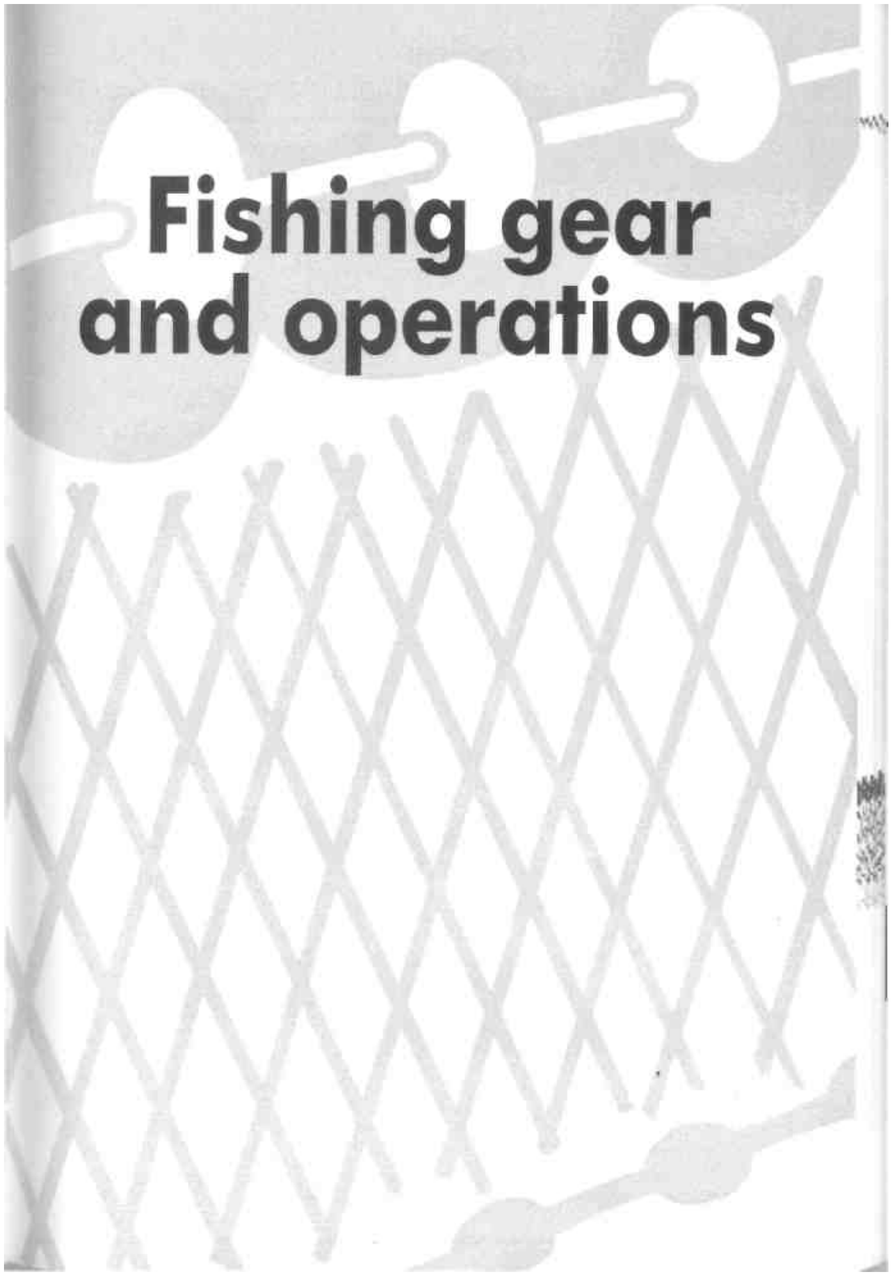
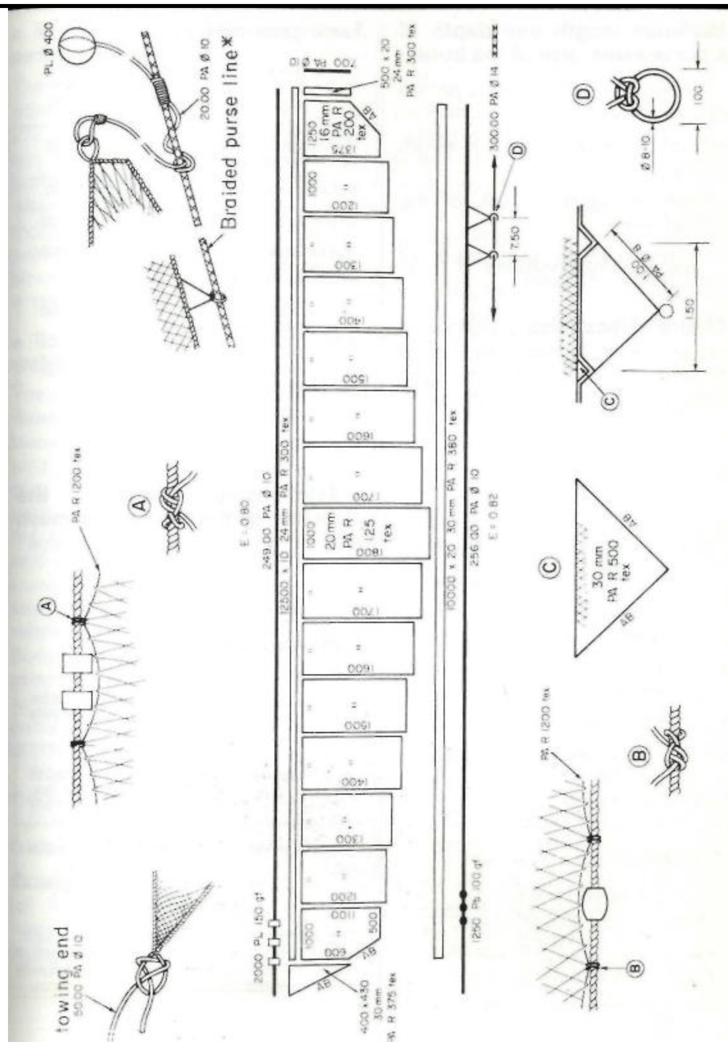
Fishing gear and operations



Purse seine: example of plan and rigging



Purse seine for sardine and other small pelagic species for a boat of 10 m LOA (PAJOT FAO) * Note :
*With small purse seines where the purse line is not coiled on a drum, the purse line may **be** lashed to the buoy line.*

Purse seines: minimum dimensions, mesh sizes, twine sizes

■ **Minimum length and depth of the purse seine, size of the bunt***

— Minimum length depends on the length of seiner : length of purse seine ≥ 15 x length of seiner

— Minimum depth : 10% of the length of seine

— Minimum length and depth of bunt = length of vessel

■ **Choice of mesh size** is a function of the target species. It is necessary to avoid enmeshing or gilling the fish (with respect for regulations on minimum mesh size].

$$OM = \frac{2}{3} \times \frac{L\ (fish)}{K}$$

(Fridman formula)

where:

OM = mesh opening (mm] in the bunt

L = length (mm) of target species

K = coefficient, a function of the target species

K = 5 for fish that are long and narrow

K = 3.5 for average shaped fish

K = 2.5 for flat, deep-bodied, or **wide fish**

Some examples

Species	Stretched meshsize (mm)	Size of twine (Rtex)
small anchovy, n'dagala, kapenta (East Africa)	12	75-100
anchovies, small sardine	16	75-150
sardine, sardinella	18-20	100-150
large sardinella, bonga, flying fish, small mackerel and Spanish mackerel	25-30	150-300
mackerel, mullet, tilapia, Spanish mackerel, small bonito	50-70	300-390
Bonito, tuna, wahoo, Scorn beromorus sp.	50-70 (min)	450-550

■ **Relationship between the diameter of the twine and mesh size** in different parts of the purse seine :

$$\frac{\text{diameter of twine (mm)}}{\text{stretched mesh size (mm)}}$$

Some examples

	Body of the purse seine	Bunt of the purse seine
Small Pelagic Fish	0.01 to 0.04	0.01 to 0.05 North Sea 0.04 to 0.07
Large Pelagic Fish	0.005 to 0.03	0.01 to 0.06

** In purse seines, as in many types of fishing gear, the 'bunt' refers to the section of net which is hauied last or the section in which the catch may be concentrated*

Weight of ballast*, buoyancy of floats, weight of netting

■ **Ratio of ballast to weight of netting (in air)**

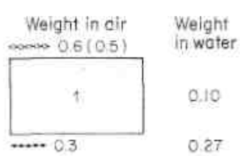
The weight (in air) of the ballast normally ranges between 1/3 and 2/3 the weight of the netting (in air).** The weight (in air) of the ballast per metre of seine footrope is often between 1 and 3 kg (although more is used for small mesh purse seines used to catch deep-swimming small pelagic fish and up to 8 kg/m is used in large tuna seines).

■ **Ratio of buoyancy to total weight of the seine**

The rigging of floats on a purse seine must take into account not only the buoyancy needed to balance the total weight of the gear in water, but also additional buoyancy.*** This additional buoyancy should be of the order of 30% for calm waters, and up to 50-60% in areas of strong currents, to compensate for rough sea conditions and other factors related to handling of the gear. Buoyancy should be greater in the area of the bunt (which has heavier twine) and mid-way along the seine (where pulling forces are greater during pursing).

In practical terms, the buoyancy of the floats should be equal to about 1.5 to 2 times the weight of the ballast along the bottom of the seine,

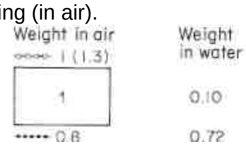
Examples
(a) If a **large purse seine** has relatively heavy netting (as is common), ballast may be relatively light, and



the buoyancy needed is a bit more than half the weight (in air) of the netting.

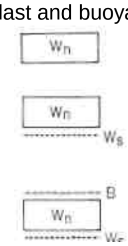
Buoyancy = 1.3 to 1.6 x (weight of netting in water + weight of ballast in water)
= (1.3 to 1.6) x (0.10 + 0.27)
= 0.5 to 0.6 kg per kg of netting (weight in air)

(b) If a **smaller purse seine** has relatively light netting (as is common), the ballast should be relatively heavy, and the buoyancy may be equal to or slightly greater than the weight of the netting (in air).

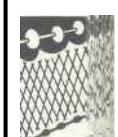


Buoyancy = 1.3 to 1.6 (weight of netting in water + weight of ballast in water)
= (1.3 to 1.6) x (0.10 + 0.72)
= 1 to 1.3 kg per kg of netting (in air)

In summary, the procedure of choosing weight of ballast and buoyancy*** required is to calculate :



(1) the weight (in air) of netting Wn**
(2) the weight (in air) of leads Ws
Ws= (0.3 to 0.8) x Wn
(3) Buoyancy = (1.3 to 1.6) x (0.1 Wn + 0.9 Ws)
= (1.3 to 2) x Ws



** Ballast in this case Is considered to include the sinkers on the leadline, purse rings, chain and any other lead or Iron rigging along the bottom of the seine*
*** Weight of netting, see page 35*
**** Buoyancy of purse seine floats, see pages*

Hanging, leadline, tow line, purse line, depth, volume on board, performance

The leadline of a purse seine is usually longer than the floatline by up to 10%; however in some types, the two lines are equal in length.

The hanging ratio (E), is usually greater on the leadline than on the floatline. Hanging ratios generally range from 0.50 to 0.90, depending on the type of net. The hanging ratio may also vary along the floatline or leadline, usually being lower in the bunt. For more on hanging ratios and methods of hanging, see pages 38, 39, and 42.

The tow line is normally about 25% of the length of the purse seine.

The purse line is generally 1.1 to 1.75 times the length of the leadline, usually about 1.5 times the length of the purse seine. The purse line must have good resistance to abrasion and good breaking strength. As a general guideline, the breaking strength (R) of the purse line should be as follows :

R > 3 x (combined weight of netting, leadline, leads and purserings)

$R\ (\text{tons}) \simeq \sqrt{\text{tonnage of vessel}}$

Volume (on board) occupied by the seine when rigged

V(m^3) = 5 x weight (tons) of the seine (in air)

Depth in water of the seine (see also pages 39 and 40). As an approximation, the actual depth or height (AD) can be considered equal to roughly 50% of the stretched depth (SD, or stretched meshsize x number of meshes) of the seine at its extremities, and 60% near the centre of the net.

AD = SD x 0.5 = SD/2 extremities

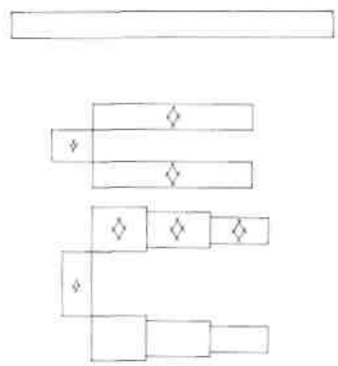
AD = SD x 0.6 centre of net

Sinking speed of a purse seine — for different seines, sinking speed has been measured in a range from 2.4 to 16.0 m/min, with an average of 9.0 m/min.

