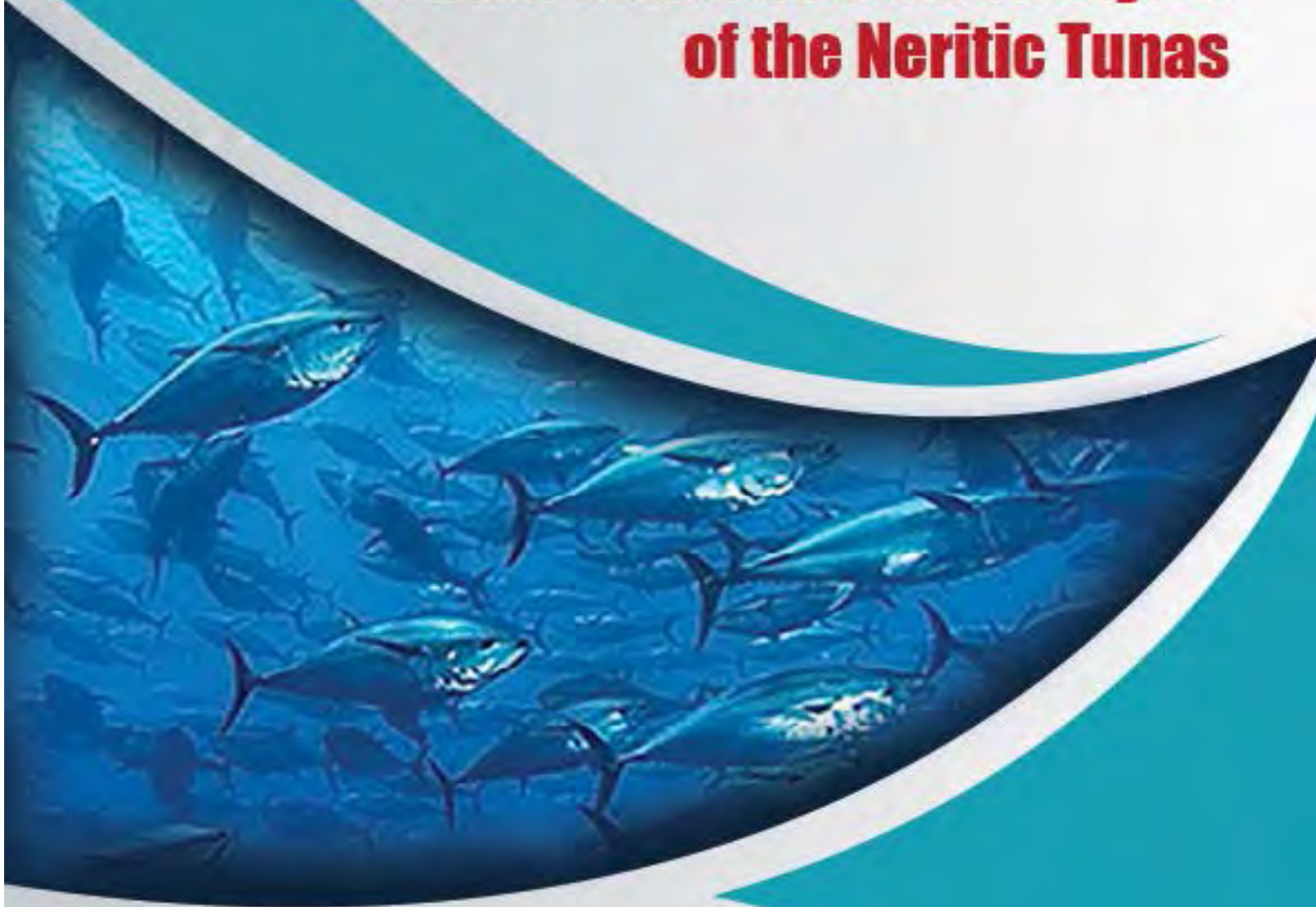


# **S**ANDARD **O**PERATING **P**ROCEDURE

## **for Data Collection and Analysis of the Neritic Tunas**



**SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER**



# **STANDARD OPERATING PROCEDURE for Data Collection and Analysis of the Neritic Tunas**

Prepared by  
Marine Fishery Resources Development and Management Department  
(MFRDMD)

Funded by:

SEAFDEC-Sweden Project



**SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER**

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## **STANDARD OPERATING PROCEDURES:**

### **Information Collection for Stock assessment of Neritic Tunas**

#### **1. INTRODUCTION**

Implementation of the Neritic Tunas Stock Assessment in the Southeast Asian Waters was proposed and agreed upon during the 1<sup>st</sup> Scientific Working Group (SWG) Meeting held at Grand Blue Wave Hotel, Shah Alam, Selangor, Malaysia from 18-20th November 2014. The meeting agreed to come out with a **Draft Standard Operating Procedures (SOP)** as recommended by the SWG.

