Work and Sampling Strategies for Pelagic Longline

IOTC ROS SFO TR16.2

Category: Sampling strategies as a function of the IOTC fishery

[IOTC ROS SFO TR16]

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This module aims to familiarize observers with sampling requirements, procedures and methods to be used in the collection of scientific fisheries data with the pelagic longline fisheries.

The module learning outcome shall be to demonstrate knowledge of sampling strategies to be used with pelagic longliners.

Trainee performance will be evaluated against the following agreed IOTC ROS competency standards:

- Capable of collecting and estimating catch weight, volumes and ratios according to ROS standard procedures.

Achieving of these standards will be demonstrated by the candidate's capacity to:

- Select correct sampling strategies to use in pelagic longline fisheries;

- Accurately estimate weights, volumes and ratios with the pelagic longline fisheries.

Work Strategies on a Longliner

| Only one observer deployed at a time on a longline vessel | Not possible to monitor the line being hauled and to collect biometrics at the same time. | Need to define clear work strategies. |

During the hauling operation on a longline vessel, each fish is brought onboard individually, allowing the opportunity to collect detailed information on the catch. Yet, it is impossible for the observer to independently determine vessel total catch and to collect biometric information on specimens caught at all times. Therefore, there is a need to define clear work strategies, so that the information recorded by observers can be used in the statistical analysis of catches and biological information on size and biology of various species in relation to ocean areas and time of the year.

Work Strategies on a Longliner

Work Strategy 1 – Line Hauling Observation Period

- Period(s) during which the observer monitors a % of the longline sections, recording catch details for each hook.

Work Strategy 2 - Biometric Sampling Period

- Period(s) during which the observer biometrically samples a representative portion of the catch and SSIs.

On longliners the observer needs to separate the observation periods on : Line hauling observation periods for catch composition, when the observer dedicates the time to collect information on what is coming out of the water and no biological sampling is conducted (i.e fish not measured); and Biometric sampling period, when the observer dedicates the time to measure the fish.

To collect statistics on catches and biological information on size, the observers need to follow two main working strategies:
- **Strategy 1 – line hauling observation periods**, during which the observer monitors a percentage of the longline sections (hooks between two consecutive floats), recording catch details for each hook, the catch (species) and the fate of the catch (retained, discarded dead or released alive), etc.; as requested on IOTC data collection forms; and
- **Strategy 2 - biometric sampling periods**, during which the observer biometrically samples a representative portion of the catch and all species of special interest (SSIs) brought on-board.

The work strategies you select will also be dependent on several additional factors including: (1) the sea-state; (2) catch rate; (3) working space on deck; and (4) observer safety to conduct sampling etc. Some of these elements can be determined before the vessel sails and agreed with the coordinator, to decide which strategy to prioritise with respect to the percentage of the line observed and number of biometric samples to take

per species. At other times it will be up to you (the observer) to decide which work strategy is most appropriate while you are at sea.

Sampling objectives include the:

A. Estimation of catch per unit of effort (CPUE) via the recording of information on catch and effort for a specific fishing set

B. Estimation of catch composition via the recording of the totality or a part of the target species and by-catch caught for a specific fishing set

C. Collection of biological biometrics and samples (length frequencies, sex and maturity, diet and collecting DNA material)

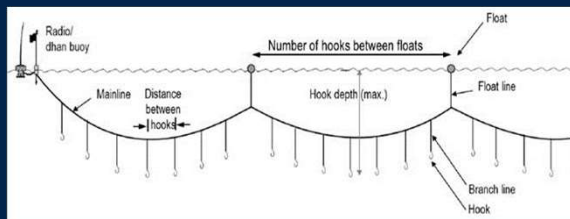# A. Catch Per Unit of Effort (CPUE)

Information on fishing operations and gear can be obtained from:

1. Fishing master logbook

2. Observer monitoring

Includes information on:

- Longline length
- Number of hooks set;
- Soak time (time the longline is in the water)
- Set depth (vertical position in the water column)
- Hook size

Information on fishing operations and gear required to estimate effort can be obtained, from fishing master logbook. Yet, it is the Observer responsibility to collect and/or verify it through observations, the measuring of the gear, the recording of vessel fishing operations, and the monitoring of the line being set and being hauled.

Information on CPUE is to be recorded by the observer in IOTC Form 3-LL: Longline Fishing Event.