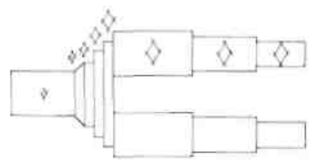
Types of beach seine, bridles, ropes

■ Beach seine without bag

A single panel of netting — no particular rules concerning height and length or Special meshsize and/or twinesize in the central part

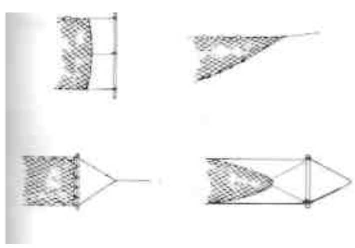


■ Beach seine with bag



■ Hauling points

For a rather high small seine with bridle, handled by one man alone



■ Ropes for hauling beach seines

Natural fibre rope or nylon, polyethylene, polypropylene

Seine length (m)	diameter synthetic fibre bridle (mm)
50- 100	6
200 – 500	14- 16
800- 1500	18

Beach seines: materials and hanging

■ Mesh size and twine thickness

In the wings, the mesh size and twine thickness may be the same as, or different from, those of the central section or bunt.

Examples of specifications for bunts of beach seines

target species	stretched mesh (mm)	twine thickness (R tex)
sardine	5-12	150-250
sardinella	30	800-1200
tilapia	25	100
tropical shrimp/prawn	18	450
diverse large species	40-50	150-300

The headrope and footrope (float line and lead line) are usually of the same material (PA or PE) and diameter.

Hanging ratios (E) are usually the same on headrope and footrope. For central sections, E = 0.5 or slightly greater (0.5-0.7). In the wings the hanging ratio is usually the same as in the bunt, but it is sometimes slightly greater (E = 0.7-0.9).

■ Floats on the headrope

The number of floats required increases with the height of the seine. The following are examples of buoyancy observed in the central part of seines :

height (m) of seine	Buoyancy (g/m of hung net)
3-4	50
7	150
10	350-400
15	500-600
20	1000

The floats are either evenly spaced along the headrope, or placed closer together in the bunt, and spaced increasingly farther apart toward the ends of the seine.

■ Sinkers on the footrope

The quantity and type of sinkers varies according to the intended use (to 'dig' more, or 'dig' less). Sinkers may be spaced evenly along the footrope, or concentrated more near the bunt.

■ Ratio of buoyancy/weight

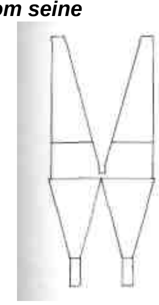
In the bunt, the ratio of buoyancy/ weight of sinkers is around 1.5-2.0, but sometimes, to make the net 'dig' more, a net is rigged with more weight than buoyancy. In the wings, the ratio of buoyancy/weight of sinkers is equal to, or slightly less than, 1.

Bottom seines: types of bottom seines and method of setting

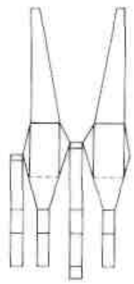
■ **Construction, rigging** :

very similar to bottom trawls

Bottom seine



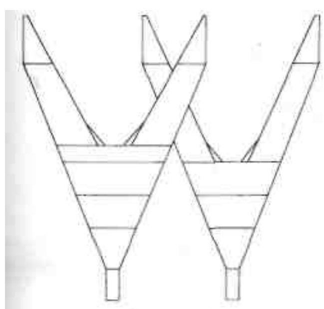
Original European type



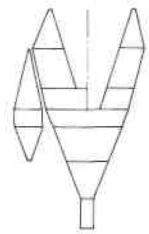
Asian type

Rigging of spreader without bridles

Bottom seine with high headline



(2 panel)



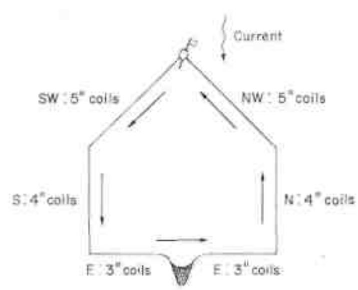
(4 panel)

Rigging of spreader with bridles

Bridles	Headline
20-25 m	35 m
45-55 m	45 m

■ **Track of the boat for shooting the anchor seine or Danish seine**

Example *:* Shooting 12 'coils' or 2640 m (1 coil = 220 m)



Bottom seines: dimensions and properties of net

■ Size of nets

	Boat		Net	
	Length (m)	Power (hp)*	Mouth" opening (m)	Headline (m)
Bottom seine (Japan)	10-15		30	50
Bottom seine (Europe)	15-20	100-200	20-30	55-65
Bottom seine (high op.)	10-20	100 200	35-45	25-35
	20		45-65	35-45
	20-25	300 - 400	~100	45-55 I
	25 +	500		55 - 65

■ Mesh size, twine size

stretched mesh (mm)	Rtex
110-150	1100-1400
90-110	1000-1100
70-90	700-1000
40-70	600-800

■ Vertical opening (estimation)

$$\approx \frac{\text{length of headline}}{20}$$

vertical opening of high-opening bottom seine with bridles

$$\approx \frac{\text{length of headline}}{10}$$

** Power in (hp) = 1.36 x Power in (kW)*

" The mouth opening is measured along the forward edge of the bellies, and is equal to (bar length x number of meshes) + (bar length x number of meshes)*
(upper panel) (lower panel)
However, there are local differences in how this term is used, (in some places it refers to stretched meshsize x number of meshes), so caution in interpretation is necessary.

Bottom seines: ropes

Durability, resistance to abrasion, and weight are essential qualities of seine ropes.

Materials

3-strands, PP with lead cores (combination rope)

Anchor seining (Danish seining) :	combination rope Ø18-20
Fly dragging (Scottish seining) :	PE or PP, Ø 20-32 (3 strands with lead core in each strand)
Fly dragging (Japan, Korea) :	small boats : manila mid-sized boats : PVA

Diameter

Rope	
Ø	Weight (kg/100 m)
PP 20	35
24	43
26	55
28	61
30	69

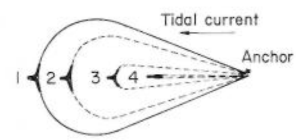
Often the diameter changes along a single rope, from 24-36 mm (for mid-sized boats). Weights are often attached along the rope.

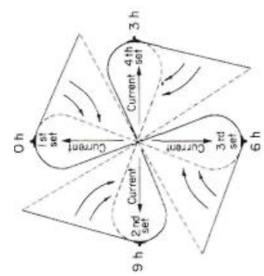
Length is expressed in coils of 200-220 m, total length usually 1000-3000 m.

Method	Fishing grounds	Rope length
Scottish technique	shallow waters (50-70 m) or small areas of soft bottom surrounded by rocky areas	less than 2000 m
	medium depths (80-260 m) or large smooth bottom areas	3000 m or longer
Japanese technique	for depths as great as 300-500 m or soft, regular bottom	8 to 15 times depth of water

Bottom seines: operations

■ Operating with an anchor (Denmark)

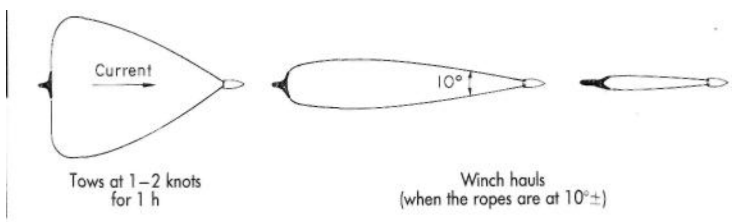




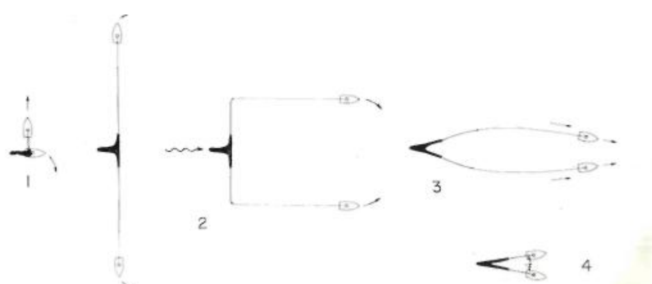
Where the direction of the current changes
with the height of the fide

■ Fly-dragging (Scotland)

■ Fly-dragging (bull trawling) (Japan, Korea)

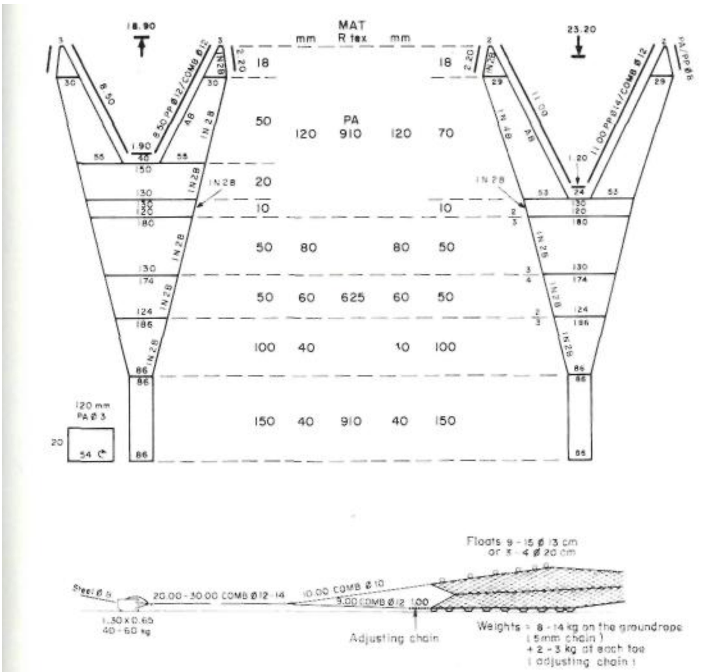


■ Operations of 2 boats (pair seining, Canada)



Plan of a 2-panel bottom trawl

This example, from FAO, is for a 50-70 hp vessel. See table below for terms.



Terms used in net plan

MAT = twine material (see pages 6-8]

Rtex = Resultant tex (twine size, see page 10)

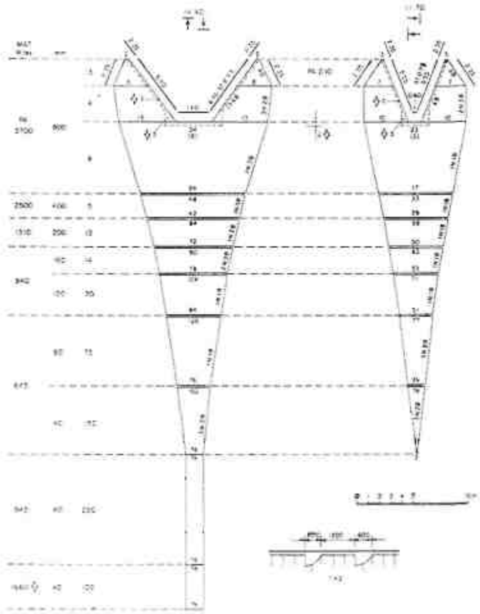
a (mm) = stretched meshsize (see pages 29-30)

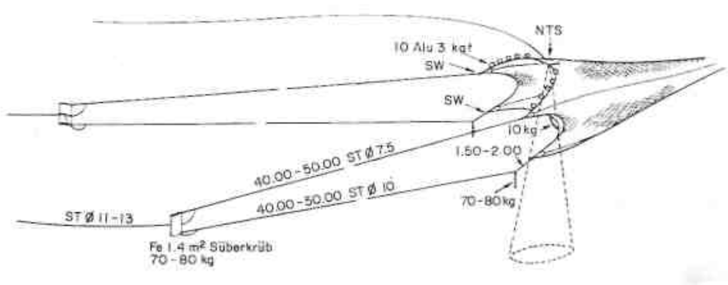
n = depth of panel in number of meshes (N direction)

The numbers appearing along the front and aft edges of panels represent number of meshes.
Numbers and letters along inside edges of net represent cutting rates; for example, 1N2B means 1 sideknot, 2 bars (see pages 32-33).
Ratios presented along inside edges represent numbers of meshes taken up when joining the corresponding panels (see page 41).
Lengths of lines are presented in metres (11.00, etc).

