SAMPLING GEAR DESIGN FOR FISHERIES RESOURCE SURVEY

-LONGLINE GEAR-

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ABOUT ME..!

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- Education
  - Mar. 2011 Bachelor of Marine Science, Kasetsart Univ.
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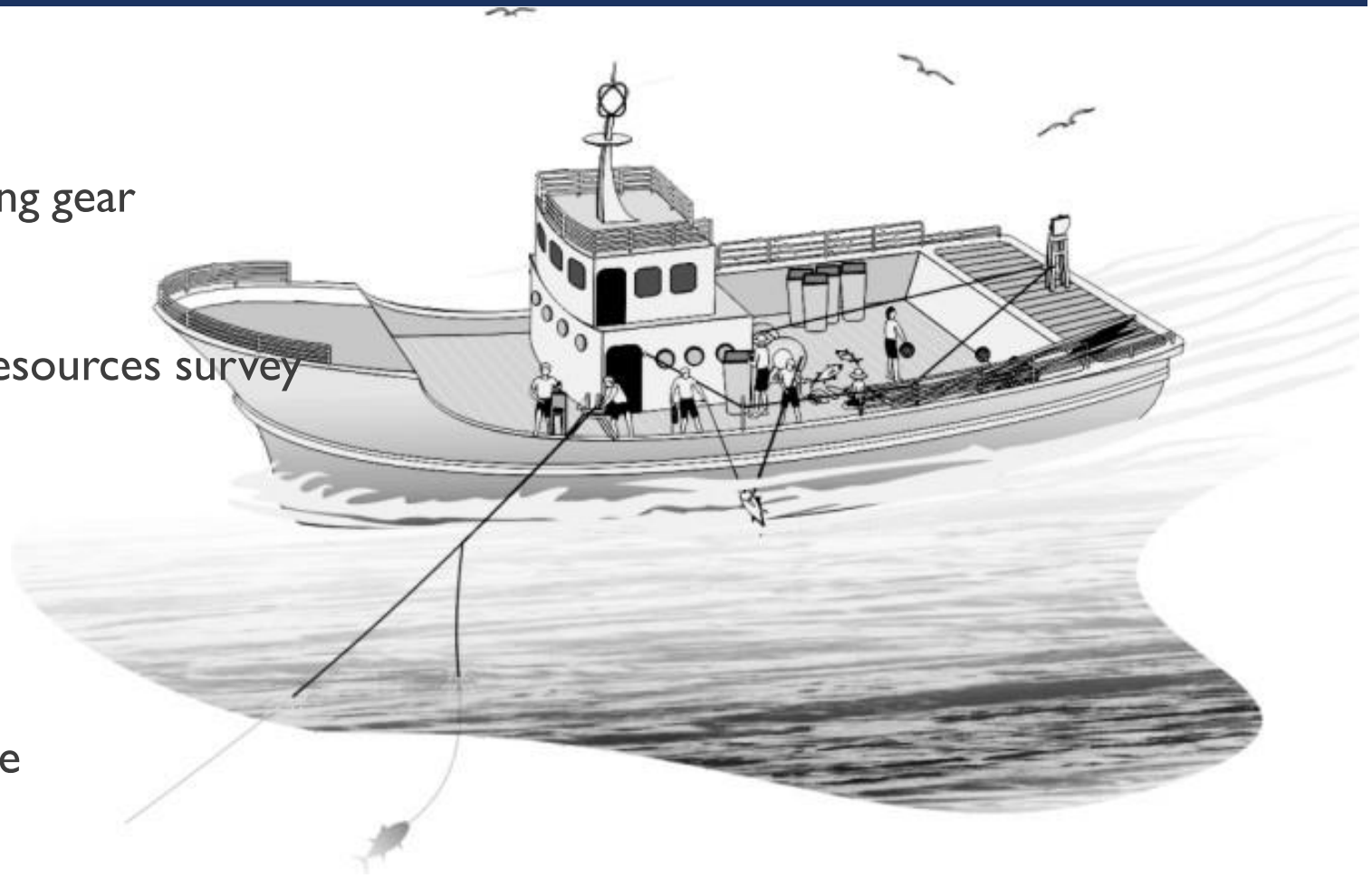
- Work Experience
  - Sep. 2015 - present, Southeast Asian Fishery Development Center/Training Department

OUTLINE

- Description of Longline
- Construction of Longline fishing gear
- Classification of Longline
- Longline fishing for fisheries resources survey
  - Set Bottom Longline
  - Pelagic Longline
  - Vertical Longline
  - Bottom Vertical Longline
- Standard Operation Procedure
- Summary



MARINE ORGANISMS IN THE WATER COLUMN

- Living in pelagic, demersal and/or benthic

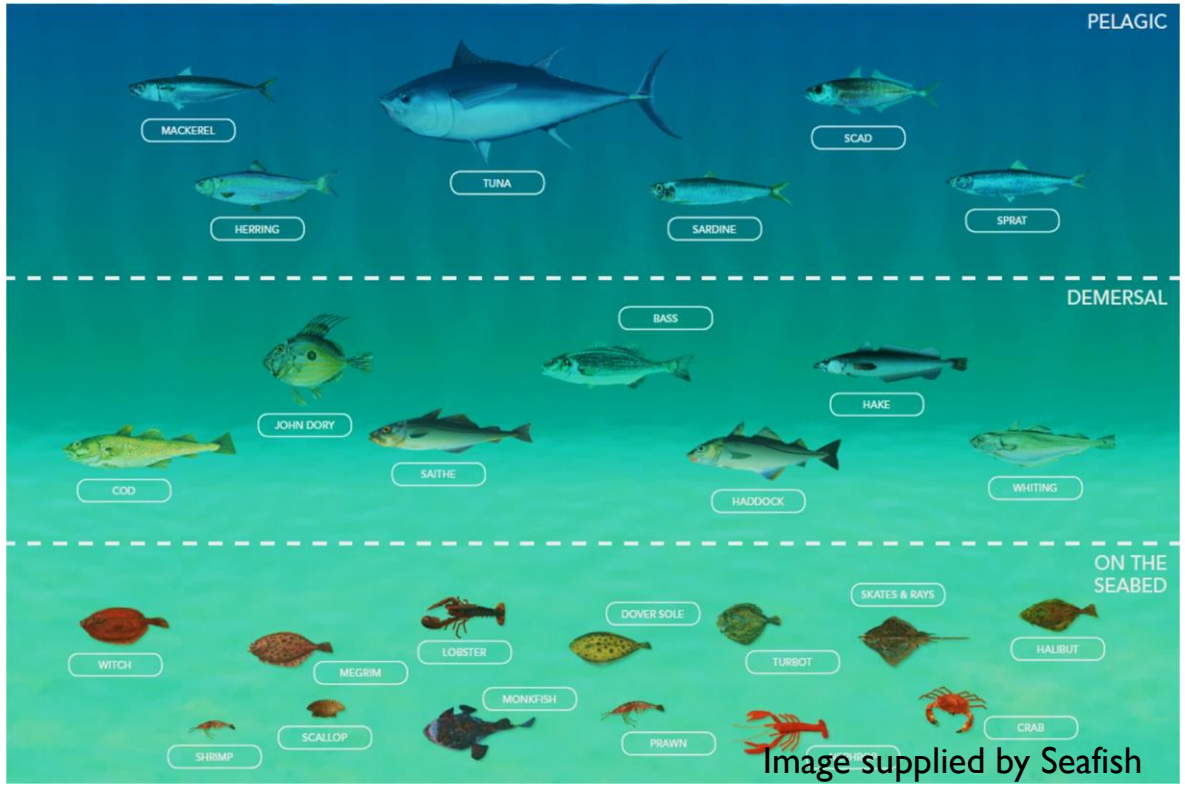


Image supplied by Seafish

- **Marine species** can be identified and grouped on the basis of some main living characteristics:
- **Pelagic species** live in mid-water or close to the surface with no, or very limited, interaction with the sea bottom;
- **Demersal species** live and feed close to the bottom of seas, but without necessarily staying and swimming directly onto the bottom; and
- **Benthic species** live on or even in the sea bottom and their biology is intrinsically related to the seafloor (Jean, 2015).

DIAGRAM OF FISHING GEAR IN THE WATER COLUMN

- The varied characteristics of fishing gear design its influence on what is actually caught

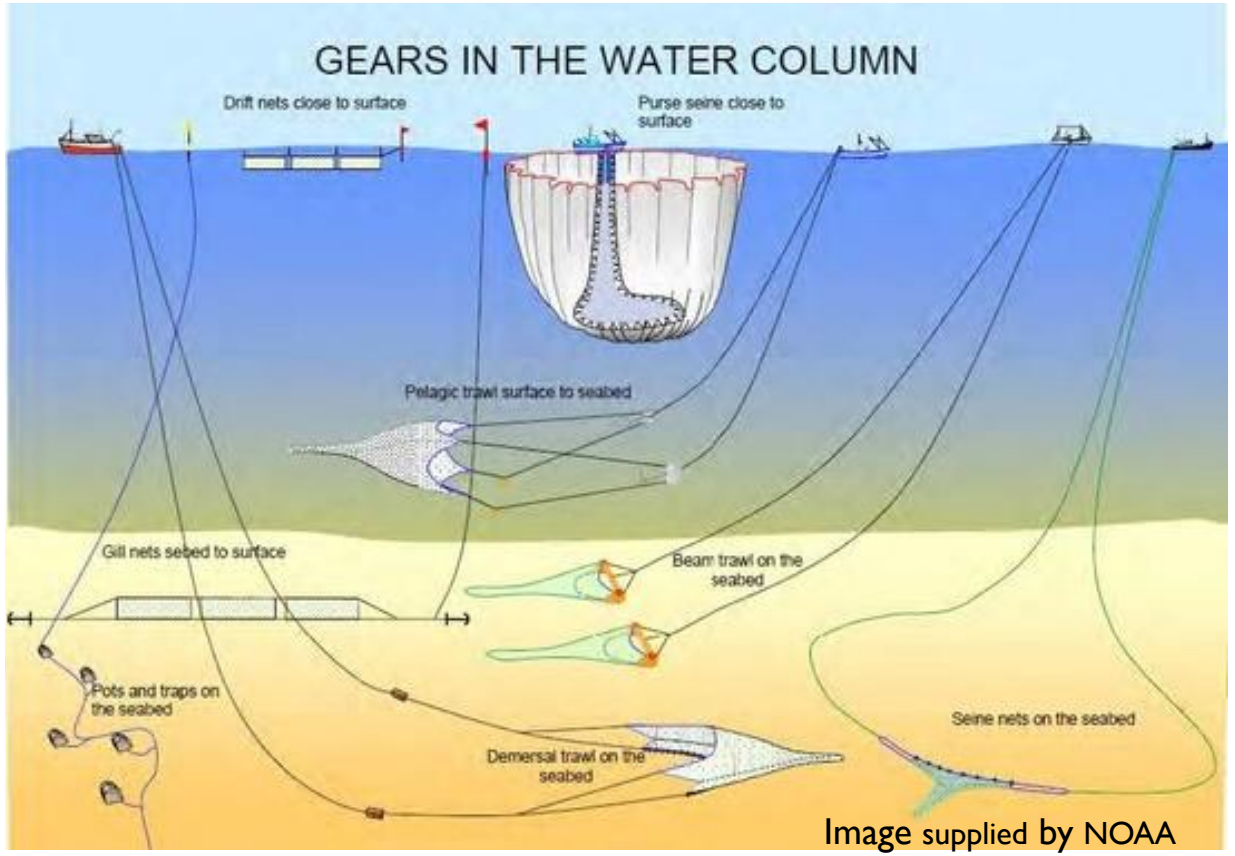


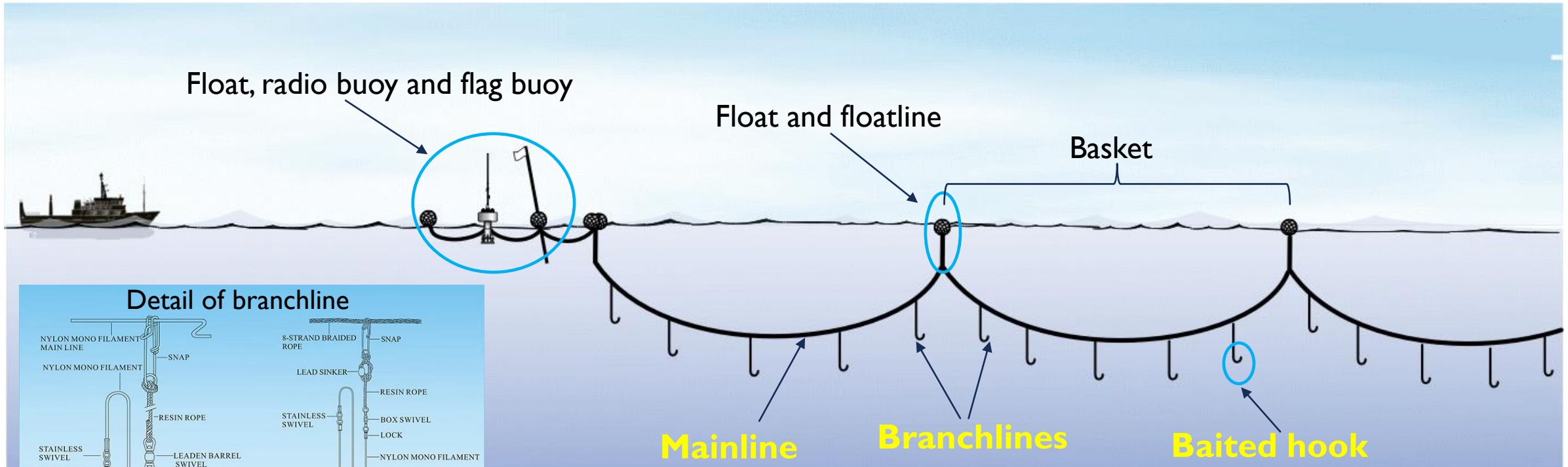
Image supplied by NOAA

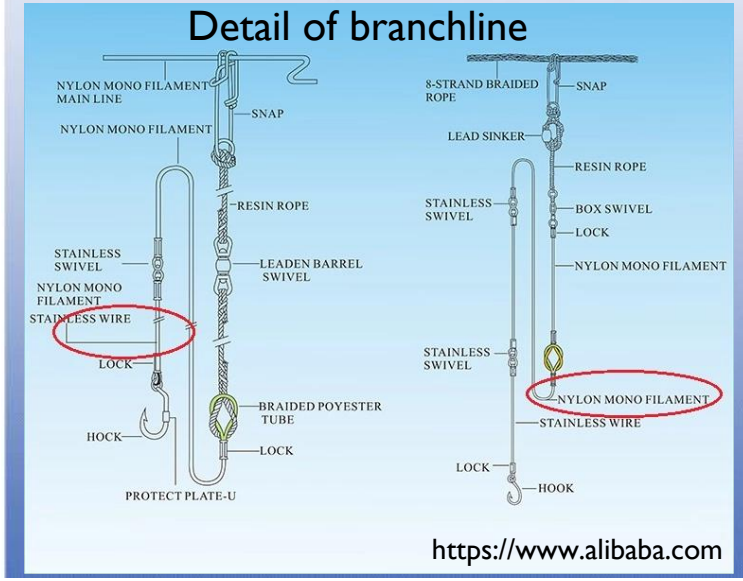
- There is a large range of types of fishing gear, with numerous variations of designs and size, and abundant possibilities for adaptation and technical adjustment.
- A fishing method enables only the targeted species and/or sizes to be caught and unwanted catches to be avoided
- The gear design, its characteristics and the material it is made of, all have a significant influence on what is actually caught (Jean, 2015).

