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REPORT OF FISHERIES RESOURCE MANAGEMENT COURSE IN 2005 (FRMC 2005)

Fourth session to support the IOTC-OFCF joint project to improve quality of tuna statistics in the Indian Ocean

complied by

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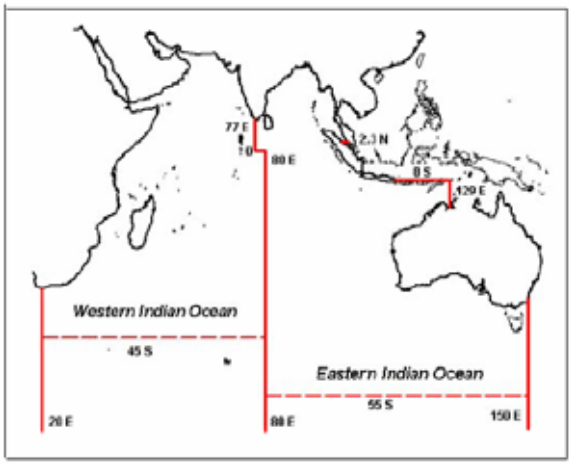

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PREFACE

BACKGROUNDS AND OBJECTIVES

The five years' IOTC-OFCF joint project to improve quality of tuna statistics in the Indian Ocean started in 2002. To now, 4.5 years have been quickly pasted and various activities have been successfully and productively achieved because of the mutual and strong understandings of the importance of this project by all relevant people and Governments in the region.

Besides the major IOTC-OFCF activities, OFCF has been also concurrently conducting the Fisheries Resource Management Course (FRMC) since 2002 to support the IOTC-OFCF project from the different angle. The immediate objectives of the FRMC is to invite tuna fisheries statistical officers in the developing countries in the Indian Ocean to the OFCF, Japan and provide various lectures and on-site studies regarding (tuna) fisheries statistics and fisheries managements based on these data. However, the long-term and intrinsic objectives are that participants will apply some of materials that they learned in the FRMC to solve problems in their tuna fisheries statistics in order to improve accuracy of the data.

PARTICIPANTS

Four times of FRMC had completed. Table 1 shows the summary of the past four and this year's FRMC.

Table 1 Summary of the past four FRMC (2002-05) and the forthcoming one in Nov-Dec. 2006.

No.	Year	Countries of participants (number)	Total	Coordinator (OFCF)	Technical Coordinator
1	2002	Indonesia (1) , Thailand (1)	2	Nemoto	Nishida (NRIFSF)
2	2003	Thailand (1), Sri Lanka (2)	3	Uchida	
3	2004	India(1), Iran (1) , Mauritius (1)	3		
4	2005	Maldives (1), Seychelles (1), Sri Lanka(1)	3		
5	2006	China (1), Indonesia (1), Kenya (1), Tanzania (2)	5		

CURRICULUM

In the FRMC, there are four components in its curriculum, i.e., (a) lectures, (b) visits, (c) presentations and (d) reports. In the lectures we offered various ranges of teaching relating to

tuna fisheries statistics by experts and specialists as shown in Tables 2 and 3. In 2005 we gave 20 lectures (53 cumulative hours) in three weeks. For the visits, we provided participants opportunities to see various and unique places relating to tuna fisheries statistics such as fish markets, tuna landing places, fisheries agencies, statistical offices in Japan etc for them to pick up tuna statistics related activities quickly (Tables 2-3). In 2005, participants visited 13 places in three weeks.

Every year participants are requested to make two PowerPoint presentations and one report. Regarding two presentations the first one is held in the National Research Institute of Far Seas Fisheries (NRIFSF) when they visit as one of the NRIFSF's Seminar series and the second presentation is taken place in the OFCF HQs in Tokyo in the very last day of the FRMC to show their progress. The presentation includes (a) general description of tuna fisheries in the participant's country; (b) tuna fisheries (catch) statistical collection system and data processing method in the participant's country to make the official tuna catch statistics; (c) Tsunami effects and recovery situations on tuna fisheries and statistics (Indonesia, Seychelles, Sri Lanka and Thailand); and (d) (in the OFCF HQ only in the vary last day) Prospects and ideas how participants can apply what they have learned during the FRMC, in order to improve quality of tuna fisheries statistics in their countries by highlighting tuna statistical collection system and data processing methods. In the report, participants summarize lectures, visits and the item (d) above.

THIS DOCUMENT

This document presents the reports made by three participants in the 2005 FRMC. To show, and understand their real works, we did not edit their original reports except some formats related compilations in the text. We believe this document will be helpful for those who are interested in our activities not only in the IOTC communities but also in other regions.

2003 FRMC

Table 2 Schedule of the 2005 FRMC

Fishery Resources Management Course 2005 Schedule					
Date		Contents			
		AM (09:30～12:30)		PM (13:30～16:30)	
		Lecture		Lecture	
13-Nov	S	Arrival in Japan			
↓ Session No.1 ↓					
14-Nov	M	Guidance &Orientation	OFCF (Uchida) OVTA (Satake)	Courtesy Visit to Fisheries Agency &OFCF	
15-Nov	T	Fisheries Statistics System in Japan			JFA (Imamura)
16-Nov	W	Spatial Analysis of Resources with GIS	Ito &. Nishida	Management Method of International Fisheries Resources	Nishida
17-Nov	T	Fisheries Resources Management	Inada	Practice of Statistic Analysis of Fish Catch Data	Tanaka
18-Nov	F	Responsible Tuna Fisheries	Harada	Method of Data Sampling	Miyake
19-Nov	S	Study Tour to Tsukiji Fish Market			
↓ Technical Training ↓					
20-Nov	S	Move to Shimizu(National Reseach Insitute of Far Seas Fisheries			
21-Nov	M	Schedule in the National Research Institute of Far Seas Fisheries (See Table 3)			
22-Nov	T				
23-Nov	W				
24-Nov	T				
25-Nov	F				
26-Nov	S	Move to Makuhari (OVTA)			
↓ Session No.2 ↓					
27-Nov	S	Day off			
28-Nov	M	Study Tour (JAFIC and and Kasai Rinkai Park)			
29-Nov	T	Study Tour (National Research Institute of Fisheries Science and JAMARC)			
30-Nov	W	Study Tour (Kanagawa Fisheries Technology Centre and Misaki tuna port)			
1-Dec	T	Japan's Fisheries	OFCF (Matsumi)	Japn's Overseas Fishery Cooperation	OFCF(Matsumi)
2-Dec	F	Distribution and Ecology of Tuna Species			Mohrii
3-Dec	S	Study Report Making			
4-Dec	S	Day off			
5-Dec	M	Study Report (Discussion)	Nishida	Study Report (Presentation)	Nishida

2004 FRMC

Table 3 Schedule (National Research Institute of Far Seas Fisheries, Shimizu, Shizuoka)

Date	Subject (*)
Nov. 21 (Mon.)	Greetings to the DG. Orientation (Nishida)
	(Lecture) “Pole and line fisheries statistics” (Uosaki)
Nov. 22 (Tues.)	(Visit) Shizuoka Statistics and Information Centre
	(Lecture) ”Purse seine fisheries statistics” (Sato) (Lecture) “Biological statistics” (Yamada)
Nov. 23(Wed.) National holiday	(Visit) Tokai University’s Aquarium
Nov. 24(Thurs.)	(Visit) Shimizu tuna fishing port branch office, Far seas fisheries division, Fisheries Agency of Japan (Visit) Tuna landing centers (Shimizu fishing port)
Nov.25(Fri.)	(Visit) Yaizu fishing port branch office of the NRIFSF (Visit) Tuna unloading site in the Yaizu fishing port (Lecture) “Statistics of longline fisheries” (Miyabe) (Presentation) by participants in the NRIFSF’s 67th seminar series

(*) Other activities in the spare time: preparation of the presentations and report (supervised by Nishida)

ACKNOWLEDGEMENTS

We sincerely thanks for all the experts and specialists provided excellent lectures, for those who made comprehensive guides for our visits and also for relevant OFCF staff who conducted administrative and logistic works on the FRMC 2005 effectively & efficiently. Our further appreciations are towards to three participants who made best efforts to learn materials in the FRMC 2005 and provided good presentations and reports.

2005 FRMC

PART 1: MALDIVES

SINAN HUSSAIN

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2. Visits

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2.3 Yaizu Port
2.4 Kasai Rinkai Park
2.5 Misaki Market

3 Application

1. Lectures

1.1 An Introduction to Japanese Fisheries Statistical System

The statistics system in Japan came in to existence in 1941. At that time, surveys from the prefecture were converted to statistical surveys based on a sampling theory. Since then various surveys have been conducted based on the population, which is a result of Census of Agriculture, Forestry and Fisheries and Agriculture.

In 1951, the system was revised and was based on food production and the species per land was found out. This system was also renewed in 1961 and in this year importance was given to find out the catch accounting for production

Fisheries data is collected mainly from the fisheries census, which is conducted to find more information regarding production and employment. This is done in a five yearly basis. A mini census is also conducted in the middle of these five years, which facilitates the main census and provide better estimates. Every year statistical surveys are carried out to find catches, harvest and the amount of input.

Every year, 1 Billion yen is allocated for Ministry of Fisheries, Forestry and Agriculture. But only 200 million of it is reserved for Fisheries Statistical surveys. This amount is excluding the labour cost

7000 survey points are developed across the country. This is from the private sector in collaboration with the government civil staff. Several blocks manage these points, which are administered by civil staff. Administrative units then manage these blocks, which is under the ministry of fisheries, forestry and Agriculture.

In the current system which is adopted by Japan, around 25% of the data is gathered by individual reports directly from fisherman. These reports are mainly through fisheries co-operatives. There are around 1500 co-operatives in Japan. 50% data is obtained from surveys, which are carried by the government. There is an uncertainty about the remaining 25% data, which is gathered from the surveys. As this surveys are carried out in very difficult circumstances.

1.2 An Introduction to GIS

Fisheries resources in Japan are managed by the help of satellite data, Fishery Data, Network and with the help of Marine GIS. These data is used for fisheries oceanography and data processing to evaluate fisheries quantity and to predict the fisheries resources.
Marine Explorer can be applied in wide variety of cases. It is used in the efficient management of observation data and Monitoring Ocean Condition and Planning based upon the available data and analyzing them. It could also be used in various management purposes and as well it act as a platform for modelling.

The GIS efficiently manages fishery information using various data. This system can be easily built using a CSV file, which can generate various outputs. GIS can produce horizontal and vertical distribution maps for all types of fishery. This helps to create oceanographic data.

GIS is also used to compute a specific area from a particular spatial distribution map domain. Also from buffering and polygon demarcation for marine preservation area can be made. The average deviation of this distribution maps for different types of data can be created grid wise as well. Just a plot of two points can derive the shortest distance and direction between two points.

The GIS is very important not only for the fishery authority. It can also be used for the fisherman as well. The various applications through GIS help the fisherman to forecast the area of good fishing ground. This helps to utilize the fisherman's resources in the most effective manner.

The GIS can be divided in to mainly three modules i.e. databases module, display module and the analysis module. Database module is responsible for the data entry, verifying and linking the data. The original CSV file is inputted. The satellite image is also fed in the database. These data is in binary form. Input data also contains normal data, which would be filtered and edited. This data can be of composite e form as well. Then this data is linked with various other databases, which contains similar information and require them. Maps are also created in this module. Both horizontal and vertical maps can be created with the help of managing the existing distributions of the map database.

The display module as the name suggests is responsible for the display functions. This module creates map, both in two-dimensional and three-dimensional. The user and the contour can also edit these maps. The multiple view function helps the users for a better understanding of the maps.

The analysis module carries out all the computational and analytical work. The function of calculating the distance between two mapping points and finding the area enclosed in the figure is done by this module. Calculating the average, deviation and the sum of the grids is also done with the help of this module. With the help of the maps data can also be extracted in a polygon form.

The GIS system uses various data from a lot of sources. They include data collected from GPS, Satellites, Vessels, Buoy, Current meter, Sediment trap, Camera, Benthos, Echo sounder, Side scan sonar, etc.

One of the very important applications is to find the movement of the current, fishing site and monitoring of temperature. The analysis of various data and categorizing them is very important in the analytical field. This is also achieved with the help of the GIS System.

1.3 Fisheries Resource Management in Japan

Abundance of fisheries species depends on the changes in the environment as other animals in the ecosystem eat it as well. We do know that abundance is mostly influenced by the catch amount in the fisheries resource.

There are two types of approaches to Fisheries Resource management
Practical approach: Fisheries is controlled for resource management purposes
Theoretical approach: Models about the management of fisheries and stock abundance.

In Japan, there are mainly three types of fisheries

- *Licensed: Minister approves the license*
- *Governor approves the license*

To maintain the resources in the pacific and to provide sustainable fisheries for the fisherman in Japan, the government controls

- *Entry regulation: the entry is limited for selective number of vessels and their sizes*
- *Input regulation: The inputs used in fishing are limited. For example: fishing gear*

After establishing the EEZ, the fishery of pelagic fishes started to decline. Oil crisis was also another factor that affected the fisheries. In previous years, the maximum pelagic fishery went

up to around 11 million tones where as now the total catch is around 4 million tones on an average.

There are some cases where fisher cooperatives that act autonomously stop some types of fishery for management of resources. Thus after few years or few months they start fishing again. Though it makes a huge loss during the stopped days, it gains more income revenue when it starts.

1.4 Fish Stock Assessment (Dr.Tanaka)

Fish is a self-regulating species. Unlike oil, fish is a self-reproducing species. Its stock retains though we catch them, but oil do not. But fish also have a limit. If we catch more fish than the reproducing rate, we end up with limited resources.

In marine biological resources,

- It can be said that it is a renewable and self-regulating resource. Thus we should ensure the sustainability of this resource
- It depends on the natural fluctuations in the surrounding environment. The global warming and other factors contribute to it.
- As fisheries resource is a shared property unless the fisherman catches it. So it is ideal that fisherman would think that if he catches first than he would owe it. So it results to over exploitation as well.

There are management objectives that are achieved by stock assessment.

1.5 Responsible Tuna Fishery

Vessels that are registered in Japan are long line, deep-sea fishery equipped with freezing compartments with around -60^0C. These vessels are more than 24m in length. These vessels cover around 90% of the longliners.