Plan and rigging of a 4-panel midwater trawl

This example is a midwater pair trawl used by French vessels of 120-150 hp, for herring and mackerel





Trawls: relationship between mesh size and twine size for bottom trawls

■ Bottom Trawls

Power 30 to 100hp*	
Stretched rnesh (mm)	Size of twine(Rtex)
100	950-1 170
80	650- 950
60	650
40	650

Power 100 to 300 hp*	
Stretched mesh (mm)	Size of twine(Rtex)
200	1 660-2 500
160	1 300
120	1 300-2 000
80	950-1 550
60	850-1 190
40	850-1 190

Power 300 to 600 hp*	
Stretched mesh (mm)	Size of twine(Rtex)
200	2 500-3 570
160	1 230-2 000
120	1 230-2 000
80	1 660
60	950-1 190
40	950-1 190

■ Shrimp trawls, American type, semi-balloon

try-net (see pg. 84)	
Stretched mesh (mm)	Size of twine(Rtex)
39.6	645

Power 150 to 300 hp*	
Stretched mesh (mm)	Size of twine(Rtex)
44 39.6	940-1190 1 190

Power 300 to 600 hp*	
Stretched mesh (mm)	Size of twine(Rtex)
47.6	1 190
39.6	1 540

$$m/kg = \frac{1000000}{Rtex}$$

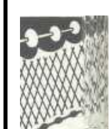
** brake horsepower (BHP) or Apparent Nominal Power (ANP), see pg. 95 Power in* HP = *1.36 x (power in kW)*

■ High-opening bottom trawls

Power 75 to 150 hp*	
Stretched mesh (mmW)	Size of twine (Rtex)
120	950
80	650-950
60	650-950
40	650-950

Power 150 to 300 hp*	
Stretched mesh (mm)	Size of twine (Rtex)
200	1 660-2 500
160	1 300-1 550
120	1 300-2 000
80	950-1 550
60	850-1 190
40	850-1 020

Power 300 to 800 hp*	
Stretched mesh (mm)	Size of twine(Rtex)
800	5 550
400	3 570
200	2 500-3 030
160	1 660-2 500
120	1 550-2 500
80	1 300-2 500
60	1 190-1 540
40	940-1 200



Relationship between mesh size and twine size for midwater trawls

■ **Midwater trawls (for single vessel)**

Power 150 to 200 hp*	
Stretched mesh (mm)	Size of twine(Rtex)
400	2 500
200	1 190-1 310
160	950-1 190
120	650-950
80	650-950
40	450
40	950-1 310

Power 400 to 500 hp*	
Stretched mesh (mm)	Size of twine(Rtex)
800	3 700
400	2 500
200	1 310-1 660
160	1 190-1 310
120	950
80	650-950
40	650-950
40	1 660

Power 700 hp*	
Stretched mesh (mm)	Size of twine(Rtex)
800	7 140-9 090
400	3 700-5 550
200	2 500-3 700
160	2 500
120	1 660
80	1 660
40	1 660
40	2 500

■ **Midwater pair trawls**

Power 2 x 100-300 hp*	
Stretched mesh (mm)	Size of twine(Rtex)
800	3 030-4 000
400	1 190-2 280
200	1 190-1 540
120	950
80	650-950
40	450-950

Power 2 x 300-500 hp*	
Stretched mesh (mm)	Size of twine(Rtex)
800	5 550
400	2 280
200	1 540
120	950-1 190
80	950-1 190
40	950-1 190

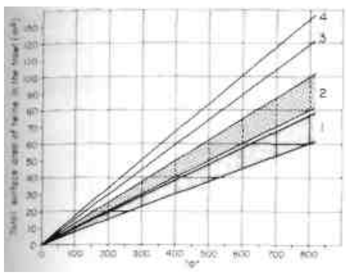
$$m/kg = \frac{1000000}{RTex}$$

** Brake horsepower (BHPj or Apparent Nominal Power(APNj, see page 95. Power in Hp = 1.36 X (power in kWj*

Choosing the right size trawl for the power of the vessel

■ Selection according to the calculated twine surface area of the net (see page 37 for twine surface area)

Given the vessel horsepower, and the type of trawling intended, the best results will be obtained by choosing a net of which the twine surface area falls within a particular range.



1 Two-panel bottom trawls
2 Four-panel bottom trawls
3 Single-boat mid-wotertrawls (stretched mesh in wings up to 200mm)
4 Single-boat mid-water trawls
(wing meshes larger than 200 mm)

Given the vessel horsepower and trawl type, the twine surface area may vary according to several factors, for example : real delivered horsepower, rate of utilisation of the motor, type of rigging, meshsize, type of bottom, strength of currents, etc.

For pair trawling, the twine surface areas (m^2) indicated above should be multiplied by the factors shown in the table:

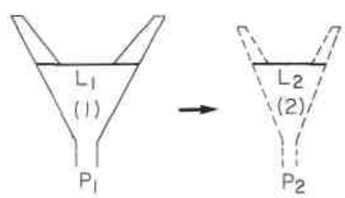
trawl type	factor
two-panel bottom trawls:	2.4
four-panel bottom trawls :	2.2
single-boat mid-water trawls (stretched mesh in wings up to 200 mm) :	2
single-boat mid-water trawls (wing meshes Iargerthan 200 mm) :	2

■ Choice by comparison with a trawl of the same type used by a vessel in the same horsepower range

Let us say you know the dimensions of a particular trawl (TI) used by a particular trawler which has horsepower P|. In order to calculate the right net size for another vessel of horsepower P_2, the length and width of each panel of P] are multiplied by

the square root of $\frac{P_2}{P_1}$.

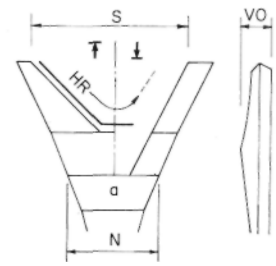
$$L_2 = L_1 \times \sqrt{\frac{P_2}{P_1}}$$



** Brake Horsepower (BHP) or Apparent Nominal Power (ANP), see page 95*
Power in (HP) = 1.36 x Power in (kW)

Opening of bottom trawls

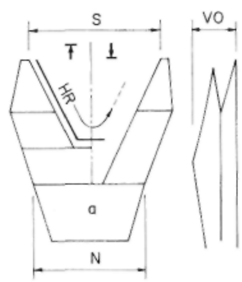
	VO (m)	S(m)
■ Bottom trawl with low vertical opening (VO)		



VO = 2 x N x a x 0.05 to 0.06

S ≃ HR x 0.50

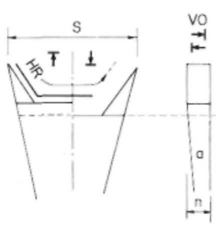
■ High-opening bottom trawl



VO = 2 x N x a x 0.06 to 0.07

S ≃ HR x 0.50

■ Shrimp trawl (flat or semi-balloon)



VO ≃ n x a x 0.40

or VO = height of panel x 1.2

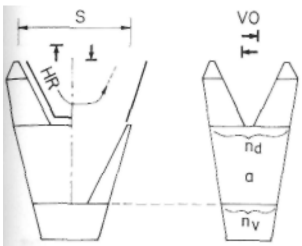
S ≃ HR x 0.67
S ≃ VO x 10

S ≃ HR x 0.7
S ≃ VO x 12

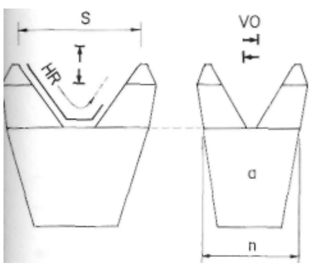
N or n = width in number of meshes of front edge of belly (seams not included)
a = meshsize, length in metres of one stretched mesh at the part of net considered
VO = approximate vertical opening of net mouth (metres)
S = approximate horizontal spread between ends of wings (metres)
HR = length in metres of headrope

Opening of bottom trawls and mid-water trawls

	VO (m)	S(m)
■ High-opening, 4-panel bottom trawl		
(1) Fork rigging:	$VO \simeq \left(\frac{n_d + n_v}{2}\right) \times a \times 0.50 - 0.60$	$S \simeq HR$ x0.60
(2) Bridle rigging:	$VO \simeq \left(\frac{n_d + n_v}{2}\right) \times a \times 0.40$	$S \simeq HR$ x0.50

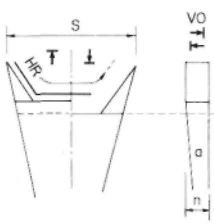


■ Single-boat mid-water trawl



VO = n x a x 0.25 to 0.30 — $S \simeq HR$ x 0.50 to 0.60

■ Mid-water pair trawl



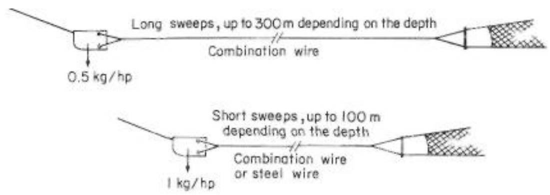
VO = n x a x 0.25 to 0.30 — $S \simeq HR$ x0.60

n = width in number of meshes of front edge of belly (seams not included)
n_v = width in number of meshes of aft edge of belly (seams not included)
HR = length of headrope in metres (not including free ends)
a = meshsize (length in metres of one stretched mesh at the part of the net being considered)
VO = approximate vertical opening of net mouth (metres)
S = approximate horizontal spread between ends of wings (metres)

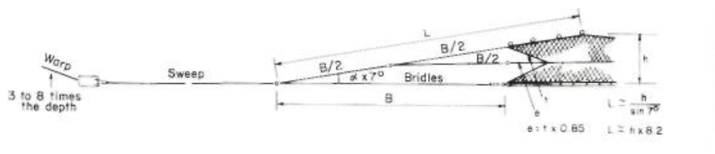
Rigging of bottom trawl for one boat

Principal types, adjustments, relative length

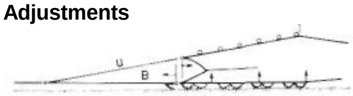
■ **Bottom trawls with low headline height**



■ **Bottom trawls with high headline heights (OV) : sweeps and bridles**



■ **Adjustments**



To increase the vertical height: lengthen the upper bridle (U) or shorten the lower bridle (B)

To increase the ground contact: lengthen thelower bridle (B) or shorten the upper Dridle (U)

N.B. the adjustments made are extremely small, measured in single chain links

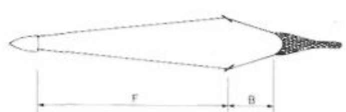
■ **Relative lengths of different parts of the trawl gear**

F about 2.2 times the depth for deep water
about 10 times the depth for shallow water

As a general rule

$$B = \frac{F}{3} \text{ to } \frac{F}{8}$$

F = trawl warps (m)
B = length of sweeps or sweeps + bridles or 'forks'**



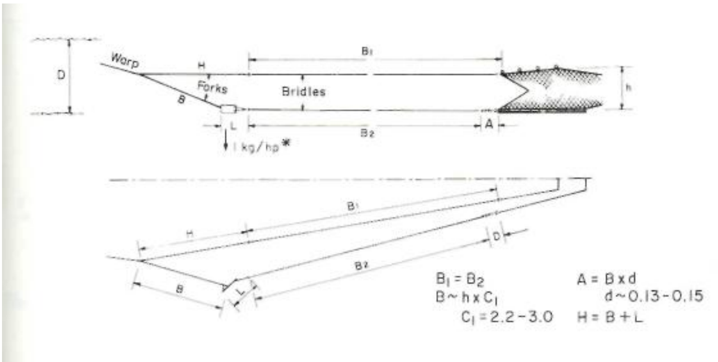
** Brake horsepower (BHPj or Apparent Nominal Power (ANP), see page 95 Power in (HP) = 1.36 x Power in (kW) ** Fork rig, see page 8 1*