#### **2. OBJECTIVES**

1. To specify method for biological data collection and analyses on length-frequency data, gonad maturity and stocks identification.
2. To provide standard procedures on data collection and analysis of fishing operation and catches data
3. To provide tools for data handling and analysis

#### **3. ENVISAGED OUTCOMES**

The results of the study will provide information on fishing operation and status of neritic tuna fishery, together with the biological information caught by several types of fishing gear in the Southeast Asian region. Most of the expected outcomes from the data collection and analyses will be applicable for the neritic tuna stock assessment in the region. The expected outputs from these studies are as follows:

##### **Biological data**

1. Monthly size composition of neritic tunas
2. Growth parameters:
  - i)  $K$  – Curvature growth
  - ii)  $L_{\infty}$  - Asymptotic length
  - iii)  $t_0$  Age at length equal to 0
3. Length-weight relationship
4. Length at first maturity
5. Sex ratios
6. Spawning season determination from Gonado Somatic Index (GSI) and % of maturity

##### **Fishery data**

- i) Fishing operation, fishing area and the status of neritic tuna fishery
- ii) Group and species composition of catches from each fishing gear deployed to catch neritic tunas
- iii) Catch and effort of each fishing gears deployed to catch neritic tunas
- iv) Catch/effort trend based on statistical data (yearly)
- v) Mortality parameters:

- a) Z – Total mortality coefficient, or instantaneous rate of total mortality or total mortality rate (per time unit),  $Z = M + F$  (including the Z estimation from catch/effort data)
- b) M – natural mortality coefficient, or instantaneous rate of natural mortality or natural mortality rate (per time unit).
- c) F – fishing mortality coefficient or instantaneous rate of fishing mortality (per time unit).
- d) Catch curve analysis is used to estimate L50% (length at which 50% of the fish is retained by the gear 50% escape) and convert it to age, t50% (age at which 50% of the fish is retained in the gear).
- e) Determination of Exploitation rate, E ( $E = F/Z$ ) using mortality parameters.
- f) Determination of yield per recruit (Y/R) pattern.
- g) Stock unit/population structure using morphological and DNA methods
- h) F-array by length and Cohort Analysis including Thompson and Bell Prediction Model.

#### **4. STANDARDIZED ITEMS FOR DATA COLLECTION**

The 1<sup>st</sup> SWG Meeting has decided and agreed on items as listed below to be standardized for improving the data collection system.

##### **4.1 Study area**

Study area will cover the South China Sea, Andaman Sea and adjacent waters of the Southeast Asian region.

##### **4.2 Countries involved in the project**

Eight participating SEAFDEC member countries are Brunei Darussalam, Cambodia, Indonesia, Malaysia, Myanmar, the Philippines, Thailand and Vietnam.

##### **4.3 Sampling location**

Sampling sites was identified by SWG during the meeting in Vietnam (see map).

##### **4.4 Species to be studied for stock assessment**

- Longtail tuna,
- Eastern little tuna,
- Frigate tuna and
- Bullet tuna

##### **4.5 Identification of target species**

It is recommended that the identification of fish species is based on taxonomic and morphological characteristics:

a) Longtail tuna



b) Eastern little tuna



c) Frigate tuna



d) Bullet tuna



#### 4.6 Major fishing gears

Purse seine, ring nets, gill nets, handline and other fishing gears depending on country.



#### **4.7 Who should collect the data?**

All data items are to be collected by enumerators and technical officer of AMS.

#### **4.8 Duty of Enumerators**

Enumerators refers to those who are assigned and trained by the Technical Officers of each country and they are stationed at selected sampling sites.

Their responsibilities are as follows:

- 4.8.1 Daily visits to fish sampling sites.
- 4.8.2 Meeting personally with the fishing boat operators/skippers and interview them in order to obtain information on:
  - 4.8.2.1 Fishing areas
  - 4.8.2.2 Fishing operation and method of fishing *e.g.* FAD, light, etc.
  - 4.8.2.3 Number of days per fishing trip
  - 4.8.2.4 Number of haul per trip
  - 4.8.2.5 Estimated total catch per trip
  - 4.8.2.6 Record the vessel information (**refer to Form xx**)
- 4.8.3 Take sub-sample accordingly and record the weight of the sub-sample.
- 4.8.4 Sort the fishes into fish group and record the weight
- 4.8.5 Sort the fish group of neritic tunas into species and record the weight of each species
- 4.8.6 Record the catch/effort data and other information on Fishing Operation and Catches Data Sheet
- 4.8.7 Measure the Total Length (TL) and Fork Length (FL) of fish for at least 100 tails per species per sampling site and record on the **Length-Frequency Data Sheet**
- 4.8.8 Compile all the data sheets and submit on monthly basis to the Technical Officer of the country.