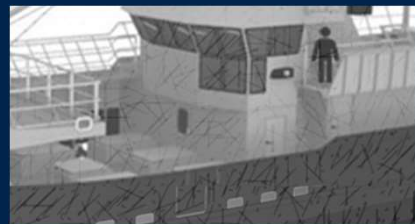# B. Catch and Catch Composition

Catch and catch composition can be obtained:

- **Vessels logbook**

- **Observer monitoring**

Observe position requires view of the longline coming out of water and of the catch coming onto the deck.

Two possibilities

1. **Total observed catch** *(100% of the hook sections set monitored)*

2. **Part of the catch** *(a % of the hook sections set monitored and the figures raised)*

Example of observer placement during the hauling of the line

The observer can obtain fishing event (set) catch composition from two sources: (1) vessels logbook, and/or (2) trough the monitoring of the line being hauled.

Vessel logbook will provide limited information on set catch composition, since in most cases, the fishing master will only record information on fish retained.

It is the observer responsibility to collect information on catch and catch composition for the totality of the catch (retained and discarded). Meaning that the observer is to monitor the line being hauled and record both catch retained and discarded (target and bycatch species).

During the hauling operation on a longline vessel, each fish is brought onboard individually, allowing the opportunity to collect detailed information on the catch. For this, the observer needs to have a clear view of the longline coming out of water and of the catch coming onto the deck. Observers should place themselves strategically when monitoring the line being hauled to avoid being in the way of the gear and of the crew. Vessels can operated in different ways depending on their layout. Therefore, observers will need to choose their hauling observation area according to the vessel configuration.

To obtain information on fishing event catch and catch composition the observer can:

1. **Monitor the whole longline hauled back (i.e. *100% of the line observed*)** and therefore observe the totality of the catch

2. **Monitor part of the longline hauled back (i.e. *a % of the hook sections hauled observed*)** and raise catch values to the total number of hook sections set.

Information on catch and catch composition is to be recorded by the observer in IOTC Form 4-LL: Longline Fishing Event (Set)- Catch Details.

Recording the totality of the catch, means that the observer monitored the whole line (100%) being hauled. Essantialy this would be exhaustive sampling of the whole line.

Information on catch and catch composition is to be recorded by the observer in IOTC Form 4-LL: Longline Fishing Event (Set)- Catch Details.

B. Catch and Catch Composition

2. Record part of the catch and raise it.

- ✓ Select WORK STRATEGY and SAMPLING METHOD (for the estimation of catch and catch composition) to follow;

- ✓ Monitor a % of the hook sections hauled for catch composition;

- ✓ Record catch composition (species, fate, number and/or weight, and weight estimation method) for both retained and discarded species, *independently if they are target or non-target species.*

- ✓ *Raise observed catch composition to the totality of the hook sections set.*

Recording a part of the line being hauled (proportional sampling) would require the observer to determine and record the percentage of the line monitored. (i.e. 50% of the hooks hauled))

Information on catch and catch composition is to be recorded by the observer in IOTC Form 4-LL: Longline Fishing Event (Set)- Catch Details.
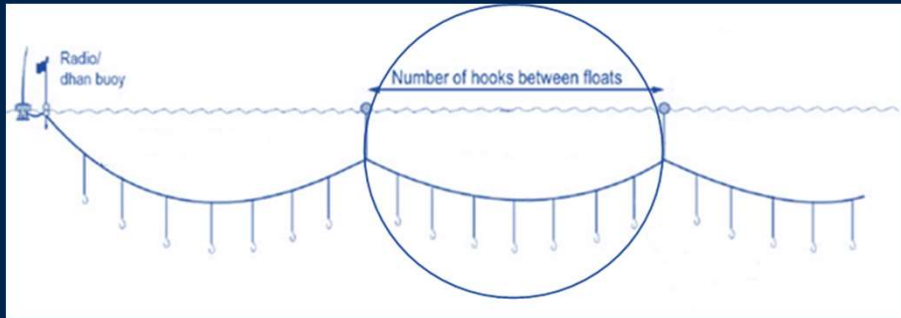
There are a number of ways to calculate the percentage of the line observed. The most practical being to divide the line up into sections, or the hooks set between buoys.