OPRT (Organization for Promotion of Responsible fisheries) was the initiation by the fisher communities with the involvement from the government. The initial task of OPRT was to eliminate the IUU/FOC vessels. At that time there were around 250 of this type of vessels.

IUU vessels are illegal vessels that fish and these vessels ignore reporting and over exploits the resources. As the Japanese market demands very high quality fish and the local fisherman cannot meet up with the demand, most of the tuna is imported from all over the world. (60% of the tuna is imported). This creates a gateway for the IUU vessels and Japan was considered the biggest market for them. By formation of OPRT and the introduction of checking reports from the importing countries, the IUU vessels reduced. This was a huge loss for the fisherman as it made to give up 3000 jobs.

Then the measure was to blacklist the IUU vessels, but these vessels change their identity quite often and it was a difficult task to maintain their tracks. Thus a new list, which is said ‘positive list’, is done. Each country is required to submit a report from the vessel operator which is larger than 24m. So the importing authorities check their reports in order to maintain the list of the operating vessels.

Now, the IUU vessels target to reduce their sizes less than 24m to escape from the list. The IUU vessels try to escape all the regulations with a lot of tricks, which is sometimes hard to track down. They ‘cook’ the data in order to meet the required quota or they report in countries where there is no registration or which doesn’t belong to a country registered in an organization.

A great achievement in the responsible fisheries is the farming process. A lot of countries have started the fish farming activity including Japan, Australia. These farming countries provide a good stock of fresh tuna to the Japanese market. It contains high amount of fat as their feed is controlled and well maintained. In this process, small tuna is caught and is maintained in a cage with controlled environment until they grow up. This fish is then exported later.

To understand responsible fisheries we have to make the public more aware of the importance, and to prove positive points from the fisherman to promote responsible fisheries. The conservation should not only meet from some countries. It should be met from all the stakeholders (International communities). There should be more promotion through Internet, newsletters, seminars and conferences.

1.6 Sampling Methods

The stocks get reduced mainly when the mortality rate at young age is high. The mortality rate gets high due to over exploitation, feed by other animals and fish and other environmental issues. Most of the people target the small species and the species that can be grown is very limited. Most of the fishes are caught when they are 3-4 months old.

When sampling is done on the fishing community we should consider, which elements we should sample. They include total catch, length (weight/age), Effort, Area/time/depth, gear efficiency and mortality rate. This is considered as essentials for stock assessment. Thus proper sampling procedures have to be met. When taking samples special emphasis has to be given to check whether the sample is a representative sample of the population.

There are two sampling procedures applied mostly

- *Stratified sampling: Reduces the number of samples to a very few number. It gives more importance to the higher sample values. A lot of effort has to be given to check whether the sample is a representative of the population*
- *Population sampling: It is a proportion of the total catch. It gives more importance to the composition of the rare species as well. But it requires more effort as the number of samples might increase in the common species to compensate for the rare species*.

A special importance has to be given on calculating the fishing capacity. Fishing capacity can be termed as the capability of the fishing fleet considering the entire factors surrounding it. For example size, gears used, holding capacity etc. There are a lot of socio-economic factors, which contributes to the fishing capacity. For example Oil and Labour cost would definitely contribute to a low fishing capacity.

1.7 Pole and Line fishery statistics in Japan

The pole and line vessels are categorized in to mainly three categories based on their Gross Registered Tonnage. The main categories are coastal, Offshore and Distant water vessels. The coastal fishery does not submit a log book but they are required to submit a log book if they fish in the EEZ.

The pole and line fisheries main catch is skipjack tuna. The decrease in the effort is measured in the number of poles. As number of poles differ from offshore fisheries to distant fisheries. The fishing points change in various seasons depending on the fishing ground. In quarter 3 the fishing vessels are more concentrated in albacore, while in November and December the fishermen quit fishing in the region, as it is too cold.

The logbook system is collected by the fisher cooperation and sent to the fishery agency. The data is then verified by the usage of satellite images and their points.

1.8 Purse Seine Fishery Statistics in Japan

Japanese vessels are categorized into mainly three categories, i.e., *i. Small vessels,ii. Medium vessels and iii. Large vessels*

The research institute collects the large vessels data. In 2002 the catch of these large purse seine vessels contributed around 98% of the total catch. The large vessels, which are categorized as 50-150 GT, operate in Japan Sea and the Pacific Ocean off north part. Larger vessels operate in tropical Pacific Ocean and in Indian Ocean. 80% of the total purse seine catch is obtained from the tropical waters. Only one vessel operates in the Indian Ocean. The fishing season starts near Japan in the second quarter and ends in the third quarter. In the recent years, the fish catch has been constant and stabilized around 210,000 tones.

The large vessels catch is obtained from logbook reported by fisherman. After the operation, which lasts for 20-50 days, the fisherman returns to port and post it. There is a lag of 3 months while the data is obtained from the fishing vessels.

The database consists of catch, operation and trip information. Operation consists of days and sea surface temperature and school codes. While the trip data consists of the dates and times of the trip. The data is then reported to the various authorities.

The port sampling is also conducted. Its purpose is to estimate the length composition of the fish. The fish landed in ports are sorted according to their size. One hundred tuna per each category are measured in length and weight. More informative information is collected if the catch is from one operation. The date and location is also recorded for that operation.

Observer Program started form 1995. It is conducted in the Pacific Ocean. 1-4 vessels are annually observed. The purpose is to monitor the catch by species. It is to find more biological data and to find the by catch and dumps.

The database is also then verified and checked for blanks, check whether the reported location is located in the land, distance between the adjoining dates. It is well maintained by a software program and if the error is found, fisherman is contacted and verification process continues.

1.9 Biological Statistics

For stock assessments we need to collect size data. Fisheries statistics consists only the catch amount. Thus a need arises to collect more information. The data is mainly collected from the fishing ports and markets. Coastal, Offshore and distant water fishery is the three data collecting system depending on the three fisheries. Tuna offshore fishery cruses around 2 weeks to one month. The size is measured in the port when they land the catch at the port. Length and weight is collected from the fish. A sample is obtained from where the fish has been landed. The skipper is asked to obtain the points where the fish has been landed. The period of operation and cruising period is also obtained. Fish length (fork length or the body length) is measured mainly.

The coverage of length and weight sampling is done on 20% of the total catch. There is lack of staff to collect data about length and weight. The local governments collect these data.

The landing information of the deep-sea fisheries is not available. The data regarding the fishing operation is unknown. Thus a notebook for measurement of tuna is issued to them. Thus every operation, the length and weight is thus measured. It is not a mandatory for the fishermen to fill those forms. As it is left for the fishermen to fill these forms, 15-20% is reported. There is no observing scheme and since it is a voluntary action for them to fill the forms thus the accuracy of the data is questioned.

The data is entered to the database. There have been 1 million fishes sampled in 2004. Catch data is divided into the area and months. The same goes with the sampled data as well. It is difficult to adopt a good sampling technique in the industry. Data is collected from various fisheries and various vessels. It is rather a small sampling.

1.10 Longline Fisheries Statistical System

Japanese longline started since the earl 1910's in the pacific. It expanded to tropical area before World War 2. Area of fishing was limited after the World War 2 until 1952.

The longline fishery boats are categorized into 3. Coastal Longline that is categorized as less than 20 GRT. Offshore Long line is 20-120 GRT and distant water Longline is greater than 50GRT – 500GRT. Small and offshore boats have limitation in area of operation. It is mainly in Pacific. But larger boats are allowed to operate in where ever they want. Trips last from few days to few months and maximum it could last for a year. Target species were albacore and yellowfin.

The fishery might change from longline fishery to various other type of fishery. The smaller boats made very less profits as the good fishing grounds near Japan were nearly over. The intermediate vessels also decreased. But the number of large vessels increased as they made profit. But it was constant, and sometimes the fishery agency reduces the fishery.

Near the equator, Bigeye and yellow fin is caught. But near Japan more of albacore, Bigeye and swordfish are caught. Smaller vessels catch it. But 50-100 ranges near the pacific but the 100-200 operates in a wider area. And more than 200GRT operates in eastern Pacific Ocean or all over the world. But these vessels do not operate near Japan, as they are not profitable for them

There is an obligation by the government for the license holders. From 1994 approval is needed by fishery agency or need to send their intension of operation, which is inside Japan EEZ. But the distant water fishery vessels, boat require license. License s limited in number from 1970. Hence the new owners have to buy license of operation.

The fisher also submits logbook after its completion of trip within 30 days. They are also required to send a notice of transhipment and the size measurement.

Logbook includes from gear composition to various species and the position of operations. It also contains crew information and the company of operation as well. They also contain the license information and information about the number of hooks used in the operation. In some other countries, the longliners are asked to request to submit the by catches such as turtles and other various discarded catch.

Number of trips (sets) for each is around 12000 (124000) for distant water LL, 1000(22000) for offshore LL, 4000(40,000) for coastal longliners. How ever the coverage is not 100%. Averages are 92%, 85%, and 70% for distant, offshore and coastal. Effort data is needed to raise the figures of the data missing. For distant water LL, sets are received by area and month through the industry. For offshore LL, information (number of sets by prefecture) is obtained through the departments of Information and statistics and for coastal LL only total catch is available from DIS (department of Information and statistics).

For verification purposes, vessel characteristics are checked with the register. Logbook is briefly viewed by the scientists (to check species reported are ok or not according to the knowledge and experience). Error check routines are used to detect possible misreporting such as wring date, too fast movements, sets on land, wrong average weight, too high CPUE, out of bounds value.

1.11 Introduction to Japan Fisheries Information Center (JAFIC)

Due to the heavy loss encountered by the Japanese fisherman in 1963 the demand for the investigation of the resources for prediction purpose increased quite significantly. As a result JAFIC was established in 1971. Its main target was to collecting and presenting necessary information regarding the oceanic conditions. JAFIC mainly involves in

- *Presenting information to the fisher community regarding the oceanic conditions*
- *Developing information processing techniques concerning fisheries and collection them*
- *Research based activities regarding fisheries*
- *Spread of knowledge of aquatic resources*
- *Incidental activities to the above activities*
- *Other tasks necessary for achieving the objectives of JAFIC*

During the past years, JAFIC has tried to bring latest technologies in collecting, processing, analyzing and transmitting to present information in time. From 2003 JAFIC has been compiling and presenting information closely related to protection and control of aquatic resources conformity with the Basic Law of Fisheries

There are 4 main sections in JAFIC,

First Service Section, which immediately transmits information to fishermen regarding the fishing grounds. It involves preparing daily reports on oceanic conditions, analyzing and compiling the information.

Second Service Section collects and compiles daily information such as locations, water temperatures and fish species. This information is sent to fisherman and other related agencies. It processes the collected data and predicts good fishing grounds.

Resources Control Unit controls and maintains the TAC and TAE management systems.
Distribution sections. This section is responsible for sending and distributing the information. It notes the movements in the industry such as landings. It also identifies the demand and supply of aquatic products.

1.12 Satellites for Oceanography

JAFIC uses satellite data for identifying good fish grounds and predict the fishing grounds. In order to identify it, the sea surface temperature is monitored by the satellites. As tuna is caught mainly in waters having temperature of 20.50C to 22.50C and with waters having chlorophyll content of 0.12 to 0.16 microgram per litre, it is quite easy to find a good fishing ground. The two maps are merged to find a good fishing ground, which has good chlorophyll content and warm temperature. Mostly tuna is found near the edges or the end of warm water current. Fishing ground is formed in warm core ring, which rotates anti cyclonically. Tsushima current can be regarded as a warm core-ring.

Aircraft surveys also give a better idea of the image obtained by the satellites. By the aircraft surveys it is shown that most of the sardine is caught in the end of a warm core ring. From the aircraft survey image, the circular dark spot identifies the stationary sardine while the image formed as a wing of a jet plane identifies the moving sardine. Warm core ring is an important factor in prediction of good fishing ground. More phytoplankton is present in the edges of warm core ring. As in the warm core rings it is more nutritious. Nourished water move to the surface while the sunlight falls on this water and the phytoplankton increase, thus increasing the zooplanktons, which in turn attracts the tuna schools.

Near the equator the water is warm and hence it is difficult to identify by using the warm streamer. So the use of depths is more favourable. Big eye tuna lives in 100C- 150C and around 300m deep. It can be found in the edge of the deep water. Thus importance has to be

given

- *For migrating species like tuna by using warm core ring it is easier to find the fishing ground*
- *Slick phenomenon illustrates more knowledge of the good fishing grounds.*
- *Total Observation system describes more knowledge of upwelling phenomenon.*
- *The data is not only from the satellite images but from fisherman as well.*

1.13 TAC/TAE Management System

The United Nations Conventions on the Law of the Sea gives utmost importance for appropriate conservation and management of fishery resources. Hence in 1996 TAE and TAC were established. TAC system sets the maximum allowable catch and controls fishery to keep fish catches within the maximum catch limit. TAC is mostly applied on fishes, which are caught in huge figures and are important for the nation, fishes where the resources are badly managed and fishes that are caught by foreigners around Japan. Fishes corresponding to sardine, Common Mackerel, spotted mackerel, jack mackerel, saury, common squid, Alaska Pollack and snow crab are included in TAC system. TAC system concentrates on Fishing date, Fishing area, Fisherman's name, Fish name, Type of Fisheries and catch quantity. Scientists decide TAC after the discussions regarding the Allowable Biological Catch. The TAC system is applied on both minister licensed fishery data and Governor licensed fishery data. Minister licensed fishery is large scale while governor licensed is small-scale fishery. The minister licensed vessels sends data to the organization for administration of fishery rights, which is sent to JAFIC, while the governor licensed vessels data is sent by the markets or fisheries cooperatives to the prefecture offices, which is received by JAFIC. These data is processed by JAFIC and sent to various fisheries agencies. These agencies issue this information to the public.

TAE Management system sets an upper limit of fishing effort by setting the number of fishing days and number of operating vessels for a specific sea area, type of fishery and fishing period and there by controls fishery to keep the fishing effort within the line. The TAE System is applied on resources of large change. It concentrates on fishing date, fishing area, fisherman's name, fish name, type of fisheries. This type of management system is also categorized in terms of minister-licensed fishery and governor licensed fishery. In implementation of TAE, the government specifies the TAE object fish and the ministry of agriculture, forestry and fisheries decides of a basic plan. The discussions are also carried with the Governors. Fishermen are also requested to produce a TAE report. Then Minister and the Governor then execute the TAE Management system. TAE is calculated based fishing days and licensed boats. It gives utmost importance not to differentiate with small-scale fishery and large-scale fishery vessels. Thus a coefficient is introduced to balance with small-scale fishery and large-scale fishery depending on the species. TAE is applied to Rough scale sole, Small-mouthed sole, Flathead flounder, Willowy flounder, Tiger puffer, Spanish mackerel, Sand lance, Squid. TAE is applied to large scale trawling, small scale trawling, gill net, medium scale purse seiners and drift gill net. The data is received by either fax, mar sheets or via e-mail. The governor licensed vessels sent data through prefecture while the minister-licensed vessel sends data through administrative fishery right organization.

