accuracy in many cases will be trapped but is the most likely of all errors to go undetected.

2.4.2.3 Numbers of errors allowable per unit

The number of allowable errors, depends heavily on the context - for example what is considered to be a unit, the type of error, and how sensitive the subsequent analyses are to errors in the data. In a perfect world, there would be time to resolve all issues relating to anomalous or spurious data. In practice, this is not the case in most fisheries departments.

The number (and types) of errors that may be tolerated varies between users in terms of the effect they have in any subsequent use. Under a policy of zero tolerance of errors, no data that have failed a quantitative range test can be loaded into the live system. This extreme level of quality control might be implemented, for example due to the potential impact of erroneous data on a statistical model used to monitor and manage the fisheries in real time (e.g. for within season TAC monitoring). Range testing eliminates most quantitative errors in the data. Obvious outliers (e.g., orders of magnitude) should not be allowed, but see note above concerning concept of 'flagging.' Redman (1992) estimated that in the US a typical payroll record has a 1% chance of having one or more errors and a typical US billing record as high as 2% - 7% of having errors. These are in many cases regarded as being within acceptable bounds. Primary errors in fisheries data have been set previously at levels in the region of 85% of all records are 95% or more correct. With modern data systems it should be possible to attain a much better level than this.

For the most part error trapping is only capable of detecting and fixing errors made during data entry. There will be a number of errors that are made during the recording phase that it may not be possible to fix, although a proportion of these errors can be flagged and excluded from the data analysis, if appropriate (see methods above).

There are a number of statistical procedures (using the hypergeometric distribution) that, given the sample size (i.e. total number of records) and the probability of errors (taken from a subset of data visually checked against the entered data), can estimate the confidence limits for a particular dataset.

2.4.2.4 Methods used to rectify errors

After potential errors have been flagged in the database, the most common and best recourse for sorting out data problems is to check the entered data against the original hardcopy paper record. If this is not available or an error in the paper record is the source of the problem, a number of options are still open to rectify the error. Values can be compared against past and future values collected for the same data field. It may show that the same value has been entered each day for the field and on one occasion a different value was entered but it was more likely to be the same as previous values. Erroneous or data that have been modified after looking at possible sources of error can also be easily excluded or partially excluded from analysis datasets by using the same set of data flags described earlier.

Flagged data can be held in a temporary 'pending' database while source documents are checked usually using an index system such as pre-numbered log-book sheets, which could be an index generated by a document management system. This means that at any one time, the live database holds only those data that pass range checking and input control. The source of error must be investigated before the data can be transferred into the live database, if necessary, by recourse to the originators of the document. An alternative solution that is commonly used throughout large database systems is that records may be flagged with a code whose value indicates at which particular level any one record failed range checking. Data will be recorded in the '*live*' database but it is then the responsibility of the administrators and users of that database to make some rational decision concerning its usage and applicability for each analysis

conducted, e.g. records where the catch data is flagged as erroneous would not be used for estimating total catch.

2.4.2.5 Policies for reviewing data

The data management section of an RFMO must be tasked with continually checking the validity of data, and must correspond with data originators to answer any discrepancies that appear in the data. This can be a costly and time-consuming task, but its importance cannot be understated. One important consideration is that the origin of official data is often known to only a few national officers. Requests for clarification several years later, when those individuals have moved on, is much less likely to lead to a resolution of the problem than questions raised immediately following submission of the data. If investment in a data management section of an RFMO is not high, a large number of historical records are likely to have low quality reliability, because of the legacy effect of delayed checking.

An essential element to an effective reviewing mechanism is the identification of data correspondents. The STATWG of the ISC recently recommended that data correspondents be identified for each Member. Data correspondents will be responsible for ensuring the quality of data collection and submissions by Members. Data correspondents will constitute the primary contact with whom the ISC will communicate in the event of data related queries.

2.5 Initiatives towards standardised data collection and reporting in the WCPO region

Significant steps have been taken towards the standardisation of catch and effort logsheets within the WCPO region:

- Through SPC/FFA cooperation in the Tuna Fishery Data Collection Committee; and,
- Through the work of the Statistics Working Group of the SCTB.

First meeting of the Data Collection Committee was held in December 1995. At the time, an array of logsheets was used throughout the region. The extent to which the situation complicated the task of data processing by the OFP and the FFA was recognised and as a result standard logsheets were designed and introduced to both the domestic fleets of SPC and FFA member countries and the DWF fleets with which they have access agreements. Subsequent Data Collection Committee meetings have followed (December 1996, December 1998 and December 2000) where an ongoing process of review has continued and standard observer forms, port sampling forms and unloading forms have subsequently been designed; translated versions of logsheets have been made available on the SPC-OFP website in French, Japanese, Korean, Mandarin and Spanish.

A special session of the SCTB Statistics Working Group was held prior to the twelfth meeting of the SCTB in 1998 (Anon., 1999a) where minimum logsheet standards were established. The minimum standards reflect the need to differentiate between data that are essential and data that are desirable. Reviews of logsheets used in the region have continued to ensure conformity with the agreed minimum standards.

Existing regional (SCTB agreed) logsheets include:

Logsheets	Languages	Instructions
Longline	English, French, Japanese, Korean, Mandarin	English, French, Japanese, Mandarin
Pole and line	English, French, Japanese	English, French
Purse seine	English, French, Spanish	English, French, Spanish
Shark longline	English	English

A summary of the status of South Pacific Regional logsheet implementation is included in Anon. (2001). Although implementation amongst FFA and SPC flagged vessels has in the majority of cases been successful, adoption by DWFNs has been limited.

Observer data

Observer data collected for research purposes include primarily species composition of target species, catch data for non-target species, and length data.

A series of forms have been developed for observers aboard longline, pole and line and purse seine vessels. In addition there are a number of general forms completed by observers aboard all vessel types. Each form is accompanied by detailed instructions defining data format and codes as required. All forms include instructions that guide observers through the collection and sampling process with the exception of the longline forms, which provide detailed instructions for form filling only. Existing regional observer data collection forms are listed below:

General Forms	Field data collection instructions
	GEN-1 - Vessel and aircraft sightings and fish transfer log
	GEN-3 - Vessel trip compliance record
	GEN-6 - Pacific regional pollution report

Longline forms	LL-1 - Longline general information
	LL-2 - Longline set information
	LL-3 - Longline haul information
	LL-4 - Longline catch monitoring
	LL-5 - Longline conversion factors

Pole and line forms	PL-1 - Pole and line general information
	PL-2 - Pole and line daily log
	PL-3 - Pole and line catch details

Purse seine forms	PS-1 - Purse seine general information
	PS-2 - Purse seine daily log
	PS-3 - Purse seine set details
	PS-4 - Purse seine length frequency
	PS-5 - Purse seine well loading

No regional manual has been developed combining instructions for collection and form filling with roles and duties of observers, statistical sampling techniques, standard classification codes, conduct of observers, safety at sea etc.

Unloading & Port sampling data

Logsheets and associated guidelines have been developed to harmonise data collection and data recording protocols throughout the region. Similarly, SPC member agencies are encouraged to use the regional logsheets and guidelines when collecting port-sampling data. This ensures standard sampling practices, data collection procedures, and a standardised format for reporting. All forms are accompanied by instructions, with the exception of the *Monthly summary forms for longliners*, as detailed below.

Fishery	**Types of forms**	**Language**
Longline	Unloading Form	English, French (no instructions)
	Port sampling form	English, French (no instructions)
	Monthly summary form	English (no instructions), French (no instructions)
Pole and line	Unloading Form	English
	Port sampling form	English
Purse seine	Unloading Form	English
	Port sampling form	English
	Well unloading form	English
Troll	Port sampling form	English

A detailed port-sampling manual has been developed by SPC-OFP, which provides background information for port samplers explaining why data are collected, how samplers should comport themselves, standard measurements, sampling protocols and data collection procedures and how data should be recorded. The manual places particular focus on purse seine, pole and line and longline vessel port inspection.

2.6 Timely exchange and reporting

Timely reporting of fishery data directly influences the capacity of an RFMO to provide appropriate and timely management advice and disseminate information on the status of the fishery in question. Three contributing factors influence the timely exchange and reporting of fishery information, these include:

- Agreement on the criteria used to allocate responsibility for data reporting;
- Agreement on a framework for data reporting, including reporting schedules and defined lines of communication; and,
- Agreement on a common format for data reporting and information exchange.

2.6.1 Fishery data reporting responsibilities

Although international instruments such as the UNFSA allocate responsibility for fishery data reporting on flag State, areas of uncertainty remain. Amongst others, these relate to circumstances arising from DWF fleet operations under access agreements and joint venture and charter arrangements. At its Eighteenth Session, the CWP revised its existing criteria in an effort to address these uncertainties, as detailed below:

The flag State of the vessel performing the essential part of the fishing operation shall be responsible for the provision of catch and landing data.

Where a foreign flag vessel is fishing in the waters under the national jurisdiction of another State, the flag State of the vessel shall have at all times the responsibility to provide relevant catch and landing data. The only exceptions to this shall be:

> *(a) Where the vessel undertakes fishing under a charter agreement or arrangement to augment the local fishing fleet, and the vessel has become for all practical purposes a local fishing vessel of the host country;*
>
> *(b) Where the vessel undertakes fishing pursuant to a joint venture or similar arrangement in waters under the national jurisdiction of another State and the vessel is operating for all practical purposes as a local vessel, or its operation has become, or is intended to become, an integral part of the economy of the host country.*

In any situation where there is uncertainty as to the application of these criteria, any agreement, charter, joint venture or other similar arrangement shall contain a provision setting out clearly the responsibility for reporting catch and landing data, which shall be reported to the flag State, and, where relevant, to any coastal State in whose waters fishing operations are to take place or competent sub-regional, regional or global fisheries organisation or arrangement.

A number of regional bodies have adopted the standards defined by the CWP including the OFP. It is strongly suggested that the Preparatory Conference consider the definition agreed by the CWP. However, in the context of Commission needs, agreement will need to be reached regarding data reporting responsibilities, particularly those relating to DWFN operations, not least if difficulties of duplication are to

be mitigated. This is of particular importance given the status of data reporting for certain fleets in the WCPO, where coastal states, rather than the flag states, are currently the best or only source for catch and effort logsheet data. For example, the coverage of Korean purse seine vessels by logsheet data compiled by Korea is less than 40% for 1999 (Koh et al., 2002), the most recent year for which coverage is stable, whereas the coverage by logsheet data provided to the OFP by SPC member countries is 98% (Lawson, 2002). This situation for Korean purse seine vessels and other DWFNs may change over the long term, but at least in the short term, it is likely that the Commission will have to rely on data compiled by coastal states.