DESCRIPTION OF LONGLINE

- Longline is one of the most fuel-efficient catching methods, it is used to capture both demersal and pelagic fishes.
- Uses a long mainline are attached hundreds or thousands of branch lines, each with a single baited hook to attract and catch fish in the fishing ground.
- Longline is set at the place where the school of fish is expected to be found. The scale of gear is comparatively larger than handline and pole-and-line fishing.
- The lines may be set vertically in the water column or horizontally along the bottom
- Usually set and hauled once daily, allowed to drift freely or set at the bottom for several hours while fishing.
- Longlines are set, either by hand or mechanically, while the boat steams away from the line and are usually hauled mechanically while the boat steams toward the line.
- The size of fish and the species caught is determined by hook size and the types of bait used

BASIC CONSTRUCTION OF LONGLINE

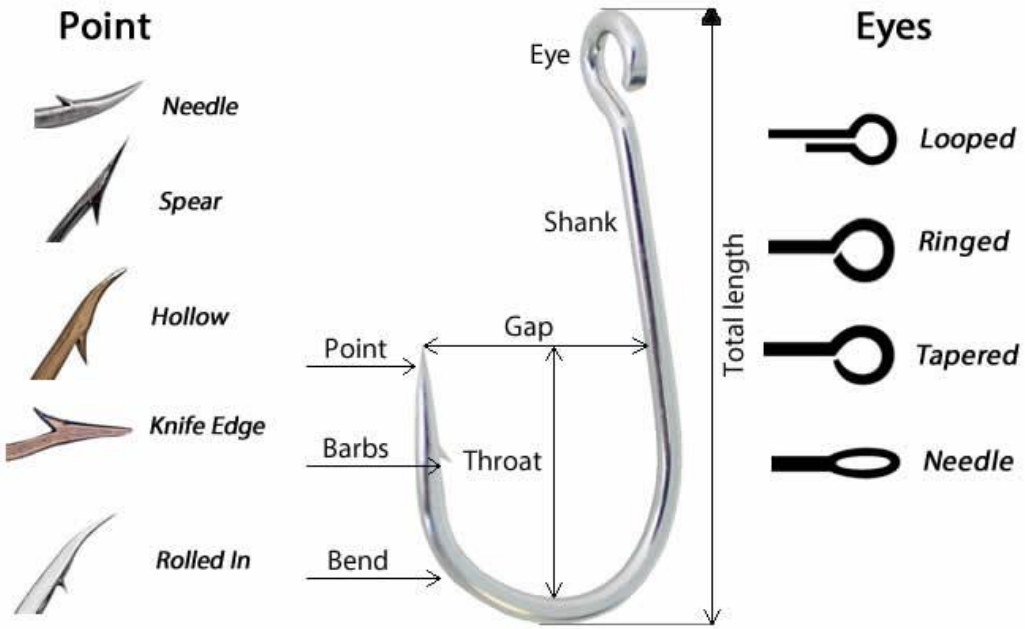




- Longline gear consists of three basic components: the mainline, the branch line, and the baited hook
- These parts are adaptable for targeting specific species through changes in materials, lengths, and deployment strategies

HOOKS USED IN LONGLINE FISHING

- The anatomy of a fishing hook



https://www.lehofishing.com/Choosing-a-Hook-id3058843.html

- Different types of hook

Tuna Circle Hook

Tuna Hook with Ring

Big-game Hook

Tuna & Swordfish Hook

BAIT USED IN LONGLINE FISHING

- Bait selection
  - Fishing ground locality
  - Freshness
  - Proper size
  - Brilliance or Mirror-like body feature
- Baiting techniques
  - Tighten or Secure bait with hook
  - Flexible waver in current (Simulation of alive fish is swimming)
  - Special accessory for increase effectiveness of bait: illuminator or light stick

- Bait species: Key species of bait supply in Thailand

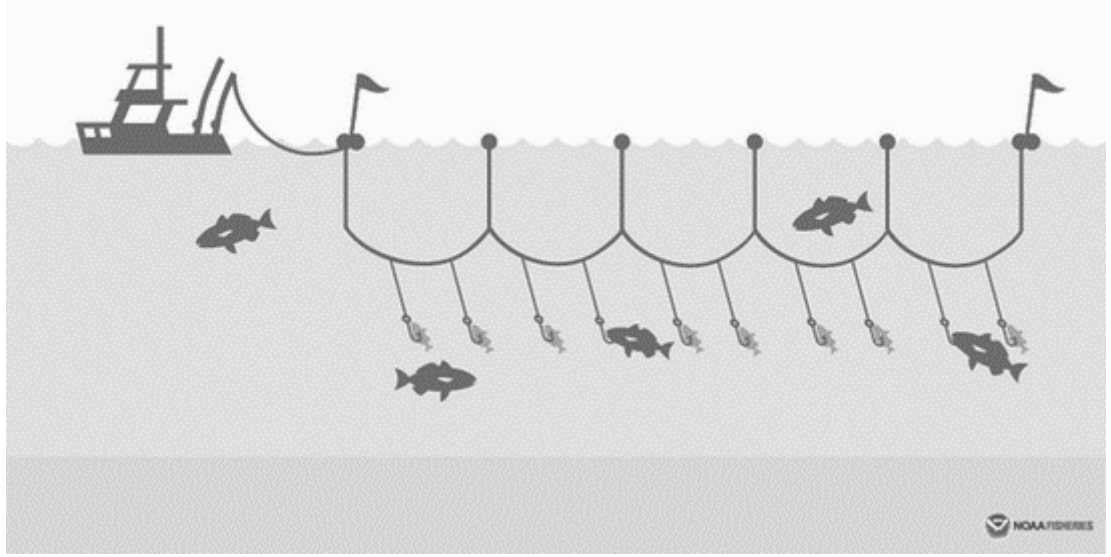
Scads (*Decapterus spp.*)

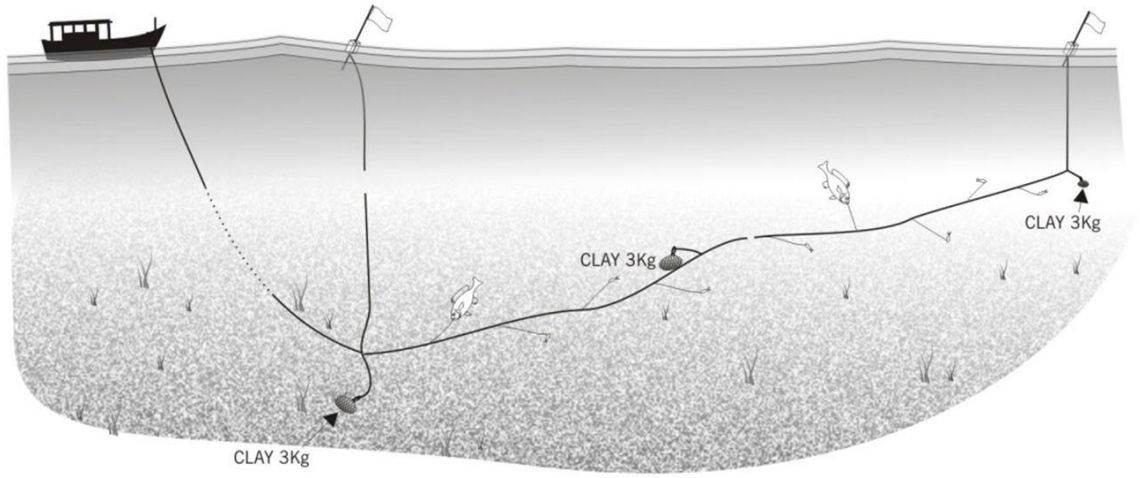
Indian Mackerel (*Rastrelliger spp.*)

Pacific Saury (*Cololabis saira*)

Oceanic Squid (*Illex Argentunus*)

LONGLINE CAN BE DIVED INTO TWO BASIC TYPE (Masthawee et al., 1989)



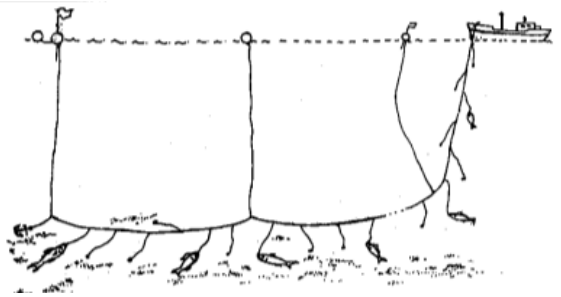
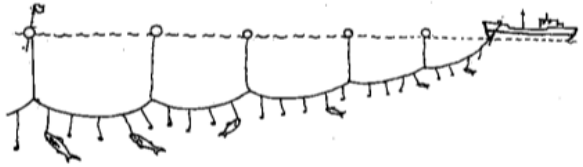
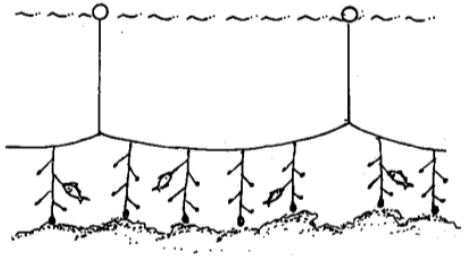


Drift longline : which uses floats to hang the main line at the desired depth in the surface or middle-depth water. This is a longline use for catching fish that migrate in the surface waters of slightly below, which the main catch consisting of tuna, skipjack, marlin, shark, etc. This category also includes middle-depth type longline used in catching mackerel, yellow tail, etc.

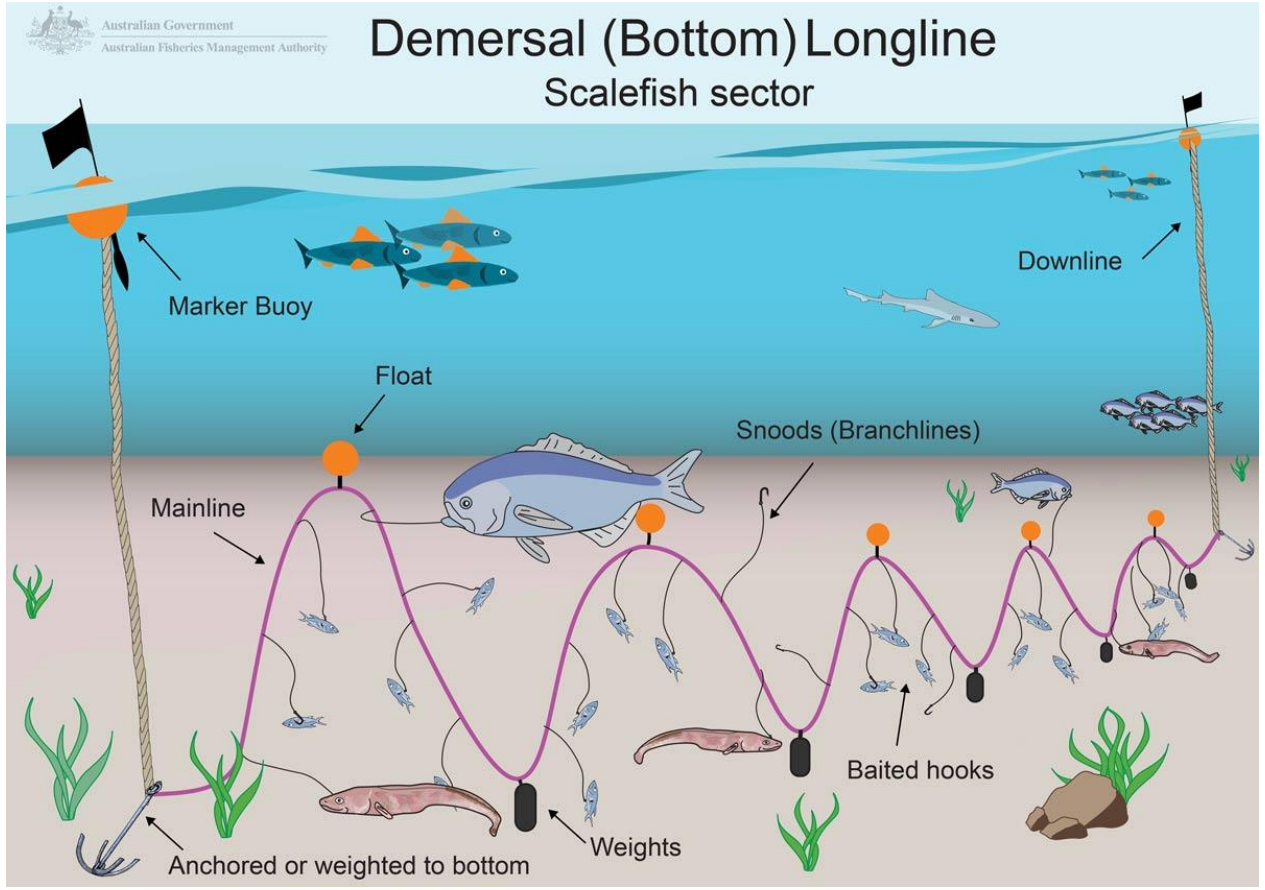
Bottom longline : which is set the way that the main line and branch lines just come in contact with the sea bottom. This is the most popular type of longline and it is used in the coastal regions of Southeast Asia. To catch a wide variety of different fish. The main catch includes fish of the grouper family, snapper family, flat fish, sea beam, croaker, etc.