B. Catch and Catch Composition

RAISING OF THE OBSERVED CATCH TO THE TOTALITY OF THE HOOK SECTIONS SET

Percentage (%) of the hook sections hauled observed equals to

*(number of hook sections observed **vs** total number of hook sections set)*

$$\text{\% Hook Sections Observed} = \frac{\textit{Number of hook sections observed}}{\textit{Total number of hook sections set}}$$

B. Catch and Catch Composition

RAISING OF THE OBSERVED CATCH TO THE TOTALITY OF THE HOOK SECTIONS SET

Example: Calculated total catch raised by percentage observed:

| number of each species observed | *divided by* | % of hook sections observed |

Species Observed	YFT	SKJ	KAW	LOT	GUT	SFA
Number observed	20	37	145	200	89	23
% of total	0.6	0.6	0.6	0.6	0.6	0.6
Calculated total catch per species (in numbers)	33	62	242	333	148	38

Sampling Methods

There are a number of sampling methods that can be used by Observers on Longliners during **Line Hauling Observation** and **Biometric Sampling Periods:**

for the estimation of catch and catch composition on longliners :

    I.   **Exhaustive sampling**

    II.   **Random sampling**

    III.   **Adaptative random sampling**

    IV.   **Systematic sampling**

    V.   **Exhaustive sampling when present**

In this training module we shall focus on sampling strategies that can be used for the estimation of catch and catch composition with longliners, these include:

I.   exhaustive sampling;

II.   random sampling;

III.   adaptative random sampling

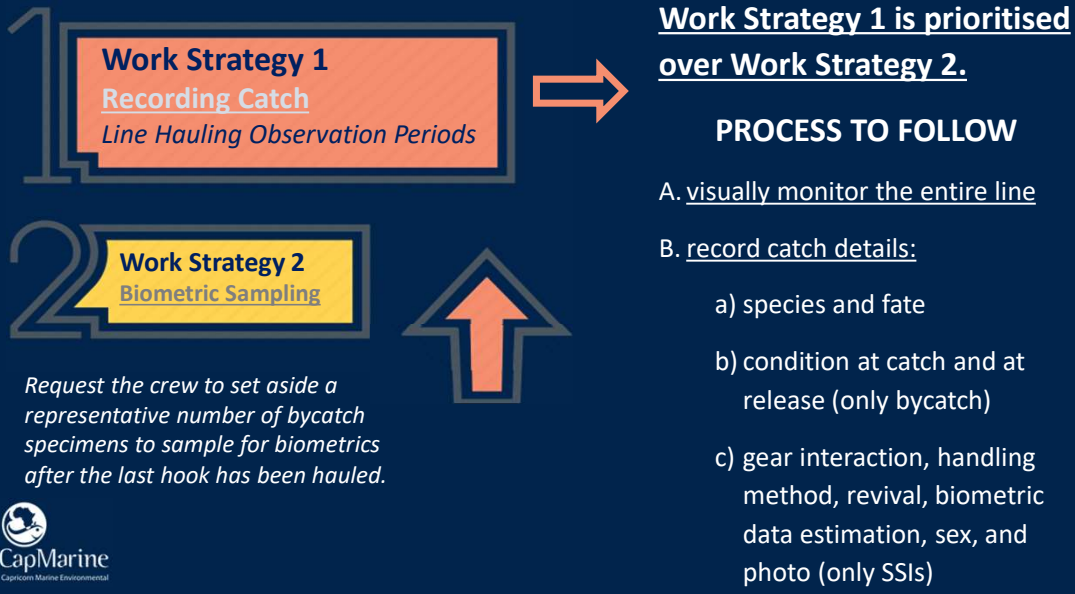IV.   systematic sampling; and

V.   exhaustive sampling when present.

If selecting **EXHAUSTIVE SAMPLING:**

- Work Strategy 1, recording catch is prioritised over Work Strategy 2 for taking biometric sampling, and the following process is followed:

    A. ensure that the entire line hauled is visually monitored, i.e., you have to observe all hooks hauled;

    B. record catch details:

        a) species and fate for all specimens caught;

        b) condition (at catch and at release), only for bycatch species (including SSIs);

        c) gear interaction, handling method, revival, and photo, only for SSIs biometric data estimation (and sex where possible) for bycatch specimens 'cut off' (including SSIs);

In this case Strategy 2 for the biometric sampling requirements will be a low priority. Should it be possible, the crew could be requested to set aside a representative number of specimens for the observer to sample after the last hook has been hauled. As this is unlikely to be practical for target or commercial by-catch, it is only likely to entail SSIs that could not be released.

RANDOM SAMPLING:

A simple random sample is where hook sections hauled and/or fish are selected randomly for sampling during an entire line hauling period. A simple random sample is meant to be an unbiased representation of the catch on an entire line.