2.6.2 Schedules for data submission

An important measure to ensure timely data submission is agreement on a framework for data reporting, which might include data specific schedules and reporting protocols. The nature of data collected and its importance with respect to the formulation of management advice and associated measures will generally dictate the regularity with which reporting should take place. Nevertheless, the development of a clearly defined reporting schedule with associated mechanisms to monitor and enforce data submissions should be considered.

Closely associated with the development of a data-reporting schedule should be the allocation of a point of contact responsible for data submissions (See Section 2.4.2.5). The identification of an individual responsible for data reporting is crucial not only for monitoring purposes but also for feedback and review, particularly where discrepancies in reported data are identified.

As discussed in Section 2.4.2.5, the ISC has recently endorsed the use of data correspondents, whilst the OFP have established a system whereby designated contacts are assigned for all countries / territories reporting data. Data handling is monitored using a *Data Registry* database; data submissions are logged and receipt of information is automatically generated and sent to the designated contact by email. The system is reciprocal in that designated contacts are able to access to secure pages of the OFP website and obtain information on the status of data processing, specific to their submissions.

Given the number of States likely to report to the Commission, it will be critical that a reporting framework be established including provision for an appropriate response if discrepancies in data are identified or in the case of delays in data reporting.

2.6.3 Data reporting formats

The range of mechanisms available for data reporting has developed significantly from traditional hard copy formats (e.g. STATLANT forms) to electronic solutions. Considerable emphasis has been recently placed on the use of electronic media for data submission. Electronic reporting formats that are independent of proprietary software have been developed and their use is encouraged by the FAO. The use of FTP sites offers a fast and secure mechanism for exchange of large data sets. These solutions are fast becoming the norm and it will be important for the Commission to consider defining reporting formats which maximise developments in the IT environment whilst acknowledging member State capabilities.

An approach similar to that taken by CCAMLR may offer an effective solution; standard reporting formats are clearly defined both for hardcopy and electronic data reporting. Whilst electronic data reporting is encouraged, mechanisms are in place for hardcopy data reporting and subsequent data entry and processing. In this way, standard formats are ensured whilst sufficient flexibility is maintained in line with

different levels of member states' data handling capacity[3]. This approach is reflected informally by the CCSBT, where it is felt that too prescribed a format for data reporting may have a negative influence on the timeliness and completeness of data reporting. As long as standards are maintained through time in reporting formats and sufficient information ("metadata") accompanies data describing them, in the short term, the benefits of standardised reporting formats may be outweighed by the need for timely reporting (pers. com. Bob Kennedy, CCSBT). A more prescribed standardised format may be more appropriate with regards Commission needs, not least given that the likely volume of Member data submissions will be significantly higher than is the case for the CCSBT.

Alongside the growth in the use of electronic media, significant emphasis has been placed on the development of international standards for describing data. Metadata is *"information about data"* and can include characteristics about the data such as the content, accuracy, reliability and the source. Metadata provides the mechanism to describe data in a consistent form that allows users to gain a uniform understanding of the content and fitness for purpose of datasets. Metadata can accompany a dataset when it is transferred to another computer so that the dataset can be fully understood, and be used effectively. The FAO, through FIDI, are currently developing a global standard for fishery metadata, which will in effect offer a baseline set of common terms and definitions that describe fishery data. Within the WCPO region, the OFP routinely includes metadata when disseminating information; equivalent use of metadata by the Commission would increase the sustainability of electronic data and should therefore be considered by the Commission.

2.7 Summary

The Convention text and the MHLC consultation report present overarching guidelines for data collection, verification and timely exchange and reporting. In addition, clear reference is made to associated standards and obligations presented in Annex I of the UNFSA. In support of this guiding instrument and others, the FAO cooperates with RFMOs, particularly through the CWP, to standardise reporting forms, procedures, definitions, classifications, and other related documentation.

It is strongly recommended that the Commission adopt standard codes and coordinate with FAO and the CWP in their development. Where it is necessary to adopt unstandardised codes in the short term, databases can easily be configured to accept temporary codes for later replacement with standard codes.

In the development of standards applicable within the region the Commission will need to consider the particular situations of developing countries as these countries may not be readily able to implement standards designed in the context of more developed fisheries.

It is essential that the initial system of standards and classifications adopted by the Commission must be capable of meeting immediate data needs and flexible enough to meet those needs which might evolve over time.

Commission participation in the FIGIS programme is recommended as this will offer member States a conduit for meeting international reporting obligations, according to commonly shared data standards.

PrepCon consideration is also recommended in relation to the establishment of a system of review and evaluation of data quality and needs. The rigorous and time-consuming process to achieve full ISO certification for data collection management standards will not likely serve the purpose of the

[3] The CCAMLR *Fishery Data Manual* is published in English, French, Russian and Spanish.This manual describes CCAMLR procedures for collecting, submitting and disseminating catch, effort and biological data for fisheries in the CCAMLR Convention Area. Information is provided on deadlines for data submissions, data requirements for each fishery, data forms and guidelines for their completion, and definitions of data fields and codes. Procedures for collecting and submitting fishery observer data and reports are described in the CCAMLR *Scientific Observers Manual* (http://www.ccamlr.org/pu/e/sc/fish/intro.htm).

Commission. However, a less rigorous procedure that follows the ISO format will provide an opportunity for the PrepCon to fully evaluate the details of sampling requirements in the context of data quality needs.

The specifics of long-term Commission data requirements for scientific purposes have yet to be agreed. Nevertheless, priority fishery data in the context of the PrepCon have been established and these same priority data types are likely to be reflected in Commission data needs, at least in the short to mid term. These data include: annual estimates of catch; catch and effort data (the scale and resolution are yet to be established, although data at the finest scale possible are recommended); and size composition data (length frequency).

Where the Commission requires information in addition to fishery data (e.g. economic and sociological data), it should seek to identify appropriate data to quantify indicators in cooperation with the CWP, which has already taken steps to address these issues.

Although international instruments such as the UNFSA allocate responsibility for fishery data reporting on flag State, areas of uncertainty remain. In the context of Commission needs, consensus will need to be met regarding data reporting responsibilities, particularly those relating to DWFN operations. It is strongly suggested that the Preparatory Conference consider the definition agreed by the CWP.

An additional consideration relates to the status of data reporting for certain fleets in the WCPO, where coastal states, rather than flag states, are currently the best or only source for catch and effort logsheet data. This situation may change over the long term, but at least in the short term, it is likely that the Commission will have to rely on data compiled by coastal states.

Significant steps have been taken towards the standardisation of fishery data collection, compilation and dissemination within the WCPO region through the efforts of the Statistics Working Group of the SCTB and through SPC/FFA cooperation in the Tuna Fishery Data Collection Committee.

Data collection standards developed and implemented within the WCPO region include: catch and effort logsheets; observer data collection forms; and port sampling and unloading forms. The forms have undergone regular review and have been widely implemented by SPC and FFA members and DWFNs active in their respective territorial waters. It is strongly recommended that the Commission consider the logsheets and forms as a baseline from which Commission data collection forms can be developed in the long-term.

The verification of data is essential to ensure that data are accurate, complete and give a true indication of the state or value of factors under consideration. Landings and transhipment records comprise an important source of information with which reported catch data can be verified and validated. Additional sources of data used to verify reported catches, include observer programmes and port sampling programmes. The adoption of standardised data collection forms will facilitate data verification significantly.

Significant Commission investment is recommended in the verification and quality control of data submissions. The Commission should consider the establishment of a framework for data submissions including the identification of data correspondents and the definition of schedules for data reporting. The identification of an individual responsible for data reporting is crucial not only for monitoring purposes but also for feedback and review, particularly where discrepancies in reported data are identified. The adoption of such a framework will facilitate the Commissions capacity to verify and validate data submissions and disseminate accurate and complete data in a timely fashion. This often costly and time-consuming task has high importance.

Standard data quality control approaches are now commonplace in data handling; it is recommended that quality control standards be set which incorporate these mechanisms, including: the double entry method of data capture (where hardcopy data are processed); real time error trapping; and transaction processing,

Considerable emphasis has recently been placed on the use of electronic media for data submission; electronic solutions to data exchange are fast becoming the norm and it will be important for the Commission to consider defining reporting formats which maximise developments in the IT environment whilst acknowledging member State capabilities.

An approach similar to that taken by CCAMLR may offer an effective solution. Whilst electronic data reporting is encouraged, mechanisms are in place for hardcopy data reporting and subsequent data entry and processing. In this way, standard formats are ensured whilst sufficient flexibility is maintained in line with different levels of member states' data handling capacity.

The Commission should consider the inclusion of metadata relating to the exchange of electronic fishery data, which will not only facilitate compatibility with international standards but may also influence the sustainability of data compiled by the Commission.

3 Technical capabilities, security, and data sharing policies

The Convention requires that the Commission collect and share, in a timely manner, complete and accurate data concerning fishing activities on, inter alia, vessel position, catch of target and non-target species and fishing effort, as well as information from national and international research programmes (Article 5(i)).

In this section we evaluate the technical capabilities, data security, and data-sharing policies of participants and organisations within the region where the types of data of interest to the PrepCon are routinely handled. For contrast with Western and Central Pacific regional organisations, we also evaluate how these matters are handled elsewhere in order to provide an objective assessment of regional standards. In addition we will evaluate the capabilities of specific candidate organisations in the region with respect to the three elements listed above, in an effort to address the feasibility of contracting out interim data services and, conclude with a shortlist of candidate organisations that meet the criteria.

3.1 Data Collection

Options for fishery data collection are discussed in relation to data type in section 2.3. In this section we review some of the mechanisms commonly used to collect fishery data. The accepted mechanism to ensure both harmonised and consistent data collection is through the use of standardised data collection forms and/or formats (e.g. logsheets). These are usually supported by detailed instructions or manuals, which define data collection procedures / sampling protocols and standard classification codes to ensure compatibility, consistency and quality of reported data.