CLASSIFICATION OF LONGLINE (Hameed and Boopendranath, 2000)

- Based on the construction and fishing method, longlines are classified into 4 categories:

Set bottom longline	Drift longline	Vertical longline	Bottom vertical longline
			

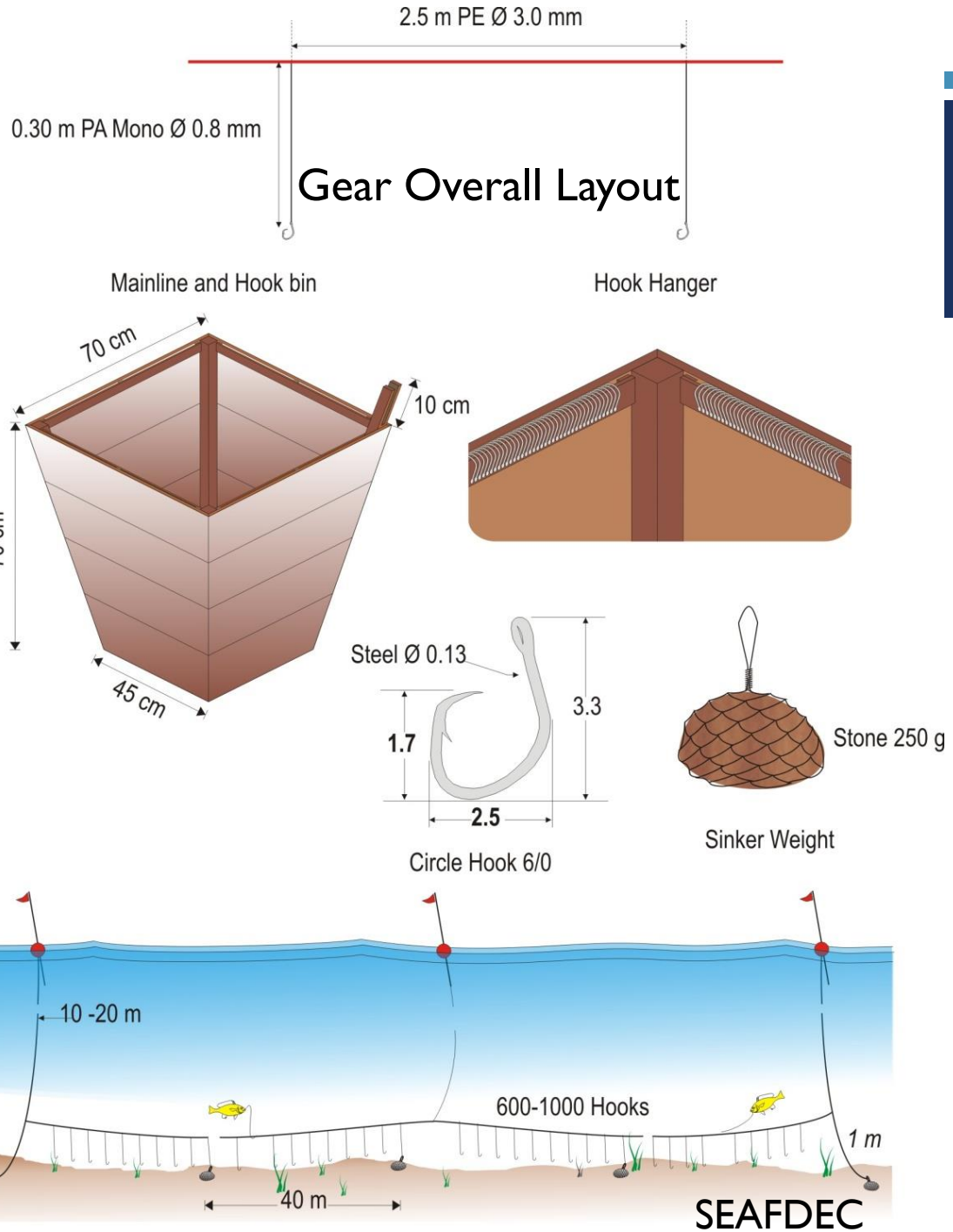
SET BOTTOM LONGLINE



https://www.afma.gov.au/fisheries-management/methods-and-gear/longlining

Demersal Longline (also known as bottom, set or anchored longlines) is used to target the bottom feeding fish. It can be very size selective simply by variation in hook size and the species can be regulated by the skipper's experience, the depth of water and the bait used.

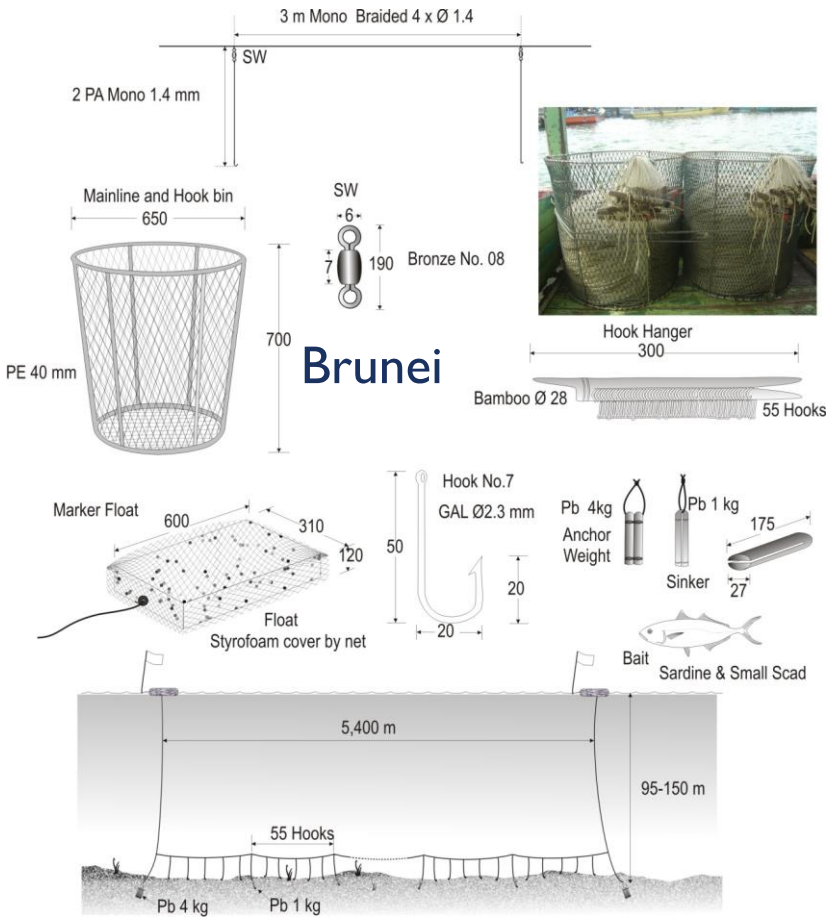
- Demersal longlines are fixed along the seafloor using anchors.
- The most common is the single-line system which consists of a single groundline with hooks attached by smaller lines called gangions.
- Demersal longline length ranges from a few hundred meters (small-vessel fisheries) to as long as 50 km in the larger vessel, industrial fisheries (FAO 2001-2010).
- In contrast to pelagic longlining, demersal operations often have shorter, more frequent branching lines (snoods) as well as shorter mainlines.

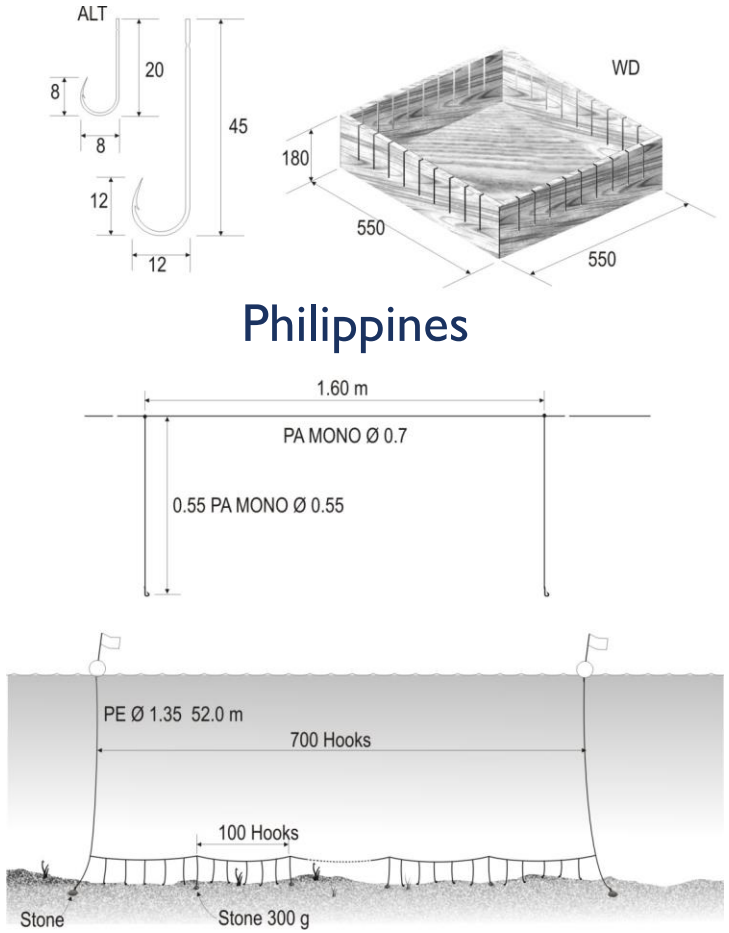


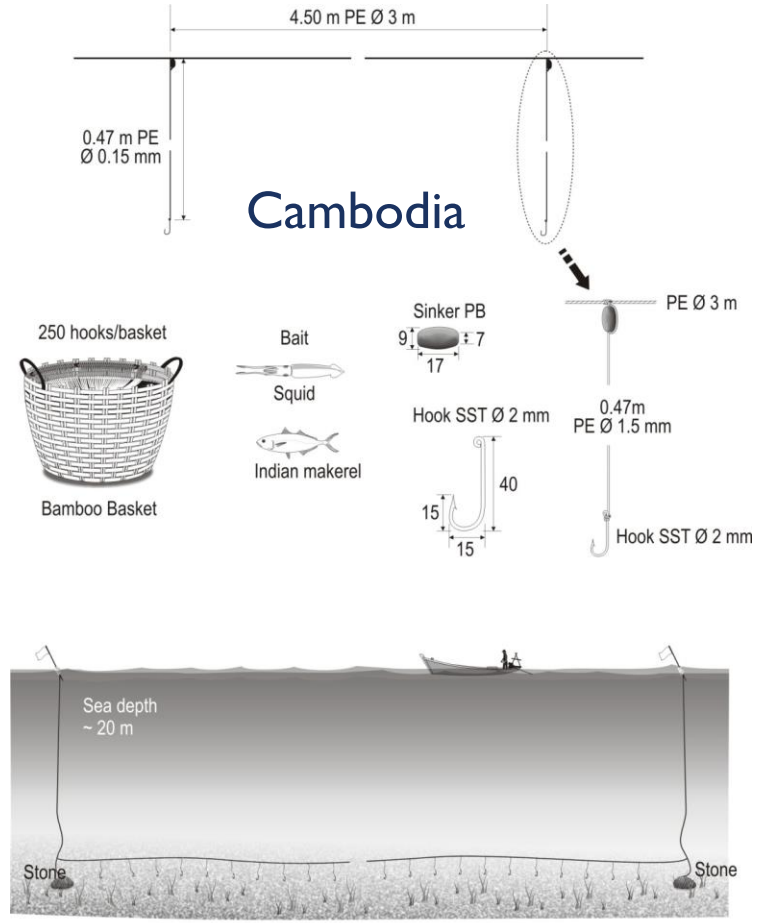
SET BOTTOM LONGLINE

- Main line is PE Ø3.0 mm
- Hook line is PA MONO Ø0.8 mm, 30 cm in length
- Distance between hook line is 2.5 m
- Float is PL Ø 300 mm
- Float line is 10-02 m
- The hook is circle hook no 6/0 (ST Ø 0.13), 600-1000 hooks in each line operation
- Sinker weight is stone 250 g (40 m of each interval)

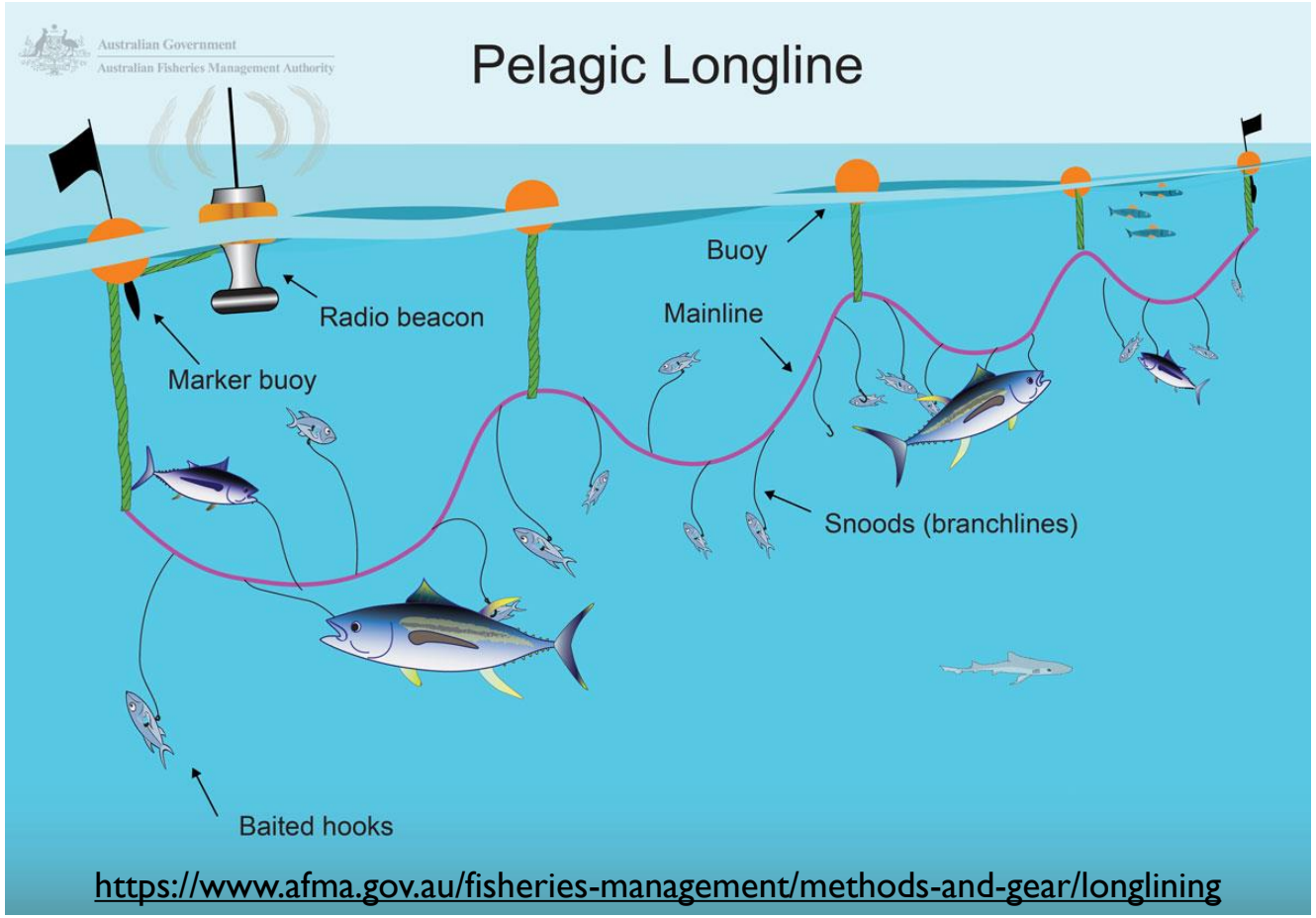
Set bottom longline are commonly used for small scale fisheries in SEA countries (Brunei, Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, Vietnam)







DRIFTING HORIZONTAL LONGLINE

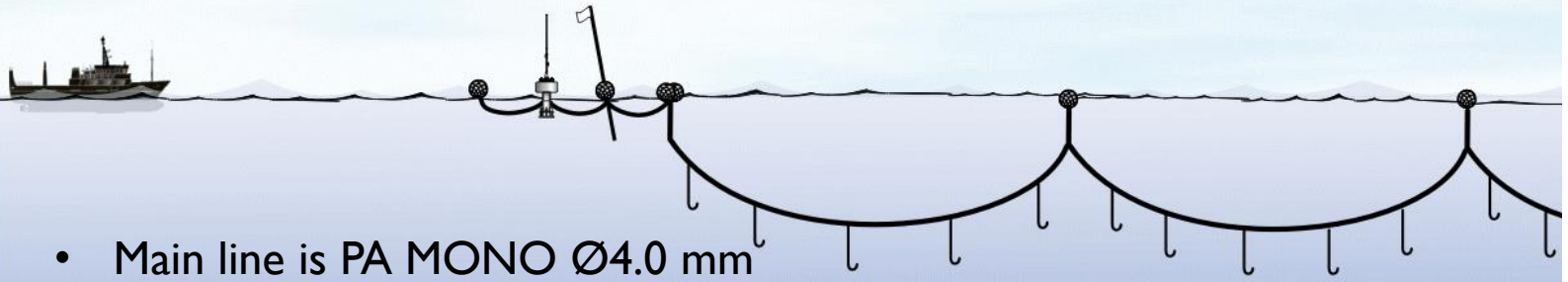


https://www.afma.gov.au/fisheries-management/methods-and-gear/longlining

Pelagic Longline is undertaken worldwide, to some degree, but tends to be concentrated in tropical regions where there are concentrations of the large pelagic species. The main target species are various species of tuna, billfish and swordfish.