### **5. DATA COLLECTION AND ANALYSIS**

#### **5.1 Fishing operation and catches data collection and analysis**

##### **5.1.1 Catches Data Collection and Format:** (see Fishing Operation and Catches Data Sheet for Example).

- a. Interview the skipper/owner of the boat in order to get information on Fishing Operation (no haul/trip, no. of day/trip, no. of trip/month) total catch/trip and fishing ground
- b. Sub-sample weight should be obtained accordingly for species composition studies
- c. Record the weight of each species of neritic tunas
- d. All data must be recorded in **Microsoft Excel Format** for easy and convenience calculation for the semi-processed data output.

**Fishing Operation and Catch Data Sheet**  
 Interviewer.....Date.....

**Vessel Owner Questionnaire**

**A. General Information**

Country	Fishing Ground		Name of Landing Port
	Lat:	Long:	
	Distant and bearing from shore		
<b>Total number of active boats in the area by gear type</b>			
<b>Estimated no. of boats in operation in a day</b>			
<b>Estimated no. of boats in operation in the month</b>			

**B. Fisheries Information**

<b>Section 1: Fishing Vessel</b>			
<b>Vessel Name/Registration:</b>		<b>Flag State:</b>	
<b>Engine type:</b> <input type="radio"/> Inboard <input type="radio"/> Outboard	<b>Vessel speed:</b>	nm/h	<b>Engine power:</b> hp
<b>Vessel size:</b> GRT/GT	<b>Length (LOA):</b> meters		

<b>Section 2: Fishing Gear</b>	
<b>Type of gear:</b>	
<input type="radio"/> Purse Seine/Ring nets	length and depth
<input type="radio"/> Hand Line	no. of hooks
<input type="radio"/> Longline	no. of hooks
<input type="radio"/> Pole and Line	no. of poles (hooks)
<input type="radio"/> Gill Net	length of net
<b>Others:</b>	
<b>Remark:</b>	

<b>Section 3: Fishing Operation</b>			
<b>Fishing method:</b>	<input type="radio"/> Free school	<input type="radio"/> Luring light	
	<input type="radio"/> FADs (Anchored/Drifting)	<input type="radio"/> Other.....	
<b>Fishing Ground:</b> (Area name)		<b>GPS position</b> Latitude .....	
		Longitude .....	
		<b>[or attach 1x1 grid map]</b>	
<b>Distance from shore</b> ..... Nautical miles		<b>Fishing time:</b> <input type="radio"/> Day <input type="radio"/> Night	