3.1.1 General fishery data collection techniques

3.1.1.1 Logbooks and data forms

The logbook or logsheet is the accepted data collection form used to record catch and effort data. In addition to catch and effort data, vessel logsheets and logbooks can offer a means of collecting additional information in a standardised manner, including information concerning vessel and gear attributes, discards etc. Other commonly used data collection forms include: unloading forms, transhipment forms, port sampling forms, observer forms and data transcription forms.

Standard approaches to the design of data collection forms are discussed in the FAO Handbook on data collection. The key to effective data collection form layout lies in the relative simplicity with which forms can be completed and that data processing methods are reflected in design and layout. Some additional considerations for the design and implementation of data collection forms include:

- The identification of essential and desirable data types through prioritisation of essential data against those data types which can be collected and *de facto,* the extent to which it is practical for additional information to be collected;
- Evaluation of the scale and precision of required data;
- The use of standard terms / classification codes / standard measurements / units etc. which facilitate harmonised data collection and data recording (where appropriate these standards must be defined with international reporting requirements in mind);
- The parallel development of detailed instructions, including statistically valid sampling protocols where appropriate;
- Linguistic requirements of both collection forms and instructions should reflect the needs of those tasked with data collection; and,
- Appropriate mechanisms for review.

With regard to the medium used, data collection forms are designed both in hardcopy format and in electronic form, either as printable copies or as data entry forms which can be uploaded directly into a data management system (database or spreadsheet files). It is becoming increasingly common to record data electronically rather than on paper. For instance, almost all research surveys and observer data are now collected on computers at sea, although there may be an intermediate paper stage if the data are being collected in a wet environment such as on the deck or in the factory. It is still probably the case that most fishing masters will prefer to use paper to collect their data, but the time is fast approaching when we can envisage the use of VMS data to collect some fisheries data.

3.1.1.2 Observer programmes

At the micro-level it is usually extremely useful to have observers on at least some vessels. Observers provide feedback on fishing practices, processing practices and the level and species composition of discards. Care must be taken to try to identify changes in fisher behaviour when an observer is on board. This is very difficult to do (for obvious reasons) but some experimental designs are available, especially from fisheries with good levels of observer coverage.

International observer programmes (e.g. the CCAMLR Observer Scheme) offer some advantages over national observer programmes. The quality of the observations from such programmes may be higher, standards are consistently applied across the entire fleet, and the added transparency increases the confidence that all parties have in the data.

Observer responsibilities have components of collecting scientific information and assuring compliance with regulations. The distribution of tasks among these components affects the observers' relationship with the fishing industry. Some national and international programmes, such as CCAMLR, use observers only to collect data. The Australian programme uses observers to collect scientific data and compliance data related to permits and marine pollution.

In point (e) of Article 28 the Convention text states that:

> *the activities of observers shall include collecting catch data and other scientific data, monitoring the implementation of conservation and management measures adopted by the Commission and reporting of their findings in accordance with procedures to be developed by the Commission;*

The observer data provided to the OFP are checked for data quality both manually prior to data entry and by the data entry and data importing software (Lawson et al. 2002). In observer programmes for which technical support is provided by the OFP, a purse seine and longline debriefing form allows the national observer co-ordinator (or a senior observer) to check each data field systematically and to query the observer as to whether they have followed the correct sampling protocol. The observer database software also screens the data in order to set a number of data quality flags that indicate whether the data can be used for various analyses, such as the estimation of catches of non-target species.

However, an examination of observer samples of the proportion of bigeye in the catch taken by purse seine vessels revealed serious problems with data quality (Lawson, 2002b). Supervisors evaluated the reliability of observers and the results indicate that only 83 out of 151 observers (55 percent) were considered to be reliable. Observer training programmes have since been conducted by the OFP and it is considered that the reliability of port samplers has as a result improved considerably (Tim Lawson, OFP, personal comment).

3.1.1.3 Port sampling programmes

The port sampling data provided to the OFP are checked for data quality both manually before data entry and by the data entry software (Lawson et al. 2002). For example, missing information are flagged; length histograms are generated for each sample to identify falsified data; and floating object sets by purse seiners are checked for the presence of bigeye tuna.

The quality of port sampling data varies among the national programmes. An examination of port samples of the proportion of bigeye in the catch taken by purse seiners revealed serious problems with data quality (Lawson, 2002b). Supervisors evaluated the reliability of port samplers, other than those of the National Marine Fisheries Service and Japan, and the results indicate that only 19 out of 129 port samplers (15 percent) were considered to be reliable.

Significant steps have since been taken by OFP to address this problem; several observer training programmes have been conducted and as a result the capacity of samplers to identify juvenile bigeye tuna in purse seine catches is judged to have improved considerably (Tim Lawson, OFP, personal comment).

3.1.2 Regional and international fishery data collection programmes

We have identified a number of international programmes responsible for the collection, compilation and dissemination of fishery data both within and outside the WCPO region. Table 3.1 provides a brief description of each of the WCPO and other international organisations identified. A discussion follows outlining the data types handled and the mechanisms employed in collation and collection of fishery data. The summary information was compiled on the basis of available literature, supplemented by information collected through telephone interviews and a structured pro-forma. In addition to the information presented here, Lawson (2002) provides the most recent and complete inventory of tuna fishery data collection, compilation and dissemination for nations in the WCPO currently available.[4]

Table 3.1 WCPO and International organisations responsible for fishery data collection and compilation

Organisation	Description
SCTB	The Standing Committee on Tuna and Billfish. The SCTB provides a forum for scientists and others with an interest in the tuna stocks of the western and central Pacific region to meet to discuss scientific issues related to data, research and stock assessment. It was established in 1988, as an advisory body to the Tuna and Billfish Assessment Programme (TBAP), the predecessor to the OFP. Its role was to be purely advisory and consultative, to assist in the conduct of pelagic fisheries research through the provision of expertise, information and technical advice. In 1997 the terms of reference and participation guidelines of the SCTB changed to promote a wider sense of ownership and enhanced scientific collaboration. The SCTB no longer advises SPCs Regional Technical Meeting on Fisheries.
ISC	Interim Scientific Committee. A scientific forum to exchange views on a full range of

[4] The Statistics Working Group (SWG) of the Standing Committee on Tuna and Billfish (SCTB) has the objective of coordinating the collection, compilation and dissemination of tuna fishery data for the WCPO. At its inaugural meeting in June 1998, the SWG agreed to (a) coordinate data collection by reviewing data collection forms currently in use in the region; (b) coordinate data compilation by reviewing the compilation of annual catch statistics, catch and effort data, and length data, on an annual basis; and (c) coordinate data dissemination by reviewing the instances of the dissemination of data on an annual basis. A paper was prepared by the Coordinator of the SWG (Lawson 2002) in order to report on progress with the coordination of the collection, compilation and dissemination of data. We have made no attempt to specifically summarise the content of that paper, but recommend that it be considered as an important information source for the PrepCon in considering the issues of data standards discussed in this paper.

Organisation	Description
	biological and other scientific issues relating to tunas and tuna-like species in the North Pacific Ocean, including status of stocks, data collection, research, and the consideration of future work programmes.
OFP (SPC)	Oceanic Fisheries Programme. A unit of the Secretariat of the Pacific Community, with a mission to provide member countries with the scientific information and advice necessary to rationally manage fisheries exploiting the region's resources of tuna, billfish and related species.
FFA	South Pacific Forum Fisheries Agency. Collects, analyses, evaluates and disseminates information to member countries. The Agency also provides legal, economic and technical advice, information and assistance in the formulation and implementation of the fisheries policies and access agreements.
IATTC	Inter-American Tropical Tuna Commission. An intergovernmental organisation with full scientific secretariat that studies the biology of the tunas and related species of the eastern Pacific Ocean to estimate the effects that fishing and natural factors have on their abundance, recommends appropriate conservation measures to maintain the stocks of fish at levels which will afford maximum sustainable catches, and collects information on compliance with Commission resolutions.
CCSBT	Convention for the Conservation of Southern Bluefin Tuna. An intergovernmental organisation established to ensure, through appropriate management, the conservation and optimum utilisation of southern bluefin tuna.
ICCAT	International Commission for the Conservation of Atlantic Tuna. An intergovernmental organisation established to recommend on the basis of scientific evidence, management measures and resolutions aimed carrying out its objective of maintaining the populations of tuna and tuna-like fishes at levels that will permit maximum sustainable catch.
IOTC	Indian Ocean Tuna Commission. An intergovernmental organisation established under Article XIV of the FAO constitution. It is mandated to manage tuna and tuna-like species in the Indian Ocean and adjacent seas.
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources. An intergovernmental organisation with a mission for the conservation of Antarctic marine living resources with conservation defined to include rational use.

3.1.2.1 Catch and effort data

Within the general region of the WCPO, the SPC-OFP, CCSBT, ISC and IATTC are regional fisheries bodies that maintain commercial fisheries data for tuna fisheries. In all cases, member nations provide catch and landings data to the regional organisation. While the SPC-OFP and IATTC have long-established fisheries database capabilities, the CCSBT and ISC are in the process of developing a comprehensive database and data management system. Of these groups, only IATTC has staff members in the field to collect supplemental catch data. All four organisations collect or receive logbook data but the data do not include all fisheries from some nations or gear types. For example, the SPC-OFP collects logbook data on standard forms from both domestic and foreign fisheries. The logsheet data held by OFP for 1999 cover 47% of the catch of tuna in the WCPO. Excluding the domestic fisheries of Indonesia and the Philippines, which account for 33% of the catch of tuna in the WCPO, logsheet coverage is 68% (Lawson et al., 2002)

In the case of the international organisations reviewed, ICCAT, IOTC and CCAMLR, all three organisations receive catch and effort data from flag states according to standardised reporting formats. In the case of IOTC and CCAMLR, contracting parties are obliged to submit data in a standard format using standard codes in either paper or electronic format. A comprehensive *Fishery Data Submission Manual*, produced in English, French, Russian and Spanish, provides guidelines for data submission including: deadlines for submission, data forms and guidelines for their completion, and standard definitions and codes.

Several WCPO organisations provide co-ordination and review of data-oriented activities. The SCTB co-ordinates data collection, compilation and dissemination according to agreed principles and procedures. While membership in SCTB is open to all interested parties, not all nations fishing in the WCPO are able to participate (for example, in past years, financial difficulties have curtailed participation by Indonesia and the Philippines). The ISC has a primary task to regularly assess and analyse fishery and other relevant information concerning tuna and tuna-like species. Its membership consists of distant water fishing nations.