1.14 Kanagawa Prefecture Technological Center

The main aim of the centre is to

- *Develop tuna fishing all over the world.*
- *Increase Technological development in fishery.*

The National Research Institute sends information of Juvenile blue fin tuna catches. And communication is also done with far sea fishery vessels every day by radio. Lone liners communicate by Morse code. They are contacted for location, condition, water, temperature, catch and quantity. The Technological centre also gives information to the fishermen regarding military drill and falling of satellites. Fishing vessel information is sent by location

and oceanographic conditions and data input in the database. The prefectural centre sends information to fishery agencies and research institutes. A report, which is made 3 times a month, is sent to the vessels and industry as a whole.

1.15 Resources management and Fisheries Management

Resource management: Provide a theory for managing resources. With only a theory we cannot manage resources but it could be managed with a good theory, which is maintained by the fishermen.

Fisheries management: Propose specific methods for fishermen for example: enlarge net size, catch quantity, and methods for fishermen to accept these methods.

Both theories and fisheries management is targeted to successfully implement resources management. The various plans for fisheries management includes, limiting catches, limiting size, Limiting catch of parent fish (establishment of close periods and close areas) and limiting over fishing which includes recruitment over fishing and growth over fishing.

Kanagawa, Chiba and Tokyo have both worked together to protect the resource. Most catch in Tokyo Bay comes from small trawling, gill net, tube trap and others.

Mantis Shrimp

The spawning ground is in Tokyo Bay and the spawning period is in spring and summer. One school of mantis shrimp may spawn in spring and other in summer. The shrimps, which are spawned in summer, are small while in spring it is large. It feeds on planktons and after metamorphosis it grows and arrives to a recruitment stage. In 1900 Tokyo started to collect mantis shrimp data while Kanagawa it started in 1960. But from 1965 Tokyo's statistics about Mantis Shrimp is not available because the fishing was stopped. As there was high economic growth in Japan and productivity was very important so the coastal fishery was changed to Industrial fishery. But due to the oil crisis, the economic growth decreased and people started to join coastal fishery as there was no jobs available. Due to the low exploitation the environment improved. But as the fishing of mantis shrimp was high after the slow economic growth more people started to emerge. A limit on catch was imposed on 1977 on per day per vessel and is still in place. In 1978 the fishing effort was regulated and in 1989-mesh size was regulated in order not to catch the small shrimps. And in 2001 instead of diamond nets squared nets was suggested as the squared nets make it easy for the small ones to escape.

Conger eel

Conger eels spawning ground has not been discovered. Although it is believed that the conger eels spawn in the East China Sea, deep sea near south west islands of Japan. Kuroshio Current transports the Leptocephalus larva to Pacific coast and by Tsushima current to south side of Japan. The larva looks very different from the actual matured species. Early spring they come to the Tokyo Bay. The eels immigrate and then metamorphosis occurs and after their growth they recruit to the fishing ground but it is not of a marketable size. They are only able to recruit to the fishery resources in the following year. Long line fishery has been replaced with the tube line from the olden days, but still the small trawling vessels catch a constant figure of the eels. The estimated exploitation rate by using tube line is around 89.2%. Main season for harvesting is around April to October. In order to minimize the juveniles, the hole size of the tube was increased to 17mm. The small eel catch was reduced by a huge margin while the bigger eel catch increased too. The fishermen were then convinced to use the larger hole tube lines. The fishermen agreed to increase the hole size to 13 mm, but now the trend is growing to increase to 17mm.

1.16 NFRA

There are 9 research institutes, 16 stock assessment agencies, 10 vessels that accounts for

the biggest research agency in the world. It promotes technology. Prevents outbreak of diseases, finds out the consumer demand for sustainable supply and increasing the engineering capability for the betterment of the fishery. NFRA also tries to find out the impact of global changes in the ecosystem. NFRA gives special attention to

- *Stock enhancement technology*
- *Development of stock enhancement*
- *Developmental studies*
- *Contributing societies*

1.16.1 Population Dynamics (TAC Species)

Japan's fishery is mostly based in Pacific, China Sea, and Japan Sea. For each of this area a different method of stock assessment method is applied. ABC is also determined in terms of approximate level of catch estimated by scientists.

Every year surveys are carried out to find length and weight. Based on this figures the catch quantity is estimated by age. Based on this cohort analysis is done. Plankton check is one to find the amount of juveniles. All this information is integrated to find the stock assessment.

Mackerel

The catch level is found by age to find the cohort analysis. If the stock sizes are maintained at the same level in the future then the stock would not be depleted. By finding the number of spawning adults ABC is found. As the currents carry the spawned eggs, the ratio of catch might vary from year to year.

Scomber

The same method, which is used for mackerel is used. The catch is caught when they were young and due to this the stock level was hampered. The fisherman then agreed to reduce the fishing intensity by reducing the vessel size and restricting fishing ground

Spotted Mackerel

Spotted mackerel and jackmackerel was mixed together in the statistics and hence the statistics for spotted mackerel was not available before 1985. But now it has been differentiated. When spotted mackerel is young the fisherman don't catch them

Saury

Saury is mostly in Southern Pacific. It is extensively concentrated in offshore. Its cohort is not available for older than 3 years. Instead of a cohort analysis production model is used. There is a very high increase in Saury fishery. Considering the MSY the ABC is determined in this type.

Pollock

It is mainly concentrated in Russia and both countries share the information regarding it. In this type of fishery a cohort analysis is also done and based on it the TAC is done. In this type of fishery a dominant class emerges every year and if the dominant class is gone, fishing decreases.

Snow Crab

The lowest level of fish catch was accounted in 1970's. But since then there is an increase in the trends. Trawl researchers; crab basket researcher's data is used for stock assessment, as cohort analysis cannot be done. The fishing intensity can be maintained. Special attention has to be given on the recruitment.

Squid

Squids are mostly caught in autumn. Its life expectancy is just around one year. Hence cohort analysis cannot be applied. MSY is applied and based on it TAC is designed.

1.16.2 Japan Marine Fisheries Research and Development Department (JAMARC)

JAMARC was a private institution before it integrated with FRA. JAMARC is responsible for the sustainable fishery. JAMARC has developed various resources to facilitate the fishery resources and to promote the sustainable use of the fishery. When fishers invest in the industry they need to understand the amount of stock and depending on the stock only the investment should be made.

1. Development of offshore fisheries

Tuna is spawned in the southern areas of Japan, which is carried by the Kuroshio Current in February and March and they migrate to the north. Skipjack tuna is mainly targeted near drifting objects. Based on this principle a FAD (fish aggregating device) was designed. The first FAD was a surface FAD that got damaged quite often because of typhoons and was not acceptable. So underwater FAD was developed. FAD is placed at eastern side which gathers more fish ground. As Kuroshio Current changes every year, the FAD has to be placed in a good fishing ground

2. Rationalization of natural resources.

By using a substitute method for the purse seine fishery in Japan, JAFARC was able to cut down the capital cost and make the fishery more profitable.

3. JAFARC also gives a high priority to expand the fishing grounds.

1.17 Japan Overseas Fishery Corporation

World war ended in 1945 and after the devastation caused in the war Japan tried to restore the natural resources. Japan received a lot of assistance from other countries. Once the country started the rebuilding process, Japan was able to provide assistance rather receiving it. By 1954, Japan was able to provide assistance to other countries. In 1990, Japan was no longer a developing country. Meanwhile, during the rebuilding process Japan got a lot of assistance, which includes

- *The construction of bullet train*
- *Construction of the huge dam*
- *Study scholarship which includes Fulbright program*

In a short while, Japan was able to transform from receiving aid to provide aid. Japan is helping the developing countries such that it would

- *Promote economic growth of the world*
- *Expand free trade*
- *Assistance for developing countries for the development.*

1.18 Marine Ecology of Tuna (Dr. Mohri)

Southern Bluefin tuna and Bluefin tuna
Southern Bluefin tuna resembles the appearance of the bluefin tuna. But in Southern bluefin tuna the pectoral, second dorsal and hips fins are short. It mainly lives in temperate zones in the southern hemisphere near the South Africa and off Australia and New Zealand.

Bigeye tuna
Big eye tuna whose eyes and head are quite big grows 2m in length and can weigh around 150kg for the medium size. It mainly lives in the Tropical zones. The mature individuals live in the low altitude area of the sea and immature individuals live in the middle latitude areas of the sea. From studies it is known that optimum temperature to catch bigeye tuna in the

Pacifica is 10-15^{0}C. The mature individuals are mostly caught in water temperature, which is greater than 26^{0}C. In the Indian Ocean seasonal changes in bigeye tuna fishing areas coincide with oceanographic parameters caused by monsoon.

Yellow fin tuna
The head is relatively small where as the tail is very long. Yellowfin tuna's eyes are quite big. It grows to 2m in length and can weigh around 200kg. It mainly lives in the tropical zones all over the world. From researchers it is known that yellowfin lives around 13-24^{0}C. Yellowfin's flesh is in bright pink color and mainly consumed raw in Japan.

Albacore
Albacore is in spindle shape and its pectoral fin is quite long and narrow. It grows to 1.2m and weighs only 40kg. It mainly lives in Tropical waters all over the world.

Longtail tuna
It is a very small tuna, which grows to 80-100cm. It is caught near the Yamaguchi Prefecture in the Japan Sea. It lives in the tropical waters and fished mostly from June to October. It mainly lives around 24^{0}C.

Skipjack tuna
It grows to around 1m in length and lives mostly in warm areas. It is caught by longline, purse seine, set nets and pole and line.

2. VISITS

2.1 Tsukiji Market

The guide gave a brief introduction, and then we checked the iced fish area. Then we proceeded to check the auction of live tuna. The auction was carried out on first come first save basis. The first fish that arrived in the market is auctioned first. The tuna is tagged with the order of arrival, the area of catch, import country, method of fishing and weight. The tuna's tail is cut and the freshness and the bidders observe the meat before they place a price. A lot of importance was given for the freshness of fish and the handling is very carefully managed. After the fresh tuna area, we then visited the frozen tuna area. The same procedure as fresh tuna is applied. But the prices quite differ in frozen fish than fresh form. Then we visited the cutting area where the buyers cut their fish in to small parts for the other buyers. Then we visited the live fish section and then visited the intermediate sellers.

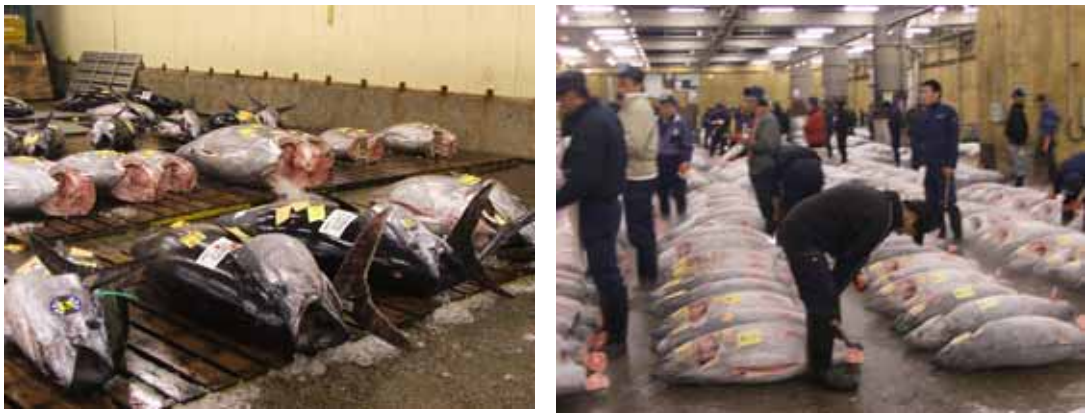

Figure1: Fresh Fish arranged for auction in Tsukiji Fish Market and bidders check the freshness of the fish in the frozen fish.

2.2 Shimizu Port

The data processing system was introduced. The data that is received is verified by the VIMS data and data from the fisheries ministry. The data has to be sent to the port one week prior to the landing. The data is then verified and made ready when the fisher vessel lands. Then unloading process takes place which lasts mainly one week or more. During the visit we observed the unloading process and the landing area from the longline vessels

Figure2: Fish loading in the port

2.3 Yaizu Port

After a brief introduction of the landing process in Yaizu port, we checked the process of unloading skipjack tuna from a pole and line fishery. We observed that a lot of fishing vessels have stopped because of the low profit level of pole and line fishery. As skipjack tuna price is quite low and due to the high prices in oil.

Figure3: Unloading of skipjack tuna in Yaizu Port

2.4 Kasai Rinkai Park

A Japanese architect designed Tokyo Sea Life Park. The design illustrates a dive into deep sea. The surrounding in the park is designed such that the view merges with the waters of Tokyo Bay. Japan has the most number of aquariums in the world. Out of 144 or more, larger aquariums in the world, 68 are in Japan and Tokyo Sea Life Park is the biggest in Japan. There are 542 different species of fish in the aquarium. This accounts around one fifth of the species in all aquariums in Japan. This aquarium displays 166 tuna of 6 different species. It is

the first aquarium to successfully display tuna, which is around 17 years ago. The tank is made from 26cm thick glass specially designed for aquariums and the water for this tank is brought from deep sea. In this aquarium, various filters are used which filters around 2200tonnes of water per hour. Ozone is used for killing bacteria and facilitating oxygen for the species.

Figure4: One of the displays in the Tokyo Sea Life Park

2.5 Misaki Town Wholesale Market

The market handles only tuna and is run by Japan Overseas Fisheries Cooperation. The tuna is mostly in frozen form. It is a jointly organized by Japan Tuna Producers Co. Ltd. and Misaki fishes. 30,000 of tuna are handled by the market every year. The market is mainly divided to Consumers market and Producers market. In producers market fish is sold in bulk and straight from the vessel. The auction is mostly done on the entire stock, which is grouped in to species, fishing ground, period and size. Where as in consumers market, the bid is done on each row of fish. The fishes are arranged in size, fishing ground, period and species.