If selecting this strategy, the observer should be able to follow both Work Strategies 1 and 2.

Following a random sample table, (for Work Strategy 1), a random sample of the hook sections between floats hauled would be selected to record catch details on the selected hook sections.

For biometrics sampling (Work Strategy 2), fish would be randomly selected as they are caught to meet the number of fish (per species) required to be sampled.

In practice, it would be difficult for an observer to practically sample hook sections as it would result in the observer having to spend time waiting during the hauling operation, and only record details from the randomly selected hook sections.
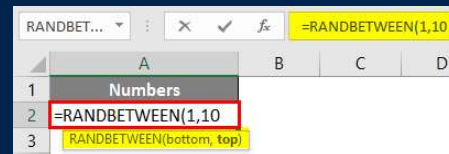
How to Generate a Random Table in Excel Using the Function RANDBETWEEN

Step 1: Start typing the RANDBETWEEN formula in cell A2.
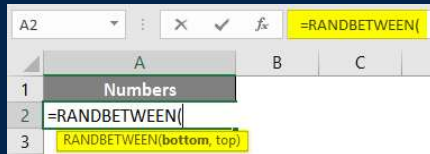
Step 2: Enter the bottom number as 1 and the top number as 10.

Step 3: Close the bracket and press Enter key to see the output.

You can see a single random number between 1 to 10 is generated under cell A2.

Step 4: If you want to generate 10 random numbers between 1 to 10, then you just drag the formula across the next 9 rows.
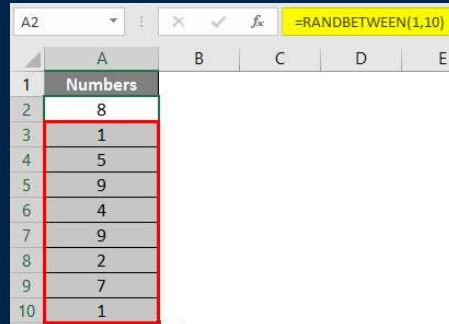
In Microsoft Excel, there is a function called RANDBETWEEN, which helps you to generate the pseudo-random numbers between a given range of numbers. Meaning these are the random numbers which are predicted with some mathematical algorithm in the backend. RANDBETWEEN is a volatile function in excel. Meaning, it will change the values generated every time we refresh/newly define the formula over the same range. Excel RANDBETWEEN function generates a single random number at one iteration between a given range of numbers. For example, say, 10 random numbers between 1 to 6. This function, by default, generates only integer random numbers.

III. ADAPTATIVE RANDOM SAMPLING

If selecting this strategy, follow both Work Strategies 1 and 2.

Work Strategy 1
Recording Catch
Line Hauling Observation Periods

Work Strategy 2
Biometric Sampling
Biometric Sampling Periods

PROCESS TO FOLLOW

A. Adapt the sampling protocol to collect as much biometric data as possible.

B. Choose hook sections to sample for biometrics during line hauling, to take advantage of periods when there are lots of fish to sample.

C. Clearly specify if collecting catch information and/or biometrics for specimens already observed during line hauling observation periods.

ADAPTATIVE RANDOM SAMPLING:

This sampling strategy allows the observer to adapt the sampling protocol to collect the maximum amount of biometric data. Instead of choosing which sections of hooks to sample during biometric sampling periods and line-hauling observation periods beforehand, the Observer tries to take advantage of times when there are lots of fish to sample. To ensure the statistical validity of this sampling strategy, do not interrupt your line-hauling observation period before the end of the hook section that you've already started to monitor.

Systematic sampling is a probability sampling method whereby a fixed number of hook sections would be sampled, or a fixed sampling period is selected (time wise), but the start times are randomly selected. A random sampling table should be used to determine random sampling times or periods.

Considering that systematic sampling includes an element of random selection as well as exhaustive sampling during the sampling periods it would most likely be the most practical strategy for an observer to follow.

Taking into account that:

- a minimum of 10% of the total hook sections set will need to be monitored for catch composition to ensure meeting IOTC 5% observation coverage requirement as stipulated in Res. 11-04 (practically this could be at least 25% or more);

- 'line hauling observation periods' and 'biometric sampling periods' should be randomly selected to cover at least, the beginning, middle and end of the hauling operation to ensure representative sampling of the line.

Clearly categorise in your notebook the information collected during:

a) **Work Strategy 1 - line hauling observation periods**

b) **Work Strategy 2 - biometric sampling periods (Systematic Random sampling of a mixed species sample)**

c) **Rest periods**

IV. SYSTEMATIC SAMPLING

For Strategy 1 we can distinguish two systematic sampling techniques to use during the hauling periods.