3.1.2.2 VMS in the region

The potential crosscutting benefits of VMS data for the purposes of fishery data verification should not be overlooked. VMS data can be used both as a means of verifying reported effort data and as a means of monitoring the completeness of data submissions. It is in this context that existing VMS capacity within the WCPO region is discussed.

The FFA has taken a leading role in the development and application of Vessel Monitoring Systems (VMS in the WCPO region. The FFA has convened a series of technical consultations for member states and DWFNs to review and discuss VMS (e.g. FFA 1996). Several nations (including: New Zealand, the People's Republic of China, Papua New Guinea, the USA, Korea, French Polynesia, New Caledonia, Australia, and Japan) have implemented or are evaluating VMS technology.

Under the existing programme any DWF fishing vessel that wishes to apply for a licence to fish in the waters of an FFA Member Country, must first be registered on the VMS Register of Foreign Fishing Vessels maintained by FFA. The VMS Register is distinct from the regional register, also maintained by the FFA. Information required includes basic vessel details (name, call sign, type, operator/charter) and specific information relevant to the transceiver (Automatic Location Communicator, ALC) installed on the vessel (including communication information, certification and installation details).

The FFA system is based on the Inmarsat-C service, which offers comprehensive coverage of the entire WCPO region. In addition, Inmarsat-C offers two-way communications and messaging capabilities, which ensures flexibility with regards potential extensions to VMS (e.g. electronic logbook reporting). A type approval process has been implemented to ensure compatibility of hardware.

FFA maintains VMS information centrally and distributes data to member countries when fishing activity occurs within their respective EEZ. Actual data collected includes: vessel identity, position (latitude and longitude) and a time stamp; course and speed are determined on the basis of this information. The frequency at which data are transmitted is standardised at 6 transmissions per day, although the frequency can be increased and decreased if and when it is deemed necessary.
No VMS transmission is currently required in high seas waters.

With regards to VMS associated with RFMOs the issue of compatibility is of increasing concern.

3.1.2.3 Biological and ecological data

Observer programmes offer an opportunity to obtain scientific data directly from fishing operations. Observer programmes provide important scientific information on target catch, non-target catch (including incidental catch of seabirds, marine mammals and turtles), and the mortality of discards. In the WCPO, both FFA and IATTC operate regional observer programmes. The OFP supports and co-ordinates national observer programmes, and employed full-time observers in the past for deployment in priority fisheries (3 full time staff provide technical support both for observer programmes and port sampling programmes to SPC member States). In addition OFP provides limited financial assistance in support of member State observer programmes. The FFA programme operates under treaty on the US purse seine fleet, achieving about 20% coverage of the vessel days. There is no coverage of the longline or pole and

line fleets. IATTC operates a regional observer programme and co-ordinates with member nations to obtain 100% coverage of vessels larger than 363-mt capacity. The CCSBT has begun planning for observer coverage.

It is important to note that the design of observer sampling programs is far from simple. The statistical qualities of the required parameters are often very poorly defined, and rarely lend themselves to that body of statistical theory that deals with normal distributions. Sampling is typically a three-stage process, with three levels that need to be considered – the vessel (i.e. how many vessels to sample), the haul (how many hauls to sample on a vessel) and within-haul (how many samples to take from any sampled haul). Solutions that have been adopted in other international forums may help to provide guidance, but observer programmes will have to be tailored specifically to the species in question and the particular operating characteristics of the various fleets. Furthermore, the ideal statistical sampling method will only rarely be practical to implement within budgetary and logistical constraints. Therefore we would caution at this stage against any decision being made about the correct level of coverage in terms of vessels to be covered, % of fishing days to be covered, etc.

Effects of fishing on non-target, associated and dependent species (NADs), typically known as bycatch, has assumed increasing importance in international forums. Analysis of fishing impacts on bycatch of finfish, porpoise (dolphins), sea turtles, and sea birds requires objective and scientifically collected data such as obtained by observers. Increasing fishing for tuna near Fish Attracting Devices (FADs) has increased the incidence of bycatch of many species, including some that are threatened or endangered. The “Agreement for the Conservation of Albatrosses and Petrels of the Southern Hemisphere” provides an example of the international attention given to means of reducing impacts of bycatch.

The following summary information is available on observer programmes on vessels fishing for HMS in the Pacific

Organisation	Function
FFA	Develops and co-ordinates regional observer programmes and assists in the development of national observer programmes. Data collected combines operational information including vessel and gear attributes, biological data collected according to defined sampling protocols and environmental data. Compliance information is also collected, although there are no defined formats for compliance data collection.
OFP	Obtains species composition of target species, catch data for non-target species, and length data from national programmes; OFP observer programme co-ordinates with member nations to expand coverage; provides training and processes observer data.
IATTC	IATTC regional programme co-ordinates with national programmes for 100% coverage of vessels with > 363-mt capacity. Detailed observer manual and log sheets ensure standard protocols and collection procedures are followed.

Port sampling programmes offer a means of identifying both species composition and size (length/weight) frequency of landed catches. The IATTC operates an extensive port sampling programme through its field offices; employing standard sampling formats supported by detailed instruction manuals. OFP supports member country territory port sampling initiatives and encourages the use of standard sampling protocols and reporting formats. The ISC Statistics Working Group has recently addressed the issue of size data collection by member countries, encouraging the use of standard protocols; species-specific measurement standards are currently being defined by the ISC’s Species Working Groups.

Outside the region size data collection is mandatory for IOTC contracting parties, whilst although biological data are not collected through port sampling programmes, length frequency data are reported to CCAMLR based on crew samples in the absence of International Scientific Observers.

No regional fishery bodies in the WCPO area conduct operations to obtain fishery-independent data. Some member nations conduct surveys to collect fishery-independent data, which are generally for local use.

Environmental data collection is in the most part restricted to data collected at sea through observer programmes. A range of public domain environmental data are however used, for example the SPC-OFP has access to public domain data which it uses for assessment purposes and shares with member countries / territories.

3.1.2.4 Social and economic data

The Convention is very clear regarding the incorporation of sociological and economic criteria into the design of management measures. This stems primarily from the need to take into account the special requirements of developing States in the Convention Area, particularly small island developing States (Article 5(b)), both in terms of the allocation of allowable levels of catch and effort (Article 10(3)), and inclusion in the scientific process (Article 30(3)).

In terms of data collection activities in support of these socio-economic objectives, however, the Convention mentions only the collection and evaluation of economic and other fisheries-related data and information relevant to the work of the Commission (Article 10(1j)). To give effect to these objectives, the Commission will need to consider what specific information will be needed to support the application of the type of criteria listed in Article 10(3).

The decisions made on the basis of fishery and biological data, stock assessment results, and management policies have direct economic and social ramifications for fishers. Yet the difficulties in obtaining data to assess these effects generally cause economic and social analyses to lag far behind other aspects of fishery science. In the WCPO region, FFA and OFP have made significant strides in obtaining and using social and economic data. The issue of the optimal level of fishing is receiving increasing attention. The OFP has begun a project to integrate the available economic information for the fisheries and markets with the population biology of major tuna species in the western Pacific to provide advice to FFA member countries on optimal (from a bioeconomic point of view) levels of fishing effort.

Research activity	Organisation	Summary of activities
Incorporation of economic information into management scenario modelling	OFP	Integrates the available information on the population biology of major tuna species in the western Pacific with economic information on the fisheries and markets; develops bioeconomic model to assess economic rent and economic benefits to FFA countries
	FFA	Collects and disseminates economic and marketing information to the government and private sector in member countries

The CWP noted the trend for socio-economic data to be increasingly requested for use in fisheries management and has recognised the need for the improved availability of such data. The CWP recognises the need for collaboration between fishery statisticians, economists and managers in determining the data required and the concepts and definitions to be applied to these data (Appendix 6 CWP-18).

Table 3.2 Summary of data types handled by the selected international and regional programmes

	Commercial fishery data	Biological and ecological data	Environmental data	Socio-economic data	Comments
SPC-OFP	✓	✓	✓	✓	Collate flag state reports including aggregated and fine scale catch and effort data. Catch and effort log sheets provided to SPC by member countries and territories, mostly within the EEZ. About 89% coverage from logbook data in SPC area. Some high seas data provided voluntarily. Missing data from some fishing nations. Aggregated (summary logbook) data submitted by DWFNs according to agreed spatial and temporal resolution by gear type. Supplemental data obtained through industry and observer reports if no logbooks provided. Use of standard regional data collection formats encouraged for catch and effort data (log sheets), port sampling data and observer data. Primary source of biological and ecological data are observer reports supplemented by national port sampling initiatives. Bio-economic models formulated on the basis of socio–economic data collected by FFA.
IATTC	✓	✓	✓		Transcribe logbook data and collate flag state reports. Collect and collate port sampling, transhipment, unloading and observer data according to standard formats. Extensive monitoring and analysis of dolphin and other species, recent emphasis on sharks; observer data.
CCSBT	✓			✓	Developing a database for fishery statistics and trade statistics. Ongoing discussions in relation to obtaining consensus from members concerning minimum data standards and the subsequent confidentiality of those data.
CCAMLR	✓	✓	✓		Collate flag state reported catch and effort data at various levels of spatial and temporal aggregation: 'real-time' catch and effort reports, for each 5-day, 10-day or monthly interval during fishing seasons; fine-scale catch, effort and biological data (operational data encouraged); and annual and monthly summaries of catch and effort (STATLANT) data. Collect biological data through scientific observer data and reports. Implement catch documentation scheme. Ecosystem information collected under CEMP.
ISC	✓	✓			A standardised format for data submissions has been agreed by the ISC Statistics Working Group – catch and effort data reported annually including total catch and effort (nationally) and summarised logbook data (nationally) for all fleet segments according to agreed spatial and temporal resolutions. Verification of catch and effort data at source using landings data; observer data; and trade statistics. Length data submissions based on data originating from national sampling programmes – standardised format for sampling and reporting encouraged. Provides for exchange on views on scientific issues for tuna and tuna-like species in the North Pacific.
ICCAT	✓	✓	✓		Catch and effort data submissions according to agreed spatial and temporal resolution by nation, vessel and gear type. ICCAT had been carrying out environmental-related activities including work on associated and independent species and by-catch.
FFA	✓			✓	Position information; regional VMS programme. Regional observer programme Collect socio-economic particularly in relation to licensing and access arrangements for negotiation purposes.
IOTC	✓	✓			Catch and effort data submissions by contracting parties obligatory and non-contracting parties encouraged according to standard spatial and temporal resolutions according to vessel and gear type by

	Commercial fishery data	Biological and ecological data	Environmental data	Socio-economic data	Comments
					nationality. Collection of data on bycatch (NADs) limited as no logbook requirement for bycatch reporting. Formal collection of biological data limited to size data reporting (length / weight data reported monthly by 5x5). Mechanisms for obtaining size data include port-based sampling. Effort data supported through annual submission of vessel and gear characteristics. Trade statistics collected for selected species. Regional tagging programme feasibility study underway.
SCTB	✓	✓	✓		Collate data, based on reports generated by SPC-OFP. Supports initiative for regional data collection standards through SCTB Statistics Working Group.