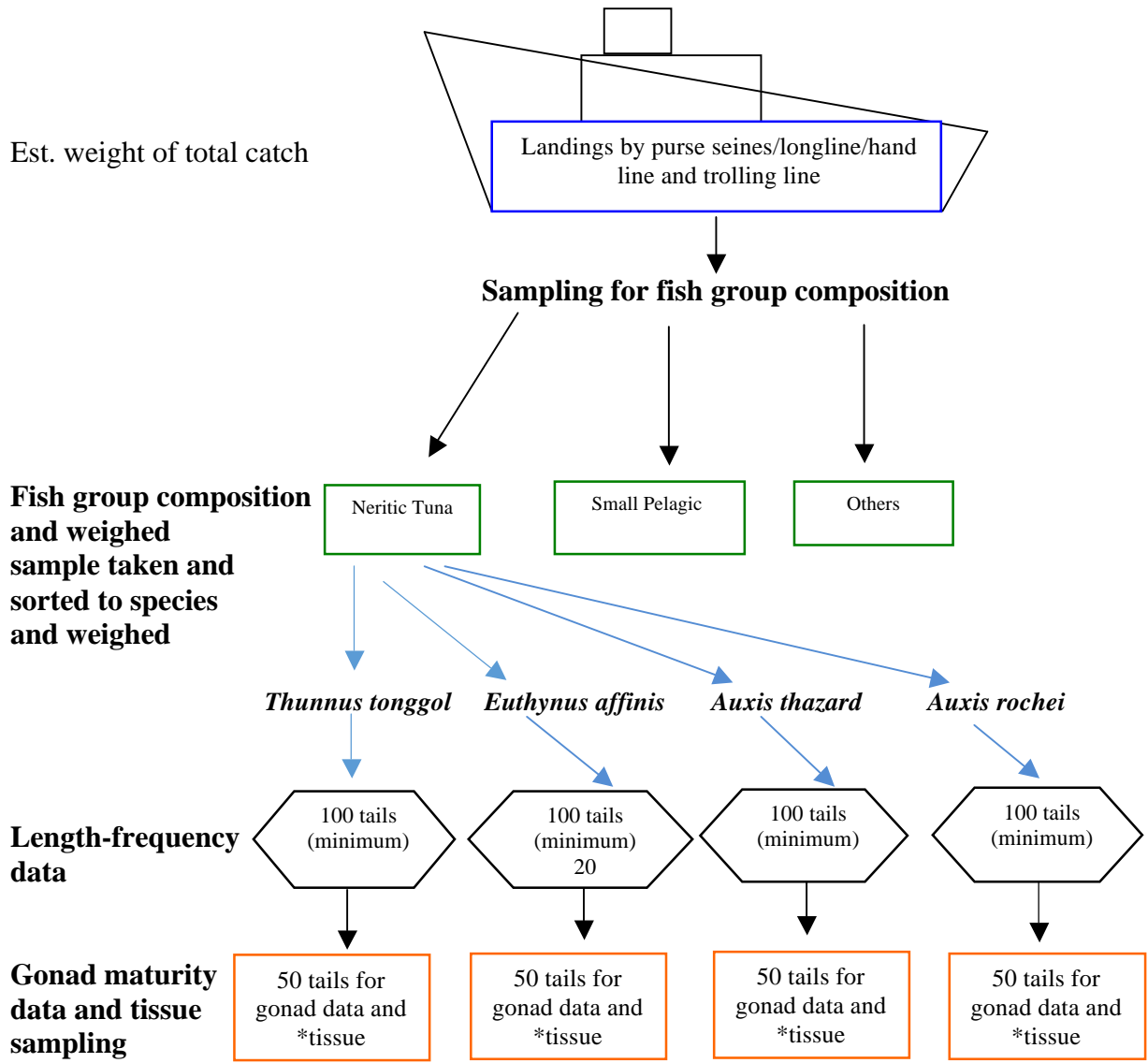
<b>Frequency of fishing operation</b> No. of haul per trip..... No of days per trip..... No. of fishing trip in the month.....	<b>Fishing effort</b> Purse Seine: catch per haul Hand Line: catch per no. of units per trip Longline: catch per no. of hooks per haul Pole and Line: catch per day Gill Net: catch per haul (soaking time)
<b>Estimated total catch (Kg per trip)</b> <b>(Estimated total catch per day)</b>	
<b>Estimated total catch per month</b>	
<b>CPUE (Kg/month/haul)</b> <b>Catch per day</b>	

<b>Section 4: Catch data</b>			
<b>Catch Details</b>	<b>Number ( Tails)</b>	<b>Total Weight (kg)</b>	<b>Sp. Composition %</b>
Longtail tuna			
Eastern little tuna			
Frigate tuna			
Bullet tuna			
Other tuna species			
Other fish group			

<b>Section 5: Market data (Optional)</b>				
<b>Top 5 species with the highest income</b>	<b>Income/trip (day)</b>	<b>Selling price (US\$/kg)</b>		
		<b>Small</b>	<b>Medium</b>	<b>Large</b>
Longtail tuna				
Eastern little tuna				
Frigate tuna				
Bullet tuna				
Other tuna species				
Other fish group				
<b>After collect catch, what will you do</b>	<input type="radio"/> <b>Sell at fresh market</b> <input type="radio"/> <b>Sell to whole seller</b> <input type="radio"/> <b>Sell directly to restaurant</b> <input type="radio"/> <b>Sell to fish industries</b> <input type="radio"/> <b>Consume in family</b>			
<b>Note: Fish price by length class or by size category (please indicate length of each size)</b>				

## Flow Diagram of Sampling Method

**Flow chart works for fish group composition, species composition, length-frequency and gonad maturity data collection**



\* Tissue sampling will be carried out once on selected species only.  
For the first stage, only longtail tuna will be sampled.

\*For BET, get as many sample as possible because of lower catch.