Rigging of bottom and midwater trawls for single-boat operation

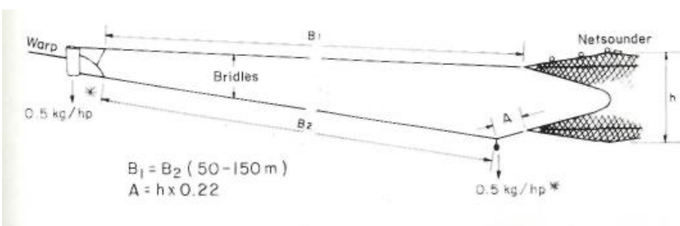
TRAWLS

■ **High-opening bottom trawls : fork rigging**

The length of warps equals 3 to 4.5 times the depth of water



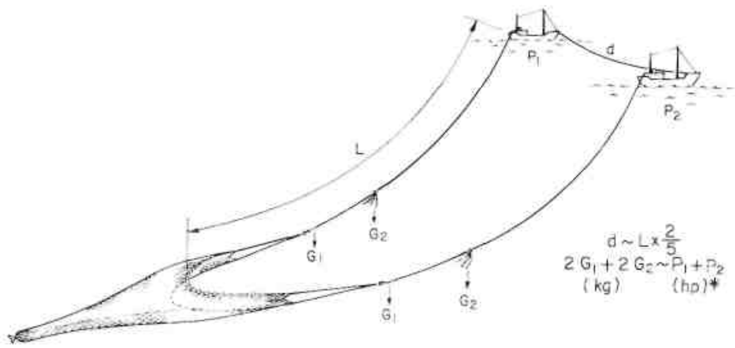
■ **Single-boat midwater trawl**



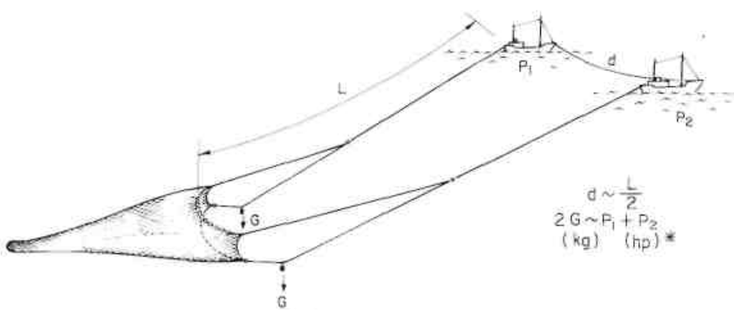
** For power to use in calculation, see page 95*
Power in (HP) = 1.36 × Power in (kW)

Rigging for pair trawling

■ **Bottom trawls**



■ **Midwater trawls**



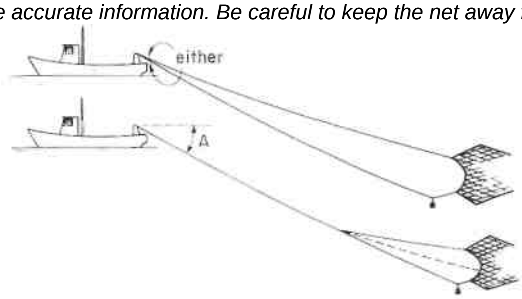
P = power of the trawler
L = distance trawl — trawler
G = weights in front of the trawl
d = distance between the trawlers

* *Broke horsepower (BHP) or Apparent Nominal Power (ANP), see paqe 95 Power in (HP) = 1.36 x Power in (kW)*

Estimating the depth of a midwater pair trawl

It is necessary to estimate the vertical angle of the warps. (In other words, the inclination, or angle between the warps and the horizontal plane.)

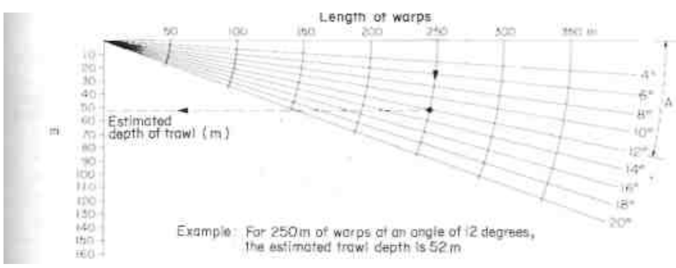
Note : *These methods give only very rough approximations. They should be used only when you have | no nelsounder to give more accurate information. Be careful to keep the net away from the bottom.*



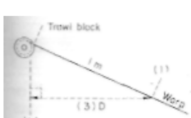
The warp angle may be measured with a protractor or other device

Depth of the trawl is estimated as follows :

(1) Measure the warp angle A
(2) On the horizontal scale of the graph below, find the warp length
(3) Follow the warp length down to the angle A
(4) Read the estimated trawl depth from the vertical scale at the left



Another method without using a protractor is shown below



(1) Mark the warp l m aft ot block

(2) Drop a vertical line from the block

(3) Measure the distance D

4) Find the trawl depth in the table on the right

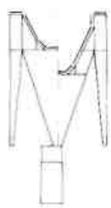
Distance measured D cm	WARP LENGTH (M)				
	100	200	300	400	500
99	14	27	42	56	70
98	21	42	62	83	103
97	25	49	72	94	116
96	28	57	82	106	130
95	31	62	92	123	153
94	34	68	103	138	174

Shrimp (prawn) trawls and their rigging

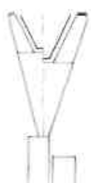
TRAWLS

■ **Gulf of Mexico type**
Example **;**

Flat



Semi-balloon



Balloon

Examples of mesh sizes
Stretched mesh (in mm)
French Guyana : 45 West Africa : 40-50 Persian Gulf : 30-40/ 43-45
Madagascar ; 33-40 India : 50-100 Australia : 44

In tropical zones the catch rate is propor tional to the horizonta spread of the trawl. In order to obtain the greatest horizontal opening, special types of trawl are used, and also special rigging.

(1) Special types of trawl

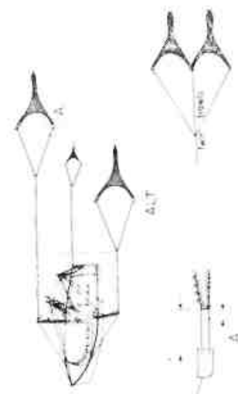
Trawl with 3 toes
Headline in two parts

Tongue trawl
Headline and groundrope in two parts

(2) Special rigging

Twin trawls

■ **Rigging of booms**
This rigging allows an increase in shrimp catch rate of 15-30% over that of a single trawl. Towing speed is 2.5 to 3 knots.



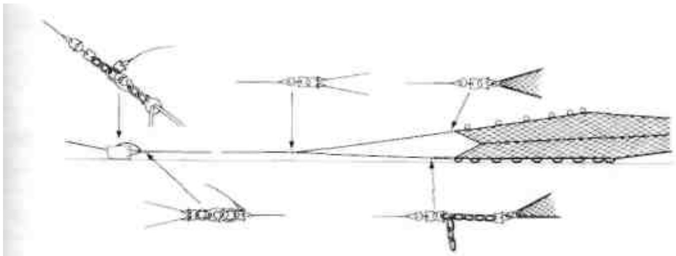
Power of enqine* **TO**	Lengths (m)		
	Headline	Bridles	Booms
150 to 200	12-14	33	9
200 to 150	15-17	35	9
250 to 300	17-20	40	9
300 to 400	20	45	10
500	24	50	12

Depth (m)	Warp length (m)
-20	110
20 to 30	145
30 to 35	180
35 to 40	220

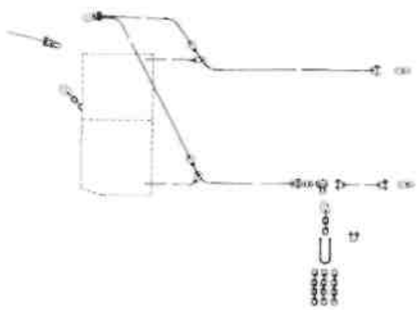
** Brake horsepower {BMP) or Apparent Nominal Power (ANP), see page 95 Power in (HP) = 1.36 x Power in (kW)*

Rigging between different parts of trawls

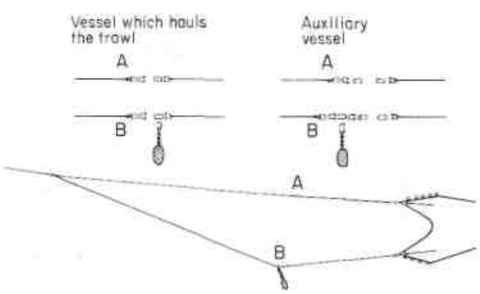
■ **Bottom trawls**



■ **Midwater trawls for 1 boat**



■ **Midwater pair trawls**



Headline buoyancy and groundrope weight recommended for trawls

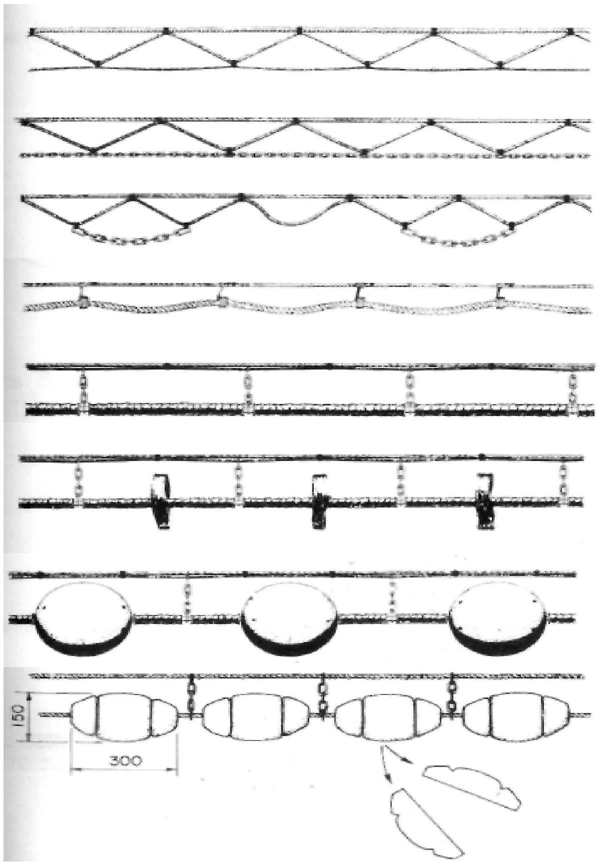
Real horsepower* hp						
	B1 (kgf) P (hp)*	W1 (kg air) P (hp)*	B2 (kgf) P (hp)*	W2 (kg air) P (hp)*	B3 (kgf) P (hp)*	W3 (kg air) P (hp)*
50	B1=Px...	W1=Px ...	B2=P x...	W2=P x ...	B3=P x ...	W3=P x ...
100	0.20	0.28	0.27	0.29	0.28	0.33
200	0.20	0.25	0.24	0.27	0.25	0.31
400	0.20	0.22	0.22	0.24	0.22	0.28
600	0.20	0.22	0.21	0.23	0.21	0.27
800	0.18	0.20	0.19	0.22	0.19	0.26

— For buoyancy, the indicated values correspond to nets made of poly-amide (nylon), a synthetic fibre with negative buoyancy (it sinks). For nets made of floating materials, the floats may be decreased by 10-15%.

— The weights presented are estimated, with a 5-10% margin of error. They may vary according to the trawling speed, type of bottom, buoyancy of the net and floats, target species, etc. These weights have been calculated assuming that steel chain will be used for ballast. If another material is used, its density must be taken into account. For example, in order to get the same sinking force in water, a length of chain weighing 1 kg in air must be replaced by a quantity of rubber rollers which weighs 3-3.5 kg in air.

** Brake horsepower (BHP) or Apparent Nominal Power (ANPj, see page 95 Power in (HP) = 1.36 x Power in (kW)*

Examples of groundropes



■ **Midwater trawls** (maximum vertical opening) joining lines of braided PP. Groundrope of leaded rope

■ **High-opening bottom trawls** : Joining lines of braided PP. Groundrope of chain

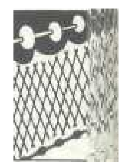
■ **Shrimp trawls, smooth bottom** Grassrope with lead rings (chain ground-rope is also common)

■ **High-opening bottom trawl** with 2 bridles : groundrope of rubber rings

For use on rougher bottom : groundrope of rubber bobbins or rollers with rubber disc spacers and chain joining lines

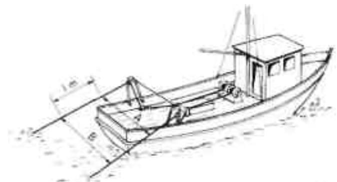
■ **Fish or shrimp trawls, hard bottom :** groundrope of rubber rings and hard plastic spheres

■ **Fish or shrimp trawls for soft or** muddy bottom : split wooden rollers which can be added or re-moved without running groundrope through centre

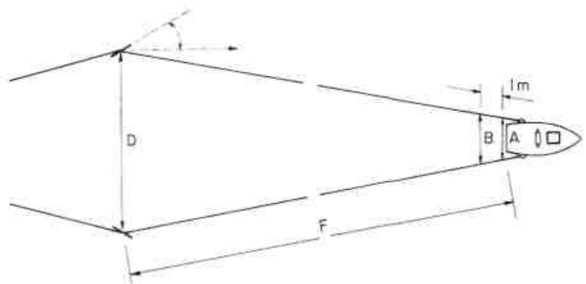


Spread of otter boards and trawl

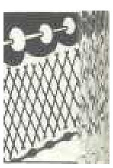
■ Estimating the spread of otter boards (doors)



$$D \sim [(B - A) \times F] + A$$
$$(m) \quad (m) \quad (m) \quad (m) \quad (m)$$