3.2 Data handling capabilities

Decision making for fisheries policy-making, planning and management relies largely on processed information, not raw data. The MHLC consultation report makes clear reference to the need for agreement on "*how to consolidate logbook and other data for all fleets in a confidential database.*" Further reference is made to the need for a "*data repository system for length-frequency and associated data*." These requirements coupled with responsibilities outlined in Annex I of the UNFSA point to the requirement for regional Database Management System capacity.

Database management systems offer a means of storing data securely, whilst permitting ready access to data for analysis purposes. A fundamental principle is that data should be held in the form in which they were submitted. This allows flexibility in the way data can be processed (e.g. filtered, aggregated, transformed), and ensures all calculations are reproduced from source data incorporating all revisions.

The primary functions of database management systems are:

- To ensure data conform to standard classifications
- To ensure validity of the data;
- To ensure data integrity and internal consistency;
- To secure and maintain primary data;
- To allow easy access to primary data;
- To process the data efficiently as required;
- To allow different data sets to be integrated, thereby increasing their overall utility.

These key functions facilitate data consolidation, integration, verification, analysis, and where necessary provide a mechanism for generating reports and information for dissemination.

In considering the issue of system design and capability, the role played by database developers should be addressed carefully; there are considerable advantages in the development of database management systems in parallel with any planned data collection system, not least with regard to enhanced opportunity for data standardisation and increased potential for data integration.

3.2.1 Database management system architecture

Available information technology is diverse and evolving rapidly; as a consequence it is important to seek the most up-to-date advice before selecting a system. When considering the approach to take for developing a new database management system, the following options are available:

- Taking commercially available software and adapting it to new requirements;
- Piecing together a system with different software components;
- Creating a custom system from scratch.

The advantages and disadvantages vary for each approach and should be weighed carefully before committing resources. The table below summarises some of the strengths and weaknesses of the three approaches.

DBMS design	Strength	Weakness
Adaptation of commercial software	Useful for prototyping purposes: • assists identification of data flows and system components; and, • assists integration process between data collection process and data storage design.	Can have long-term limitations particularly with regard to data collected under large-scale sampling programmes – eventual migration necessary to larger more robust system
Adaptation of existing components	Quick to instigate Comparatively low start-up costs	Significant modification of an existing system may lead to potential conflicts. As a result there may be high maintenance costs associated.
Custom designed systems	Flexible - can be configured to match data collection / sampling methodology closely. Database development itself can contribute to (act as a tool) data collection programme development, where standardisation can be of mutual benefit through standardisation of data collection and data storage	Essential presence and continuing support required of system developers, which can be costly.

In addition to data specific requirements a number of issues will influence the sustainability of system design, including hardware and software and the capacity of personnel to manage the system. In the short term there may be room for exploiting an existing system or combination of systems, although a custom designed system is likely to offer a more viable and sustainable long-term solution.

3.2.2 Hardware

Hardware solutions employed by selected RFMOs are summarised in the table below. All institutions assessed employ client server style configurations. There are considerable advantages to using a client-server type configuration, as employed by the OFP, FFA, IATTC and CCSBT, including: greater potential for expansion, relatively straightforward backup needs and central control of data.

Organisation	Server & Client machines	Upgrade policy
CCSBT	Combined file and database server Compaq 1.25 Gb RAM RAID type HD Broadband internet connection	Informal upgrade policy, predominantly driven by operating system compatibility. The system is 2 years old – server lifespan expected to exceed 5 years and 4 years for client machines.
OFP	Separate Database, Web and Mail servers. Database server specifications include: HP3000 900 MHz; I Gb RAM; Data storage - 6 drives 2 x RAID0, 3 x RAID5, 1 Hot swap	No routine replacement cycle. Upgrades chiefly motivated by software compatibility.

Organisation	Server & Client machines	Upgrade policy
	Client machine minimum specifications include: Pentium 4; 1.7 Ghz processor; 512 Mb RAM; 80 Gb Hard drive. Backup facilities include a 60 Gb supporting tape drive, soon to be upgraded to 840 Gb. The current drive is capable of backing up all existing data.	
FFA	VMS and FFA have separate networks and servers HP 9000 servers 10 x 5Gb HD.	Hardware upgraded when perceived necessary to support programmes.
IATTC	Servers include: database; mail; file; and web. Minimum specification - Pentium processor 512 Mb RAM, Storage 9 Gb Network 10/100 Mb TX Ethernet Numerous client machines with minimum specification – Pentium 400MHz 256 Mb RAM, Storage 20Gb	Flexible hardware standard set to accommodate change. Bi-annual capacity and obsolescence evaluations.

The issue of redundancy is an important one when considering hardware. The capacity to replace individual components should they fail is essential. RAID-style hard disks offer this facility. In the event of complete hardware failure it is important that a contingency plan exists. Comprehensive support contracts are commonly offered when hardware is purchased and may offer an appropriate solution. The CCSBT server is supported by just such a service contract, which offers complete server replacement within two working days in the event of complete system failure.

3.2.2.1 Backup and redundancy

The OFP, FFA, IATTC all maintain regular schedules for database backup. A combination of differential and full server area backups is undertaken on a daily, weekly and monthly basis. Backups are maintained in secure fireproof locations, both on and off site. CCSBT undertakes full server area backups daily and monthly; password protected copies are maintained both on and offsite. No provision has been made for out of country backups: data confidentiality issues were cited as potential stumbling blocks preventing out of country backups by both the OFP and CCSBT. No information was available regarding the ISC's backup policies.

3.2.3 Software

Software choice is integral to the operation of the database, and is reviewed below for WCPO organisations.

3.2.3.1 Operating systems and database software

	Database	Analysis software Embedded controls and processes
CCSBT	**MS SQL Server** For simplicity and flexibility, some links (particularly to the "CODES" table) are maintained through triggers and stored procedures rather than via referential integrity constraints. Date and time stamps used to manage data.	Standard routines including: referential checks, reports and, standard loading routines based on custom queries written in visual basic –using custom query building software (*Quick Query*). No other analysis software bar standard MS products.

	Database	Analysis software Embedded controls and processes
	Do not use public metadata standards although description fields are included for internal database administration purposes.	Any transformation and adjustment to data undertaken in a development version of the database in the first instance.
OFP	**Visual Fox Pro (VFP)** Relational database including administrative databases and metadata: Data registry database; Global reference tables	Custom written VFP routines for: Verification Analysis Data retrieval
CCMALR	**MS SQL Server** In house custom design and development. All major data sets integrated where possible	Off the shelf (MS Office, S-Plus, FORTRAN) and purpose built routines
FFA	**Oracle v 7.3** UNIX operating system Data integrated where possible: Regional vessel register, observer database, people and organisations, vessel activity and catch (US Treaty), violations and prosecutions, Fisheries agreements and licensing.	Custom written query software, designed and maintained by contracted developers.
ISC	Desktop PC database Still under development	No information

3.2.3.2 User interface

	Client interface
CCSBT	Client machines use 3 x MS Windows 2000 Professional, 1 x XP, operating systems. Visual basic interface - Limited for the time being to module associated with data entry Comprehensive data entry interfaces for three modules: • the Tag Recapture module; • the Trade Information Scheme module; and, • the Reference File module. All other data loaded electronically and extracted via SQL queries for other modules.
OFP	Visual Fox Pro (VFP) front-end (MS ACCESS front-ends developed for SPC clients) Comprehensive custom designed data entry system; the system is under continual development, paperless solutions are under investigation including FTP logsheet transfer. Comprehensive post processing query and data retrieval system also written in VFP – 80-90% of queries are pre-written. A professional licence is held by OFP that permits 3rd party software and subset dissemination.
CCMALR	MS Access front end.
FFA	Database front-end – custom written ORACLE VMS front-end – custom programme (*MapTrac*) based on MapInfo
ISC	No information

3.2.3.3 Upgrade policies

	Upgrade policy
CCSBT	Informal upgrade policy Driving force behind upgrades is software compatibility with member States
OFP	No scheduled review Upgrades when necessary, driving force is compatibility. Extensive software testing prior to upgrades incl. patches upgrades
CCMALR	Annual review and upgrade cycle
FFA	Upgrade as and when available
ISC	No information

3.2.4 Personnel

Staffing requirements necessary to maintain a database management system depend greatly on the data types processed, the amount of data received, and the format in which they are made available.

Staffing needs may be high during the early stages of database management system development. Subsequent needs may level out although continued commitment to database management is essential. Essential personnel include a database administrator, a programmer and data entry staff. Outsourcing data entry may be an option, although experience has shown that outsourcing data entry can have negative implications on data quality and may also be regarded as a threat to data security and confidentiality.