## Fishing Operation and Catches Data Sheet: Data Analysis

Fishing Operation and Catches Data Sheet					
Country:					
Sea areas:					
Fishing areas:					
Grid area (Referred to Grid number from SOPs)					
Name of sampling port:					
Date:					
Name of enumerator:					
Estimated no of boat in operation in a day					
Estimated no of boat in operation in the month					
Fishing Operation					
	<b>No of Boats Sampled</b>	<b>1</b>	<b>2</b>	<b>3 Total</b>	<b>Average</b>
No of haul per trip					
No of fishing trips in the month					
No of day per trip					
Estimated total catch (Kg) per trip					
Estimated total catch per day					
Estimated total catch per month					
CPUE (Kg/month/haul)					
CPUE (Kg per day)					
Species Composition					%Spp Com
Samples Weight (kg)					
Weight of <i>T. tonggol</i>					
Weight of <i>E. affinis</i>					
Weight of <i>A.thazard</i>					
Other tuna species					
Other fish group					

## 5.2 Biological Data Collection and Analysis

### 5.2.1 Length-frequency data collection for growth and mortality of tuna species

#### List of materials

1. Measuring board
2. Weighing balance
3. Data sheet

#### Method for Length-frequency data collection

##### Port Sampling

- a. Sampling is carried out at landing sites in a monthly basis, and sampling **at least 10% of total number of boats by gear type**. See the flow diagram of sampling method

- b. Measure Fork Length (FL) of **at least 100 tails per species per month** using measuring board and recorded the length on a standard format of the Length Frequency Data Sheet
- c. Record the samples weight of all fish measured by type of boat category
- d. Prepare length frequency data set for further analysis.

### 5.2.2 Length-Weight relationships

Fork Length (FL) of some fish samples, from the smallest to biggest sizes, should be measured in centimeters (cm) and individually weighed to the nearest grams (g). A set of data should be obtained from each sampling port. At least 200 tails per species per country (except Big-eye Tuna) should be sampled.

#### *Biological Sample Data Sheet (Length-Weight)*

Collector name:	Vessel name/ID:	Trip/Cruise No.:	Sheet ID:
-----------------	-----------------	------------------	-----------

Station No.:	Position : Lat.	N Long.	E	Date:	Fish Sampler No.:
--------------	-----------------	---------	---	-------	-------------------

No.	Species	Length (cm)	Weight (g)	No.	Species	Length (cm)	Weight (g)	No.	Species	Length (cm)	Weight (g)
1				31				61			
2				32				62			
3				33				63			
4				34				64			
5				35				65			
6				36				66			
7				37				67			
8				38				68			
9				39				69			
10				40				70			
11				41				71			
12				42				72			
13				43				73			
14				44				74			
15				45				75			
16				46				76			
17				47				77			
18				48				78			
19				49				79			
20				50				80			
21				51				81			
22				52				82			
23				53				83			
24				54				84			
25				55				85			
26				56				86			
27				57				87			
28				58				88			
29				59				89			
30				60				90			

*Length-Frequency Data Sheet*

Collector name:	Vessel name/ID:	Trip/Cruise No.:	Sheet ID:
-----------------	-----------------	------------------	-----------

Station No.:	Position : Lat.	N Long.	E	Date:	Fish Sampler No.:
--------------	-----------------	---------	---	-------	-------------------

No.	Species	Length (cm)	No.	Species	Length (cm)	No.	Species	Length (cm)	No.	Species	Length (cm)
1			26			51			76		
2			27			52			77		
3			28			53			78		
4			29			54			79		
5			30			55			80		
6			31			56			81		
7			32			57			82		
8			33			58			83		
9			34			59			84		
10			35			60			85		
11			36			61			86		
12			37			62			87		
13			38			63			88		
14			39			64			89		
15			40			65			90		
16			41			66			91		
17			42			67			92		
18			43			68			93		
19			44			69			94		
20			45			70			95		
21			46			71			96		
22			47			72			97		
23			48			73			98		
24			49			74			99		
25			50			75			100		

***Length-Frequency Semi-process data sheet***

Country: Fishing ground: Fishing Area: Name of sampling port: Date: Time: Type of fishing boat: Name of Species: Total catch of species (kg): Total weight of species (kg): Sample weight of species (kg): Name of enumerators Raising factor							
Lower limit MM	Upper limit MM	Mid-length MM	Lt-Freq	Raising Freq.	Lt-Freq	Raising Freq	Pool Freq
Total							

Notes: This format is easy for raising and pooling the length frequency in that particular month and sampling site



### 5.2.3 Gonad maturity data collection for “reproductive biology of tuna”

#### List of materials

1. Measuring board
2. Spring weighing balance
3. Digital weighing balances
4. Scissors
5. Forceps



Figure 1: Materials for Gonad Maturity data collection

1. Collect fish samples at least 50 tails for each species per port (Refer to Appendix VI for table of Five-Point Maturity Scale for Partial Spawners).
2. Measure and record fork length (FL) in centimeters and body weight (BW) in gram and gonad weight (GW) to the nearest 0.01 gram.
3. Identify sex and gonad stage of fish visually. For the characteristic of gonad stages, refer to the standard maturity scale as attached (Five-Point Maturity Scale for Partial Spawners).
4. Record the data in the standard format in Gonad Maturity Data Sheet.