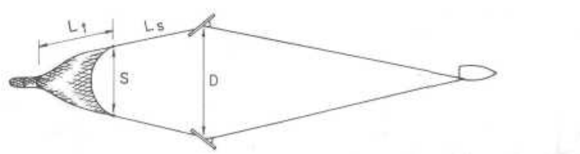


***Example**:* On the vessel above, if :
A = 4.00
B = 4.18
F = 200
then
D = [(4.18 - 4.00) x 200] + 4 = 40 m spread at otter boards



■ Estimating the spread of the trawl
To estimate the horizontal spread between the wing ends :

$$S = \frac{\text{spread of otter boards (D)} \times \text{length of trawl without bag } (L_t)}{\text{length of trawl without bag } (L_t) + \text{length of sweep } (L_s)}$$

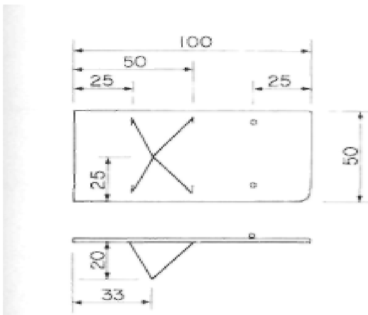


***Example**:* given a trawl of 25 m in length (without bag) rigged with sweeps of 50 m and otter board spread of 40 m, then spread of trawl wing ends :

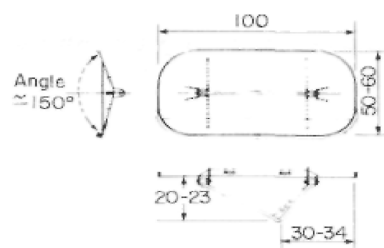
$$S = \frac{40 \times 25}{25 + 50} = 13.33 \text{ m}$$

Otter boards: proportions, angles of attack

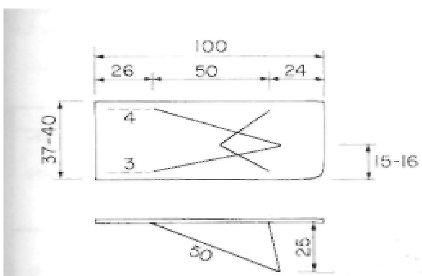
■ **Flat rectangular otter boards**



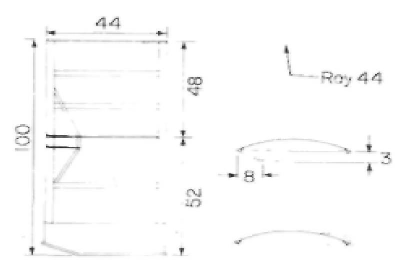
■ **Rectangular V section otter boards**

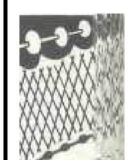


■ **Shrimp otter boards**



■ **Suberkrub pelagic otter boards**



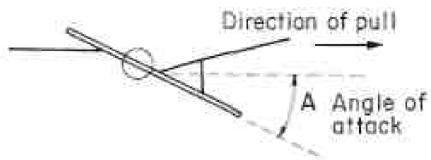


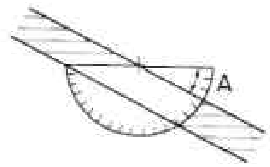
■ **Angles of attack**

	Rectangular flat	Rectangular V section	Oval flad	Oval curved	Rectangular curved (suberkrub)	Rectangular curved (japanese)	Rectangular flat (prawn)
	35° 40°	35°	35°	35°	15°	25°	25° 30°

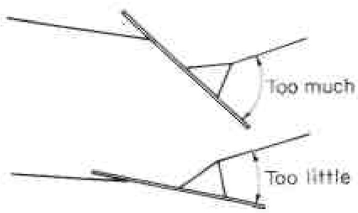
Otter boards: angle of attack, adjustments

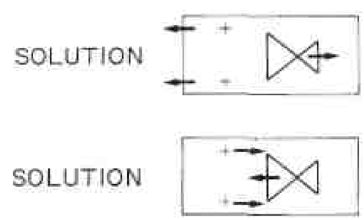
■ **Angle of attack**



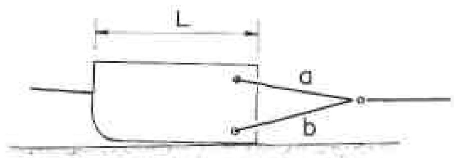


■ **Adjustment of angle of attack**



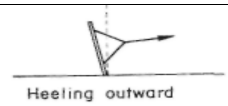
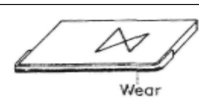
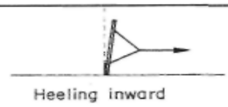
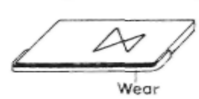
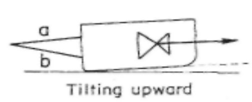
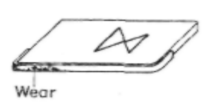
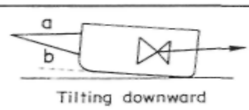
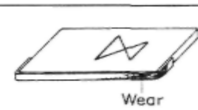


■ **Adjustment of orientation**



a ~ L x 1-2
Generally a = b
or b = a + (2-5% of L)
However on soft muddy bottom or small corals, some upward tilting (b) longer than (a) may be good

Problem

		**Recommended adjustment** Raise the towing brackets a little if possible
		Lower the towing brockets a little if possible or add weight to the keel
		Lengthen the upper back-strop (a) or shorten the lower backstrop (b), keeping in mind that a little upward till is good for certain bottom con-ditions
		Lengthen the lower back-strop lb) or shorten the upper backstrop (a)

Otter boards: properties of the principal types, choice depending on the trawler's power

■ Rectangular and oval curved

The weights indicated below (for single board) are the maximum values used. For a given horsepower, the surface area listed below is often used, but with a lighter material which may make a board as much as 50% lighter.

Power* (hp)	Rectangular flat otter boards			Oval Curved Otter boards			Weight (Kg)
	Dimensions		Surface	Dimensions		Surface	
	L(m)	h(m)	m2	L(m)	h(m)	m2	
50-75	1.30	0.65	0.85				45
100	1.50	0.75	1.12	1.40	0.85	0.93	100-120
200	2.00	1.00	2.00	1.75	1.05	1.45	190-220
300	2.20	1.10	2.42	1.90	1.10	1.65	300-320
400	2.40	1.20	2.88	2.20	1.25	2.15	400-420
500	2.50	1.25	3.12	2.40	1.40	2.65	500-520
600	2.60	1.30	3.38	2.60	1.50	3.05	600-620
700-800	2.80	1.40	3.92	2.90	1.60	3.65	800-900

■ V otter boards

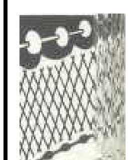
Power* (hp)	Surface m^2	Weight kg
100	1.40	240
200	2.10	400
300	2.50	580
400	2.90	720
500	3.30	890
600	3.60	1 000
700	3.90	1 100
800	4.20	1 200

■ Shrimp otter boards (double rig)

Power (hp)*	Dimensions m	Weight kg
100-150 150-200 200-250	1.8 x 0.8-2.4 x0.9 2 x 0.9 - 2.45 x 1 2.4 x 1 - 2.45 x 1	60-90 90-100 120
250-300 300-450 450-600	2.5 x 1 -2.7 x 1.1 3 x 1.1 -3 x 1.2 3.3 x 1.1 -3.3 x 1.3	160 220 300

■ Midwater, Suberkrub

Power* (hp)	Dimensions		Surface (m^2)	Weight (kg)
	H(m)	L(m)		
150 200 250	1.88 2.05 2.12	0.80 0.87 0.94	1.50 1.80 2.00	90-100 110-120 150-160
300 350 400	2.28 2.32 2.42	0.97 1.03 1.07	2.20 2.40 2.60	170-180 220-240 240-260
450 500 600 700-800	2.51 2.68 2.86 3.00	1.12 1.14 1.22 1.33	2.80 3.00 3.50 4.00	260-280 280-300 320-350 400-430

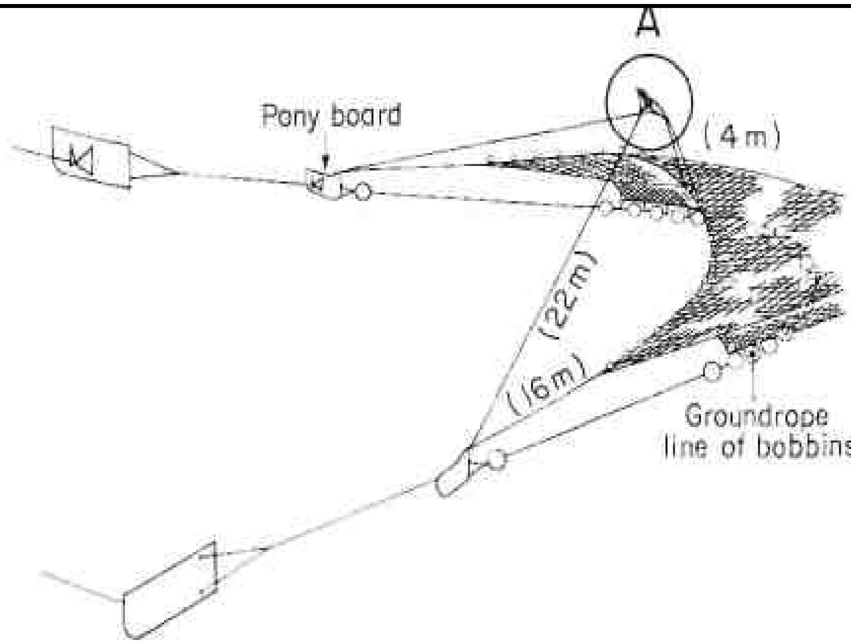


Example of the relationship between the twine surface *area* (see page 37) of a pelagic trawl (S_f in m^2) and the surface area of a Suberkrub otter board used by the boat (S_p in m^2)

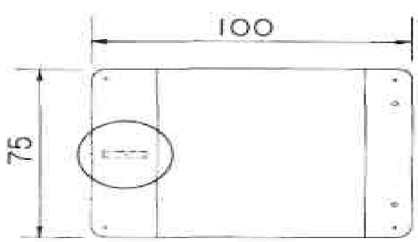
$$Sp = (0.0152 \times S_f) + 1.23$$

** Brake horsepower (BHP) or Apparent Nominal Power (ANP), see page 95*
Power in HP = 1.36 X Power in (kW)

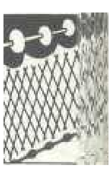
Kites



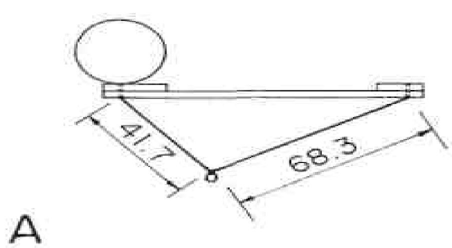
May be mounted directly on the headline



Power (hp)*	Lxl
150-250	0.55 x 0.45 m
250-350	0.60 x 0.45 m
350-500	0.65 x 0.50 m
500-800	0.80 x 0.60 m



Many types of kites exist and are being tested, the simplest being a piece of sail cloth mounted on the headline and patched to the inside netting.



** Brake horsepower (BHP) or Apparent Nominal*

Warps: diameter and length

■ Characteristics of steel trawl warps, according to power of trawler

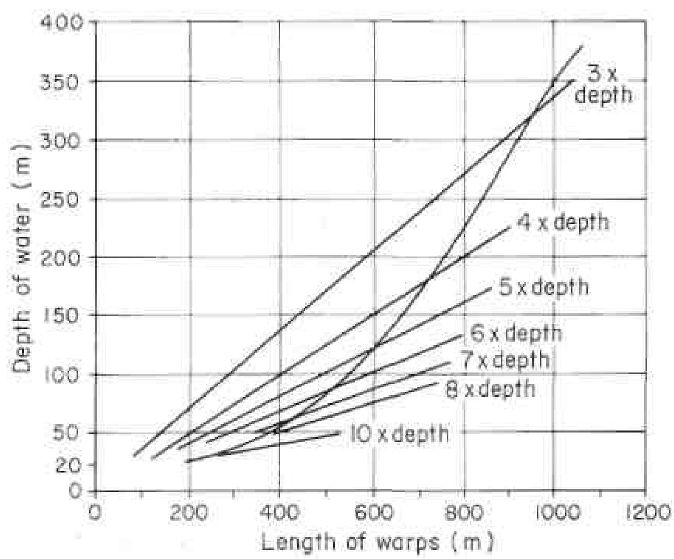
hp*	0 (mm)	kg/m	R kgf
100	10.5	0.410	5 400
200	12.0	0.530	7 000
300	13.5	0.670	8 800
400	15.0	0.830	11 000
500	16,5	1.000	13 200
700	18.0	1.200	15 800
900	19.5	1.400	18 400
1 200	22.5	1.870	24 500

R= breaking strength

■ Length of warps according to depth of water (for bottom trawling)

(for shallow water less than 20 m, the length should not be less than 120 m)

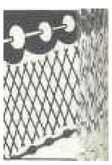
This curve gives only estimates; the captain should decide warp length according to the type of bottom, sea conditions, current, etc.