OFP	8 permanent staff • 1 x Fisheries Statistician responsible for overall management of the section, liaison with users external to SPC, editing and publication of statistical bulletins, and conducting statistical analyses • 1 x Programmer / Research Officer responsible for maintaining data processing and query interface software, providing technical support for tuna fishery database systems in SPC member countries and territories, and compiling data summaries. • 1 x Research Officer / Analyst responsible for maintaining data processing and query interface software, providing technical support for tuna fishery database systems in SPC member countries and territories, and maintaining the SPC/OFP website. • 1 x Fisheries Database Supervisor is responsible for supervising the processing of data, maintaining data processing software, and compiling data summaries • 4 x Data Entry Technicians responsible for data entry and other secretarial duties, as required. In addition, technical support is provided to national and regional port sampling and observer programmes through the work of 3 further staff members not strictly linked to data handling, but who nevertheless influence the quality if data submissions. These include a port sampling supervisor, an observer supervisor, and a port sampling and observer trainer. IT system management is handled independently of the OFP by the SPC IT unit that handles operating systems and server backup.
FFA	4 permanent staff including a database developer – the bulk of design work and development has been outsourced. A combination of data entry clerks and FFA admin staff manage data processing needs.
ISC	No information – the system is to be managed by the Fishery Agency of Japan
IATTC	IATTC employs 7 permanent IT staff including: • 1 x System manager • 1 x Assistant system manager • 1 x Data administrator doubling as a • 1 x Data administrator • 2 x Programmers • 1 x Graphics/web designer Additional support is available from some 7 data editing and data entry personnel. IATTC are unsure if current staffing levels will be sufficient to support all projects.
CCSBT	Data submissions predominantly take electronic form, although on occasions there is a requirement for data entry (e.g. tagging returns, trade information). Data entry was formerly outsourced but the quality was deemed poor; all data entry is now undertaken by the database manager with assistance from the administrative office. • 1 x database manager responsible for editing and publication of statistical bulletins, supervising the processing of data, maintaining data processing software, compiling data summaries and maintaining the SPC/OFP website. • 1 x administrative officer who occasionally assists with data entry.

There is still some room for increasing the data management workload at OFP without increasing the number of current staff (Tim Lawson, OFP, pers. comm.). However, if, in the long term, there is a major increase in (a) logbook data, (b) port sampling data, (c) observer data and/or (d) implementation of a large-scale tagging programme, then increased staffing may be required. On the other hand, OFP currently has a need for an additional position to conduct statistical analyses related to data management,

including the evaluation of data quality, the estimation of annual catches, and the design of sampling programmes.

Staffing levels associated with data handling at IATTC appear adequate, although it is felt that these should be monitored closely to assess whether research needs can be met sustainably.

3.2.5 Summary

With regard to assessing data handling capacity of candidate organisations within the WCPO region, information insufficient for comment was made available regarding ISC staffing and database capacity. Conversely, available information indicates that OFP could manage data on behalf of the Commission in the short term without an immediate requirement for additional staff, other than a position to conduct statistical analyses related to data management (Tim Lawson, OFP, pers. comm.). If, in the long term, there is a major increase in data compiled on behalf of the Commission, then additional staffing may be required.

In terms of technical capacity (hardware and software associated with the OFP database management system) all indications point to a relatively sophisticated system on a par with systems used elsewhere for the management of regional fishery data. The OFP already compiles fishery data for the entire WCPO region, although data submissions are made on a voluntary basis and as a result are not comprehensive. Notwithstanding this, the types of data handled by OFP reflect the data types likely to be collected on behalf of the Commission.

3.3 Data security provision and policy

The importance of data security and confidentiality policies can not be overstated in the context of a RFMO, and stems from the recognition that data is a resource and as such has a value, whether economic or otherwise. Confidence in RFMO security and confidentiality policies underpins the willingness of member States to submit data.

Security policies address overarching needs relating to the confidentiality of data submitted to RFMOs and must reflect security considerations relevant to both hardcopy and electronic data. Security policies must mitigate against theft of data and hardware; data loss (hardware and software failure, data corruption); and contravention of confidentiality policies. Commonly applied security measures include:

- Restricted access to premises where data are held, whether in electronic or hard copy format.
- Hardware access limited to valid data users, server access limited to database administrators/engineers;
- Integral database system security including username and password protected access to processed and pre-processed data;
- Restricted levels of access to data reflecting user requirements;
- Encrypted and password protected means of data transmission, including FTP sites, CD-ROMs, disks etc.;

In addition, provision must be made for data recovery in the cases of data corruption or loss. Routine backup procedures are essential, including provision for offsite backup. Recently, consideration has also been placed on the importance of developing provisions for so called *doomsday scenarios*, where copies of data are maintained out of country to ensure recovery in the event of serious environmental disaster or political instability (see Section 3.2.2.1).

The table below summarises some of the security policies of fisheries organisations both in and outside the WCPO region.

Organisation	Data security provisions
OFP	The OFP makes specific provision to ensure security and confidentiality of all data submissions *Access to unauthorised users is restricted through:* • Firewall protection • Integral operating system based password and username requirement for access to data. • Automatic system lock with password protection is instigated after 5 minutes • Restricted access to data for authorised users – e.g. scientists only have access to data through the query system (read-only access) • Development system (db command line) access restricted to database developers. *External users:* • SPC Fire wall –logically secure from external attack. • Web access password protected; access restricted to Member nations and OFP personnel. Member nations only have access to their own data sets (one user per nation). • Virus checking software is regularly updated *Physical security:* • All hardcopy data are stored in locked file cabinets in a secure area of SPC. • Offices locked out of hours • Access to hardware (servers restricted to IT personnel (locked room)
ISC	No details available
CCSBT	The CCSBT has recently agreed policies relating to data security. *Electronic data security* • The Database Manager will control the level of access that is allocated to individuals. • Access to the Secretariat's computers will require logging on with a valid user-name and password. Passwords of users will be changed every 60 days. • The Secretariat's computers will have screen savers with password protection. Screen savers will have a "wait" time of less than 10 minutes. • Access to the Secretariat's database will require a valid username and password. Direct access to the database will not be available via the internet. • Any confidential data that is not held on the database (e.g. data files received by the Secretariat prior to being loaded onto the database) will either be stored in a password-protected file, or on an encrypted section of the hard disk that requires a password to be accessed. • Transmission of confidential data via electronic means (e.g. e-mail, disk, CD, FTP) will always use password protected files (e.g. password protected Excel and Zip files), or an e-mail encryption system. • Backups of CCSBT data (e.g. tapes, disks) will be password protected and/or be stored in an external secure environment. *Physical data security* • The Secretariat's office is locked when unattended and is monitored by an electronic security system when the building is closed (e.g. in the evenings). • Physical data (e.g. paper records) of a confidential nature will be kept within the Secretariat's office, or in the company of a Secretariat staff member. • Physical data that are deemed to be highly confidential will be stored in filing cabinets and cupboards that are locked when the office is unattended. • Physical copies of electronic data provided to the Secretariat (e.g. CD's) will be destroyed or returned to the supplier of the data.
IOTC	Procedures for safeguarding records and databases include: • Access to logbook-level information will be restricted to IOTC staff requiring these records for their official duties. Each staff member having access to these records will be required to sign an attestation recognising the restrictions on the use and disclosure of the information. • Logbook records will be kept locked, under the specific responsibility of the Data Manager. These sheets will only be released to authorised IOTC personnel for the purpose of data input, editing or verification. Copies of these records will be authorised only for legitimate purposes and will be subjected to the same restrictions on access and storage as the originals. • Databases will be encrypted to preclude access by unauthorised persons. Full access to the

Organisation	Data security provisions
	database will be restricted to the Data Manager and to senior IOTC staff requiring access to these data for official purposes, under the authority of the Secretary. Staff entrusted with data input, editing and verification will be provided with access to those functions and data sets required for their work.

3.3.1 Physical security

Physical security of data applied by organisations within the region appears comprehensive when compared to policies applied outside the region. The OFP maintains a strict data security policy; servers are maintained in a secure room to which only appointed personnel have access; and user access is restricted to authorised OFP personnel whilst hardcopy data are stored in locked filing cabinets. FFA and CCSBT maintain similar restrictions on physical access.

No information was available regarding the physical data security policies of the ISC.

3.3.2 Electronic data security

Access to electronic data should be controlled to ensure database integrity and confidentiality, but interfere as little as possible with legitimate access. OFP, IATTC, FFA, and CCSBT all demonstrate similar systems ensuring that data are logically secure. These centre upon access restrictions for nominated personnel based on a username and password system that tailors user access based on operational requirements. In this way, development system (database command line) access is restricted to database administrators ensuring database integrity. Access to other OFP users is restricted through a (read-only) query system. All organisations use software-based firewall protection against access by unauthorised external users and an additional layer of security exists, at the user level, through an automated system lock with password protection in the case of temporary absence of valid users.

No information was available on electronic data security associated with the ISC database.

3.4 Data confidentiality and data dissemination

Given the clear requirement for data dissemination, criteria and protocols for data confidentiality will need to be established, which define the framework within which data may be disseminated. These criteria and protocols generally constitute rules-based data confidentiality policies. Where agreement has been reached, confidentiality policies describe the type and resolution of public domain data and actions necessary to gain access to non-public domain data. A number of common conditions surrounding issues of data confidentiality exist.

It is usual, when faced with a data request, for an organisation to be obliged to either seek the data owner/originator's permission or to at least inform them that the data have been supplied, to whom and for what reason.

Most organisations protect the identity of individual vessels, even in requests from Member scientists. The point is usually made that the name of the vessel is not important, that a code is sufficient. Although data may be supplied for scientific work, there are usually strict rules on the application of the data outside of the particular analysis for which it was intended.

Many organisations apply rules that preclude the supply of aggregated data if that aggregation contains fewer than 3 vessels. This is because if one knows which vessels have participated in a fishery, and there are only one or two of them, it is fairly easy to determine where a competitor has been fishing.

Rules-based confidentiality policies are usually defined in an effort to establish procedures for the release of data and generally specify data type and resolution. In certain cases (e.g. CCSBT) the issue of confidentiality is treated on a case-by-case basis. Protocols are defined outlining procedures to be

followed if access to data is requested. Similar procedures are outlined in rules-based confidentiality policies where ad hoc data access is requested, both from Members and non-Members.

The table below includes information relating to data confidentiality policies of organisations both within the WCPO region and outside.