Figure4: Bidders inspects before bidding the price

3. Applications

As Maldivian Fishery statistical system was developed long-time ago and there is a high level of inaccuracy in the data, the need to develop another system is of a lot of use. Thus to design a new system of collecting data, understanding and gathering the useful advantages which could be applicable to the Maldivian fishery was the primary objective. A lot of information regarding data collection, analysis and stock management was learnt in the entire course

Ministry of Fisheries Agriculture and Marine Resources under the new 5-year developmental plan has urged the need for satellite imagery on improving the fisheries in Maldives. Hence talks are going on regarding the introduction of GIS System in Maldives. The information obtained regarding the GIS System was priceless.

There have been no major developments in the stock assessments in Maldives so far. As fishery is mainly based on pole and line, the sustainability of stock could be achieved. But since the fishery is tuna based and due to the migratory pattern of it, the need for stock assessment is quite high.

As Maldives fishery issues license through registered companies, maintaining the industry and safeguarding is quite easy. But due to lack of technology in the ministry it is very difficult to monitor and to verify the data provided by the EEZ vessels. Thus information about these vessels and the data gathering system is very vital for the industry.

The Maldivian fishery statistics system gathers all the information from the fisherman individually (complete enumeration). Hence the need for sampling arises in the economic surveys and length frequency sampling surveys. The information regarding the sampling methods was also highly useful.

Maldivian fishery is based on pole and line fishery. The Ministry is trying to introduce a log book system which would come in to effect most probably in the next year. The system used in Japan for data collection and the logbook was highly importance. Especially as logbook system is completely new to Maldives, a pilot survey is done to find the advantages and disadvantages. The use of navigational points are only limited for the EEZ vessels in the reports. But as Maldives is trying to use satellite imagery for data analysis it is essential to include the navigational points. Thus the information from this course is vital.

The other fishery information can be regarded as one of the basics, as the fishery in Maldives is in a transformation process. The information gathered could be used as a base for the development in fishery.

The data for the biological analysis is mainly collected by the Marine research center. But I think that there is a huge need to collect the size information in a more organized way. From the information gathered about the biological statistical system in Japan, some of the aspects could be implemented. Especially the size measurements are a huge necessity.

In Maldives, the interaction between the ministry and the fishermen is not much as in Japan. But in order to improve the fishery the cooperation of both parties is a huge factor. Especially in the implementations and the need verification process. Providing data and issuing much needed information should be a primary target.

The handling process in the Japanese fish market is very valuable as Japan is one of the main markets of Maldives exports. The handling and the procedures of the exports is a huge necessity in understanding and building policies for the exporters.

The statistics section does not carry population dynamic surveys. The marine research section mainly does it. There is a huge necessity to collect information and to base the statistical system such that the information is available for stock assessment, population dynamics and responsible fisheries.

To conclude, the training provided a platform to create a much better statistical system, which could supply data to stock assessment, population dynamics and responsible fisheries as a whole.

ACKNOWLEDGEMENTS

I consider it as a privilege to acknowledge the valuable guidance and assistance from a large number of individuals, which inspired and helped us to a very large extent for the completion of this training program.

I would like to thank all the staff of OFCF who was responsible for the betterment of this training program specially to Mr. Uchida and Mr. Kobari who was always with us and helped in every way they could making our stay in Japan more fruitful.

Secondly I would like to thank Dr. Nishida and his team of lecturers for the continuous guidance and the informative sessions, which was produced in the whole program. It would be a disgrace if I did not include the various other lecturers from various research institutes who was so keen to learn about the fisheries in our country and giving more broader view of fisheries in Japan

I would also like to thank the members of OVTA who really tried to render the best service they could give whether it is accommodation or food, they provided us with the best they have. It made our stay in Japan more pleasant.

Overall, I thank the OFCF and the Japanese government for giving me the opportunity to participate in the course. I would be going back to Maldives not only with fisheries resource management notes, but I would be going as a more knowledgeable person in fisheries and Japanese culture as well.

Thank you

PART 2: SEYCHELLES

JULIETTE DORIZO

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1.0 Introduction

The overseas Fisheries Corporation Foundation of Japan (OFCF) conducted a one-month training course in Japan on Fishery Resources Management in November 2005. The objective of the course was to contribute to the management of international fishery resources in related coastal countries and to foster amicable relations between the countries and Japan in the Fisheries field. The course comprises of a series of lectures and Visits to Tuna fisheries related offices, Market and Ports. This paper provide a report of the various topic covered during the lectures, brief description of all visits and gives prospect and ideas of the participant to contribute and improve the statistical system of it's country following the completion of the course.

2.0 Lectures

This section provides a summary of each lecture presented to the participants.

2.1. Fishery Statistics System in Japan (Ministry of Agriculture Fisheries and Forestry)

The first lecture introduced the fisheries statistics system in Japan where a fishery census is conducted every five years while a smaller scale fishery census is carried out in between two censuses. In addition a production survey is done annually. There are 7000 survey points across the country where 200 private sector staffs, appointed by the government, carry out survey for both fisheries and agriculture at each sites.25% of fisheries catch data are collected from fisherman's catch report while other data are obtained from fishermen corporative. However there is 10-20% cases where fisherman lands their catch at a different production company and fail to report their catch to their respective corporative. This creates uncertainties in the data, which is accounted for through survey. For fishing effort a separate survey is carried out to obtain number of days spent at sea. A separate survey is also carried out to obtain data such as farming pond area and employment data for the marine aquaculture.

Japan fisheries statistics is base on the catch accounting for production method and the production figures and fishing effort are published annually in the annual report while other statistical survey result are published in separate report when available. The annual report is then used to calculate total allowable catch (TAC) for the migratory species by area, period and fishing effort and Total Allowable Effort (TAE) for local resources by size of fleet and number of fishing days allowed. By calculating TAC and TAE, the stock status of important species is estimated.

Some problems the Japanese statistics system is currently facing are the fact that there is no penalty for fisherman if they don not produce catches report, some operators of both fishery and marine aquaculture refuse to give details of their activities and the proposal by the government to cut down the staffs by 1000 people in 5 yrs.

2.2. GIS Spatial Analysis of Fisheries Resources (Nishida and Ito)

Dr. Ito from the environmental Simulation Laboratory, Inc presented the marine explorer software, which contains three integrated modules; the database module, display module and analysis module. The software uses VMS, catch, effort and oceanographic data to efficiently manage, generate, output fishery data and predict good fishing ground. It also smoothly displays submarine geographical feature of an area, creates distribution maps for all type of fishery oceanographic data, compute

spatial data analysis and overlay various maps such as fish catch distribution or satellite images up to a maximum of 128 layers. Figure1 below shows the input data type, the data processes and the output of the Database module.

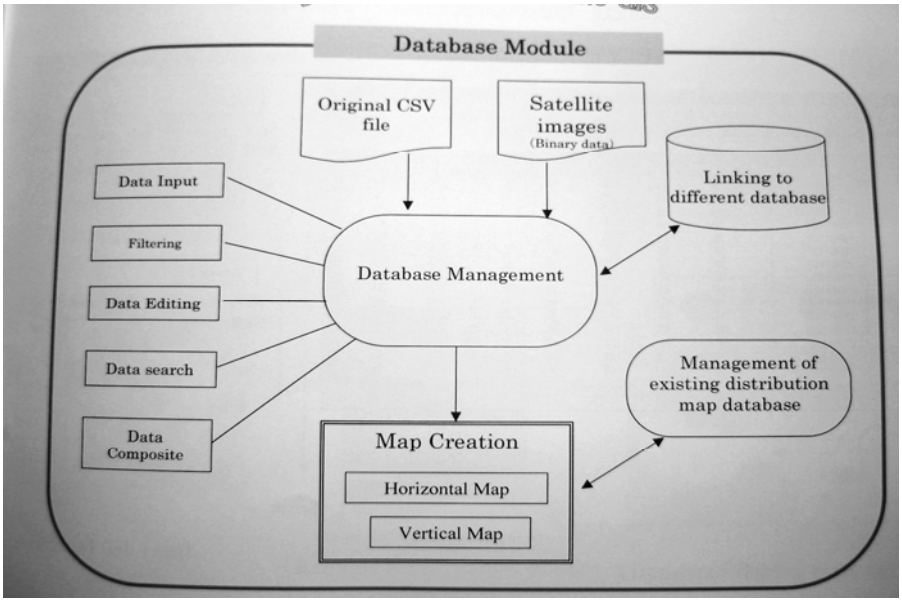

Figure1. Database Module of GIS Marine Explorer.

2.3. Method of Fisheries Resources Management

Three approaches mainly used in fish stock assessment were explained. The frontier approach uses mathematical and statistical model and real world data to obtain prediction of stock status. The practical approach analyses real data through exploratory data analysis and the third approach is the simulation approach. For all these methods the management goal is to estimate Total Allowable Catch (TAC), Total Allowable Effort (TAE), Allowed Biological Catch (ABC), Individual Quota (ITQ), and tempo-Space closure of fisheries. Table 1 below shows some stock assessment method and the data used for these methods.

Table 1. Stock assessment method and data type.

Method	Data
CPUE (Catch per Unit Effort)	Catch and effort
De Lury	Catch and CPUE
Production Model	Catch and effort
VPA (Virtual Population Analysis)	Catch at age and CPUE
ASPM (age-structured production model)	Catch, CPUE and selectivity by age.
Methods independent of fishery	Acoustic data, aerial surveys, observer data, line transect survey.

2.4. Fisheries Resources in Japan (Inada)

This lecture was presented in four chapters. Chapter one covered the approaches to Fisheries management, which are either theoretical or practical. The theoretical approaches are model-based approaches, which establish a relationship between fish and fisheries to grasp changes in fish abundance. This approach is mainly use when calculating TAC for the offshore and high seas fisheries management. The practical approach is used to formulate management method for the coastal fisheries

such as calculating the total allowable Effort to control fisheries for resource management and to plan resources restoration.

Chapter two provided an overview of coastal fisheries management in Japan and three successful cases of coastal fisheries management was presented; the management of sand lance fishery in Ise bay, coastal surf clam fishery in Fukushima prefecture and Sandfish fishery in Akita bay.

In chapter three, Dr. Inada explained the production model, the Maximum Sustainable yield (MSY) which is a basic concept of resource management and the Maximum economic yield (MEY), the optimum yield from the economic point of view.

The estimation of Resource abundance was covered in chapter four of his lecture. Various figures and tables was used to briefly explain the CPUE to find the fluctuation of resource abundance, De Lury method which estimate the abundance at the beginning of fishing period and the cohort analysis which seeks recruitment abundance in fishing grounds and the resource recruitment abundance by age.

2.5. Fish stock Assessment and Management (Tanaka)

The basic concept of fisheries management and management objective was presented in this lecture. The surplus production model was used to illustrate the concept of sustainability where the maximum sustainable yield (MSY) is the objective of the stock management for food supply to human. Obtaining the maximum net economic yield (MEY) is another concept of fisheries management to reduce catch and maximize profit. The dynamic pool model is an analytical model used based on recruit in weight, growth of body weight, natural mortality and catch weight while the ecosystem management concept look at the prey-predator relationship. This includes knowing how to exploit the prey and predator stocks and how to reduce by-catch of valueless species. Lastly the precaution approach is to developed fishery but reduce effort, which is difficult to implement. Hence the exploitation of fish stock should be expanded conservatively.

In order to achieve the concepts outline above various management measures are required. These are prohibition of fishing method, regulation of gear scale, limitation of number of fishing units, number of operation days, size of fishing boat, of horsepower engines, mesh size and legal size, closed area, seasonal limitation, catch limit, and prohibition of female catch.

To conclude the lecture, brief explanation was given on stock estimation using regression models and virtual population analysis (VPA) method.

2.6. Responsible Tuna Fisheries (Harada)

OPRT is a non-governmental Organization for Promotion of Responsible Tuna Fisheries. The main objectives of the organization are to eliminate IUU tuna fishing, reduce excess fishing capacity, promote responsible tuna farming, reduce by-catch and increase public understanding and awareness for responsible tuna fisheries.

Various measures being used against IUU vessels was presented which include market control measure, scraping and sinking IUU vessels and introducing the positive list of vessels whereby trade is only allowed for such vessels. In order to reduce excess fishing capacity, OPRT is working to reduce number of fishing vessel and to introduce responsible fishing activities on purse seiners. OPRT promotes responsible fishing technologies such as using the “Tori pole” and circle hook to reduce seabird and turtle by-catch respectively.

2.7. Sampling Method (Miyake)

The lecture started with a graphical description of sampling from the total fisheries population and the use of sampling data for stock assessment was elaborated upon. The catch and effort data are used to compute the Catch per Unit Effort (CPUE). It must be noted that gear efficiency need to be taken into consideration for that purpose as effort is not constant due to technological development. Hence the CPUE needs to be standardized before using to estimate fish abundance. The length and weight of the fish are used to estimate catch at age and to show how the population is acting. Area, time, depth and behavioral study through the use of archival tag provide information on the behavior of the fish. Biological (stomach content) and genetic (tissue study) sampling is also useful in stock assessment.

The second part of the lecture was concentrated on fishing capacity, which is equal to fishing effort plus the efficiency applied to the stock. In order to calculate the capacity index, the fleet statistics, effort, vessel size, GRT, carrying capacity, fish wells etc need to be taken into consideration. Fishing capacity is a great concern for fisheries management since the fish stock is decreasing while the vessel capacity is increasing.

2.8. Pole and Line Fishery Statistics (Uosaki)

This lecture provided an overview of pole and line fishery in Japan. The pole and line vessels are categorized into three groups as illustrated in table2 below.

Table 2. Categories of Pole and Line vessels

Category	**Size class of Vessel**
Coastal	< 20 GRT
Offshore	20-120 GRT
Distant Water	>120GRT

For the offshore and distant Water vessels, a logbook system exists whereby catch and effort data are collected by day with effort being recorded as number of fishing day and number of pole used.

The historical catch statistics was presented through the aid of graphs and it could be observed that the catch decreased gradually throughout 1980's and was then stable after 1991. Skipjack is the dominant species caught followed by albacore. Quarterly maps were used to illustrate the fishing ground of the offshore and distant water fishing vessels, which operate mostly in the Pacific Ocean.