**Gonad Maturity Data Sheet**

Country: Fishing Area: Name of sampling port: Type of fishing gear (PS/HL/LL/PL/Gill net): Total catch of the boat: Sample Weight: Name of Enumerators Species name:	Fishing Ground:  Date: Time:
---	---------------------------------------

Sample no.	FL (cm)	BL (cm)	FL (cm)	SL (cm)	BW (g)	Sex & Stages	GW (g)	GSI

Total GSI Males Average GSI Males S.D. of males Total GSI Females Average GSI Females S.D. of females Note: $GSI = GW/BW * 100$ Average GSI Males = $\text{SumGSI} / \text{number of males}$ Average GSI Females = $\text{SumGSI} / \text{number of females}$
---

## 5.2.4 Stomach contents "Food composition of neritic tuna"

### List of materials

1. Surgical kits
2. Ruler or measuring tape/measuring board
3. Spring weighing balance
4. Digital weighing balances
5. Plastic bottle
6. Formalin 10%
7. Stereo microscope

### Method for Stomach contents:

1. Measure Fork Length: FL
2. Weighing of fish
3. Preserve stomachs (freeze or preserve in 10 % formalin)

In the laboratory, then a three-step analysis will be conducted:

- (a) The total weight of the stomach contents
- (b) The content in the stomach by large categories (fish, molluscs, crustaceans).
- (c) The weight of each category

## 6. DATA SUBMISSION AND COMPILATION

1. All data should be stored in *Microsoft Excel* format
2. Data should be processed into a **semi-processed** form and sent through e-mail or fax to the National Technical Officers. The National Technical Officers will then send the data to the Technical Coordinator at SEAFDEC/MFRDMD
3. Four sets of data should be compiled and submitted: a) Fishing operation and catches, b) Length frequency, c) Gonad data, and d) Stomach contents.

## 7. DATA ANALYSIS

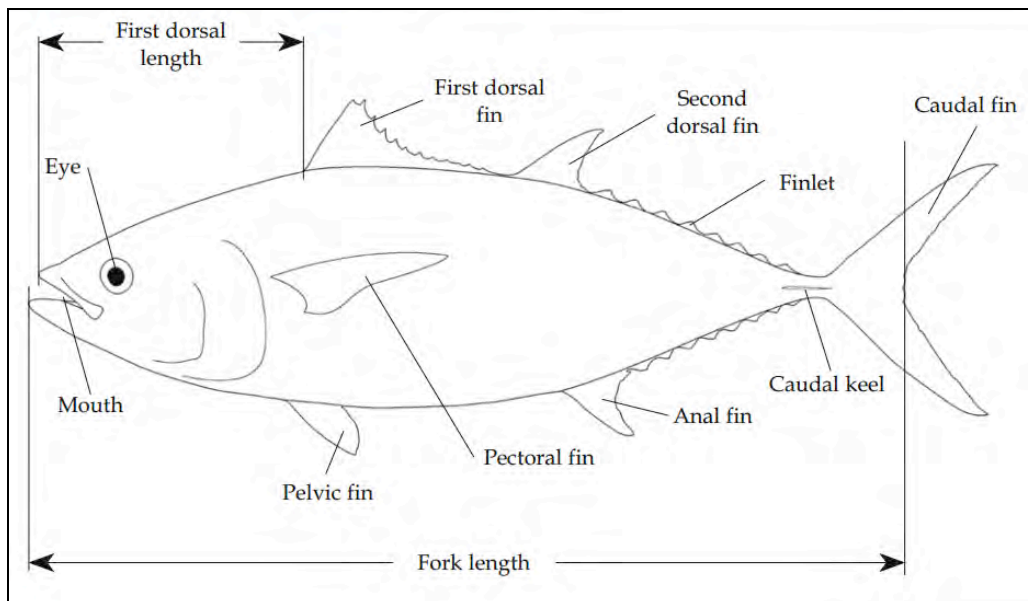
- 7.1 Technical Scientists (SRWG Members) of each country are responsible to analyze all types of data at the national level. Chief Scientists are responsible for regional analysis of the data
- 7.2 Optionally, combined Length-frequency data from the three countries can be analyzed using FiSAT to obtain growth and mortality parameters and other parameters
- 7.3 Gonad maturity data should be analyzed in order to obtain:
  - i. Length-weight relationships,
  - ii. Sex ratio,
  - iii. Spawning season through GSI,
  - iv. Length at first maturity using Udupa, 1986.