- The gear is very similar to the demersal longlines, but they are not usually anchored, and are allowed to drift below the surface.
- The snoods are usually spaced further apart to suit the widely dispersed nature of the target species.
- The line is suspended below the surface by short lines with floats attached, spaced out along the main line. The length of these lines is set to hang the baited line at a suitable depth for the target species. (Seafish, 2015)

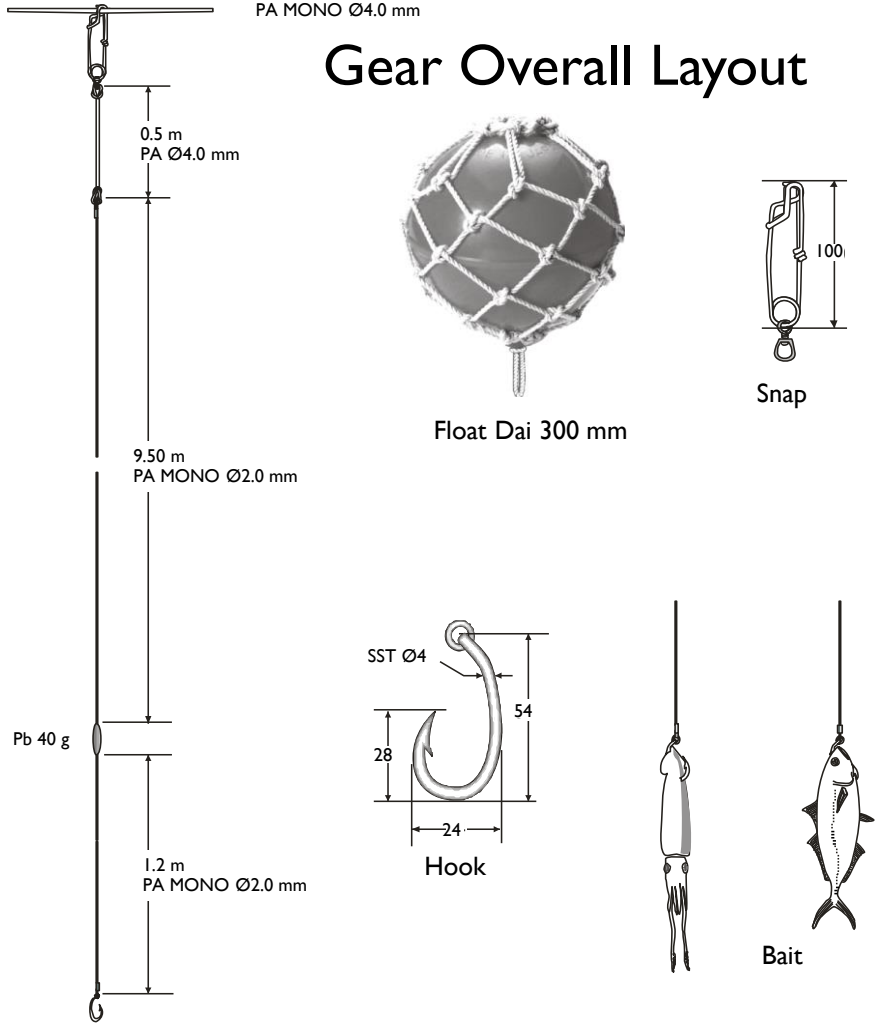
PELAGIC LONGLINE

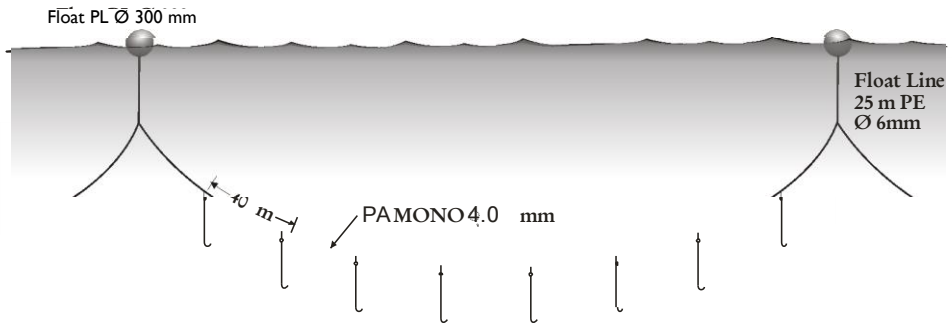


- Main line is PA MONO Ø4.0 mm
- Hook line is 10-15 m in length of PA MONO Ø2.0 mm with the sinker of Pb 40g is attached (8-15 branch lines/baskets)
- Distance between hook line is 40 m
- Float is PL Ø 300 mm
- Float line is 25 m of PE Ø6.0 mm
- The hook can be used circle hook, tuna hook, skipjack hook, tuna & swordfish hook

URL for Download: http://hdl.handle.net/20.500.12067/1469

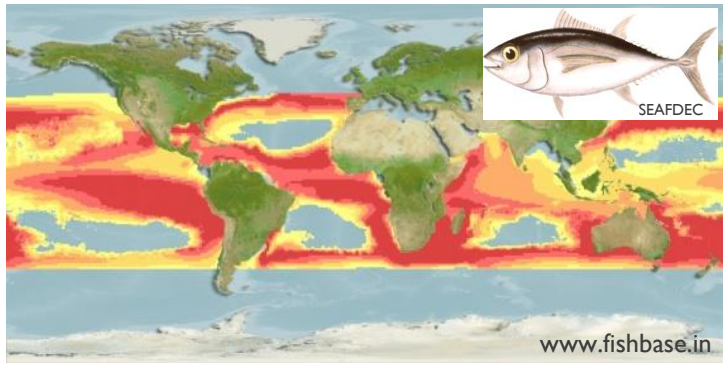
Gear Overall Layout



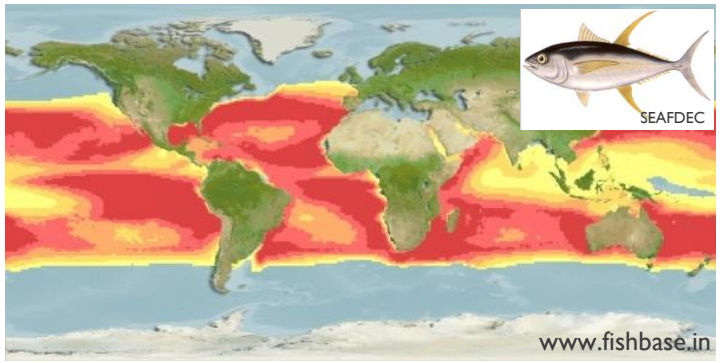


TARGET CATCH

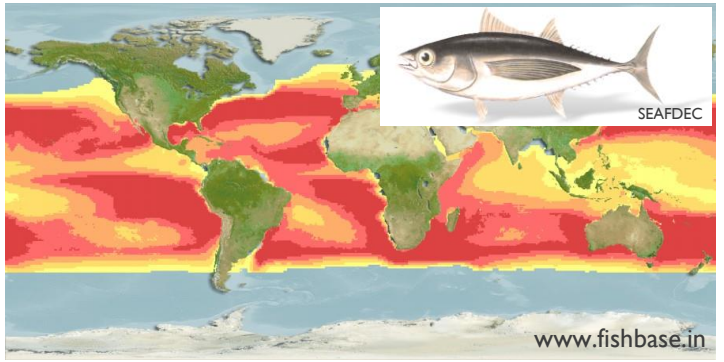
- Where are the target species?