2.9. Purse Seine Statistics (Satoh)

The lecture on Japanese purse seine fishery covered the vessel specifications, the catch and effort statistics, port sampling and observer program. Table 3 shows the different vessels category for the purse seine fishery in Japan. The large vessels are further divided into two groups. Those that operate in coastal sea of Japan (50-150GRT) and the large vessels (349 and 761 GRT) those operate in tropical water and Indian Ocean.

Table3. Categories of Purse Seiners

Category	**Size class of Vessel**
Small	< 5 GRT
Medium	>=5 and <15 GRT
Large	>=15GRT

The purse seiners target mainly skipjack, accounting for 74% of the catch. The total catch has stabilized to nearly 200,000Mt in recent years. Logbook data are collected from large vessels only. Once collected the data is inputted to an MS Access based database, which is composed of a catch table, operation table, and trip table. Quarterly maps illustrated the fishing ground of Japanese Purse Seiners.

Port samplings are conducted twice a month in Yaizu port and once a month in Makurazaki port. Skipjack, yellowfin and bigeye tunas are measured and for 2004 the modes for these species were 36-39cm, 45cm and 62-66cm respectively.

A scientific observer program started for purse seine fishery in 1995 mostly in the Pacific Ocean. The observers monitor catch, fishing efficiency, and collect biological information.

2.10. Biological Statistics (Yamada)

For stock assessment it is important to collect size data. For the Japanese offshore fishery, size data are collected at landing port upon the vessel return to port. The fish are measured and the weight data is collected from the auction. The time and area where the fish was caught is obtained by asking the skipper. For distant water fishery, since the vessels may stay at sea for up to one year, size data cannot be collected at landing port. For this fishery, the forms are distributed to the fisherman whereby they record the sizes of tuna caught every day and upon return to port, the forms are sent to National Research Institute of Far Seas Fishery. It is not an obligation for fisherman to fill the forms so coverage is only 15 to 20%.

2.11. Statistics of Longline Fisheries (Miyabe)

The lecture provided an overview of longline fisheries statistics starting with the vessels specification (Table 4).

Table 4.Categories of Japanese longliners.

Category	Size class of Vessel
Coastal LL	< 20 GRT
Offshore LL	20-120GRT
Distant Water LL	>50 – 500GRT

The trend in fleet sizes and area of operation was illustrated through graph and maps. The obligations of the fishers were then elaborated. The small vessels need approval to fish outside of the EEZ and need to declare their intention of operation inside the EEZ. The larger vessels required a license to operate, need to submit logbook and transhipment data and are required to make size measurement.

The logbook form and the compilation of its data were explained. For the sets not covered by logbook, estimates are raised to get total statistics. The lecture concluded with a list of all error checks that are made on the data before analysis. This includes verifying vessel characteristics, species composition, date, sets on land etc.

2.12. Japan Fisheries Information Service Centre (JAFIC) (Tameishi)

The participants attended three lectures at the Japan Fisheries Information Service Centre (JAFIC) in Kanagawa. The first lecture was an overview of JAFIC which is an organization established to collect and present fisheries information. The main activities of JAFIC are:

- Present information concerning fishing and oceanic condition
- Collect and develop information processing techniques concerning fisheries.
- Investigate and research the effects of fisheries information
- Spread knowledge concerning aquatic resources and oceans.

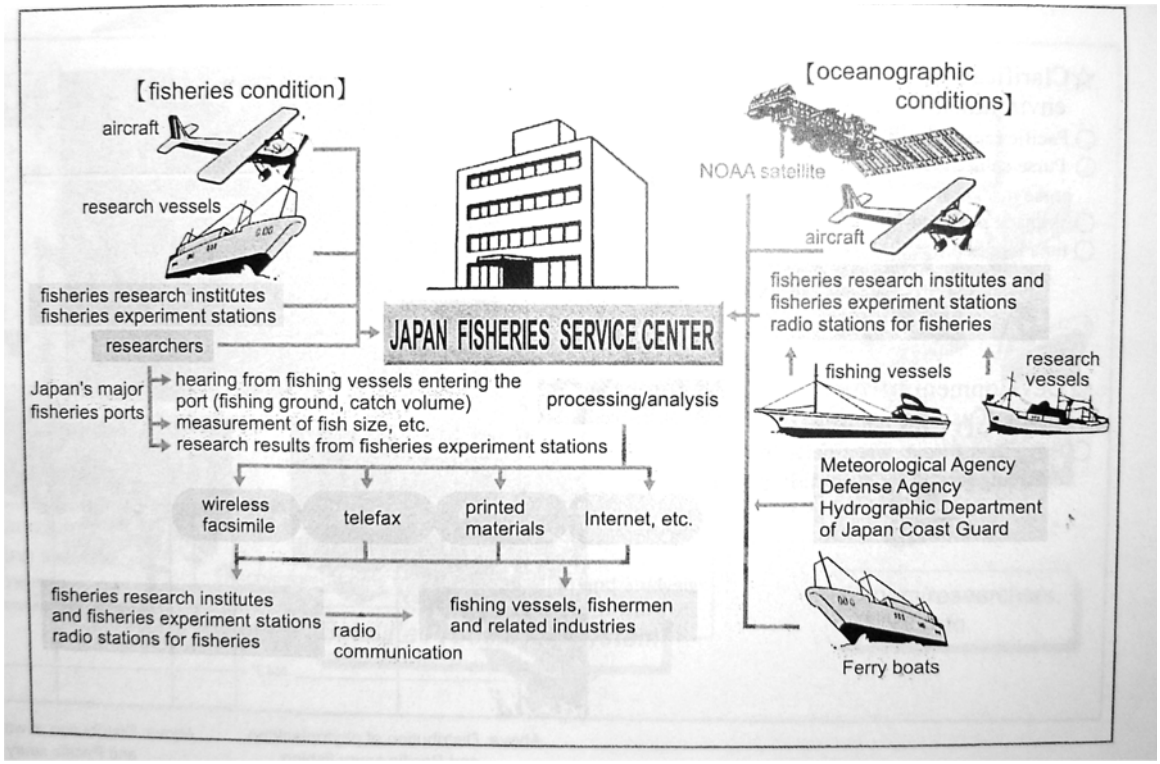

Figure 2. JAFIC data flow chart.

The next lecture explained with aid of various examples the use of satellite images of ocean condition in fisheries. Analysis of satellite images of warm core ring of subtropical counter current, phytoplankton, chlorophyll, and temperature (SST) provide information of good fishing ground and migratory patterns of pelagic fish. In addition study of slick phenomena is very important for making clearly the reason of fishing ground formation and total observation system of time and area data is important for finding new phenomena in the ocean. Hence it is necessary to develop the use of fishery oceanography with satellite information for fisheries development.

The last lecture provided the participants with an overview of the TAC and TAE system in Japan. The TAC system sets the maximum allowable catch and control fishery to keep catches within the MSY. In Japan the TAC system is define for fish caught in large quantities and is important to national life, for resources that is in urgent need of management and for fish caught by foreigner around Japan. The National Fisheries Research Agency investigates the stock status and calculates the maximum Allowable Biological Catch (ABC) with a large safety margin. Then the TAC is set based upon the ABC. The TAE sets an upper limit of fishing effort for a specific area and period of time and is calculated by multiplying the number of fishing days by the number of licensed boat in a given area.

JAFIC is responsible for collecting catch and landing data, put them together and send to the Fishing agency where the data is processed and disclose to the public as depicted in figure2.

2.13. Kanagawa Fisheries Technology Centre

The Kanagawa Fisheries Technology Centre main functions are to act as a medium for data flow of vessels operating from Misaki port, research on fisheries resources, oceanography and fisheries resource management and to develop fishing technology.

The Kanagawa fisheries technology centre communicate to distant water fishing vessels that belong to the Misaki port via radio everyday to collect information on their location, ocean condition and catch data. The data is then inputted in a database and the information is then passes on to fisheries operators and research institute

The centre carried out resource and fisheries management of coastal fishery such as the mantis shrimp and the conger eel, two delicacies of the Japanese cuisine. For managing the mantis shrimp fishery a TAC per vessel per day was imposed since 1977 and a TAE for number of operation days per week was imposed since 1978. The mesh size is also regulated and the diamond square mesh size was change to the square mesh size in 2000 to reduce catch of juveniles in Tokyo Bay. As for conger eel the tube trap that is highly selective for conger eel with very little by-catch, account for around 80% of the total catch of conger eel in recent years. Following investigation with different diameter for holes of the water vent, the management measures adopted was that fisherman uses 13mm diameter holes to reduce catch of small sized conger eel.

2.14. Fisheries Research Agency Headquarters (Yatsu)

During the visit to the Fisheries Research Agency a lecture on the ABC and TAC of eight species in the coastal area of Japan was presented. ABC and TAC has been calculated for the Sardines, Jack mackerel, scomber, spotted mackerel, saury, Alaska Pollack, snow crab and the Japanese common squid. For all these species some management measures are in place so as to either maintain the MSY or to restore the stock.

Through a Video, a visit and another lecture, the participants was introduce to the various activities carried out by the Fisheries Research institutes which comprise of research and survey on fisheries, working on development of stock enhancement technology and carrying out development surveys.

Finally the participants was given an overview of the Marine Fisheries Research and development department (JAMARC) whose main objective is to carry out developmental studies through studies related to the rationalization and development of Marine fisheries resources, the comprehensive development of offshore fishing ground and the construction and verification of new fishery production system.

2.15. Introduction to Japan Fisheries

The participants were firstly given a summary of the history of Japanese fishery when the industry was booming before the introduction of the 200 nautical miles. Following the latter Japanese fishery was downsized and it was through corporation with other countries that the fishery recovered and today Japan is the third largest producer of fisheries products in the world.

The characteristics of the Japanese coastal fisheries focus on how the Kuroshio current contribute to the migration of species such as the salmon, trout, skipjack and other tunas leading these species to abundant feeding ground.
Various measures are in place to ensure fisheries production in Japan. This include controlling industrial activity to maintain water quality and avoid pollution, conduct

stock assessment, regulate fishery method, gear and fishing period and carry out activities to attract young people to take fisheries related jobs and Japan involvement in international fisheries management through IWC, IATTC, IOT, OPRT, OFCF and research institutes.

2.16. Japan Overseas Fishery Corporation

Through this lecture and video the participants learnt about the history of Japan overseas Fishery Corporation and the Official Development Assistance (ODA) of Japan to the developing countries. After the world war two, Japan needed and received assistance from other countries so as to rebuild its economy. After nine years Japan economic growth and prosperity enable it to change from a recipient to a provider of assistance. Japan contributes to help Europe rebuild its economy through Organization for European Economic Corporation (OEEC), to promote economic growth of the world and to assist developing countries by providing Official Development Assistance (ODA). This is done through financial assistance such as grant aid, food aid, grant aid for disaster relief and cultural grant assistance. Japan also provide technical corporation through acceptance of trainees, dispatch of experts, provision of equipment, development study program and project type technical corporation .

2.17. Distribution of Tuna Resources (Mohri)

From this lecture the trainees learnt about the characteristics of different tunas and marlins species and their seasonal distribution in relation to depth and sea temperature. Main emphasis was placed on bigeye and yellowfin tuna in the Indian Ocean and on longtail tuna in the Sea of Japan off the coast of Yamaguchi Prefecture.

The main characteristics of big eye tuna are the head and eyes are big. The size can be up to 2m long and a medium size big eye tuna weigh around150Kg. Big eye tunas are distributed in temperate and tropical waters with adult more mature big eye tuna distributed mainly in low latitude area of sea and immature individuals in middle latitude areas of sea. The optimum temperature to catch big eye tuna in the Indian Ocean is between 10-16°C and at a depth of 200-300m.

The yellowfin tuna's can measure be up to 2m long and 200kg in weight. Yellowfin tunas are distributed in temperate and tropical waters and the optimum temperature to catch yellowfin tuna in the Indian Ocean is between 13-24°C and at a depth up to 200m.

The longtail tuna found off the coast of Yamaguchi Prefecture has fork length ranging from 125mm to 166mm. The fishing season for longtail tuna is during the period between June to October and the optimum temperature for longtail tuna is 24°C.

3.0 Visits

This section present a brief overview of various visits paid to statistical offices, landing port and fish market.

3.1 Tsukiji Market

The visit started with an introduction by the guide, which was followed by visit to the Fresh tuna section and the frozen tuna section. The tuna's were all line up ready for auction each with a tag labeling their weight and area caught as illustrated in figure 3 below. Their tail was cut off so that the buyers could check for the quality of the fish. It

must be pointed out that good quality of the fish is very important for the Japanese hence care are taken to keep the good quality from the time it is fished to the time the fish is eaten. The tunas are then auction (figure 4), and the highest bidder gets to purchase the fish. The visit was then continued to where Tunas are cut into pieces, to the live fish section and to the wholesale department of the market where various marine species are sold.

Figure 3. Frozen tuna at Tsukiji market.

Figure 4. Tuna auction at Tsukiji market.

3.2 **Shimizu Port**

Following an introduction by the person responsible for data collection at the Shimizu port, the participants visited the port where a transshipment vessel was unloading catch from a Japanese tuna longliners (figure 5), comprising of southern bluefin tuna, bigeye tuna, swordfish loins and shark loins. Once remove from the vessels the fish are weighed (figure6) and loaded to different trucks according to their species. The fish are kept at -60° in the vessels, the trucks and in the storage centers to preserve its quality. The fish are kept in storage until the market prices are good sometime up to 5 years.

Figure5. Unloading a longliner's catch

Figure 6.Weighing the fish landed.

3.3 **Yaizu Port**

At the Yaizu port the participants observe the unloading of skipjack tuna from a pole and line vessel. Once unloaded the tunas are sorted according to weight. At present the fuel prices are high and the fish market prices are low which might cause fishing vessels to withdraw from fishing.

3.4 **Kasai Rinkai Park**

Tokyo Sea Life Park was the first aquarium to exhibit school of bluefin and yellowfin tuna .It is an educational and social exhibition of 5,057 different marine species.

3.5 Misaki Town Wholesale Market

We visited the Misaki wholesale market where mainly frozen tunas are traded, on average 30,000Mt per year. This market based in Kanagawa prefecture has two markets, the producer's market, and the consumers market. The producers market buys fish directly from the fishing vessels while the consumers market gathered fish from fisherman, through intermediate buyers, from trading companies, and from brokers. The fish are first sorted by species, fishing ground and time caught, and size and are then sold through a bidding process whereby the highest bidder gets to purchase the fish figure 7.