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## APPENDIXES

### Appendix I: Standard methodology for length measurement



Source: [http://www.iotc.org/sites/default/files/.../IOTC\\_IDTuna\\_vfinal4\(E\).pdf](http://www.iotc.org/sites/default/files/.../IOTC_IDTuna_vfinal4(E).pdf)

#### Measurements used for neritic tuna:

- Fork length (FL)
- First dorsal length or predorsal length (FD1)

## Appendix II: Example of Fishing Operation and Catches Data Analysis

### Example of Fishing Operation and Catches Data Analysis

<b>Fishing Operation and Catches Data Sheet</b>					
Country:	Malaysia				
Sea areas:	Sulu Sea				
Fishing areas:	Tawau				
Grid area	(Referred to Grid number from SOPs M.V.SEAFFDEC2)				
Name of sampling port:					
Date:	15-Dec				
Name of enumerator:					
Estimated no of boat in operation in a day	10				
Estimated no of boat in operation in the month	45				
<b>Fishing Operation</b>					
<b>No. of Boats Sampled</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>Total</b>	<b>Average</b>
No. of haul per trip	2	3	2	7	2.3
No. of fishing trips in the month	22	20	18		20
No. of day per trip	2				
Estimated total catch (Kg) per trip	500	600	400	1500	500
Estimated total catch per day					
Estimated total catch per month					
CPUE (Kg/month/haul)					
CPUE (Kg per day)					
<b>Species Composition</b>					
					<b>% Spp Com</b>
Samples Weight (kg)	30	59	35	41.33	100.01
Weight of <i>T. albacares</i>	7	10	12	9.67	23.39
Weight of <i>T. obesus</i>	4	6	3	4.33	10.48
Weight of <i>T. pelamis</i>	5	25	8	12.67	30.65
Other tuna species	2	1	2	1.67	4.03
Other fish group	10	14	7	10.33	25.00

Record the total catches from unsampled boats at sampled landing site.

Record how many boats landing in that sampled day.

### Appendix III: Example of Length-Frequency semi-process data

*Example of semi-process data:*

Country:		Malaysia		Malaysia			
Fishing ground:							
Fishing Area:							
Name of sampling port:							
Date:							
Time:		1800		1900			
Type of fishing boat:		PS		PS			
Name of Species:							
Total catch of species (kg):		1200		100			
Total weight of species (kg):							
Sample weight of species (kg):		80		30			
Name of enumerators		N. Rahman		N. Rahma			
Raising factor		1200/80		15		1000/30	
						3	
Lower limit MM	Upper limit MM	Mid-length MM	Lt-Freq	Raising Freq.	Lt-Freq	Raising Freq	Pool Freq
100	104	102.5		0		0	0
105	109	107.5	1	15		0	15
110	114	112.5	3	45		0	45
115	119	117.5	7	105		0	105
120	124	122.5	12	180		0	180
125	129	127.5	23	345	2	6	351
130	134	132.5	46	690	4	12	702
135	139	137.5	30	450	5	15	465
140	144	142.5	26	390	9	27	417
145	149	147.5	19	285	10	30	315
150	154	152.5	12	180	13	39	219
155	159	157.5	6	90	20	60	150
160	164	162.5	4	60	12	36	96
165	169	167.5	1	15	9	27	42
170	174	172.5	4	60	7	21	81
175	179	177.5	7	105	4	12	117
180	184	182.5	9	135	2	6	141
185	189	187.5	5	75	1	3	78
190	194	192.5	7	105	3	9	114
195	199	197.5	12	180	6	18	198
200	204	202.5	24	360	9	27	387
205	209	207.5	19	285	10	30	315
210	214	212.5	13	195	17	51	246
215	219	217.5	16	240	25	75	315
220	224	222.5	13	195	9	27	222
225	229	227.5	9	135	8	24	159
230	234	232.5	3	45	1	3	48
Total			331	4965	186	558	5523

Notes: This format is easy for raising and pooling the length frequency in that particular month and sampling site