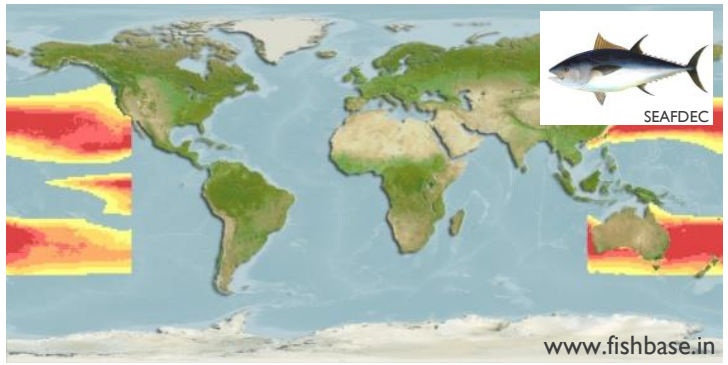
Bigeye Tuna



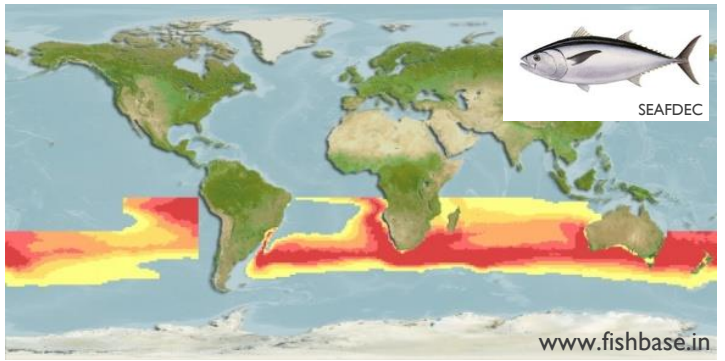
Yellowfin Tuna



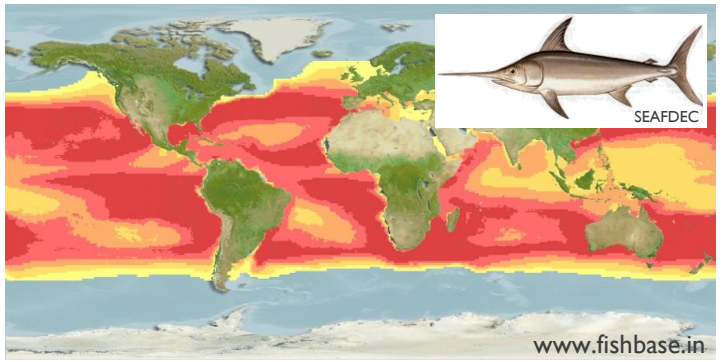
Albacore



Northern Bluefin Tuna



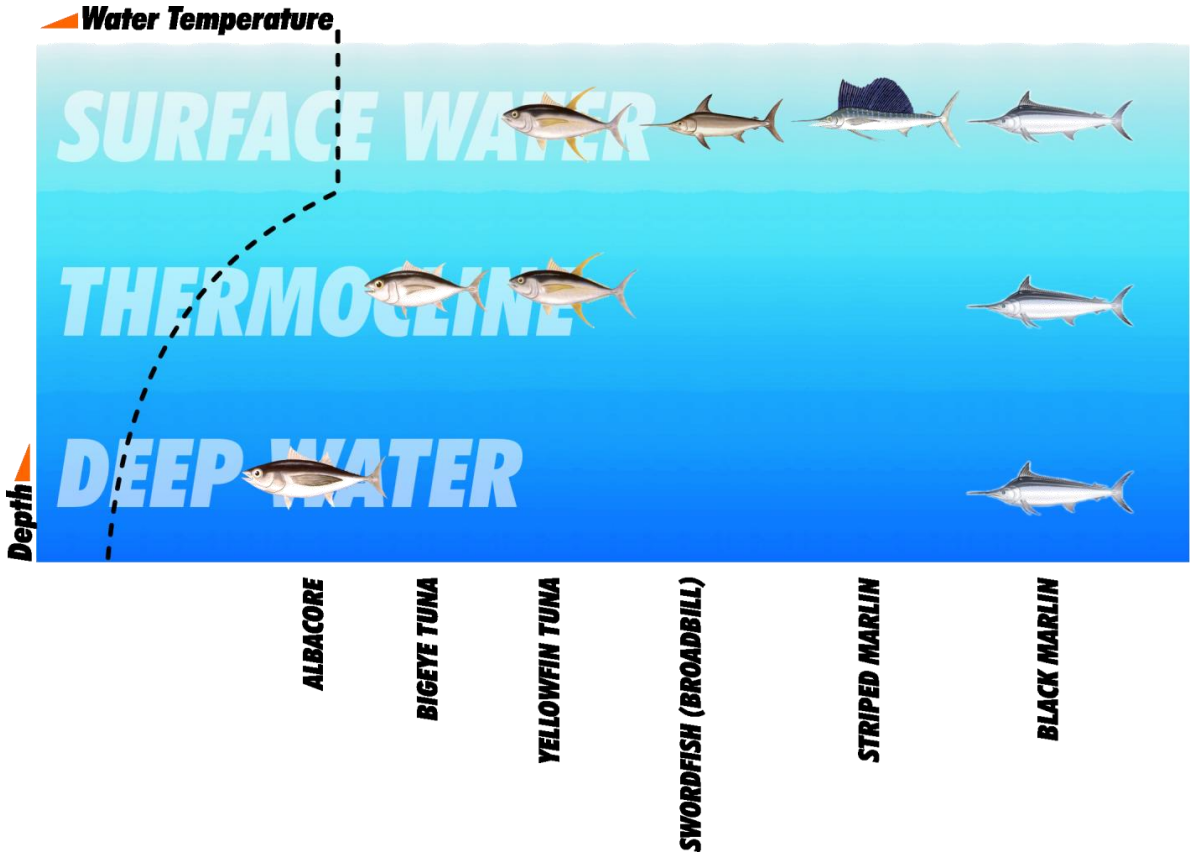
Southern Bluefin Tuna

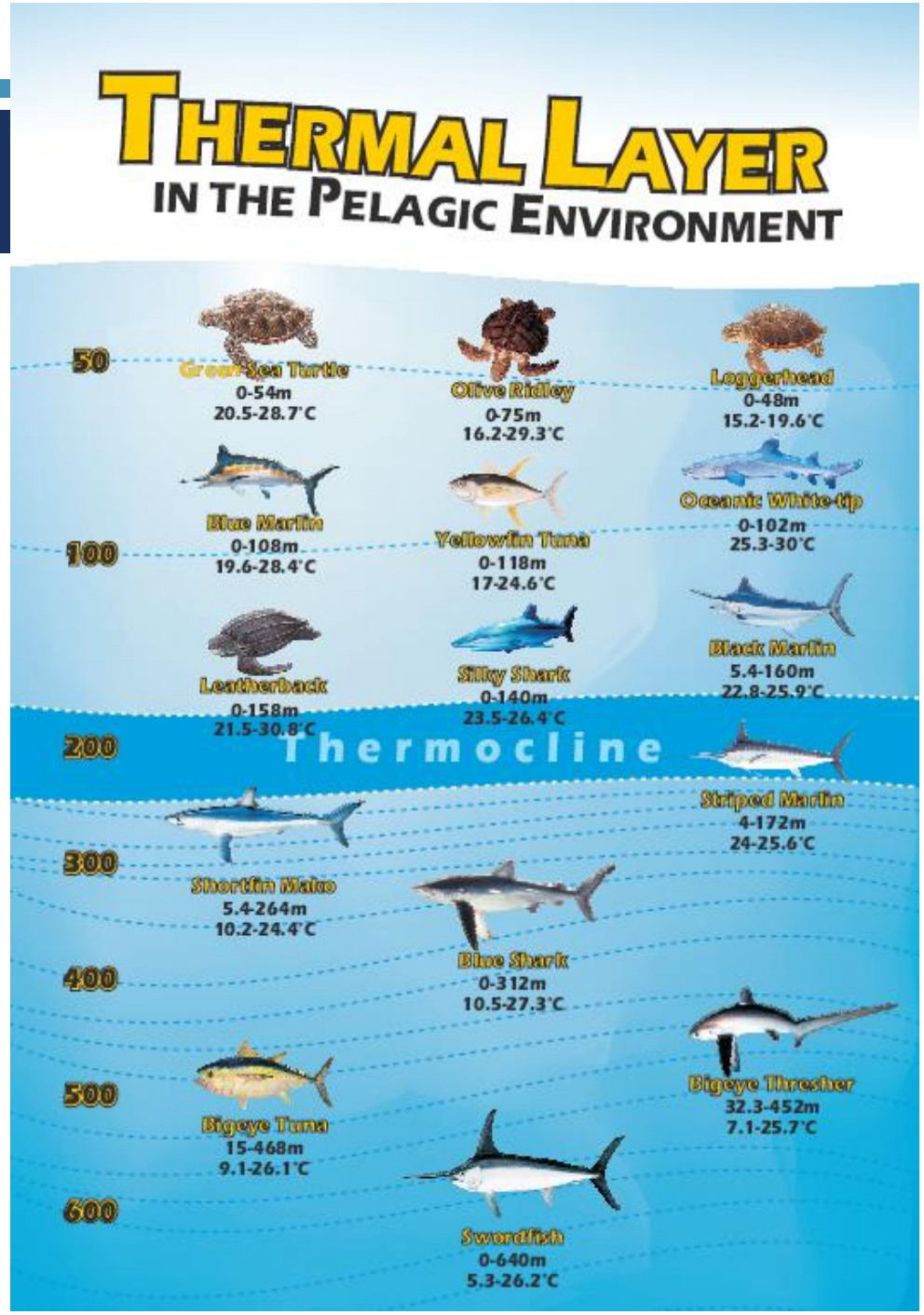


Sword Fish

TARGET CATCH

- Swimming layer of target species
  - Sea surface temperature or thermocline layer
  - Feeding organisms





TARGET CATCH

- Main parameters for location and catching target species (Beverly et. al., 2003)

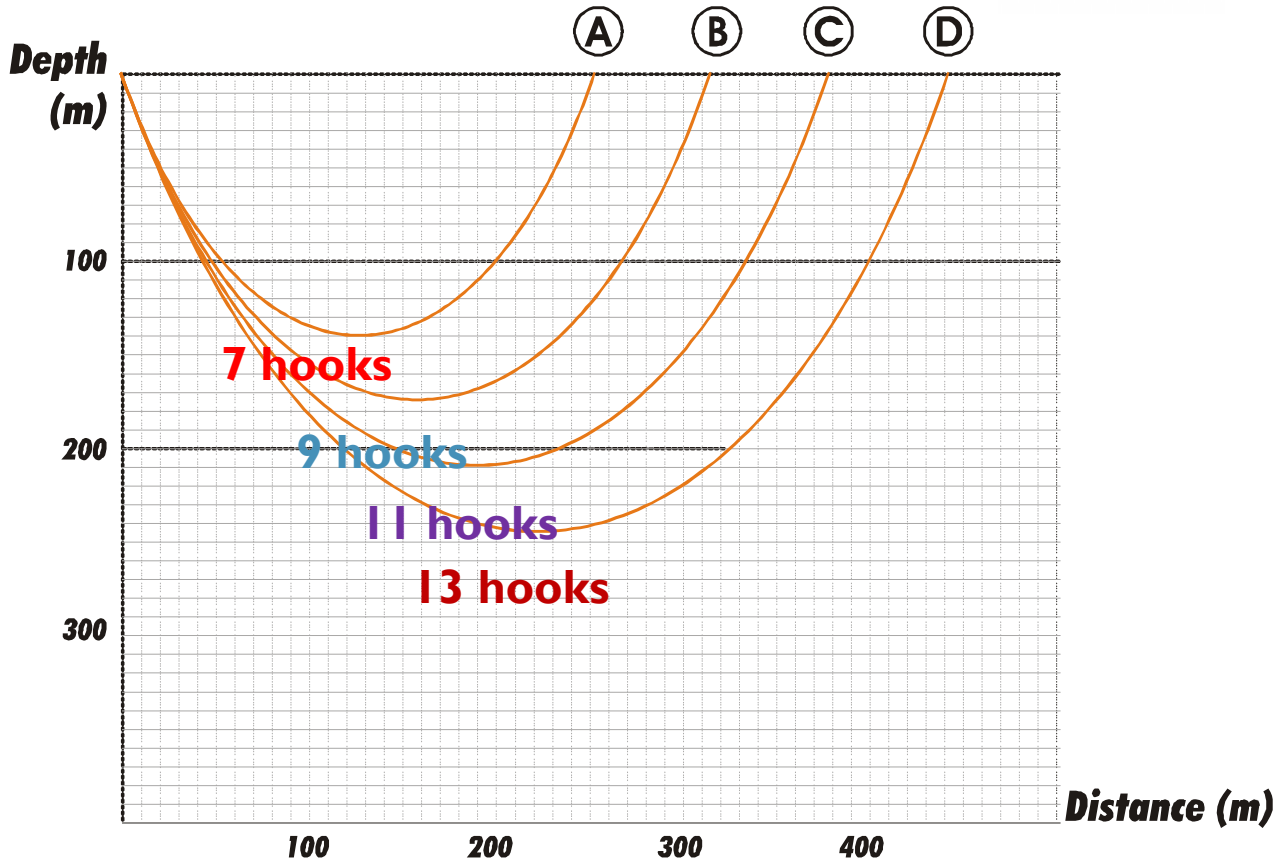
Species	Capture depth	Temp. range	Best baits	Season	Set/haul times
Bigeye tuna	50-600 m, thermocline	10-17˚C	Saury, bigeye scad, pilchard, squid	Winter	0400-0800/ 1400-1800
Yellowfin tuna	50-250 m, mixed and intermediate layer	18-28˚C	Saury, bigeye scad, milkfish, squid	Summer	0400-0800/ 1400-1800
Albacore tuna	50-600 m, thermocline	10-17˚C	Saury, pilchard, sardine	Late summer, autumn, early winter	0400-0800/ 1400-1800
Broadbill swordfish	50-150 m, mixed and intermediate layer	18-22˚C	*Illex* spp. Squid, lightsticks	Late winter and spring	1800-2000/ 0600-0800
Striped marlin	50-250 m, mixed and intermediate layer	20-23˚C	Saury, bigeye scad, milkfish, squid	Late winter and spring	0400-0800/ 1400-1800

FISHING DEPTH AND HOOK DEPTH SETTING

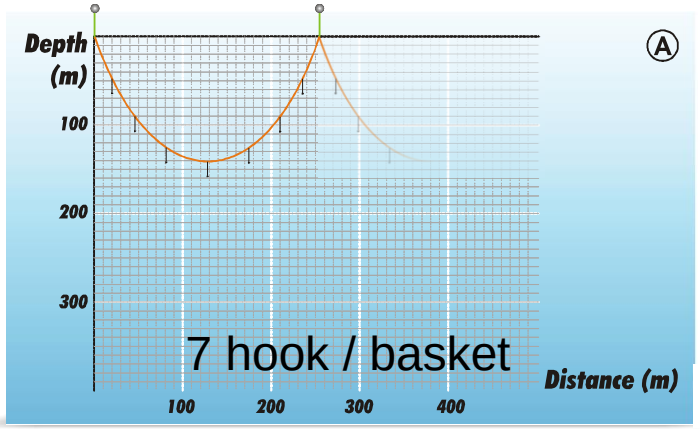
- Mainline and hook depth setting

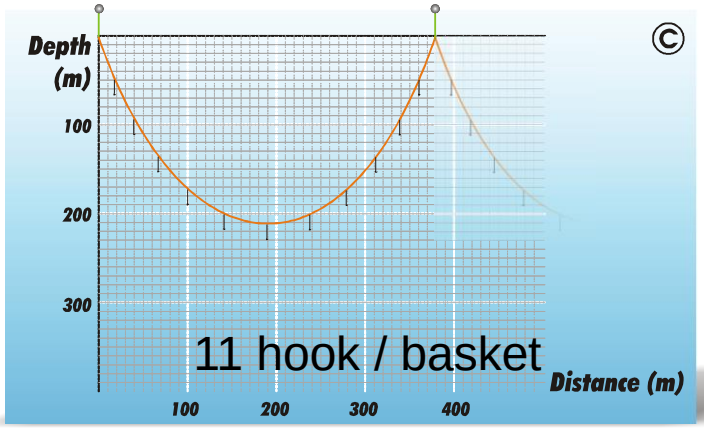
  - Depth layer of hooks in basket should cover the target species swimming layer
  - If same designed longline was deployed under the same circumstance the only thing made the hook layer different is the number of hook per basket

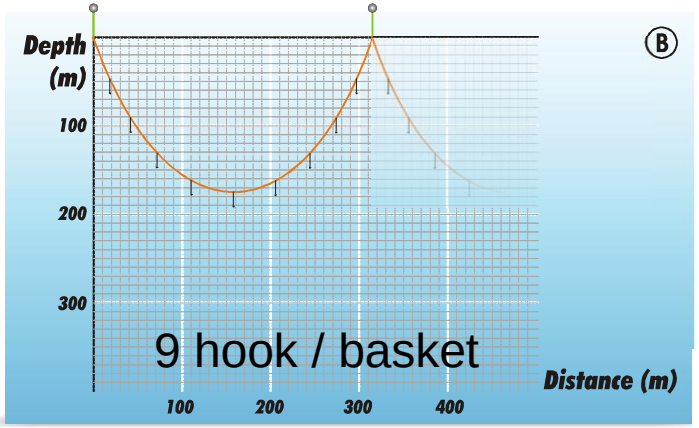
  - **Example**
    - Length of float line = 25 m.
    - Length of hook line = 15 m.
    - Hook line interval distance = 50 m.
    - Boat speed = 7 kt.
    - Shooting interval time of hook line = 9 sec.