Figure7. Bidding process at Misaki Wholesale Market

4.0 Prospect to Improve Statistical System in Seychelles

Prior to coming to Japan, I held in hand only a Bachelor degree in Applied Statistics and Mathematics and two-year working experience as a fisheries statistician with little knowledge of fisheries resource management. Having attending the course, I now hold fundamental knowledge of the different type of coastal, offshore and distant water fisheries in Japan and their characteristics. I have as duty to analyze Asian Longline data in my country and with the knowledge gained about the longline fishery and the statistical system in Japan I am now better equipped to compile and analyze such data.

Secondly, the stock assessment and resource management lectures have deepens my knowledge on the importance of properly managing fisheries resources and the various methods available for such task. Hence I now feel more confident to participate in resource management surveys for the coastal fishery and semi Industrial fishery in Seychelles. As for the distant water fishery, the knowledge gained in Japan will enable me to participate more actively in international working group such as the IOTC working party.

Furthermore I am now more knowledgeable in various management measures available and can hence contribute to the development and assessment of different management measures for the coastal and semi Industrial fishery in Seychelles.

In addition I now comprehend the importance of integrating satellite images with fisheries data to obtain better information on fishing grounds. Equipped with knowledge of factors affecting the distribution of tuna resources in Indian Ocean, I

can now participate in integrating and analyzing satellite images that we do received in Seychelles, with fisheries data so as to better understand the tuna fishing ground in the Seychelles Exclusive Economic Zone.

Lastly, this course has taught me the importance of disseminating fisheries information to the public hence the importance of producing timely and reliable statistics for publication. For such achievement I will need to put in place a structure so that data collection, verification and analysis are done more efficiently and promptly.

5.0 Conclusion

Having attended the fisheries resource management course, I have gained important knowledge on different type of fisheries, fisheries statistics, stock assessment methods, resource management, responsible fisheries, fisheries resources distribution and the integration of fisheries data and GIS. Such knowledge will help me to contribute effectively to help the statistics section attain it's objective which are to put in place one reliable database management system for all industrial fisheries, to produce timely and more reliable fisheries statistics, to reinforce the research capacity and perform more complex data analysis. In conclusion the Fisheries Resource Management Course has made me better equipped to contribute to research, development and management of fisheries resources in Seychelles.

Acknowledgements

I would like to express my sincere gratitude to OFCF, on behalf of the Seychelles Government for this excellent opportunity to expand my knowledge in fisheries resource management, an indispensable knowledge required for the fisheries development in Seychelles. Special thanks goes to the all those who organized all the logistics and lectures of the course notably Mr. Uchida, Dr. Nishida, and Mr. Kobari. To all OFCF staffs, all lecturers, Ms Noriko our translator and all those who in one way or another have contributed to make this course a success, a heartfelt thank you to you all.

PART 3: SRI LANKA

J.A.D.B. JAYASOORIYA

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2. **Over view of Japan's fisheries industry**
    a. **Importance of fisheries**
    b. **Fishery communities**
    c. **Coastal Fisheries**
    d. **Offshore Fisheries**
    e. **Far Seas Fisheries and world fishing grounds**
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Charts and Figures

Fig 1: Fluctuation of fish production in Japan
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Fig 10: Fish catch in purse seine fishery
Fig 11: Fish catch in purse seine fishery
Fig 12: Fish marketing channel in Japan

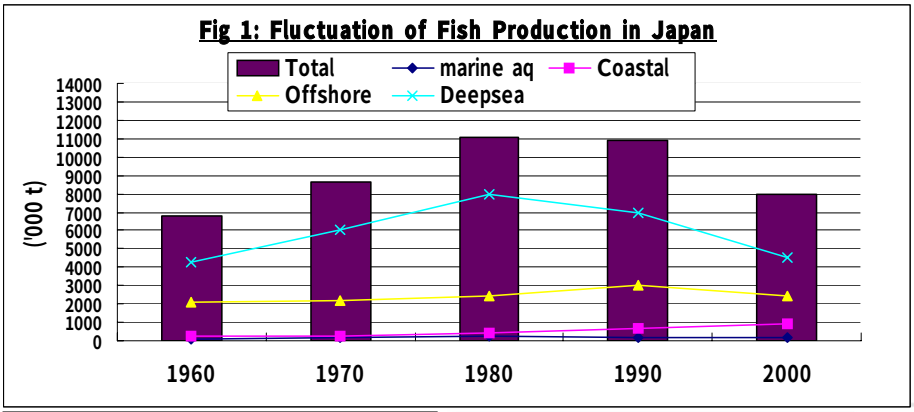
1. Overseas Fisheries Cooperation Foundation (OFCF)

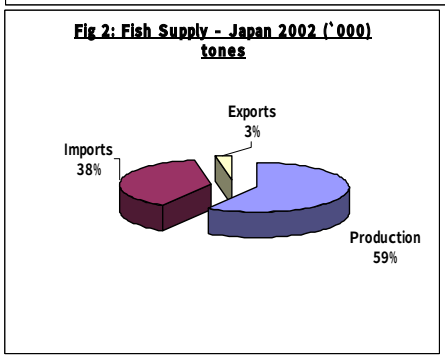
- OFCF is functioning under the Fisheries Agency, which belongs to the Ministry of Agriculture, Forestry and Fisheries in Japan. Official Development Fund (ODA) of the Japanese Government provides funds.
- Objectives of OFCF are to promote the friendly relations with coastal countries by providing economic and technical cooperation in the fisheries field through subsidies from the Japanese Government (ODA).
- Role of the OFCF is to providing training, technical experts, goods and services, project type technical cooperation, soft loans, exchange visits, information services and Assist the Coastal countries involved in fisheries. When request made by the countries, the OFCF responds quickly.
- **IOTC - OFCF** project assist to improve the statistical system in Indian Ocean Coastal countries. Improvement of the quality of statistics, assist greatly for the assessment of tuna stocks in respective countries. Tuna Long line and purse seine fisheries are operated in Indian Ocean. Tuna gill net fisheries are also operated in Iran, Oman, Pakistan and Sri Lanka.

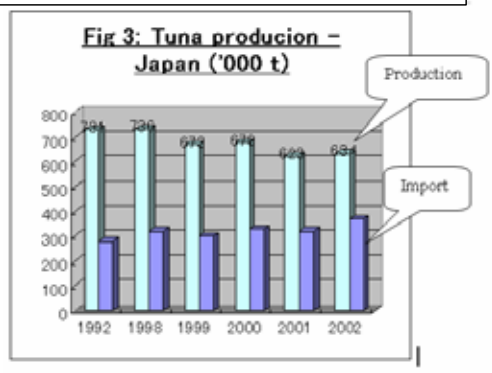
2. Over view of Japan's fisheries industry

a. Importance of Fisheries

- 24% of animal protein (20% of total protein) supply from the fish for the Japanese diet. Fish add the valuable nutritional properties (DHA, EPA, Taurine, Calcium, Iron etc.) for the diet and contributes to make healthy nations in Japan.
- Contribution for the world's fish production is around 4.0%.
- Annual foreign income from export is around USD million 1,300 and contribution to total export value is 0.3%.
- Over 136,000 fishery operators and over 243,000 fishermen are employed.







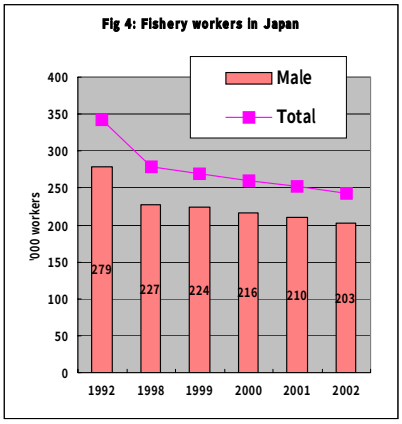
b. Fishing communities

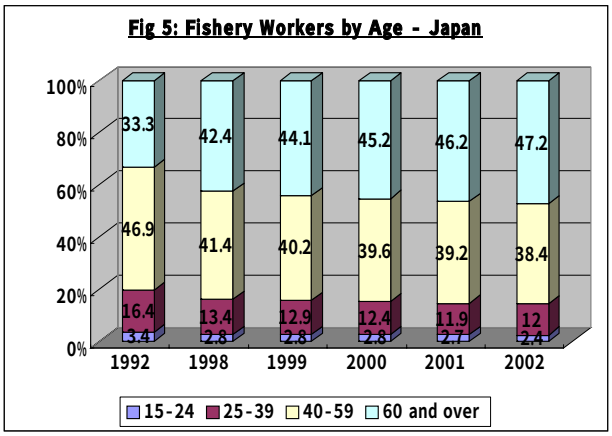
- The coastal length is about 34, 812 Km. the number of fishing port are 2,927 and every 12 Km has fishing port on an average. Around 6,245 fishing villages and one fishing village for every 6 Km of Japan's coast line on average.
- Numbers of fishing vessels are over 230,000. Fishery workers are decreasing and new enrolments of males for the sector is becoming lower (Fig 4).

c. Coastal fisheries:

Japanese history provides, enough evidence that the coastal fishery had been carried out by traditional manner since 10,000 years ago. Japan has engaged in fisheries using motor powered vessels early 1900s. Beach seine net fishing (18th to 19th centuries), Danish seine and small sail trawl fishing (1913th); purse seines and drift net fishing (1923rd) were used by fishers

Currently, fewer than 10 GRT vessels with 3 to 4 crews are engaging fishing. The fishing methods used are gill net, line fishing, long line, drag net, round haul net etc. Major species are sardines, horse mackerel, and mackerel, and saury, squids, salmon, tout and bottom fish.





d. Offshore fisheries

1945 and thereafter, government has introduced fishery rights (fisheries cooperatives), licensing system to manage the fisheries. During the first half of the 20th century, Fisheries has developed by the Japan in response to the rapid increase of population and to meet the food demand. 1920 – 1930 motorized large vessels were introduced. Large fishing vessels and world fishing grounds were opened in 1950 and the peak production period is 1957 to 1990 (Fig 1).

Currently, 10 to 50 GRT vessels carry out fishing operations with the crew size 10 to 30 people. They engage in offshore drag net fishing, medium and large size round haul net fishing, pole net fishing for saury, off shore squid fishing etc.

e. Far Sea fisheries and world fishing grounds

Since 1990s, fish production in Japan has began to decrease and had to import of fish and fishery products from other countries to meet the demand.

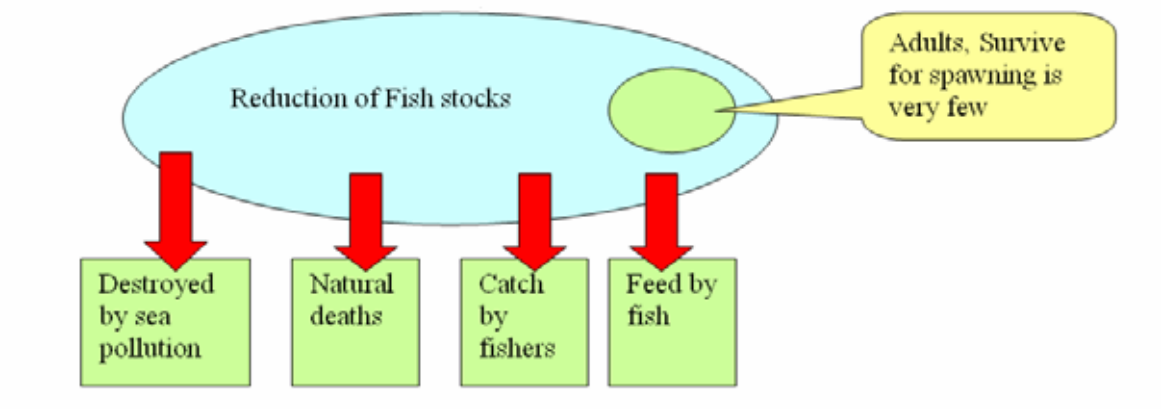
Tuna Long liners and Purse seiners were encouraged to fishing in far seas (Fig 2 and 3) (North Atlantic Ocean, Southern Indian Ocean, western and Northern Pacific Ocean).

f. Ocean Aquatic farming

Japan has practiced the cultivation of edible fish species since 1880s and has been engaged in creation of fishing grounds of gathering places for fish, cultivated fishing grounds and the preservation of fishing grounds.

g. Environmental problems in fisheries

Disposal of chemicals and micro organisms from the Industries in Japan contaminated the sea water and make Environmental pollution severely. Therefore, polluted seawater destroyed the large amount of valuable fish resources in Japanese sea. If the destruction of immature fish is larger, adults survive for spawning is very few.



3. Fishery Cooperative System in Japan

a. Cooperatives associations

Fisheries cooperative system has established in Japan in early 1940s. The cooperative societies make the steady link between the government and fishermen by the fisheries law. Fisheries is managed and controlled under the cooperatives. The current fishery cooperative system is given below (Fig 6). Fisheries data collection system is carried out in efficient manner, by the Fisheries Authorities through the cooperatives. Cooperatives are involved in fishing, fish farming, processing, marketing, managing etc.

- Local fishery cooperatives
- Specialized fishery cooperatives
- Inland water fishery cooperatives
- Aquatic product processing cooperatives
- Fisheries production Associations
- National Federation of cooperative associations

b. Role of Cooperatives

- To provide the members Credits/grants in interesting rates
- Purchasing of boats, equipments, fishing gears, nets, at reasonable prices

- Assist of national and international involvement of Sales in fish and fishery products
- To give Guidance and awareness by timely for the improvement of fisheries and related industries
- To make Facilities for fish landing, storing and infrastructures etc.