## Appendix IV: Example of semi-process data of Gonad Maturity

### Gonad Maturity Data Sheet

Country:		Malaysia			Fishing Ground: Kelantan			
Fishing Area:		off Kelantan waters						
Name of sampling port:		Tok Bali			Date:	2-Nov'02		Time: 0600
Type of fishing gear (PS/HL/LL/PL/Gill net):		PS						
Total catch of the boat:		12000kg						
Sample weight:		80kg						
Name of enumerators		N. Rahman						
Species name:		<i>Rastrelligerkanagurta</i>						
Sample no.	TL (mm)	BL (mm)	FL (mm)	SL (mm)	BW (g)	Sex & Stages	GW (g)	GSI
1	205	167	184		112	F1	0.3	0.27
2	210	173	187		114.9	F1	0.2	0.17
3	228	209	227		211.7	F3	8.3	3.92
4	244	193	213		163.2	F3	3.4	2.08
5	252	280	220		193.1	F3	7.8	4.04
6	248	193	212		176.2	F3	5.8	3.29
7	215	176	195		137.3	F3	3.1	2.26
8	216	179	195		125.6	F3	3.3	2.63
9	258	217	225		218.7	F4	8.5	3.89
10	222	181	196		145.4	F4	7.2	4.95
11	265	212	232		226.6	F5	6.6	2.91
12	255	211	225		185.6	M3	7	3.77
13	242	295	213		176.1	M3	10.2	5.79
14	252	214	223		193.2	M3	8.9	4.61
15	254	203	222		198.7	M3	7.2	3.62
16	216	179	195		127.9	M3	4.3	3.36
17	222	184	203		139.6	M4	3.2	2.29
18	226	183	204		131.8	M4	2.8	2.12
19	215	174	193		124.4	M4	0.6	0.48
20	230	167	183		102	M4	1	0.98
21	215	175	192		114.8	M4	5.9	5.14
22	225	185	202		143.7	M5	7.6	5.29
23	214	175	191		119.7	M5	2.7	2.26
24	212	174	188		109.6	M5	1.4	1.28
Total GSI Males							41.00	
Average GSI Males							3.15	
S.D. of males							1.737	
Total GSI Females							0	
Average GSI Females							30.41	
S.D. of females							0.29	
							1.516	
							2	
Note: $GSI = GW/BW * 100$								
Average GSI Males = $\text{SumGSI} / \text{number of males}$								
Average GSI Females = $\text{SumGSI} / \text{number of females}$								



## Appendix V: Maturity parameters of neritic tunas

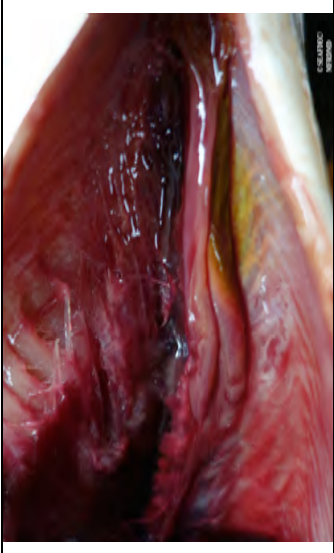





Scientific name	Age	Size at maturity	
		FAO	Country Ref.

Source:

FAO: <http://www.fao.org/fishery/topic/16082/en#Reproduction>

Sulu Sulawesi Seas: Sub-regional Technical Meeting for Finalizing Workplan of Activities for SEAFDEC Joint Program on Tuna Research in Sulu Sulawesi Sea, 18-21 August 2014 at Tawau-Sabah Malaysia

**Appendix VI: Five-point maturity tuna scale for partial spawners**

Stage	State	Description	Picture (Female)	Picture (Male)
I	Immature	<p>Ovary and testis about 1/3 of the length of body cavity. Ovaries pinkish, translucent; testis whitish. Ovary not visible to naked eye.</p>		
II	Maturing virgin and recovering spent	<p>Ovary and testis about 1/2 of the length of body cavity. Ovary pinkish, translucent; testis whitish, more or less symmetrical. Ova not visible to naked eye.</p>		
III	Ripening	<p>Ovary and testis is about 2/3 of the length of body cavity. Ovary pinkish-yellow colour with granular appearance, testis whitish to creamy. No transparent or translucent ova visible.</p>		

Stage	State	Description	Picture (Female)	Picture (Male)
IV	Ripe	<p>Ovary and testis from 2/3 to full length of body cavity.</p> <p>Ovary orange-pink in colour with conspicuous superficial blood vessels. Large transparent, ripe ova visible. Testis whitish-creamy, soft.</p>		
V	Spent	<p>Ovary and testis shrunken to about 1/2 length of body cavity. Walls loose. Ovary may contain remnants of disintegrating opaque and ripe ova, darkened or translucent. Testis blood shot and flabby.</p>		
	Fully spent			

Source: FAO: <http://www.fao.org/docrep/003/f0752e/f0752e05.htm>