Organisation	Data confidentiality
OFP	The OFP policy on the dissemination of data is identical to the policy that was established by the Standing Committee on Tuna and Billfish at its eleventh meeting in July 1998 (Anon., 1998). Annual catch estimates, by gear type, flag state and year, are considered to be in the public domain. Policies relating to catch and effort agreed at the eleventh meeting of the Standing Committee on Tuna and Billfish (SCTB11). • Catch and effort data grouped by 5° longitude by 5° latitude by month for longline and 1° longitude by 1° latitude by month for surface fisheries, for all fishing nations combined, are considered to be in the public domain. • Catch and effort data grouped by 5° longitude by 5° latitude by month for longline and 1° longitude by 1° latitude by month for surface fisheries, stratified by fishing nation, are available for release at the discretion of the Co-ordinator of the SCTB Statistics Working Group (SWG), for those sources of data which have so authorised the SWG Chairman. For those sources of data that have not authorised the SWG Chairman to release data at his discretion, authorisation for the release of data must be obtained from the sources of the data. • Catch and effort data grouped at a finer level of time-area stratification may be released with authorisation from the sources of the data. • Catch and effort data are released for research purposes only, and to individuals who can be trusted to use the data responsibly. The person requesting the data is required to provide a description of the research project. The data are released only for use in the specified research project and the data must be destroyed upon completion of the research project. However, catch and effort data may be released for general usage, such that the data need not be destroyed, with authorisation from the sources of the data. • The person requesting the data will be asked to provide a report of the results of the research project to the SWG Chairman for subsequent forwarding to the sources of the data. All SPC member countries and territories, except New Zealand, have authorised the OFP Fisheries Statistician to release data at its discretion. Of the non-SPC sources of data held by the OFP, the Forum Fisheries Agency, Japan and Korea require authorisation before their data can be released. Policies relating to length data are the same as those detailed for catch and effort data Observer data - observer reports released to the agency that arranged the placement of the observer (when the agency does not already have a copy of the report) or to the captain and owner of the vessel (if a request is received by the OFP). Otherwise, only summary information for research purposes is released by the OFP.
IATTC	Confidentiality is provided by laws against search and seizure of IATTC records. Detailed data (e.g. logbook or company records) are only released with written permission of the individuals providing the data to the IATTC. Access is provided to summary data, which does not reveal the identify of operations of individual companies or vessels. Catch & effort data summaries on 5x5-quarter resolution are available on request. Coastal state agencies may be provided 1x1- month catch & effort summaries for their EEZs on request. Other formats may be provided on an ad hoc basis by request to and approval of the Director of Investigations: requests for scientific purposes and research collaboration are seldom disapproved. Release of selected data from the observer program is provided for by signature agreement of vessel skippers and owners. This data is available to flagging nations, and to the International Review Panel (IRP) without vessel identification, for purposes of investigating compliance with marine mammal protection.

Organisation	Data confidentiality
	IATTC catch and effort data aggregated by 5° by 5° are made available, if catches by individual vessels cannot be identified in the aggregated data. Data aggregated by 1° by 1° may be released if justified by reasonable use. Raw logbook data may only be released with authorisation from the skipper and the owner. Observer data are confidential, although under certain conditions observer data are provided to the government of the fishing nation in which the vessel is registered. Other research data collected by individual scientists are exchanged with scientists outside IATTC on an ad hoc basis.
IOTC[5]	The IOTC has a defined policy for releasing catch-and-effort and length-frequency data: • Catch-and-effort and length-frequency data grouped by 5° longitude by 5° latitude by month for longline and 1° longitude by 1° latitude by month for surface fisheries stratified by fishing nation are considered to be in the public domain, provided that the catch of no individual vessel can be identified within a time/area stratum. In cases when an individual vessel can be identified, the data will be aggregated by time, area or flag to preclude such identification, and will then be in the public domain. • Catch-and-effort and length-frequency data grouped at a finer level of time-area stratification will only be released with written authorisation from the sources of the data. Each data release will require the specific permission of the Secretary based on the following criteria: o A Working Party will specify the reasons for which the data are required. o Individuals requesting the data are required to provide a description of the research project, including the objectives, methodology and intentions for publication. Prior to publication, the manuscript should be cleared by the Secretary. The data are released only for use in the specified research project and the data must be destroyed upon completion of the project. However, with authorisation from the sources of the data, catch-and-effort and length-frequency data may be released for long-term usage for research purposes, and in such cases the data need not be destroyed. o The identity of individual vessels will be hidden in fine-level data unless the individual requesting this information can justify its necessity. o Both Working Parties and individuals requesting data shall provide a report of the results of the research project to IOTC for subsequent forwarding to the sources of the data. Data submitted to working parties • Data submitted to Working Parties will be retained by the Secretariat or made available for other analyses only with the permission of the source. The above rules of confidentiality will apply to all members of Working Parties.
CCAMLR	CCAMLR has a series of rules for access to data. 1. For the preparation of scientific papers for CCAMLR, all scientific data are available but only on request from nominated scientific committee representatives, for specified reasons. All data originators/owners are informed that the data have been supplied. 2. If scientists wish to publish analyses that include CCAMLR data, they must obtain permission of the data owner/originators. 3. For data pertaining to compliance and enforcement, data access is limited to nominated Member officers. These are highly sensitive data, often including commercial information. Therefore, the data are filtered on a need-to-know basis, so that for instance the owners can see all the data whereas importing states can only see quantities (not destination companies, and not origins) of fish. 4. Although haul-by-haul data may be released to CCAMLR Members requesting them, the identity of observers and vessels is protected by the adoption of codes. CCAMLR has recently become concerned about the commercial confidentiality of data available to participants at working groups. This concern has come about because some delegations to scientific working groups bring with them representatives of commercial organisations. The solution has been to apply the same rules as above at working groups. Thus data are only supplied to specific requestors (not made generally available to all participants) for specific work (for instance, in the WCPO context someone conducting an assessment of bigeye would only be given bigeye data, not yellowfin data).

[5] The IOTC policy on data dissemination was modelled on the OFP policy (David Ardill, IOTC, personal comment)

Organisation	Data confidentiality
	The following Rules for Access and Use of CCAMLR Data were adopted by the Eleventh Meeting of the Commission (CCAMLR-XI, paragraph 4.35*): These rules replace those adopted at the Eighth Meeting of the Commission (CCAMLR-VIII, paragraph 64) (a) All data submitted to the CCAMLR Data Centre should be freely available to Members for analysis and preparation of papers for use within the Commission, the Scientific Committee and their subsidiary bodies. (b) The originators/owners of the data should retain control over any use of their unpublished data outside of CCAMLR. (c) Requests to the Secretariat by individual scientists of a Member for access to data in the CCAMLR Data Centre will only be considered if the request has been approved in writing by the Representative to the Scientific Committee (or his nominated deputy) of that Member. The Representative is responsible for informing the individual scientist requesting the data, of the rules governing access to CCAMLR data and for obtaining the requester's agreement to comply with these rules. (d) When Members request access to data for the purpose of undertaking analyses or preparing papers to be considered by future meetings of CCAMLR bodies, they should indicate the reason for the request and the nature of envisaged data analysis. The Secretariat should supply the data and inform the originators/owners of the data of this action, together with the details of the original request. When data are requested for purposes other than consideration by future meetings of CCAMLR bodies, the Secretariat will, in response to a detailed request, supply the data only after permission has been given by the originators/owners of the data. (e) Data contained in papers prepared for meetings of the Commission, the Scientific Committee, and their subsidiary bodies should not be cited or used in the preparation of papers to be published outside of CCAMLR without the permission of the originators/owners of the data. Furthermore, because inclusion of papers in the *Selected Scientific Papers* series or any other of the Commission's or Scientific Committee's publications, constitutes formal publication, written permission to publish papers prepared for meetings of the Commission, Scientific Committee and Working Groups should be obtained from the originators/owners of the data and authors of papers. (f) The following statements should be placed on the cover page of all unpublished working papers and background documents tabled: This paper is presented for consideration by CCAMLR and may contain unpublished data, analyses, and/or conclusions subject to change. Data contained in this paper should not be cited or used for purposes other than the work of the CCAMLR Commission, Scientific Committee, or their subsidiary bodies without the permission of the originators/owners of the data.
ISC	Public domain: Total catch and effort aggregated over entire North Pacific with caveat that some discards in N Pacific not reported. Confidential: Raw data, both commercial and biological contains proprietary information and is therefore considered confidential. Access restricted to contributors and authorised scientists of ISC WGs. Any requests from non-contributing parties, all ISC members and observers will be informed of details of the request and permission solicited from contributors. If species specific data are requested the appropriate WG head will take lead in seeking approval. Access to non-public domain data by contributors for purposes other than stock assessment treated as above. Access rules cannot be changed without agreement of all contributors
CCSBT	Data provided for the CCSBT database will be treated confidentially and will not be released by the Secretariat except where members of the Extended Commission approve the specific data release on a case-by-case basis. Consensus at SAG/ESC meetings and subsequent approval by the Extended Commission is sufficient approval for release of specific data to members of the Extended Commission for the purpose of routine data exchange for the stock assessment and management procedure. This approval will apply until the Extended Commission revises the data confidentiality policy. Release of other data requires case-by-case approval from an exchange of correspondence (including e-

Organisation	Data confidentiality
	mails) between Extended Commission member's nominated contacts. When providing approval to release specific data, members of the Extended Commission can specify that the particular data does not require their re-approval for future releases by the Secretariat. In these situations, members of the Extended Commission must also specify the groups of people (e.g. public, Extended Commission members) to whom the Secretariat may release the data without requiring case-by-case re-approval. The Secretariat will maintain a list of data sets (and associated groups of people) that are approved for release without requiring case-by-case re-approval. The list will be provided to members of the Extended Commission and members of the Extended Commission have the right to revise the approvals that they have given.

3.5 Summary

In considering the required capabilities of organizations within the WCPO region to meet the Commission's interim data management needs, three possible candidate organizations are identified as currently handling equivalent data to that likely be required by the Commission: SPC-OFP, FFA, and ISC, as summarized in Table 3.2. A commercial consulting company could undertake interim data needs for the Commission. However, the development time and equipment necessary make such consultants less time- and cost-effective than the candidate organizations considered.

Priority data requirements of the Commission in the short- to mid-term are likely to comprise fishery and biological data, including: annual catch estimates; catch and effort data, and biological information, specifically length frequency data. Data sources are likely to include flag state reported catch estimates, catch and effort data submitted by flag states and coastal states, and observer data and port sampling data.

Given these interim priorities, FFA's limited management of catch and effort and biological data limits its comparative strengths as a candidate for the provision of interim data management services to the Commission. FFA handles both technical and economic data which although likely to be important aspects of the long-term data needs of the Commission are unlikely to be regarded as a priority, in the context of scientific data needs in the short to mid-term. Nevertheless, FFA capacity and expertise in relation to a future regional vessel register and regional VMS should not be overlooked, particularly in the context of the Commissions MCS needs. Crosscutting benefits associated with the implementation of a comprehensive regional vessel register and regional VMS will undoubtedly influence the Commissions' capacity to monitor stock status and fishing effort more effectively in the long-term.