Case 2A - Monitoring catch composition of a fixed no. of hook sections during randomly selected periods during hauling.

PROCESS TO FOLLOW

Before hauling starts decide on the no. of hook sections to be monitored or sampled for the entire line, allow for rest periods. Divide this into the no. of hook sections to be sampled at a time.

Case 2B - Before hauling starts decide on a fixed period of time to be *'randomly observed / sampled / or not'*, during line hauling.

PROCESS TO FOLLOW

Monitor catch composition of all hook sections during fixed periods of time selected randomly during hauling.

For **Strategy 1** we can distinguish two systematic sampling techniques to use during the hauling periods. For catch composition, determine a fixed number or batch of hook sections during randomly selected periods during hauling (case 2A), or monitoring for catch composition of all hook sections during fixed periods of time selected randomly during hauling (case 2B).

Example – Case 2A -– Fixed No. of *hook sections* randomly selected periods

A longliner set 240 *hook sections* (HS) each with 10 hooks (i.e., 2400 hooks). Vessel skipper estimates that hauling will take 12 hours. Therefore, the observer decides to:

- Monitor a total of 80 *hook sections* for catch composition, in batches of 20 *hook sections*, selected random intervals along the line (i.e.; 33% of the line);
- Conduct biometric catch sampling of another 80 *hook sections* hauled outside of the 'line hauling observation period' (i.e.; total of 33% of the line);
- Rest or undertake other tasks in the remaining time;
- Follow a work pattern that ensures the representative sampling of the line.

Random work pattern table											
OP	**OP**	**RP**	**OP**	**SP**	**RP**	**SP**	**OP**	**RP**	**SP**	**SP**	**RP**
20 HS	20 HS	1 hour	20 HS	20 HS	1 hour	20 HS	20 HS	1 hour	20 HS	20 HS	1 hour

OP: Line hauling observation period; SP: biometric sampling observation period; RP: rest period

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Example – Case 2B -– All *hook sections,* random fixed periods of time

A longliner sets 240 hook sections (HS) each with 10 hooks (i.e., 2400 hooks). Vessel skipper estimates that hauling will take 12 hours. Therefore, the observer decides to:

- Monitor line hauling for catch composition, for a total time of 4 hours, in batches of 1 hour (i.e., total of 30% of the estimated hauling time);

- Sample the catch brought onboard for another 30% of the estimated hauling time;

- Rest the remaining time;

- Follow a work pattern that ensures the representative sampling of the line.

Random work pattern table											
SP	OP	OP	RP	OP	SP	OP	SP	RP	SP	SP	RP
1st hour	2nd hour	3rd hour	4th hour	5th hour	6th hour	7th hour	8th hour	9th hour	10th hour	11th hour	12th hour

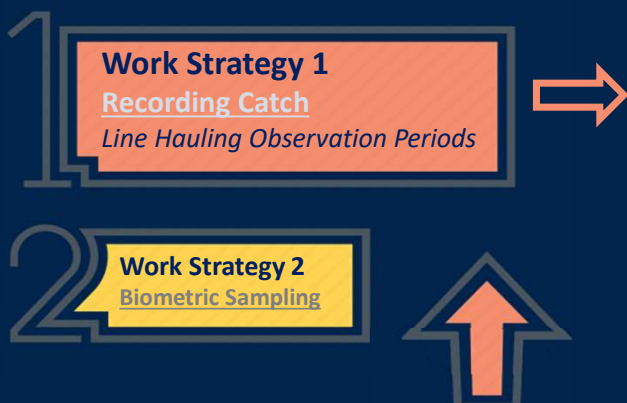*OP: Line hauling observation period; SP: biometric sampling observation period; RP: rest period*

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This sampling method can be used when the observer is required to observe the entire line (whole line, start to finish) being hauled, but due to the duration of hauling, which can be up to 14 hours or more, he/she will need to take lunch breaks and visit the washrooms etc. If the observer has opted for this method, the observer notebook becomes vital as all breaks must be recorded to provide an opportunity to raise the observed catch to the total catch.

When selecting this option, the observers will have to ensure that all the hooks sections hauled are monitored during the line hauling observation period. **You will therefore proceed according to the instructions for the Exhaustive Sampling Strategy.**

C. Catch Biometrics

Fish biometrics can be obtained :

- **Fishing master fishing book (catch retained)**

- **Observer sampling (catch retained and discarded)**

Observe position requires access to the catch coming onto the deck.