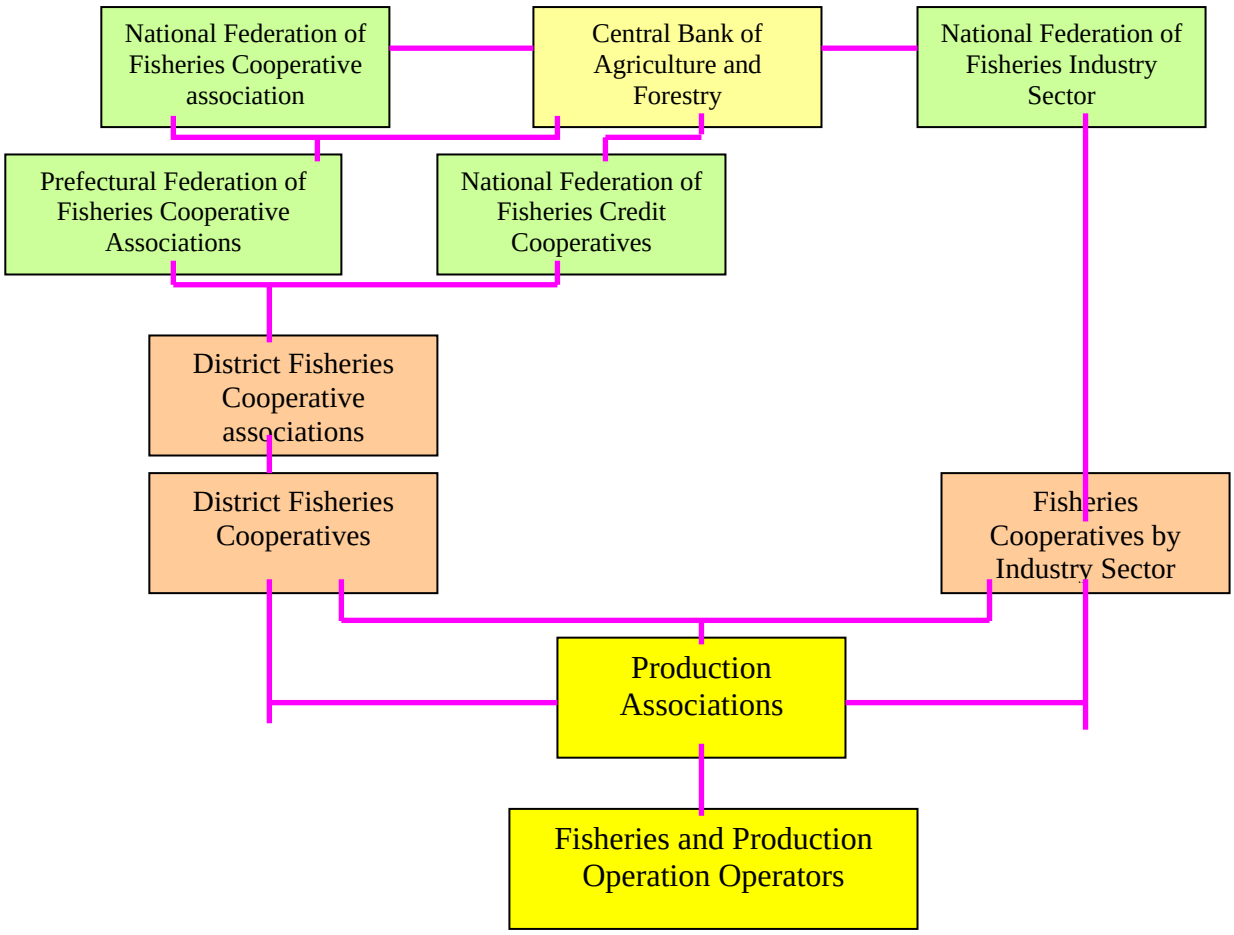


Fig 6: Organizational Diagram of the Fisheries Cooperative System

4. Fishery Management in Japan

a. Characteristics of coastal fisheries management

Fishery operations are divided into three sectors by the Fisheries law as follows.

- Fisheries based on fishery rights: set net fisheries, demarcated fisheries, and common fisheries are included.
- Licensed of fisheries: Minister and Governor licensed fisheries such as tuna long line, purse seine are covered.
- Free fisheries: persons make living by fisheries are covered

b. **Management bodies**:

Prior to UN fisheries law, Japan has engaged in open sea fisheries. After the introduction of EEZ, fishery resources have become depleted. Therefore, the National Federation of Fisheries Cooperative Association Proposed to conduct fishing operations, managing the resources appropriately.

- The independent management (bottom up system)
- The system management (the top down system)

c. Successful cases of coastal Fishery Management

- Reproductive Management type (sand lace fishery in Ise Bay)
- Recruit resource management and price maintenance (Surf clam fishery in Fukushima prefecture)
- Individual allowable catch management and effort management (Small scale trawl fishery of Squilla (maintis shrimp) Yokohoma city fisheries cooperative association
- Catch amount management and effort management (Sand fish fishery in Akita prefecture)

d. GIS Module (Marine explorer) for fisheries management

Fishery scientist has developed (GIS) Marine explorer, which can link with various databases, and data sources such as fish catch, satellite images etc. Processing, analyzing data are quick and accurate. Fishers use reports, maps, and predictions through fax or Internet.

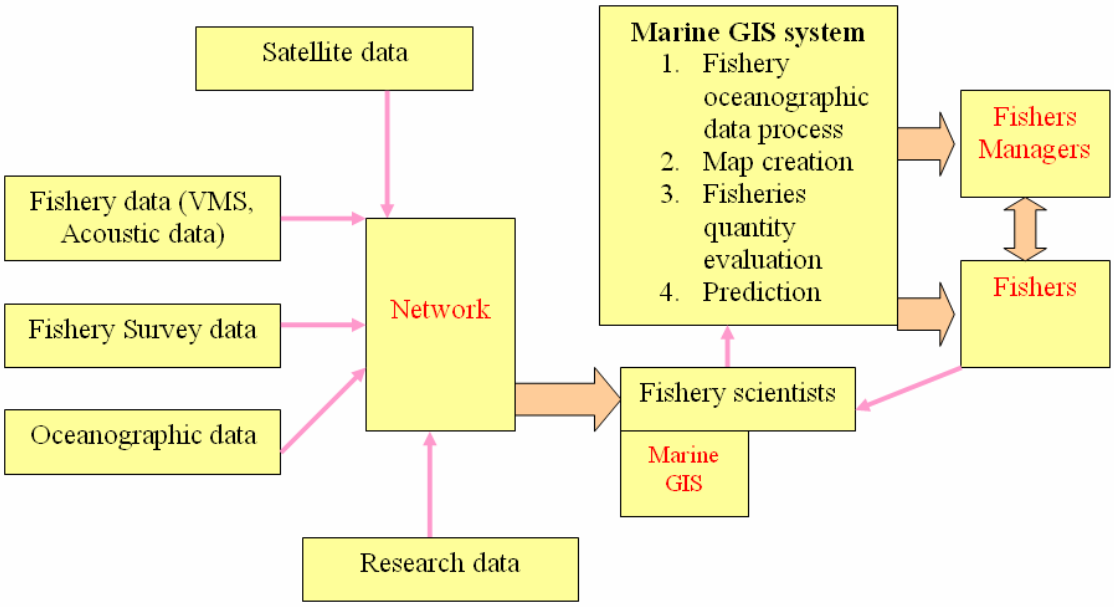


Fig 7: GIS application for fishery managements

5. Fishery Resources Management

a. The principles of Theoretical Fisheries Management

- **Production model** (Relationship between resource abundance (principal) and natural increment (interest).

  Fishery resources are resources capable of autonomous renewal (reproduction). We call this naturally increased volume "the natural increment" or the surplus production.
  The ceiling figure, which is the point beyond which volume of fish cannot increase, further is determined by environmental factors. We call this ceiling figure "the carrying capacity".

- **Maximum sustainable yield (MSY)**

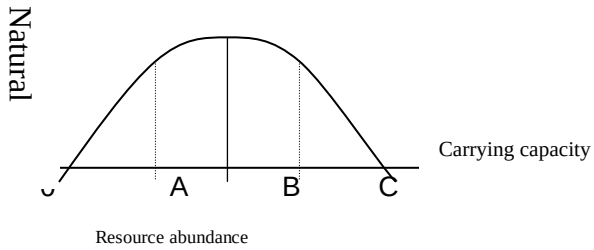


Fig 8: relation between resource abundance and natural increment

A, B and C means three different resource abundance levels. The catch amount that can be sustainable taken is largest when the resource abundance in the graph is at level B. We call catch amount level B at this time "the maximum sustainable yield (MSY)". This MSY is an important concept in fisheries management.

- **Maximum Economic Yield (MEY)**

  This section looks at the situation when economic factors are taken into consideration.

  - Assume that the catch amount is determined proportionately according to the fishing effort and resource abundance.
  - Assume that the unit price of price of fish is not affected by the size of the catch amount.
  - "The maximum economic yield (MEY)" determines the production volume when the result of "catch sum minus yield cost" is largest.

- CPUE

  The catch per unit effort (CPUE) is the basic statistical figure used when taking the problem of resource management. This indicates the size of the catch per one unit of fishing efforts. We use the CPUE as an important indicator to judge the increases and decreases in resource abundance.

- **TAC system (Total Allowable Catch**)

"The upper limit of the amount of fish catch that is permitted to be taken for resource management purposes" is defined as the "allowable biological catch

(ABC)". (TAC) Total Allowable catch is "the amount of fish that is possible to take (or the total amount of fish catch that is permitted to be taken)".
We call the method of managing using the TAC "catch amount control" or "output control".

- **ABC (Allowable biological Catch)**

  Scientist in FRA is using scientific calculations to estimate the ABC. The basic idea for estimation of ABC is to maintain or restore resources to a level at which the MSY can be realized.

6. Fisheries Data Collection System

a. Ministry of Agriculture, Forestry and Fisheries

New fisheries policy reviewed the existing fish catch data collection system and action has taken to change the scope and structure of the data collection surveys. Considering the production structure and resource distribution, survey items were changed (fishing trip, trip duration, fishing area, bait types). Data collection and processing system is shown in fig 9.

b. Statistical surveys

- Survey of operational volume

  - Data: Fishery business entities, Labour input for production, effort, type of
  - Operation, farming method, farm area,
  - Time: Annual survey
  - Method: interview

- Survey on marine fish catch

  - Data: number of trips, duration of operation, catch
  - Time: quarterly
  - Method: interview, reports

- Survey on marine farming yield

  - Data: feed, yield, sales of seedlings
  - Time: quarterly
  - Method: interview, reports

- Survey on Inland water fishery production

  - Data: catch, natural seedlings gain for fishery, yield, sales of seedlings, type of Operation, type of water body
  - Time: annual
  - Method: interview, reports

- Survey reports: catch by species and area, economic value is calculated for annual reports. The reports are published in Prefectural level and national level through in print and electronic media for the information of public as well as fishers. Digital media also used.

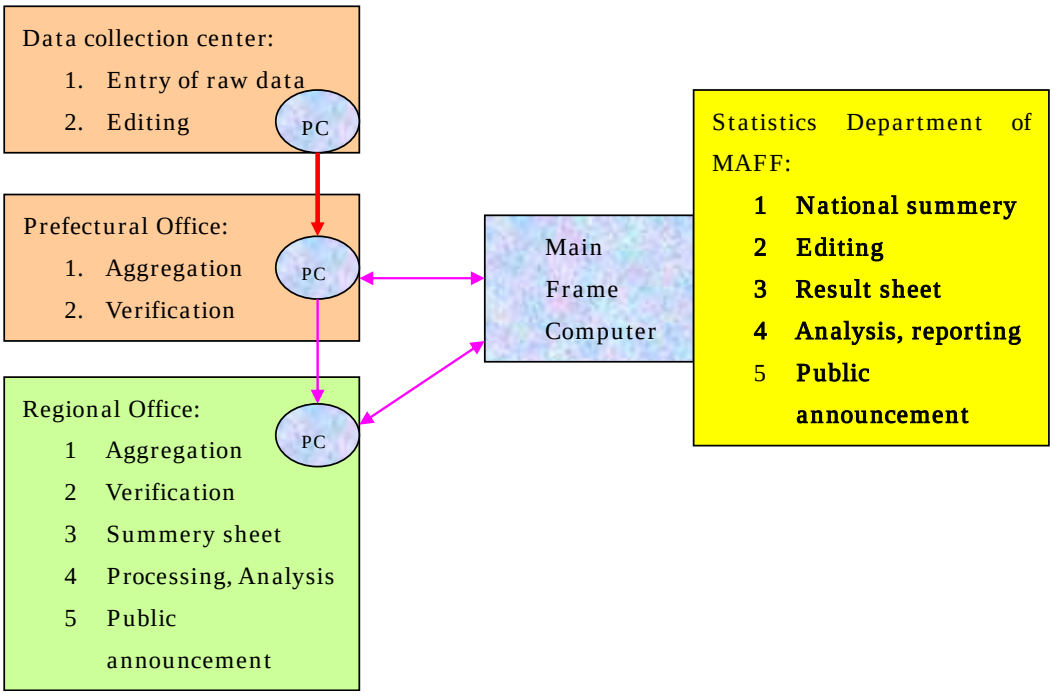


Fig 9: Data processing system of Statistics Department of MAFF

7. Landing Data Collection and monitoring systems

a. Tuna Purse seine fisheries

- The small boats categorized into three boat strata according to size
  - Small (< 5G.T.)
  - Medium (>=5G.T. and <15G.T.)
  - Large (>= 15G.T. mainly 50 to 150 G.T.)
- The Larger boats categorized into two boat strata according to size
  - 50 to 150 G.T. operated in coastal sea in Japan
  - Larger ships operated in tropical waters and Indian Ocean
- Effort 8000 days or more
- Species: Skipjack, Yellowfin, Bigeye, and bluefin
- Catch statistics:
  - Sampling at the ports
  - Observing of scientists – biological information
  - Log books (information on fishing ports, Information cruse, Information on fishing process, 4.Body length record)
  - Fishing grounds: 1. In Pacific Ocean 2. Indian Ocean

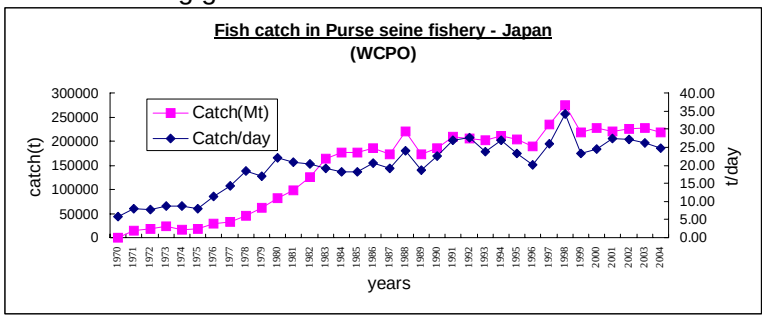


Fig 10: Fish catch in purse seine fishery

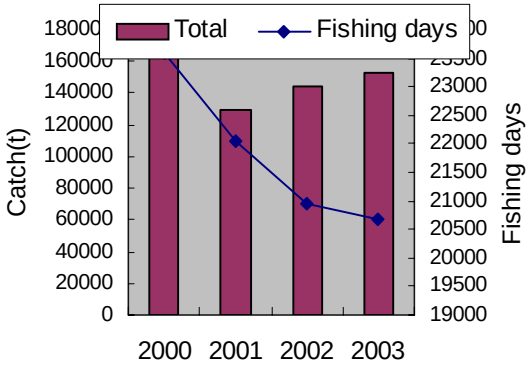
b. Tuna longline fisheries– Shimizu harbour

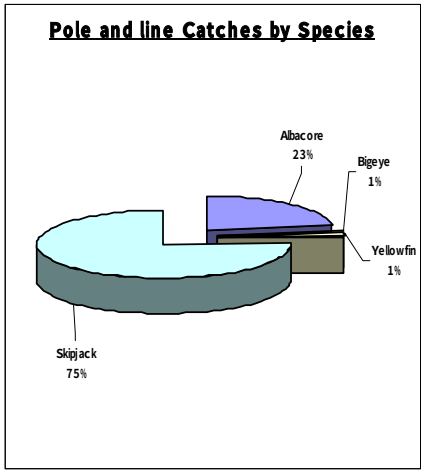
- Coastal long line (less than 20 GRT) need to approved fishing off EEZ
- Offshore LL (20 to 120 GRT) required a license to fishing
- Distant water LL (50 to 500 GRT) Limited license entry system
- Log book should be submitted after the completion of trip (Within 30 days)
- Required to send transhipments report and size measurements.

c. Pole and line fishery for Skipjack tuna

Pole and line for tuna is operated by the larger than 20 GRT vessels in western central Pacific Ocean. Catch is estimated using logbook reports.