Both ISC and OFP manage data equivalent to those likely to be of priority to the Commission. The ISC compiles both fishery (annual catch and catch and effort data) and length frequency data for the North Pacific, with the exception of longline and purse seine data that are compiled for the entire Pacific[6]. The OFP compiles data for the entire WCPO region, including fine-scale (operational) data, submitted by coastal states for domestic and DWF fleets operating in their respective territorial waters.

OFP and ISC both compile length frequency data; mechanisms for the integration of OFP length frequency data into the ISC database have been established. In addition to length frequency data, obtained through submissions from national port sampling programmes, the OFP also compiles data collected by national and regional observer programmes, which includes both operational (vessel and gear attributes and detailed catch and effort data) and biological data.

With regard to data handling capacity, limited information was available describing ISC technical capacity. Although details describing data collection and reporting standards and proposed data fields to be applied

[6] Amendments are planned relating to future fishery data submissions on the basis of sub-areas; appropriate spatial resolutions are to be proposed by the ISC Species Working Groups based on stock areas of major tuna species and billfish (ISC, 2002).

in a data management system were made available, no specific information relating to associated technical capacity (hardware, software, human resources) was available, preventing further assessment of capacity.

A significant body of information was available describing OFP technical capacity. The hardware used by the OFP is equivalent to that employed by other RFMOs handling similar volumes of data. OFP has particular strengths in the use of distinct file, mail and web servers, a forthcoming upgrade in data backup capacity, and the implementation of a minimum standards policy for client machines.

The use by OFP of a client server style configuration is reflected in all other data management systems reviewed, and indicates the significant benefits of such a configuration, including: increased capacity for expansion; central control of data (increasing security and database integrity) and relatively straightforward provision for system backup.

The operating system employed by OFP offers integral security features and associated benefits to data confidentiality. The database software used is MS Visual Fox Pro (VFP), regarded as a powerful database engine. Notwithstanding this, the conceptual design of the database could be relatively easily transferred to another system in response to the establishment of a recognized international benchmark.

At the client end all graphical interfaces are custom written in VFP, complimented by a suite of comprehensive, post processing, error checking routines. Double entry of data is undertaken ensuring the quality of hard-copy data processing. An estimated 80-90% of queries have been pre-written which account for all standard data requests and reporting needs. The query and data retrieval system is maintained in isolation (read-only) from the actual database, ensuring database integrity.

The data management system itself is integrated as far as possible and includes a global reference table and data registry database permitting real-time monitoring and evaluation of data submissions and data processing.

A professional license is held by OFP for VFP that permits third party dissemination of software and data sub-sets, facilitating data dissemination. All published datasets are accompanied by metadata, increasing data utility and ensuring compatibility.

If the OFP were to take on the role of interim data management on behalf of the Commission, significant modifications to hardware and software are unlikely. Computer memory is now relatively cheap, and therefore could easily be added to existing hardware, although in the short- to mid-term this is unlikely to be necessary. Similarly, the database software employed by OFP is adequate for the task of interim data management and could be transferred to a different system with relative ease if international standards call for this in the future. Were this to be the case, significant effort would be required for re-writing data quality control and data interrogation queries. The planned up-grade of back-up hardware is more than capable of handling likely increases in data volume.

The implementation of interim Commission data management needs is unlikely to significantly increase OFP staff workload, given that the majority of data are already handled by the OFP. In terms of technical personnel there is still some room for increasing the data management workload at OFP without increasing the number of current staff (Tim Lawson, OFP, pers. comm.). Data types to be handled are unlikely to differ significantly especially the majority of data standards recommended for the interim mirror those already applied by the OFP.

However, if a major increase in (a) logbook data, (b) port sampling data, (c) observer data and/or (d) implementation of a large-scale tagging programme occurred in the long term, then increased staffing may be required. OFP currently has a need for an additional position to conduct statistical analyses related to data management, including the evaluation of data quality, the estimation of annual catches, and the design of sampling programmes.

4 References

Anonymous. 1998. Report of the Eleventh Meeting of the Standing Committee on Tuna and Billfish, 28 May – 6 June 1998, Honolulu, Hawaii, United States of America. Secretariat of the Pacific Community, Noumea, New Caledonia. 108p. http://www.spc.org.nc/oceanfish/Docs/SCTB11.pdf

Anonymous. 1999. Report of the Third Meeting of the Tuna Fishery Data Collection Forms Committee, 9–10 December 1998, Brisbane, Queensland, Australia. Secretariat of the Pacific Community, Noumea, New Caledonia, and Forum Fisheries Agency, Honiara, Solomon Islands. 84p. http://www.spc.org.nc/oceanfish/Docs/FC_1998.pdf

Anonymous. 2001. Report of the Fourth Meeting of the Tuna Fishery Data Collection Committee, 6–8 December 2000, Brisbane, Queensland, Australia. Secretariat of the Pacific Community, Noumea, New Caledonia, and Forum Fisheries Agency, Honiara, Solomon Islands.

CCAMLR. 1999. Fishery Data Manual. CCAMLR, Hobart, Australia.

Everett, E., M.G. Hinton & W.H. Bayliff. 1991. Procedures for Collection and Handling of Tuna Fishery Data by Field Station Personnel. Revision C, January 1991. Inter-American Tropical Tuna Commission, La Jolla, California, United States of America. 46p.

FAO. 1999a. Guidelines for the Routine Collection of Capture Fishery Data. Prepared at the FAO/DANIDA Expert Consultation, Bangkok, Thailand, 18-30 May 1998. FAO Fisheries Technical Paper. No. 382. Rome, FAO.

FAO. 1999b. Legal Aspects of the Collection of Fisheries Data, FAO Fisheries Circular No. 953. Rome, FAO.

FAO. 1999c. Report of the eighteenth session of the Coordinating Working Party on Fishery Statistics. Luxembourg, Grand Duchy, 6-9 July 1999. FAO Fisheries Report No. 608. Rome, FAO. 1999. 62p.

FAO. 2000. Satellite-based vessel monitoring systems international legal aspects & developments in state practice. FAO Legal Papers Online #7. http://www.fao.org/legal/Prs-OL/vms7.pdf

FAO. 2001. Report of the nineteenth session of the Coordinating Working Party on Fishery Statistics. FAO Fisheries Report No. 656. Rome, 10-13 July 2001. 91p.

FFA. 1996. 6th Technical Consultation on Fishing Monitoring Systems. FFA Report #96/31.

Koh, J., D. Moon & D. An. 2002. National tuna fisheries report in 2002, Republic of Korea. Working Paper NFR–10. Fifteenth Meeting of the Standing Committee on Tuna and Billfish, 22–27 July 2002, Honolulu, Hawaii, United States of America. National Fisheries Research and Development Institute, Busan, Korea. 4p.

ISC 2002. Report of Statistics Working Group. Third Meeting of the Interim Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean. Nagasaki, Japan, January 2002.

Lawson, T. A. 2001. Observer data held by the Oceanic Fisheries Programme covering tuna fishery bycatches in the western and central Pacific Ocean. Internal Report No. 45. Oceanic Fisheries Programme, Secretariat of the Pacific Community, Noumea, New Caledonia. 40p.

Lawson T. 2002. Status of data collection, compilation and dissemination. SCTB15 Working Paper SWG-1. Hawaii, July 2002.

Lawson, T., P. Williams, C. Millar and E. Schneiter. 2002. Data requirements of the SPC Oceanic Fisheries Programme and status of data. Oceanic Fisheries Programme Internal Report No. 47.

Miyake, M. 1990. Field Manual for Statistics and Sampling of Atlantic Tunas and Tuna-Like Fishes. Third Edition. International Commission for the Conservation of Atlantic Tunas, Madrid, Spain. 184p.

Williams P.G. 2002. Current status of data available from the Indonesian and Philippines domestic tuna fisheries. SCTB15 Working Paper SWG-7. Hawaii, July 2002.

5 Figures

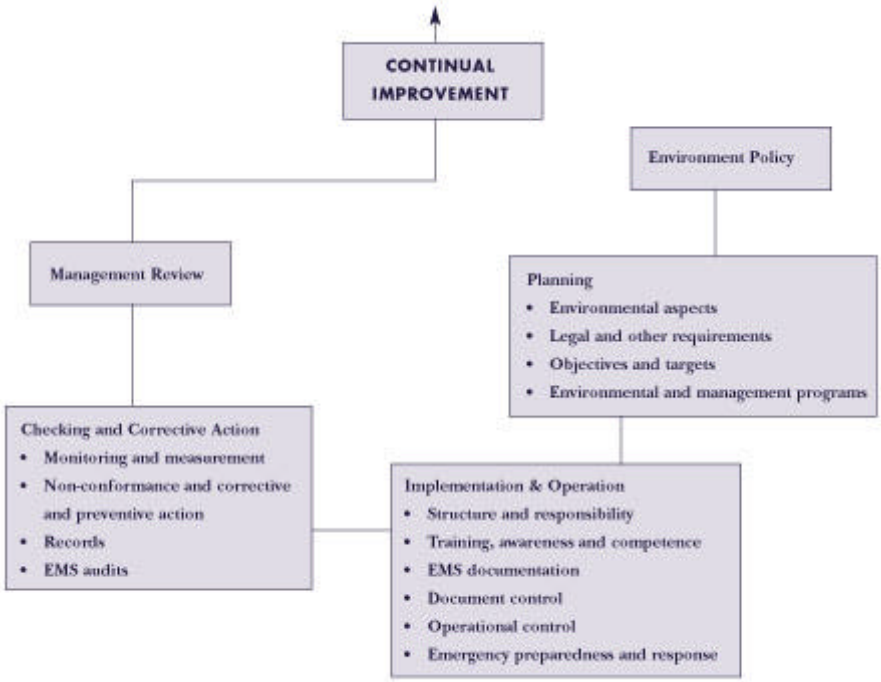

Figure 2.1 Best Practice Management. From: AS/NZS ISO 14001 (Int). (1995). Environmental management systems; Specifications with guidance for use.

6 List of Organisations Contacted

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