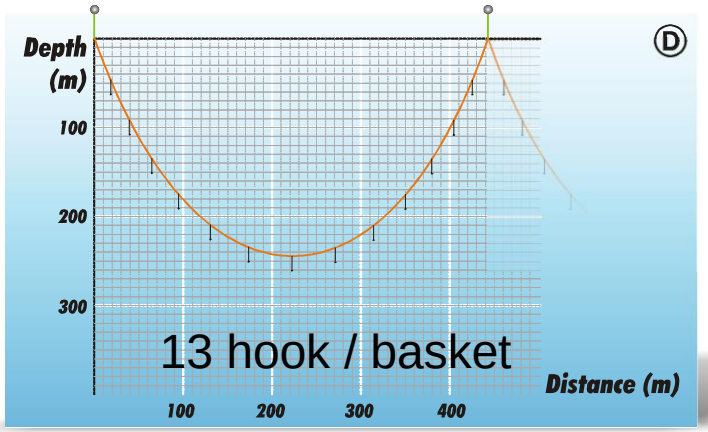


FISHING DEPTH AND HOOK DEPTH SETTING









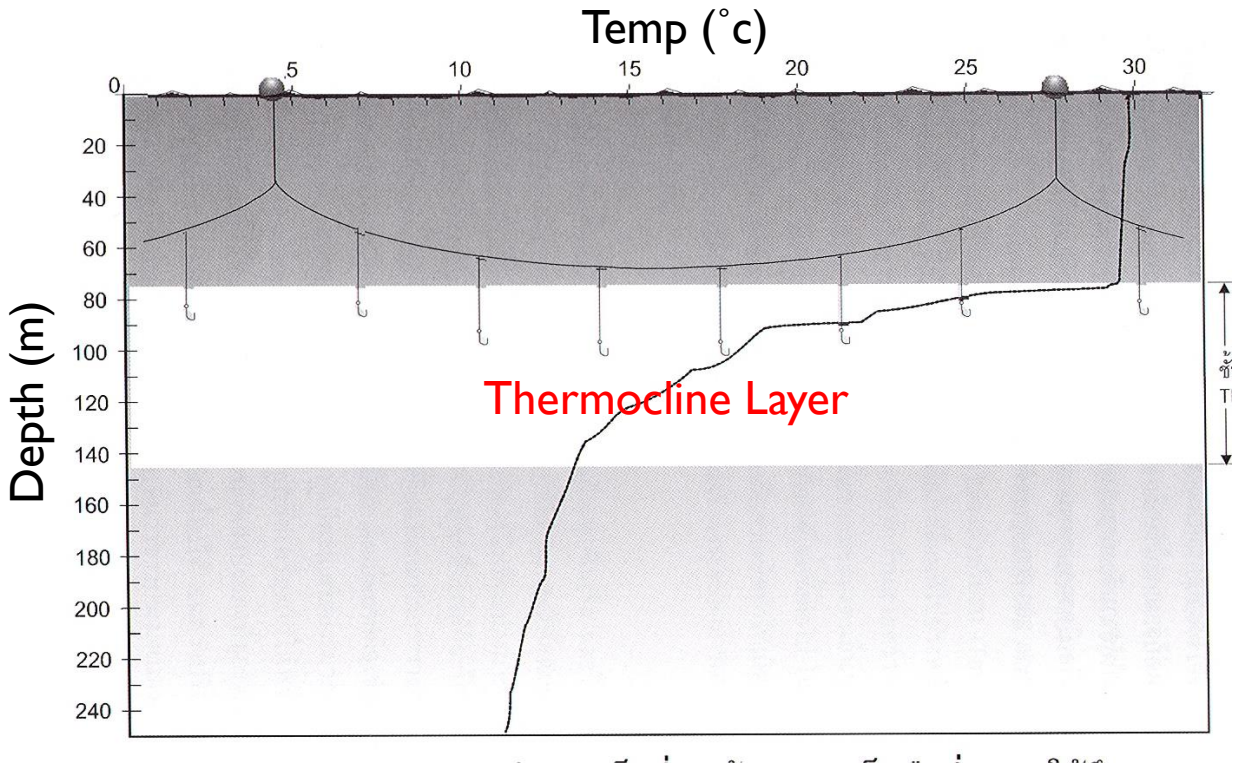
- ***Example A***, a set composed of 7 hook lines
  - Length of hook line = 15 m
  - Length of float line = 25 m
  - Hook line interval = 50 m
  - Length of mainline (50 x 8) = 400 m
  - Shrinkage = 0.63
  - Float interval distance (400 x 0.63) = 252 m
  - The sag of mainline (top to bottom) = 140.3 m
  - Therefor, the deepest hook will be at

    = Sag depth + Hook line length + Float line length

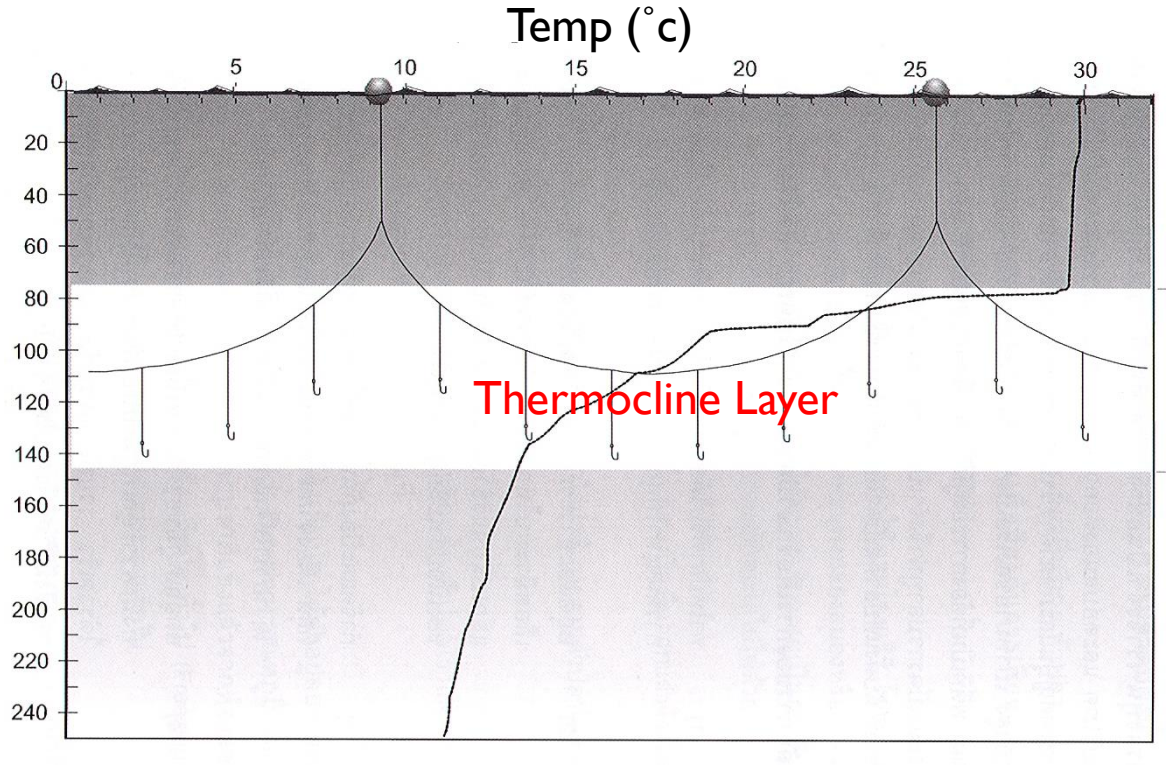
    = 140.3 + 15 + 25

    = **180.3 m**

FISHING DEPTH AND HOOK DEPTH SETTING



Vessel Speed : Fast
Line Speed : Slow



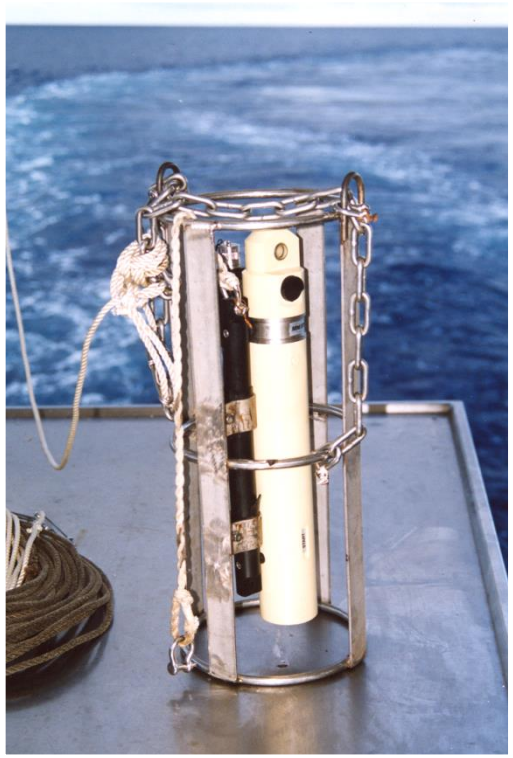
Vessel Speed : Slow
Line Speed : Fast

MONITORING DEVICE

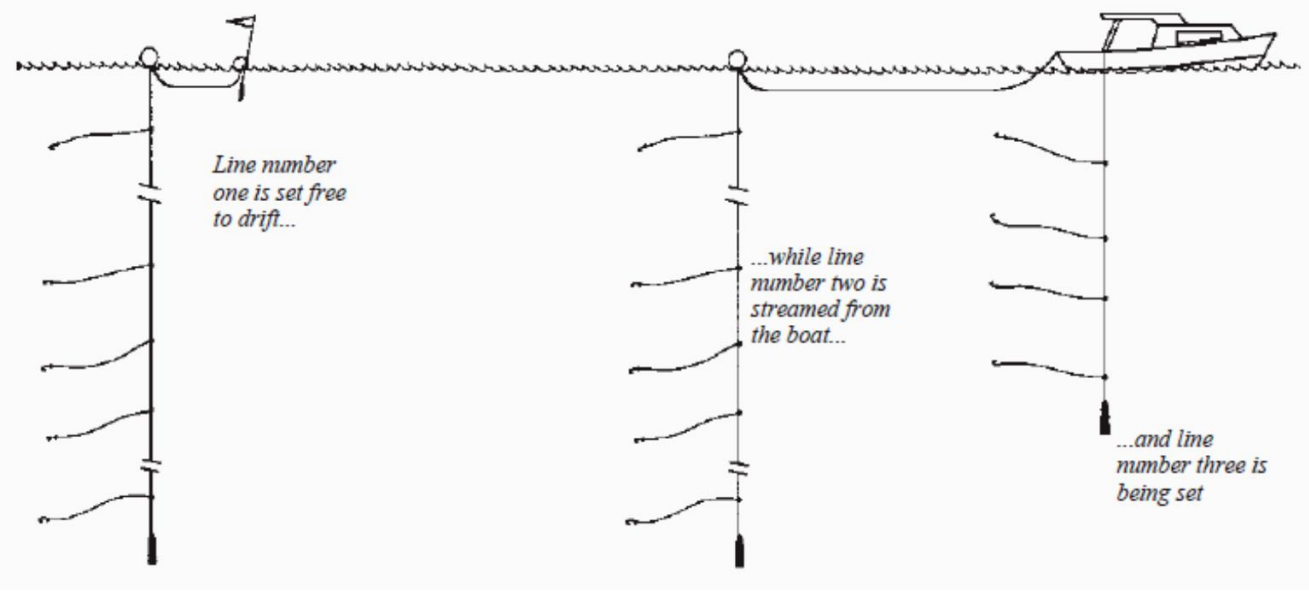
- Using of **Time-Depth Recorder (TDR)** to know the actual depth of hook in each operation

BIOLOGICAL AND OCEANOGRAPHIC DATA INFORMATION

- Collect oceanographic data by using of oceanographic equipment
  - Temperature and Depth relationship profile
  - Other oceanographic parameter such as DO, Salinity, Chlorophyll-a etc.



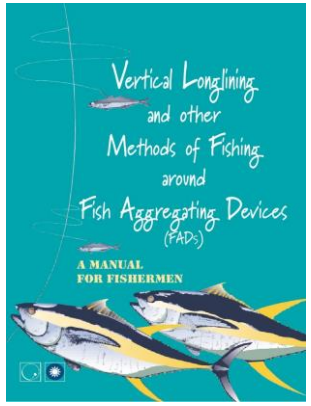
VERTICAL LONGLINE

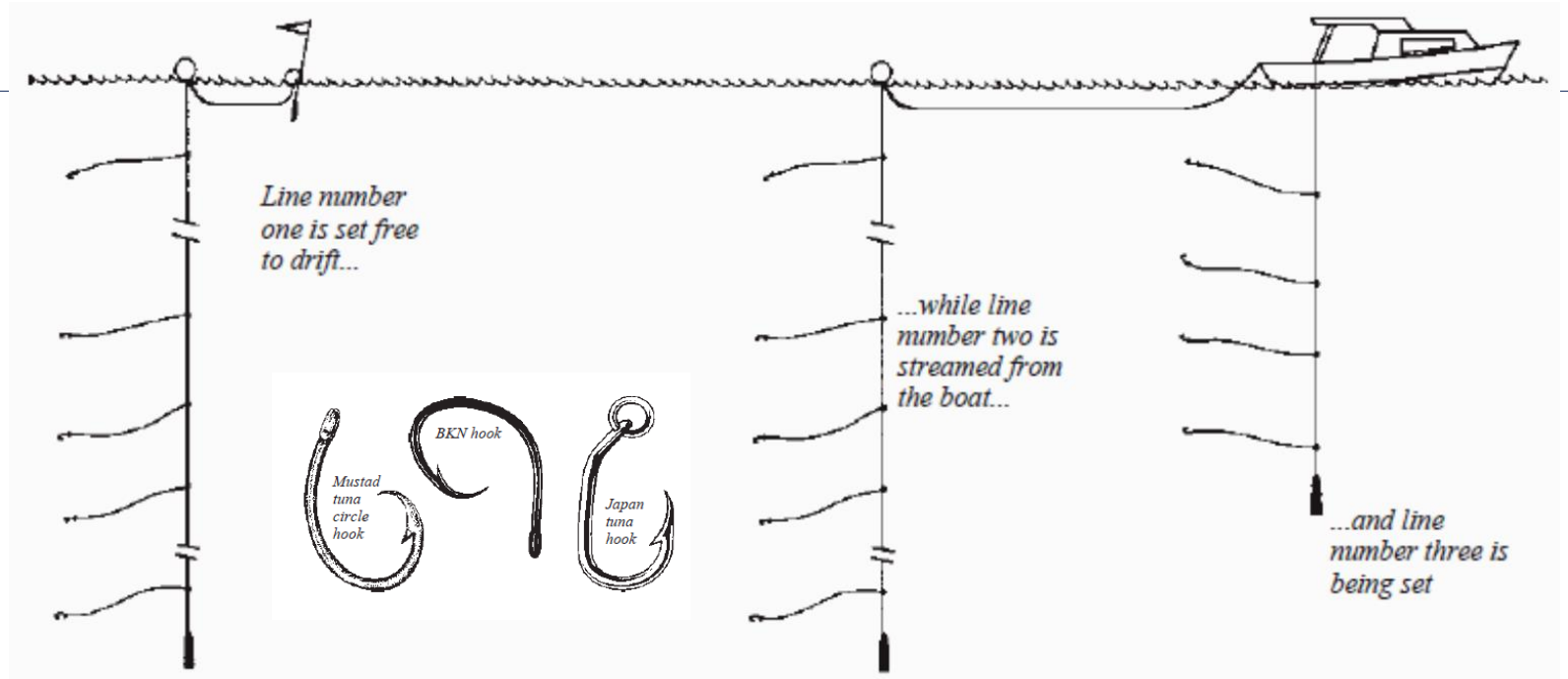


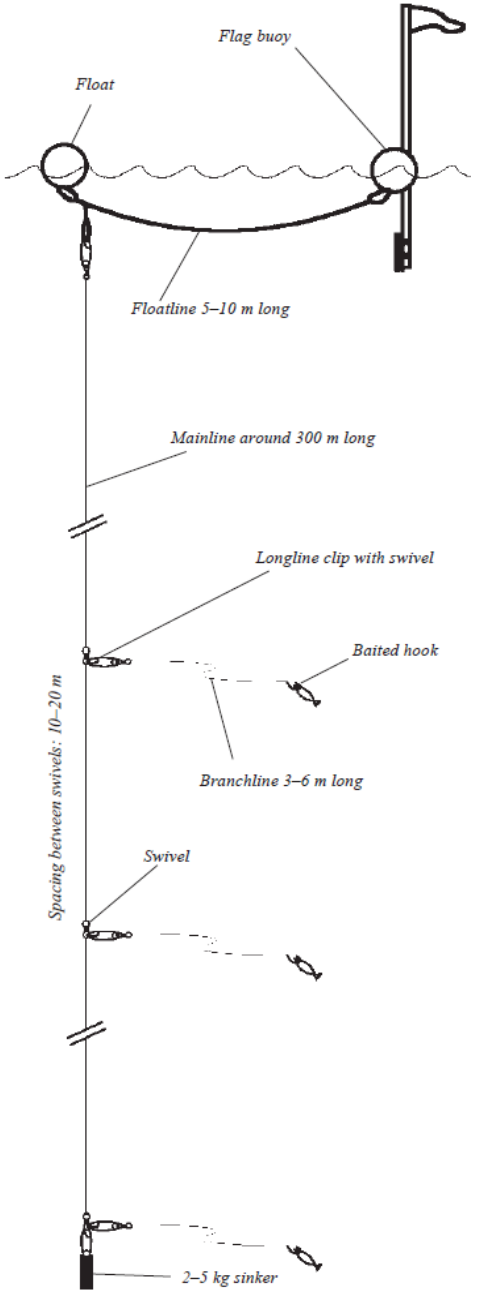
Vertical Longline is used to catch fish with a wide vertical distribution in deep waters up to 1,200 m and in shallow areas having rough bottom conditions or in areas where fish aggregating devices are deployed.