** Brake horsepower (BHP) or Apparent Nominal Power (ANP), see page 95 Power in (HP) = 1.36 x Power in (kW*

Trawling speed

Main species groups	Average trawling speed (knots)
shrimp, small bottom species, flat fish very small trawlers mid-sized and large trawlers	 1.5-2 2.5-3.5
mid-sized bottom species, small pelagic fish small trawlers mid-sized to large trawlers	3-4 4-5
cephalopods (squid, cuttlefish)	3.5-4.5
mid-sized pelagic fish	>5



Power of trawlers

■ **The choice of fishing gear depends on the power of the trawler**

For trawlers with a fixed propeller, reduction gear between 2 : 1 and 4 : 1, and no nozzle, the tables in this book are intended for use with the Brake Horsepower (BHP). This is the figure given most often by manufacturers as the horsepower or rated power of an engine. It is expressed in horsepower (HP) or in kilowatts (kW).

1 HP = 0.74 kW 1 kW=
1.36 HP

If a trawler has a variable pitch propeller and/or a nozzle, Apparent Nominal Power (ANP), should be used in the tables of this book.
It may be calculated as follows :

ANP = bollard pull (kg) x 0.09

***Example** :* A trawler, with a variable pitch propeller and a nozzle, has an engine rated at 400 BHP, and the bollard pull is 6000 kg

ANP = 6000 x 0.09 = 540 HP

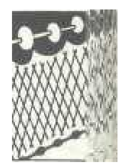
Thus, the fishing gear should be chosen from the tables according to an Apparent Nominal Power of 540 HP, and not 400 HP.

Power available for trawling (p), is usually 15 to 20% of the BHP or ANP. This power is used to pull the gear, and may be calculated as follows :

In calm waters, p = 0.75 x k x (BHP or ANP)

type of propeller and engine		k
fixed propeller	high RPM engine	0.20
	slow turning engine	0.25 - 0.28
variable pitch propeller		0.28 - 0.30

In rough weather, p is reduced by 1/3.



Pulling power of trawlers

■ **Bollard pull BP_0 of a trawler at fixed point (speed = 0)**

BP_0(kg) = 10 to 12 kg per BHP* (with fixed propeller)

13 to 16 kg per HP of Apparent Nominal Power* (with a variable pitch propeller or nozzle)

■ **Bollard pull BP (when fishing)**

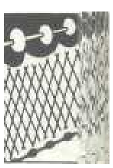
If you have calculated the engine power (p) available for towing (page 95),

$$BP\ (kg) = \frac{150 \times p\ (HP)}{\text{trawling speed (knots)}}$$

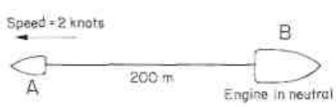
If you have measured the bollard pull BP0 at speed 0 knots,

BP(kq) = BP_0(kg)

$$\times \left(1 - \frac{\text{trawling speed (knots)}}{\text{maximum free running speed (knots)}}\right)$$

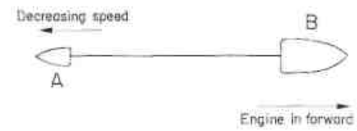


Choosing the appropriate engine speeds (RPM) for 2 boats of different characteristics for pair trawling



Vessel A pulls vessel B, engine in neutral, at the chosen speed, for example 2 knots. Then vessel B engine is engaged and the revs progressively increased until vessel

B holds vessel A stationary.



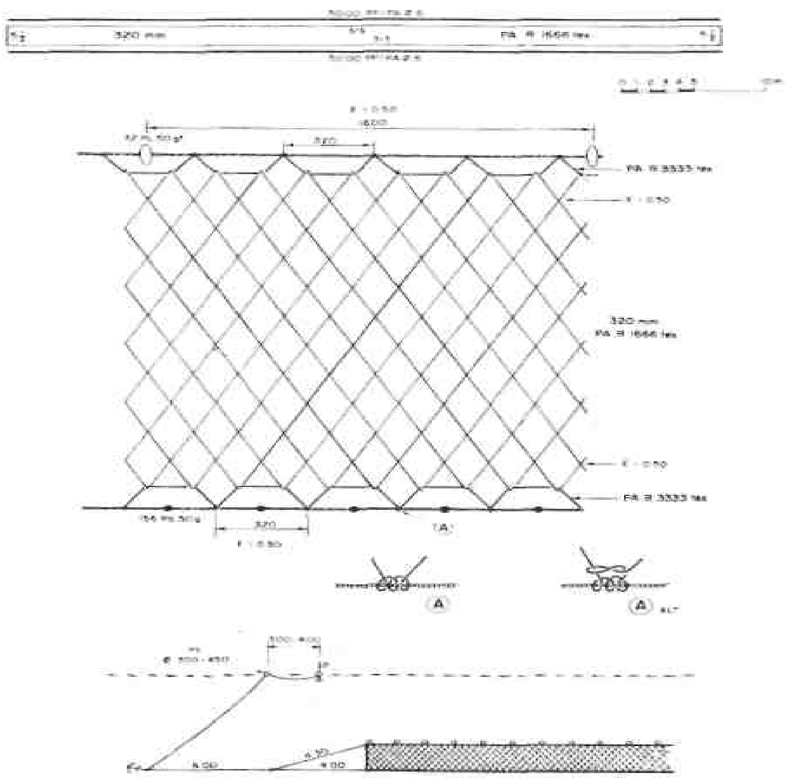
The engine RPM of both vessels A and B are noted, for the chosen speed of 2 knots. The same operations are repeated for other speeds until the range of normal trawling speeds is covered.

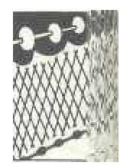
Revs	Vessel A	Vessel B
Speed		
2 knots	—	—
2.5	—	—
3	—	—
3.5	—	—

Plan and rigging of a gillnet : example

Gillnet
bottom set for spider crabs
Brittany, France

Vessel
length 5-15 m
HP 15-20

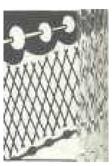




This drawing shows the following information about the net:

		for more details
Stretched meshsize : 320 mm		*pages 29-30*
Length	*: 313 meshes*	
Height	*: 5 1/2 meshes*	
Hanging ratio (Ej	*: 0.50*	*pages 38-39*
Floats"	*: 32 plastic floats, each with buoyancy of 50 gf*	*pages 47-49*
Sinkers	*+. 156 leads, each weighing 50 g*	
Twine	*: material — polyamide; size — R 1666 tex*	*pages 7-10*
Floatline	*: polypropylene/polyamide, diameter 6 mm, length 50 m*	*pages 7-8*
Leadline	*: polypropylene/polyamide, diameter 6 mm, length 50 m*	*pages 7-8*

Choosing the meshsize of gillnets*



■ **Choice of meshsize according to fish species**

There is a ratio between the body girth or length of a fish one wants to catch, and the gillnet meshsize which will be effective for that fish (Fridman formula).

$$OM = L(fish)/K$$

where

OM = mesh opening (mm)

L(fish) = average length (mm) of fish one wants to catch

K = coefficient, according to species

and

K = 5 for long, thin fish

K = 3.5 for average-shaped fish (neither very thick nor thin)

K = 2.5 for very thick, wide or high (shaped) fish

A few examples of stretched meshsizes (mm) adapted for particular species

Demersal tropical species	
threadfin (Polynemidae)	50
small catfish	75
grunt (Pomadasidae)	50
mullet	110-120
maigre (Sciaenidae)	120-140
croaker (Sciaenidae)	160-200
seabream (Sparidae)	140-160
barracuda	120

Temperate demersal species	
cod	150-170
pollack	150-190
Pacific pollack	90
sole	110-115
hake	130-135
red mullet (Mugilidae)	25
halibut (Greenland)	250
turbot, monk, anglerfish	240

Crustaceans	
shrimp (India)	36
shrimp (El Salvador)	63-82
green spiny lobster	160
red spiny lobster	200-220
spider crab	320
king crab	450

Small pelagic species	
sprat	22-25
herring	50-60
anchovy	28
sardine	30-43
sardinella	45-60
shad (Ethmalosa)	60-80
small mackerel	50
large mackerel	75
Spanish mackerel	100-110

Large pelagic species	
mackerel, bonito, skipjack	80-100
marlin, flying fish	120-160
bonito, jacks	125
Atlantic bluefin tuna	240
sharks	170-250
swordfish	300-330
salmon	120-200

** For clarification of terms stretched meshsize and mesh opening see page 29*

Choosing twine type for gillnets

The twine should be **relatively thin,** but not so fine that it damages, entangled fish. **Good breaking strength** is important, especially for bottom set gillnets, taking into account the size of the fish and the meshsize. The twine should have **low visibility,** either clear (mono or multi-monofilament) or of a colour which blends in with the environment. It should also be **flexible.**

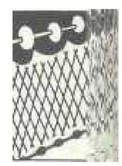
Note : *A length of twine may stretch 20-40% before breaking*

■ **Choosing twine diameter for gillnets**

Twine diameter should be proporional to meshsize. The ratio

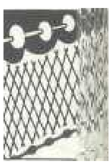
$$\frac{\text{twine diameter}}{\text{stretched meshsize}}$$ (same units of measurement)

should be between 0.0025, for calm waters and low catches, and 0.01, for rough waters or bottom set. An average ratio is 0.005.



■ **Examples of twine sizes used with certain types of gillnets and meshsizes**

stretched meshsize	inland waters, lakes, rivers		coastal waters			pen ocean		
mm	multifil. m/kg	monofil. Ømm	multifil. m/kg	monofil. Ømm	multimono. nxØmm	multifil. m/kg	monofil. Ømm	multimono. nxØmm
30			20 000	0.2		10 000	0.4	
						6 660		
50	20 000		13 400	0.2		6 660		
60	13 400	0.2	10 000			4 440		
80	10 000		6 660		4x0.15	4 440	0.28-0.30	6a8x0.15
100	6 660		4 440	0.3		3 330	0.5	6x0.15
120	6 660		4 440	0.35-0.40		3 330	0.6	
140	4 440		3 330	0.33-0.35	6x0.15	2 220		8x0.15
160	3 330		3 330	0.35	8a10x0.15	2 220	0.6-0.7	
200	2 220		2 220			1 550	0.9	10x0.15
240	1 550		1 550			1 100	0.9	
500						1 615-2 220		
600			3 330			1 615-2 220		
700			2 660					



Rigging or hanging gillnets

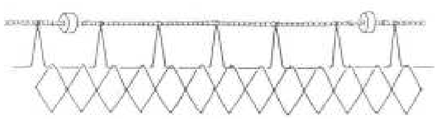
■ **Effect of the hanging ratio on the catching efficiency of the net**

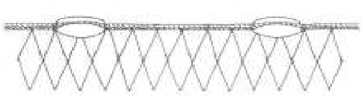
Generally the horizontal hanging ratio is about 0.5 for gillnets (see page 38).

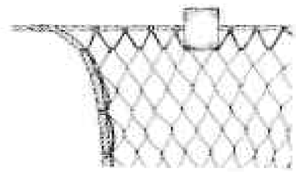
- — If E is smaller than 0.5 the net will tend to tangle fish, and will capture a variety of different species. This is the case with most set nets.
- — If E is greater than 0.5 the net will tend to gill the fish and be more selective than in the preceding case. This is the case with most driftnets.