Fig 11: Pole and line Fishery catch





8. Fishery Harbours and Fish Auction Centers

a. Yaizu Fish harbour and Auction Center

We visit the regional fisheries office in Yaizu. Research office in Yaizu collect sample data especially from Southern blue fin tuna vessels. They collect catch data, length-weight data, fishing area etc. They published annual report for the use of fishers and make awareness programs regarding the fishing grounds. They provide required data for research institute and Fisheries agency regularly. Yaizu fisheries cooperative Association published a data sheet for the use of fishers and planners.

b. Tsukiji Fishery harbour and Auction center (Sashimi Fish market)

c. Masaki Fishery Harbour and Auction Center – Kanagawa

Frozen tuna for **Sashimi** from long line vessels and purse seine vessels are taken to these markets for action. Japanese Fisheries Cooperative societies are handled the fish markets. Auction system is almost similar in the two markets (**Tsukiji** and Masaki). Prices are low in Masaki market and prices are high in **Tsukiji** market. That is due to the changes of quality, fish sizes and fishing areas.

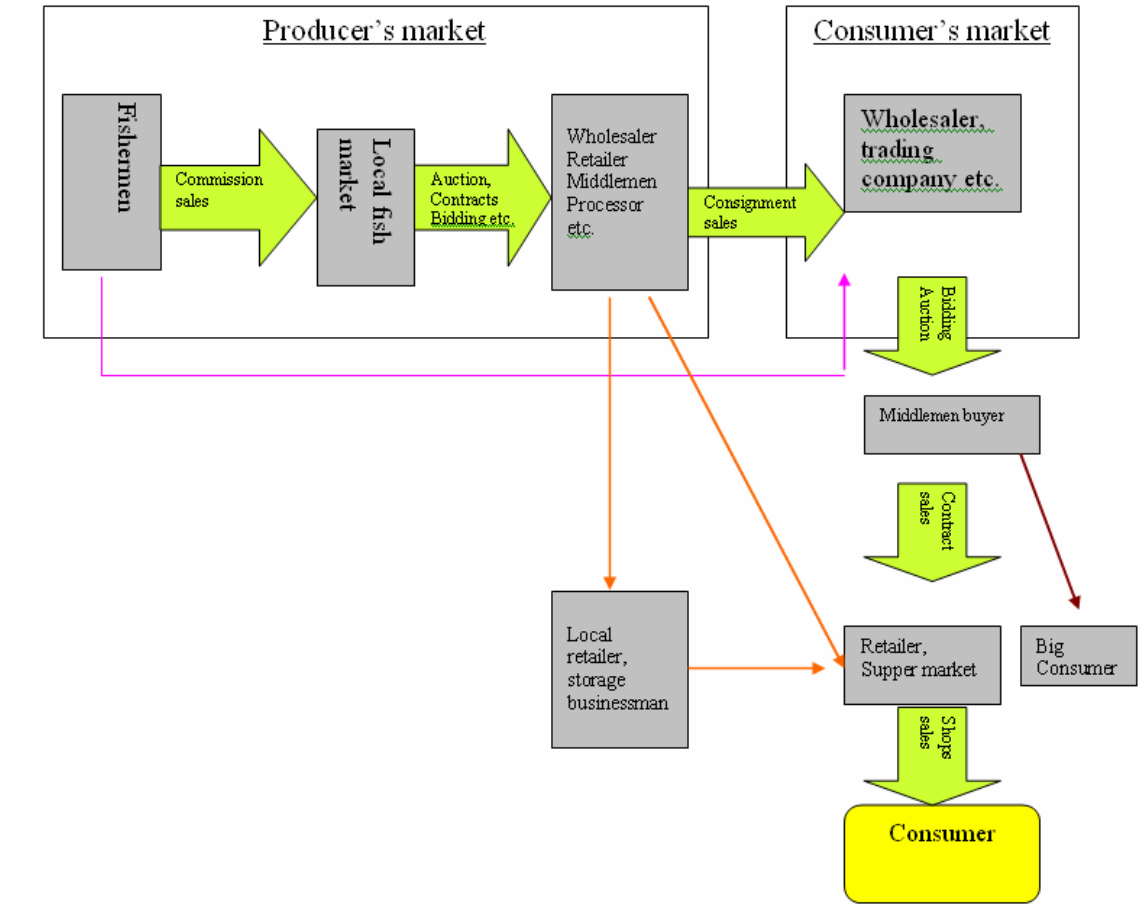


Fig 12: Fish marketing channel

9. Fishery Research programs in Japan

a. Japan Fisheries Information Center (JAFIC)

Objectives: To provide information service necessary for fisheries, including that regarding fisheries and oceanographic conditions, thereby promoting effective utilization of fishery resources and ensuring fisheries entrepreneurial management and contributing, enhancing the information technology regarding fisheries.

Data collection and analysis: Fisheries and oceanographic information are collected from the following sources. The JAFIC staffs make prompt process and analysis of data and Information and result of the fisheries and oceanographic conditions are forecast via Internet and other means.

- Observation data from 1.research vessels 2.fishing vessels 3.merchant vessels 4.ferry boats 5.Aircraft 6.artificial satellites
- Operation data on fishing vessels are from 1.radio stations 2.prefectural fisheries experiment stations 3.fishery research institutes in each region.

Following projects also entrusted by the central government to JAFIC

- To analyze the supply and demand of fishery products
- To analyze and to published the allowable catch and progress report

- To analyze and to publish the report on catch reports from distant water fishing vessels and foreign vessels engage in fishing within the EEZ of Japan.
- To develop the technology for identification system of fishing vessels and aircraft that employed in fishing via satellite.
- To carry out study about application of satellite remote sensing for fisheries. (To understand the behavior of fish schools and migration roots using research vessels, satellite images, aerial observations and commercial catch data.)

Services and assistance for the fisher: Provide oceanographic conditions (sea temperature, sea currents etc.) fishing grounds, weather conditions and market information for fishing vessels in far seas.JAFIC makes close coordination providing information for the Fisheries Agency.

b. National Research Institute of Far Seas Fisheries (NRIFSF)

NRIFSF established in 1967 and thereafter, many contributions were given to promote the fisheries and oceanic ecosystems. Scientific activities of the institute are focus on mainly tuna, whales, dolphins, and oceanic squids throughout the world. Scientists in the NRIFSF are in close relations with 14 international organizations. (CCAMLR, CCSBT, CITES, GFCM, IATTC, ICCAT, IOTC, ISC, IWC, MHLC, NAFO, NAMMCO, SPC, PICES)

c. Organization for Promotion of Responsible Tuna Fisheries (OPRT)

OPRT promotes responsible tuna fisheries to ensure the sustainable use of tuna resources. The main activities are Registration of vessels, Elimination of IUU/FOC, Reducing excess fishing capacity. OPRT is cooperating with international fishing related organizations.

d. Research Institutes of Japan

- National Research Institute for Far Seas Fisheries (NRIFSF)
- Yaizu Branch office of NRIFSF
- Shizouka Statistics and information Center
- Japan Fisheries Information Center (JAFIC)
- Kanagawa Prefectural Fisheries Technology Center (KPFTC)
- Fisheries Research Agency (FRA)
- Japan Marine Fishery Resources Research Center (JAMFRC)

e. Research papers in relation to the Indian Ocean

- Distribution of Big eye tuna and its relationship to the environmental conditions in the Indian Ocean based on the Japanese long line fisheries information (Dr. MasahikoMohri –National Fisheries University, Shimonoseki, Yamaguchi, Japan)(Dr. Tom Nishida –National Research Institute of far Fisheries, Shimizu, Shizouka, Japan)
- Seasonal Changes in Big eye tuna fishing areas in relation to the oceanographic parameters in the Indian Ocean(Dr. MasahikoMohri –National Fisheries University, Shimonoseki, Yamaguchi, Japan)
- Consideration on horizontal and vertical distribution of adult yellowfin tuna (Tunnus albacores) in the Indian Ocean based on the Japanese tuna longline

fisheries information(Dr. Masahiko Mohri –National Fisheries University, Shimonoseki, Yamaguchi, Japan)

- Distribution of Skipjacks: a study based on purse seine catches in the Indian Ocean(Dr. MasahikoMohri –National Fisheries University, Shimonoseki, Yamaguchi, Japan)(Dr. Tom Nishida –National Research Institute of far Fisheries, Shimizu, Shizouka, Japan)(Mr. Junko Sadakata)
- Consideration of distribution of adult yellowfin tuna (Tunnus albacores) in the Indian Ocean based on the Japanese tuna long line fisheries information (Dr. MasahikoMohri –National Fisheries University, Shimonoseki, Yamaguchi, Japan)(Dr. Tom Nishida –National Research Institute of far Fisheries, Shimizu, Shizouka, Japan)

Some Important findings:

- Somalia current active in western Indian Ocean and cold water which is low oxygen upwelling during SW monsoon
- Oxygen contents in deep-water layers are low around Bay of Bengal and Arabian Sea.
- Water Temperature 10 to 16 level in shallow waters (up to 300 m)
- Matured tuna are in deep water layers
- Gonad Index (GI) = $W/L^{(3)}x10^{(4)}$
- W= gonad weight (g)
- L= folk length (cm)
- If GI>= matured
- Water temperature does not change by areas
- Fishing operations in shallow water for big eye tuna and yellowfin tuna is best.
- Between 10N and 15S adult tuna schools high

10. Practical Applications

- In this training, I understood that the accuracy of fisheries data is very affective in fishery resources management. The scientists in Japan highlighted the importance of resource management of tuna species and their effort made on fishery researches using the technology (GIS) and existing data.
  - Sri Lanka is in need of collecting and analyzing of tuna fisheries data using new scientific tools as GIS system. To implement the system training of officers and technical assistance is proposed.
- The research institutes and researches in Japan keep close relations with the government and published their findings for the benefit of fishers. They monitor the tuna fishing operations by fisheries and area and use high technology for analysis (In some cases they use DNA test also).
  - Fishery researches on tuna fishery and feed back of the findings to the fishers and the government, to be enhanced in Sri Lanka.
- Fisheries policy and fisheries law in Japan follows the existing data collection, research and data reporting.
  - A Document of National Fisheries Policy has developed by the Ministry of Fisheries and Aquatic Resources in Sri Lanka. It is proposed to consider the inclusion of paragraph on Fisheries data collection, regular fisheries censuses (by decennial), and regular surveys and to enhance the fishery researches.
- Fish catch estimates of Sri Lanka is based on eye estimates of the Fisheries Inspectors. The system followed by the Statistics Department of MAFF, Japan is provided accurate and timely data. Therefore, Catch data collection system in Sri Lanka can be improved by the assistance of Fishery unions and fisher organizations.

- Fishery cooperative act in Japan has provided provisions to collect information from their members and has rights to manage fisheries. Fishery cooperative system has established in Sri Lanka in 1960s, but no properly active. However the fisher organizations could be activate for proper data collection system.
- Local Administration system of Sri Lanka is almost similar to Japan. As in Japan, Automated data collection and processing system could be implemented with the assistance of regional authorities.
- Harbour based data collection and vessel-monitoring system is very affective in Japan. Standard data collection formats are used and close relationships exist with the research scientists and other officials. The data collecting agencies, scientists, administrators who are in hand length in Sri Lanka should make close relations in connection with the fisheries statistics.
- Japanese Scientist conducts annual biological surveys to estimate the ABC and TAC and make recommendations to the Government regarding the fisheries management measures. They also conduct researches on genetics, oceanography, Fishing technology, fish economics, Special etc. to enhance the management and utilization of fish.

Acknowledgements

Japanese Government in many aspects through the ODA funds. The Chairman and his staff of the OFCF are leading to promote the friendly relations with coastal countries by providing economic and technical cooperation in the fisheries field. Sri Lanka is participating in the FRMC 2005 with a view to enhance the fisheries statistics collection and analysis system to efficiently use the fishery resources management.

IOTC - OFCF project and the General Secretary of OFCF are attempting improve the statistical system in Indian Ocean Coastal countries for the assessment of tuna stocks in Indian Ocean. I greatly appreciate the above project activities on behalf of my Ministry of Fisheries and Aquatic Resources, Sri Lanka.

Dr. Tom Nishida (NRIFSF) and all the subject specialists made great effort, giving lectures and sharing their experiences with us in many ways such as data collection, fishery resource management, tuna researches, tuna fish marketing, GIS data analyzing etc. I thank much for them for their kind assistance.

Under the guidance of Chairman (OFCF), Mr. Uchida and others has arranged successfully the training, lodging (OVTA), transports and other facilities are greatly appreciated.