Two possibilities

1. **Measure every specimens brought on-board (100%)**

2. **Measure part (a %) of the specimens brought on-board**

Example of observer placement while conducting biometric sampling.

The observer can obtain fish biometrics (length and weight measurements) from two sources: (1) fishing master fishing book (when the fishing master instructs the crew to measure / weight each individual fish retained), and (2) trough the sampling of the catch. Fishing book will provide limited information on fish biometrics, since only the fish retained for commercialization will be hypothetically measured/weighted. It is the observer responsibility to biometrically sample the catch for both retained and discarded species according to IOTC ROS sampling priorities, listed below (see page 23 of IOTC ROS Guidelines for Observers Deployed with Pelagic Longliners).

During the hauling operation on a longline vessel, each fish is brought onboard individually, allowing the opportunity to collect biometrics on the specimens caught. Observers should place themselves strategically when biometrically or biologically sampling the catch, to access specimens coming onto the deck but at the same time avoid to be in the way of the gear and of the crew.

Vessels can operated in different ways depending on their layout. Therefore, observers will need to choose their biological sampling area according to the vessel configuration.

- On large industrial vessels, the observer should be given access to the factory deck where fish are processed for freezing. Observer sampling station should be close to

where the fish comes into the factory.

- <u>On smaller open deck vessels</u>, the observer should place themselves where fish are temporarily held before being transferred to the hold (this could be in bins or baskets or sections of the deck partitioned of with planks)

To obtain biometric information on the catch the observer can:

1. **Measure every specimens (100%) brought on-board (i.e. conduct exhaustive sample), or**

2. **Measure part (a %) of the specimens brought on-board (i.e. chose sampling to collect a sub-sample from the catch and biometrically sample specimens present on the sub-sample)**
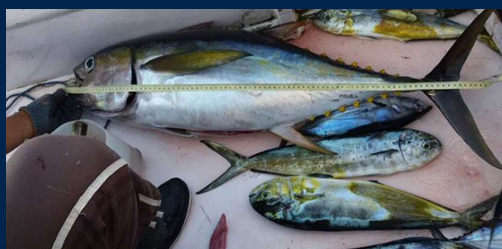
C. Catch Biometrics

1. **Biometrically sample every specimen brought on-board**

2. **Biometrically sample part of the specimens brought on-board**

   Record (species, fate, sampling period, sampling method, length value, type and length measuring tool, and/or weight value, fish processing state, and weight estimation method, and sex where possible) **for** :

   ✓ **Retained specimens**

   ✓ **Discarded specimens**

   Being target or non-target

   specimens.

Information on catch biometric is to be recorded by the observer in IOTC Form 5-LL: Longline Fishing Event (Set)-Catch Details-Biometric information.

Information on biological sampling (length, weight, sex, maturity stage and sample collection) is to be recorded in the IOTC Form 6-LL: Longline Fishing Event (Set)-Catch Details-Biological data and sample collection. The observer is only to collect biological samples and information when specifically instructed by their coordinator.

Sampling Methods for Sample Collection

There are a number of sampling methods that can be used in the collection of a biological sample/sub-sample with longliners:

    I.   **Exhaustive Sampling**

    II.   **Systematic Proportional Sampling**

    III.   **Systematic Random Sampling of a Fixed Number of Each Species**

    IV.   **Systematic Random Sampling of Mixed Species Sample**

    V.   **Systematic Random Sampling of Priority Species**

In this training module we will focus on sampling methods to be used in the collection of a biological sample/sub-sample with longliners, as per detailed by the IOTC, these include:

I.   **Exhaustive sampling:** the totality of the catch or all individuals caught for this species has been subsampled.

II.   **Systematic proportional sampling:** a proportion (%) of the catch or of the individuals caught and brought on-board for this species has been sub-sampled in a systematic way. (E.G., Every 10th fish is sampled).

III.   **Systematic random sampling of a fixed number of each species:** of the random sample taken, the fish are identified to species level. Once the main species have been determined, a pre-determined number of fish of each species is subsampled.

IV.   **Systematic random sampling of a mixed species sample:** of the random sample taken, a small random subsample is taken and biological information extracted.

V.   **Systematic random sampling of priority species:** of the random sample taken, priority species are selected and biological information extracted.

The observer is to provide detail if using another sampling method than the ones listed above.