■ **Examples of rigging**

On the headrope with floats attached



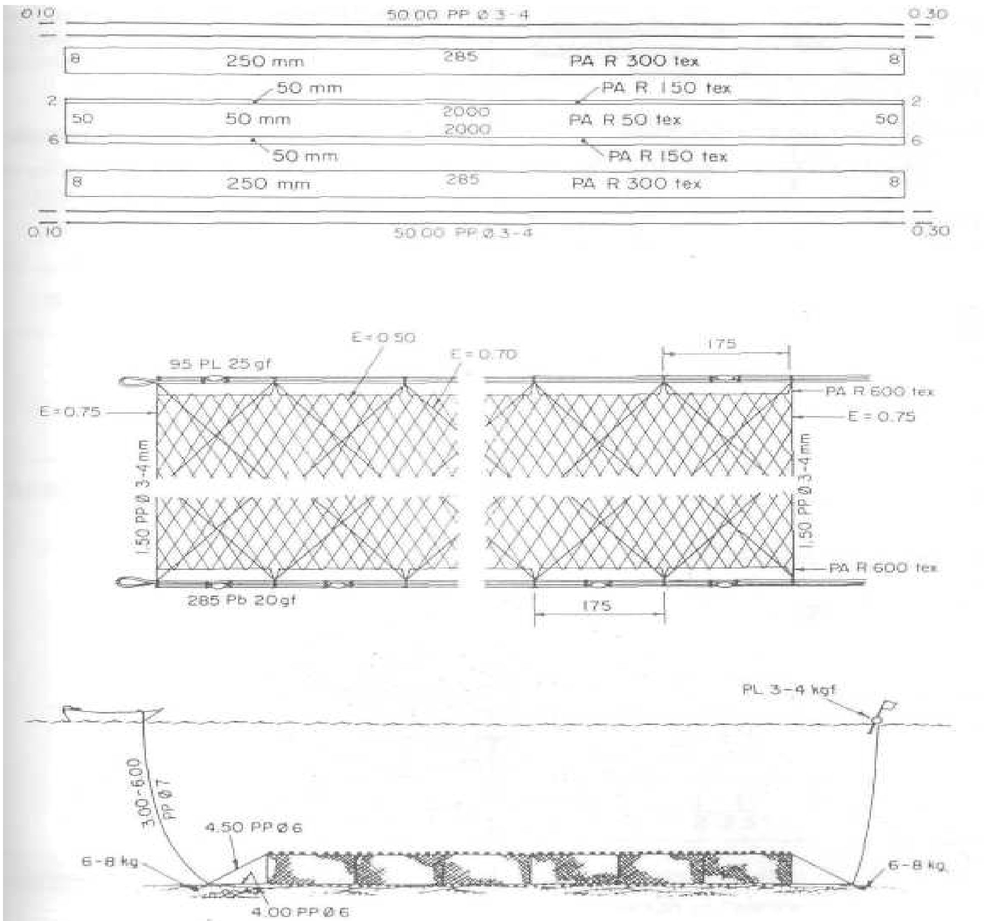


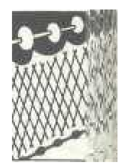


On the footrope with sinkers attached

plan and rigging of trammel net

Trammel net*
Bottom set or drifting, for shrimp
Sri Lanka





* *For clarification of symbols used in drawing of entangling net* see *page 97*

Trammel nets: mesh sizes and rigging

■ **Choosing the mesh sizes according to the size of target species***

— **Central panel : The meshsize** should be small enough to catch the smallest fish wanted, by bagging. A rough estimate of the required mesh-size is given by the Fridman formula for net bags:

OM should be smaller than :

$$\frac{L}{K} \times 0.66$$

where

OM (mm) = mesh opening of the central net

L (mm) = length of the smallest fish wanted

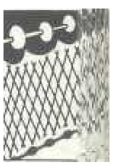
K = coefficient dependent on the target species

K = 5 for long and narrow fish

K = 3.5 for average fish

K = 2.5 for flat, thick or large fish

— **External panels :** the mesh size should be 4 to 7 times larger than that of the central netting.



** For clarification of terms stretched meshsize and mesh opening see page 29*

The stretched height of the central net panel should be 1.5 to 2 times the stretched height of the external netting.

The actual height in the water of the trammel net depends on the height of the external netting. The central net panel should be very slack.

■ **Hanging ratios of the net panels**

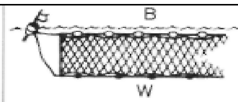
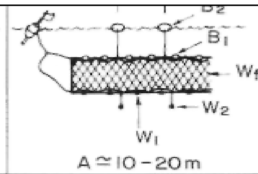
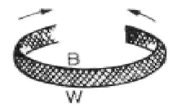
The horizontal hanging ratios are often close to the following values:

E central netting = 0.4 to 0.5

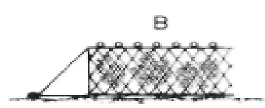
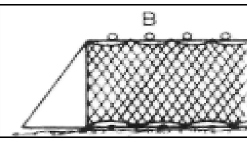
E external netting = 0.6 to 0.75

Average bouyancy (B) and ballast (W) of gillnets and trammel nets

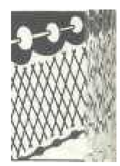
■ Floating gillnets and trammel nets

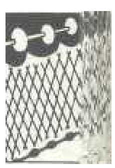
			
B(gf/m)	100-160	B2 = 50-120 B1 = 50 - 80	600 - 1 500
W (g/m)	50-80	W1 = 30-80 W2 = 25-60	300 - 1 000
B/W	2	$\frac{B_2}{W_2}$ ~ 2-2.5	1.5-2
	Length of leadline ≤ 1 Length of floatline (smaller or equal)	B1 - Wf + W_1 Wf = weight of netting in water	

Bottom set gillnets and trammel nets

		
B (gf/m)	40-80	100-200
W (g/m)	120-250	250-400
B/W	$\frac{1}{3}$ $\frac{1}{5}$	$\frac{1}{2}$ - $\frac{1}{2.5}$
		$\frac{\text{length of leadline}}{\text{length of floatline}} \geq 1$ (greater or equal)

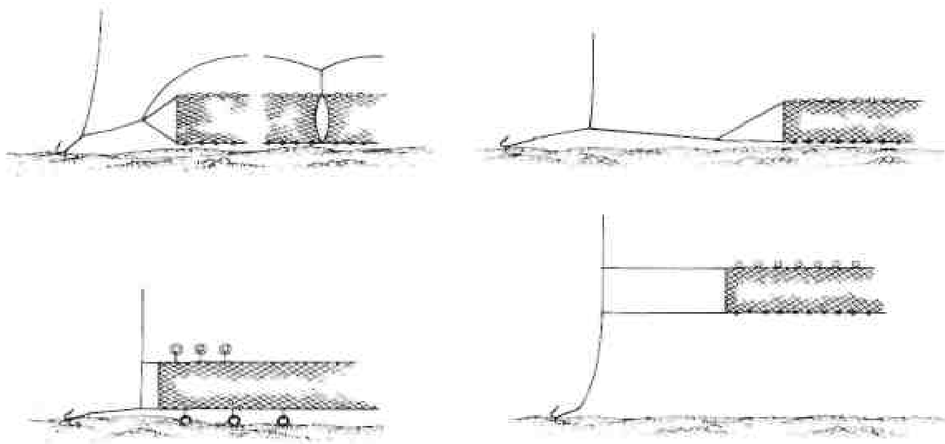
Note : *These weights do not include anchors, etc.*



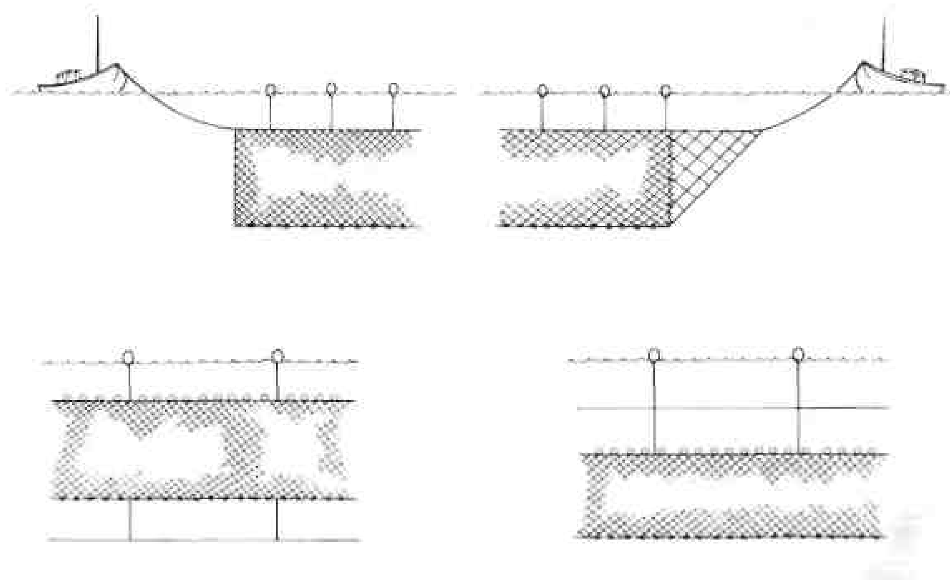


Rigging of entangling nets: some examples

■ **Set gillnets and trammel nets**



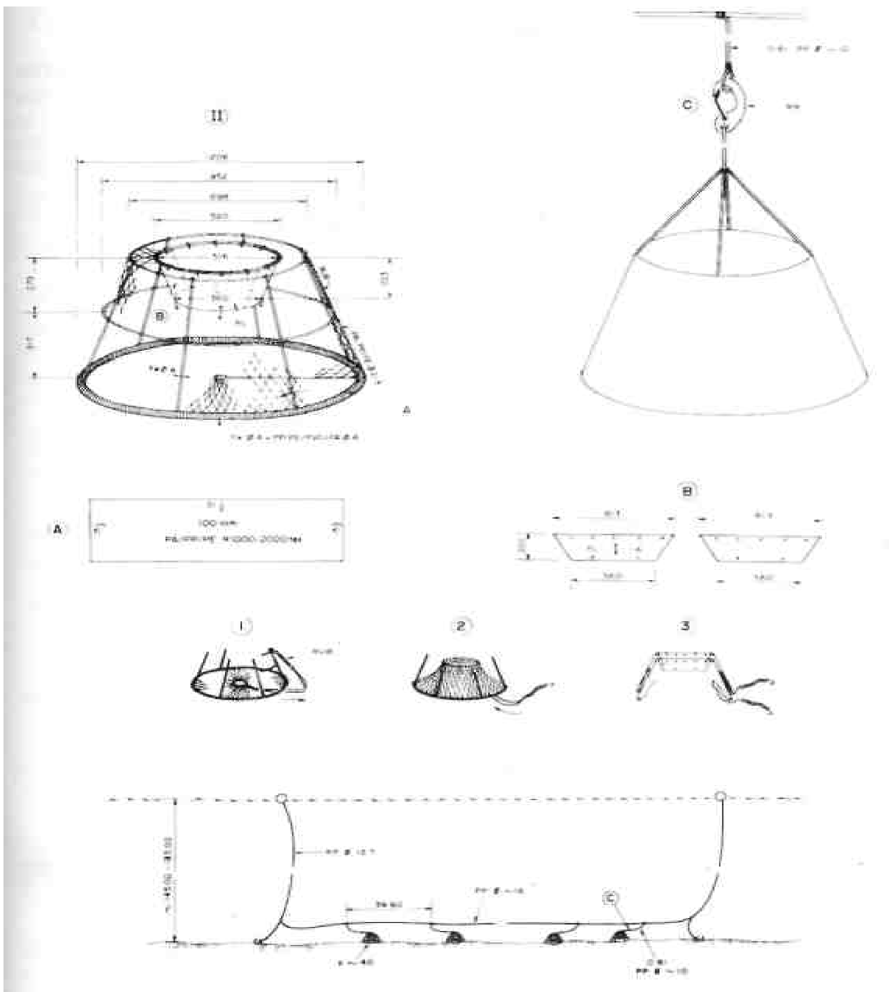
■ **Drifting gillnets**

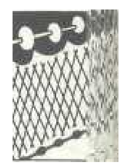


Plan and rigging of pots: an example

Crab trap
Hokkaido, Japan
Nova Scotia, Canada

Vessel
Length 12-15 m
hp 40-100





Dimensions of pots and traps

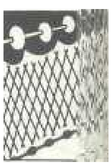
These gears, which can be used for catching fish, crustaceans, molluscs, and cephalopods (squid, octopus, etc.), are made in a wide variety of shapes and sizes, using many different materials. They may be used on the bottom or in mid-water, with or without bait.

■ Choosing the size of a pot or trap

If a pot gets too crowded with captured fish inside, it will stop catching. The interior volume of a pot must be large enough to avoid this situation. On the other hand, in some cases an interior volume which is too large may lead to cannibalism (some captives eating others). Some types of pots appear to be effective because their shape and size make them attractive shelters for certain species.

A few examples:

Species	Country	Volume (cubic decimeters - see p. 157)
octopus		6
small shrimp		40-70
small crabs	Japan	70-90
crabs	Canada	450
King crab, snow crab	USA	2500-4500
spiny lobster	Europe	60-130
lobster	USA	200
spiny lobster	Caribbean	300-800
spiny lobster	Australia	2500
sea bream	Morocco	150-200
mixed reef fish	Caribbean	500-700 (up to 2000)
torsk, wolf fish	Norway	1300
grouper	India	1400
black cod	USA, Alaska	1800



Making fish traps and pots

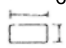
Choice of materials must consider such factors as durability, resistance to immersion, corrosion, and fouling by marine growth.