- The gear construction is consisting of a single line with a float at one end and a weight at the other. The mainline extending across the vertical range of the swimming layer of the target species is attached to the buoy line with a swivel.
- Branch lines are attached to the mainline.
- The mainline is set vertically with the upper end joined to a large float and flagpoles, and the lower end is provided with a sinker (Hameed and Boopendranath 2000).

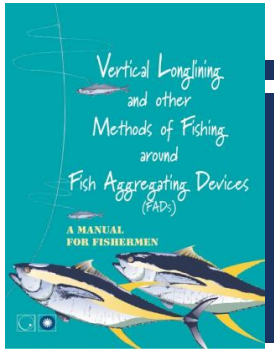
DRIFT VERTICAL LONGLINE







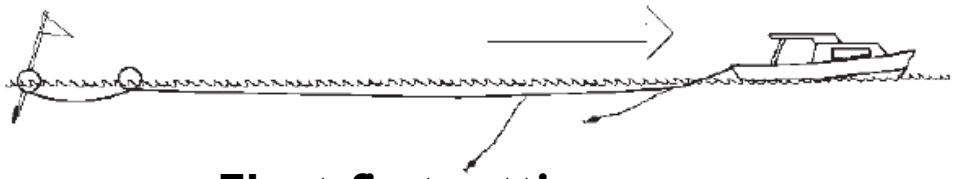
- Mainline is PA MONO (200-500 kg test) around 300 m length
- Spacing between swivels is 10 – 20 m
- Branch lines is PA MONO (125-250 kg test), 3 – 6 m long
- Hooks is mustad tuna circle size 14/0, 15/0, 16/0 or BKN size 48 or Japan tuna hook size 3.6 mm
- Float line is PP Ø 6-8 mm, 5 - 10 m long
- Sinker made by tying together lengths of rebar (weight is 2-5 kg)
- Longline clip with swivel size 1-12 cm
- Surface float is plastic Ø 300 mm



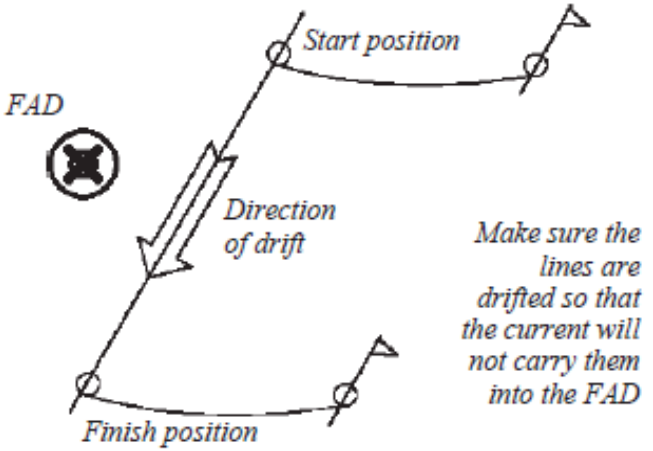
BASIC PROCEDURE

SETTING THE LINES

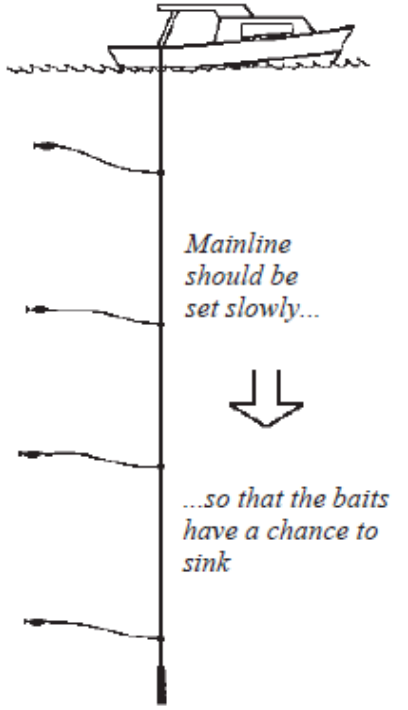
- The boat is drifting or tied to a FADs.
- Drifting lines past the FAD is necessary to know which way the current is running
- The line should always be set from the part of the boat which avoid the line and the boat being pushed together by the action of wind and current
- Setting sinker first or float first?
  - Sinker-first setting is takes longer but can be done when the boat is drifting or tied to a FAD
  - Float-first setting is faster but is only really practical while the boat is under way.



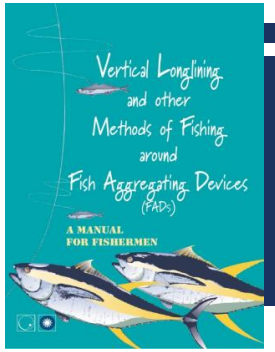
Float-first setting



The lines drifting direction



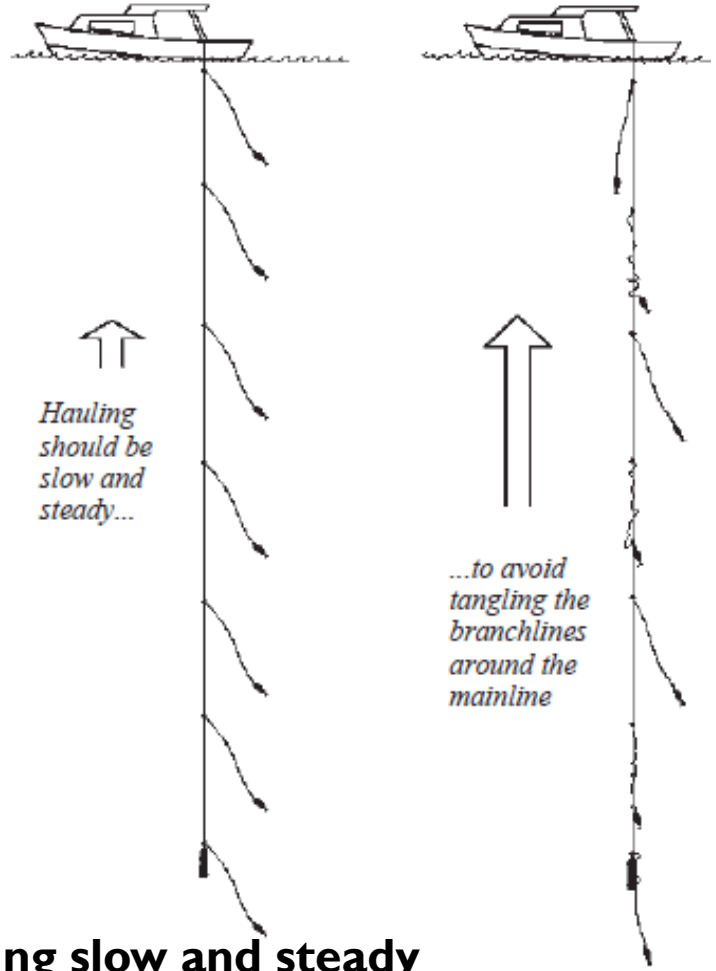
Sinker-first setting



BASIC PROCEDURE

HAULING THE LINES

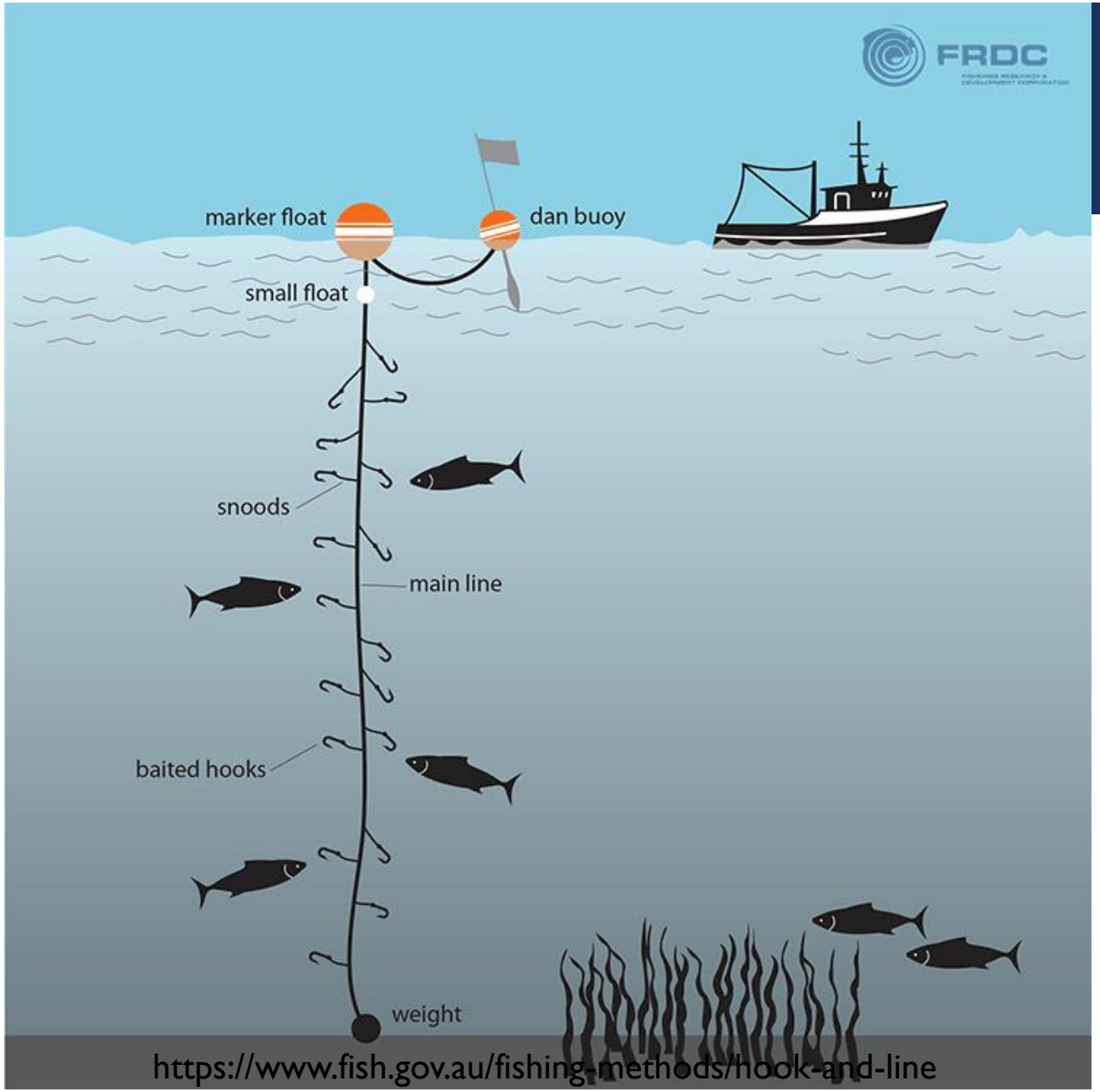
- Hauling being after lines have soaked for 2-5 hours or when it is obvious that fish have been hooked
- Hauling always takes place float-first
- Use of reels or a hand-hauling system
- The line should be hauled relatively slowly and with as steady a motion as possible.



Hauling slow and steady

Hauling quickly

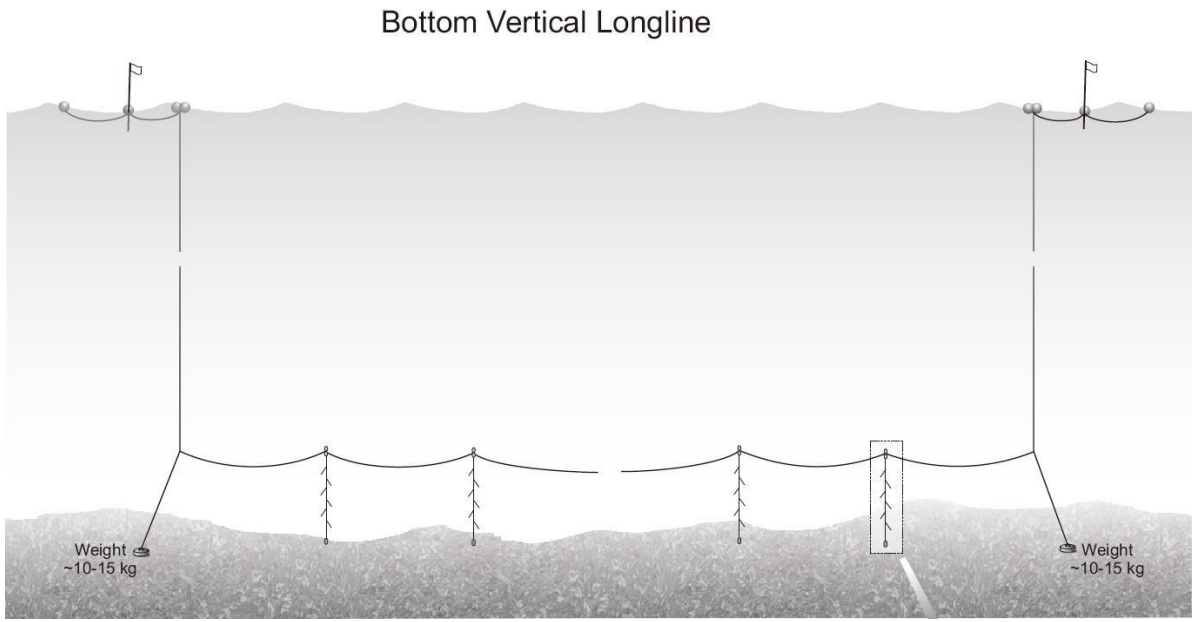
DROPLINE



https://www.fish.gov.au/fishing-methods/hook-and-line

- **Dropline** is anchored longlines and can be set vertically in the water column.
- Droplines are used mainly on the continental slope to target fish such as Blue-Eye Trevalla, Striped Trumpeter, Snapper and shark species etc.
- Consist of a mainline of rope, wire or nylon that is anchored vertically in the water with a weight on the bottom and floats attached at the surface. Short lengths of twine or nylon called snoods or traces have a clip attached to one end and a hook on the other.

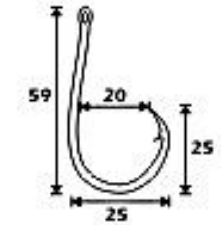
BOTTOM VERTICAL LONGLINE

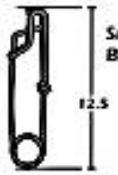


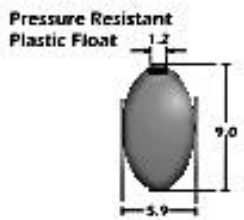
Bottom Vertical Longline is as the further refinement of bottom longline we can see a new variation called the vertical-line, in which the main line is floated about 10 meters from the sea bottom to allow the branch lines to hang down vertically to the bottom the method is an improvement on the bottom longline having the advantage of being able to be set even in areas with rocky reef bottom

- Setting the main line close to the bottom and connecting it to branch lines have an appearance similar to vertical lines.
- The mainlines is suspended at some distance above the bottom, depending on the length of branch line.
- If a branch line get caught by some obstacle at the bottom, only that particular line get damaged or lost without a risk to the rest of the gear.

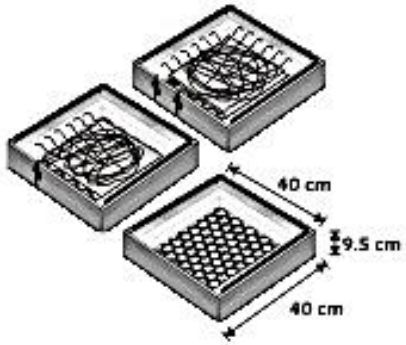
BOTTOM VERTICAL LONGLINE



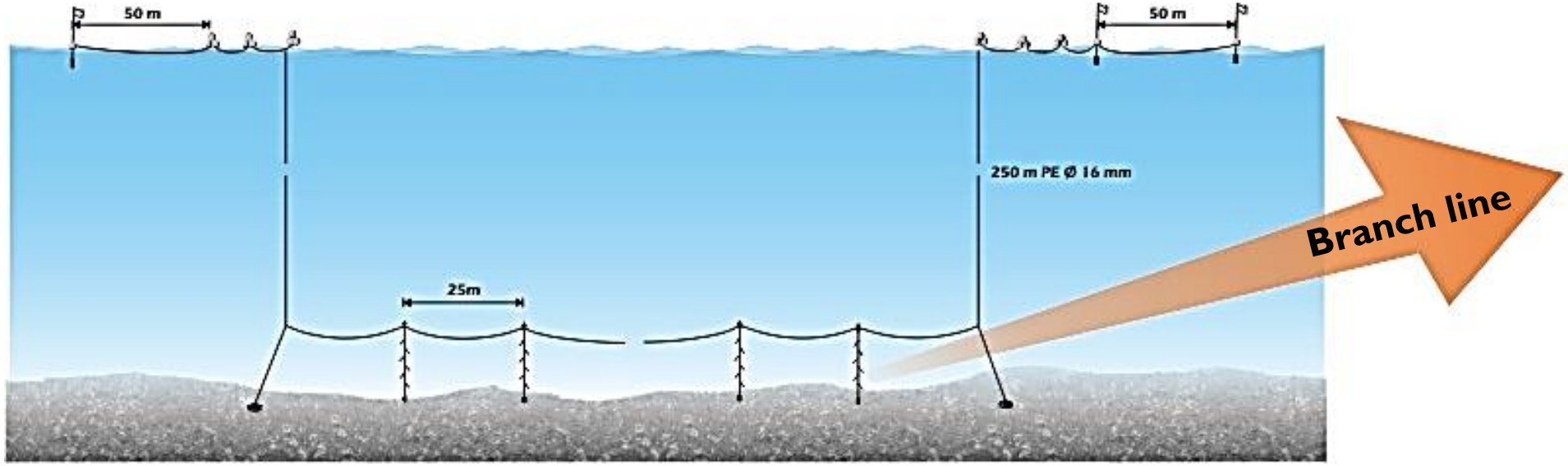


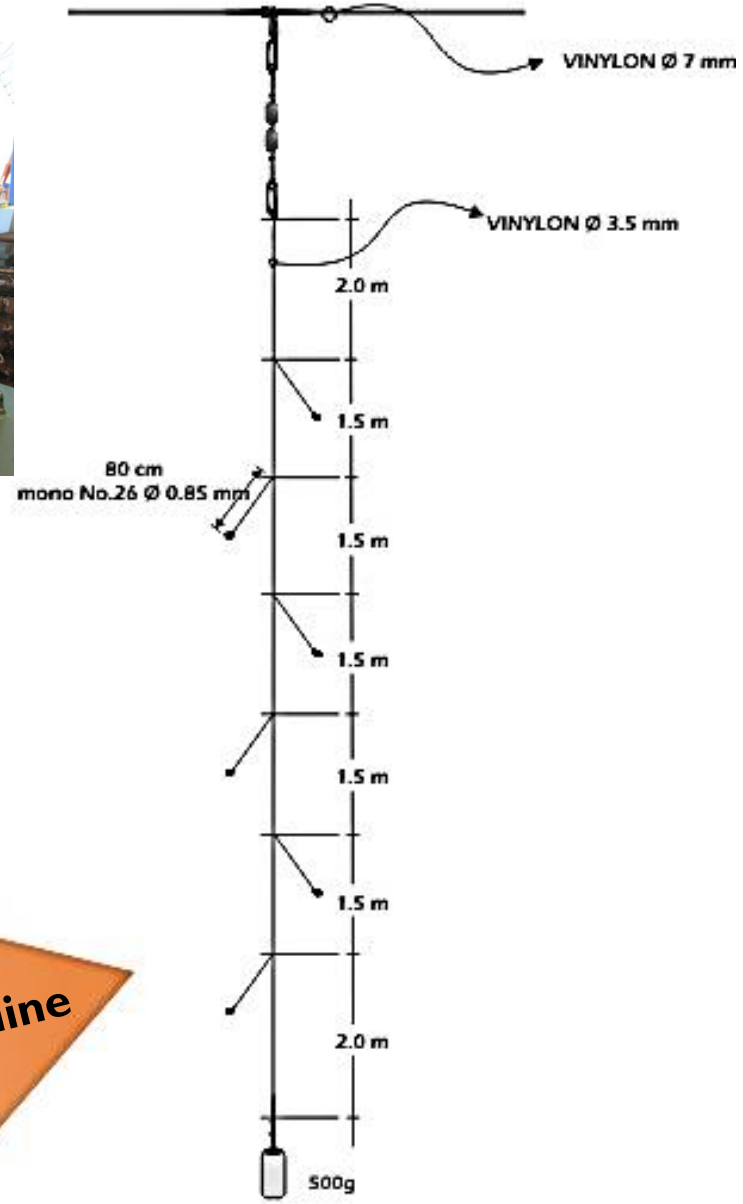


Cement sinker
500g



- Main line is Vinylon Ø7.0 mm
- Branch line is 10-15 m in length of Vinylon Ø3.5 mm attached with 500 g cement sinker at the end (1.5 m hook interval and 6 hook/branch line)
- Distance between branch line is 25 m
- Float line is 250 m of PE Ø16.0 mm
- The hook is SST Circle hook are using





STANDARD OPERATION PROCEDURES

Fishing Operation Preparation	• **PLL** : before fishing operation, oceanographic survey shall be conducted in order to examine thermocline characteristic. Master Fisherman and Researcher concerned shall adjust the hook layer follow the thermocline information. • **BVL** : fishing ground shall be surveyed by hydroacoustic equipment
Period of Operation	• Fishing operation could conduct in nighttime or daytime.
Immersion time	• **PLL** : Immersion time of the gear shall be at least 6 hours and not exceed 15 hours • **BVL** : Immersion time of the gear shall be at least 2 hours and not exceed 6 hours • Calculated from time spent on shooting divided by two plus time spent on hauling divided by two and plus waiting time (period between finished shooting to start hauling)
Depth of Operation	• **PLL :** Depth of water at least 300 meters. • **BVL :** Depth of water between 50-300 meters (Rocky bottom, hard coral ground is preferred)
Shooting Speed and casting details	• Vessel's shooting course and speed shall be able to adjust during an operation but consideration for the rule of safety • Line setter speed shall be able to adjust during an operation but consideration for the rule of safety • Length of line setting shall be recorded in the fishing log • Shooting course shall be record in unit 'degree' with three digits places

STANDARD OPERATION PROCEDURES

Information Recording	**Speed measurement:** Shooting speed shall be recorded from average speed over ground during shooting. Unit of speed shall be measured by unit of Knot (nautical mile per hour) **Start fishing time:** when any part of the gear reaches the sea **Finish fishing time:** the time that the last part of the gear shot overboard **Start hauling time:** the time when any part of the gear hauled up on board **Finish hauling time:** the time when all part of the gear was hauled on board **Fishing position:** fishing position shall be recorded by using the GPS or an equally accurate navigation system and recording in terms of Latitude and Longitude **Start fishing position:** the position that the gear reaches the sea **Finish fishing position:** the position that the last part of the gear shot overboard **Start hauling position:** the position that any part of the gear is hauled onboard **Finish hauling position:** the position that all part of the gear are onboard ***Set bottom longline and Bottom vertical longline is a kind of stationary fishing gear, so that information of start hauling position and finish hauling position are not required***
Monitoring devices	• Time-Depth Recorder (TDR) with neutralized buoyancy should be attached to the mainline with rope as the same length of hook line in selected position to detect actual depth of the hook ***No monitoring devices are required to attach with Set bottom longline and Bottom vertical longline***
Gear malfunction	• The malfunction or lost of gear, mainline usually found entangled during hauling operation. Details should be recorded numbers of branch line entangled and record the malfunction of the operation or gear into the fishing log sheet.

STANDARD OPERATION PROCEDURES

Catch sampling and recording	• Fish hauled on board shall be individually classified and measured (recommended not to sampling but if catches of each species is more than 100 samples, samples 100 fish for the measurement) • Catch data should included order of branch line and hook which caught that fish, in the consequence of hook line on the branch line. (the first hook count from the top to the bottom)
Samples measurement	• Fish hauled on board shall be identified to species. Common name and Scientific name shall be recorded in logsheet. • Fish hauled on board shall be measured the total length, and girth length in the unit of centimeter(cm) with one decimal place. • Fish hauled on board must be weighted in the unit of Kilogram(kg) with one decimal place. • Sampling of stomach content of each specie hauled on board shall be determined and recorded • Fish, which fall off the hook during hauling, shall be counted in the hook rate if researcher or crew could identify its specie. Weight estimation shall be accepted if possible. • Other data (if any) should be recorded such as position of hooking, condition of catch (dead, alive or bitten by other fish) and etc.

STANDARD OPERATION PROCEDURES (FISHING LOGSHEET)

PELAGIC LONGLINE FISHING LOGSHEET
Operation No. 7

Recorded by O.Sukanya
Certified by

Cruise no: 71-1/2004		Name of Vessel				Air temp:	32.8	° C
Survey station No: 7		M.V.SEAFDEC				Air pressure:	1010	mbar
Date: 22-Nov-04						Humidity :	-	%
Moon age: 10 phase 82		Start shooting22/11/04		Finish shooting22/11/04		Water		
Wind		Time	1655	Time	1800	Surface temp:	27.3	°C
Spd (kt)	Direction	Lat.	12_40.78 N	Lat.	12_34.29 N	100 m. temp :	20.9	°C
6.2	NE 60	Long.	96_12.03 E	Long.	96_05.11 E	Thermocline :	30-200 m.	
Weather cond: BC		Start hauling 23/11/04		Finish hauling 23/11/04		Current		
Sea condition: Slight		Time	0605	Time	0905	Depth	Spd (kt)	Direction
Gear		Lat.	12_30.93 N	Lat.	12_36.99 N	10	0.1	NW/N 330
No. hook/basket: 10		Long.	96_02.54 E	Long.	96_07.82 E	50	0.3	SE/E 127
Total hook no: 458		Memorandum: 1) Speed of vessel: 8 knots				100	0.4	NE/N 41
Immersion time: 13.08 Hrs.		2) Setting distance: 9.3 nm course 226 °				Total catch in number: 16		
Type of bait: Scad		3) Mainline paid out: 20,272 m (Setting machine)				Total catch in weight: 673.5 kg.		
		4) Sea depth: 2,105 m(chart)						
		5) Depth of hook: 168 m						

No.	Species	Length (cm)	Weight (kg)	Remarks
1	*Xiphias gladius*	202	23.00	FL = 189
				SL = 175
				BL = 130
				EFL = 192
				HL = 39
				BD = 26
				Girth = 67
				Sex = Male

BOTTOM VERTICAL LONGLINE FISHING LOGSHEET
Operation No.

Recorded by
Certified by

Cruise No:		Name of Vessel				Air temp:		° C
Survey station No:		M.V.SEAFDEC 2				Air pressure:		mbar
Date:						Humidity :		%
Moon age:		Start shooting		Finish shooting		Water		
Wind		Time		Time		Surface		° C
Spd (kt)	Direction	Latitude		Latitude		Bottom		°C
		Longitud		Longitud		Thermoclin		
Weather cond:		Start hauling		Finish hauling		Current		
Sea condition: Slight		Time		Time		Depth	Spd	Directio
Gear		Latitude		Latitude		10		
Total hook no:		Longitud		Longitud		50		
No. hook/branch line:		Memorandum:				100		
Immersion time:		Sea depth :				Total catch in number:		
		Total distance nm Setting course						
Type of bait:		Shooting speed				Total catch in weight:		

No.	Species	Number	Weight (kg)	Remarks

STANDARD OPERATION PROCEDURES

INDICATOR OF ABUNDANCE

- Hook rate shall be calculated by individual number of target fish caught per 1,000 hooks deployed. (Concerned researcher must specify ‘target fish’ and ‘non-target fish’ in research proposal)
- Number of hook to use in hook rate calculation shall be counted from the hook hauled on board.

SUMMARY

Types of Gear	Area of Operation	Target Catch
1. Set Bottom Longline	- Mainline are fixed along the seafloor using anchors. - Operate close to the bottom for demersal fish	- Sea beam, sea bass, groupers, sharks, and snapper etc.
2. Drifting Horizontal Pelagic Longline	- Not anchored but drifts freely in the sea - Operated close to the surface in middle water layers for pelagic fishes	- Tuna, sword fish, marlin, billfish, mackerel and shark
3. Vertical Longline	- To catch fish with wide vertical distribution in deep sea and shallow waters in areas where FADs are deployed	- Tunas and other pelagic fish living around FADs
4. Bottom Vertical Longline	- The main line is floated from the sea bottom to allow branch lines hang down vertically - Having advantage to be set even in rocky, reef bottom area	- The demersal fish and the fish which dwell near or at the bottom such as snapper, groupers, sea beam, and sharks etc.

THANK YOU