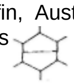
Spacing of bars or laths; or size of meshes has a direct relation to the size of the target species.

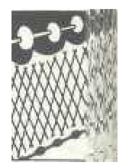
A few examples (measurements in mm] :

Species	bar of mesh (diamond shape)
small shrimp (Europe)	8-10
small crabs (Japan)	12
rock crab (Europe)	30
crab (Canada, USA)	50
King crab (Alaska)	127
spiny lobster (France, Morocco)	30-40
lobster	25-35
torsk, wolffish (Norway)	18
sea bream	(see Alternatives)
grouper (India)	40
reef fish (Caribbean)	15-20
black cod (USA)	(see Alternatives)
threadfin (Australia)	(see Alternatives)

Alternatives

— For lobster pots : Triangular meshes  60-80 mm side Rectangular meshes  25 x 50 mm
Parallel wooden strips or laths, spaced 25-38 mm apart

— For fish pots : For sea bream, triangular meshes  35-40 mm on a side For black cod, USA west coast, square meshes  51 x 51 mm For threadfin, Australia, hexagonal meshes  25-40 mm across



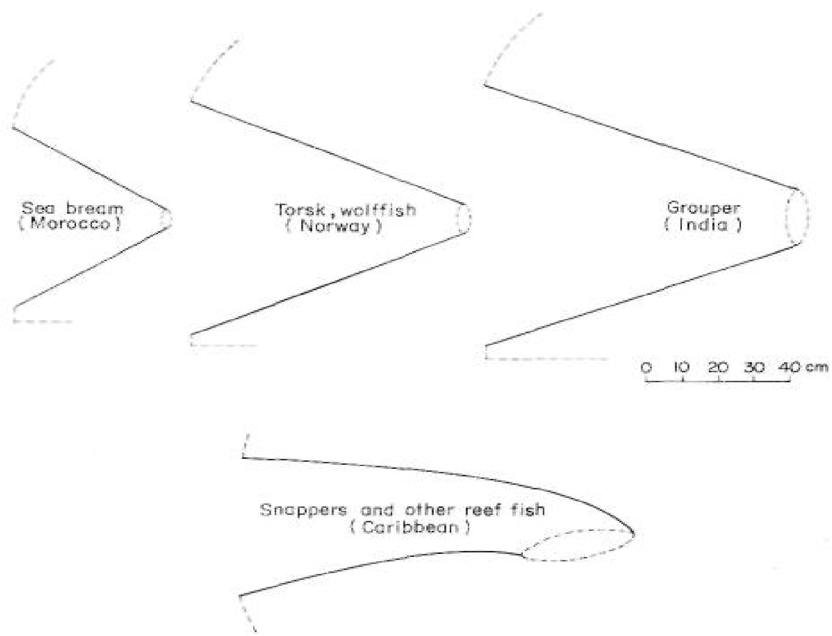
Ballast in traps is very variable, from 10 to 70 kg per trap, according to the type and size of trap, the type of bottom, and strength of currents.

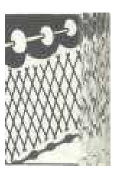
Entrances: shape and position

The shape is usually that of a cone or truncated pyramid, straight or curved.

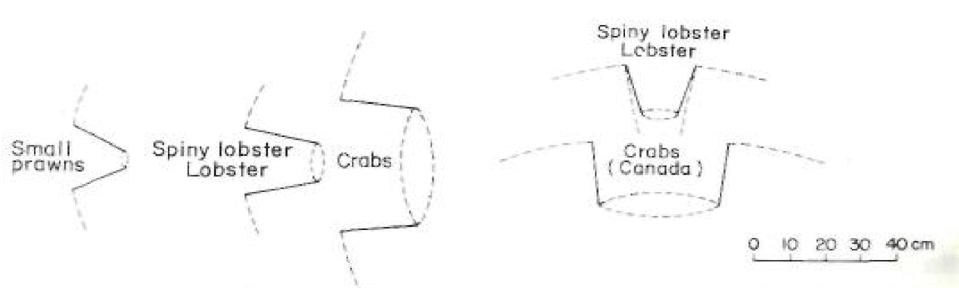
■ **The position : examples**

Traps for fish and cephalopods : entrance(s) at the side(s)





Traps for crustaceans : entrance(s) on the side(s) or on the top

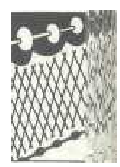


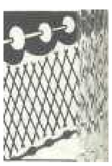
Entrances: dimensions

The diameter of a pot entrance is directly related to the size and characteristics of the target species.

A few examples:

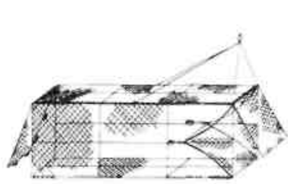
Species	Country	Entrance diameter (mm)
small shrimp		40-60
small and medium crabs	Japan, USA	140-170
snow crab	Canada	360
King crab	USA Alaska	350-480
spiny lobster, crayfish	Europe	100-200
spiny lobster	Australia, Caribbean	230
lobster	Europe	100-150
sea bream	Morocco	70-100
torsk, wolffish	Norway	100
grouper	India	210
black cod	USA, W. coast	250
threadfin	Australia	250-310
snapper	Caribbean	230



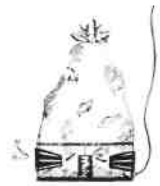


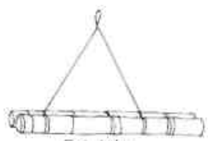
Examples of pots or traps

■ Forfishorcephalopods



Cod (Norway)

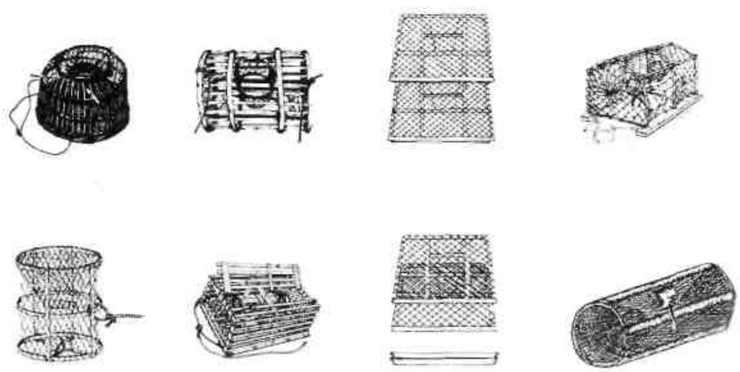




Eel tube
(Japan)

Octopus pot
(Japan , Tunisia)

■ For crustaceans



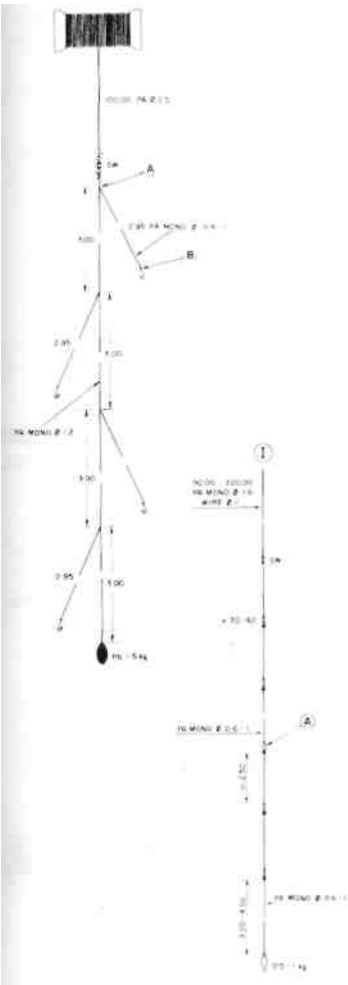
Crayfish, lobster, crab

Shrimp

Vertical line fishing: examples, breaking strength

A: Mainline

B : Branchline (also called snood leader, gangion, drop line)



The breaking strength of the mainline should be greater than or equal to the maximum weight of an individual fish to be caught (even if there are several branchlines).

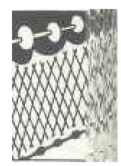
Examples of mainline breaking strength in common use for certain species

Species	Breaking strength (kg, wet, knotted)
sea bream,snapper	7-15
meagre, conger, dogfish	15-30
weakfish, grouper, cod, moray	30-40
snapper, grouper	100
yeliowfin tuna	150-200

Note : *Some vessels equipped with hydraulic or electric reels for catching snapper and grouper in depths greater than 180 m, use stainless steel or monel mainlines with breaking strength of the order of 400 kg.*

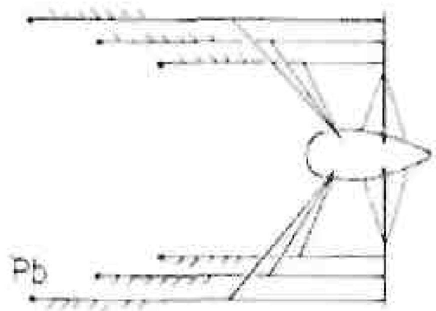
The breaking strength of branchlines is usually 50–100% of the breaking strength of the mainline.

For hooks and lures see pages 43–45

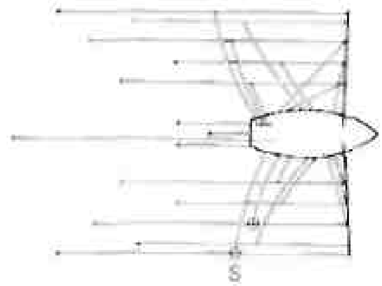


Trolling methods

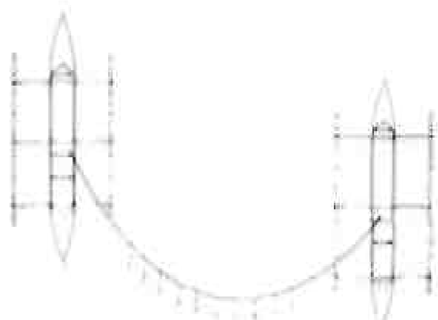
Trolling speeds vary from 2 to 7 knots, depending on target species



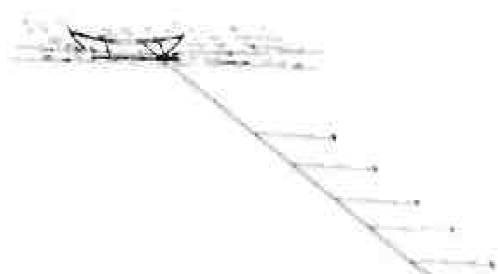
salmon trolling, near-surface
to deep water, northeast Pacific



albacore trolling, surface, France

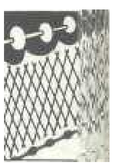


Tuna trolling, surface, Philippines



Deep water trolling, Pacific

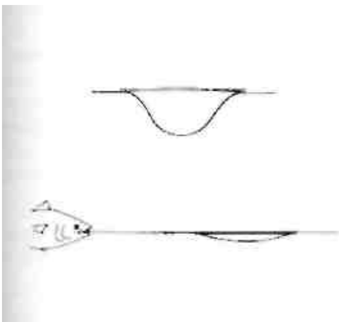
S ; shock absorber or snubber
DP: depressor or diving board
Pb : 'cannonball' weight



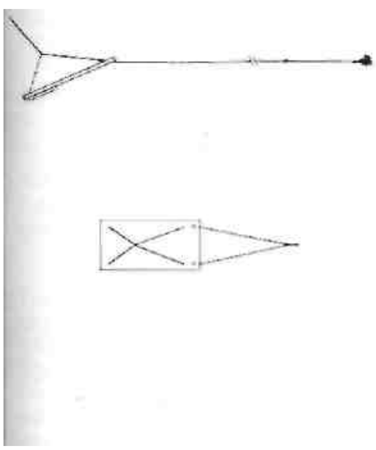
Trolling lines: rigging equipment

■ **Shock absorber or snubber**

Absorbs the shock load on the line when the fish strikes

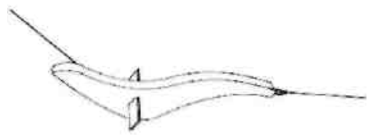


Depressor or diving board to troll deeper



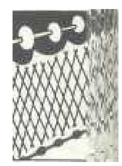
■ **Shearing depressor or diving board**

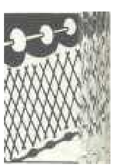
May be adjusted to dive and also shear horizontally to spread lines



Left divergent depressor

Depressor



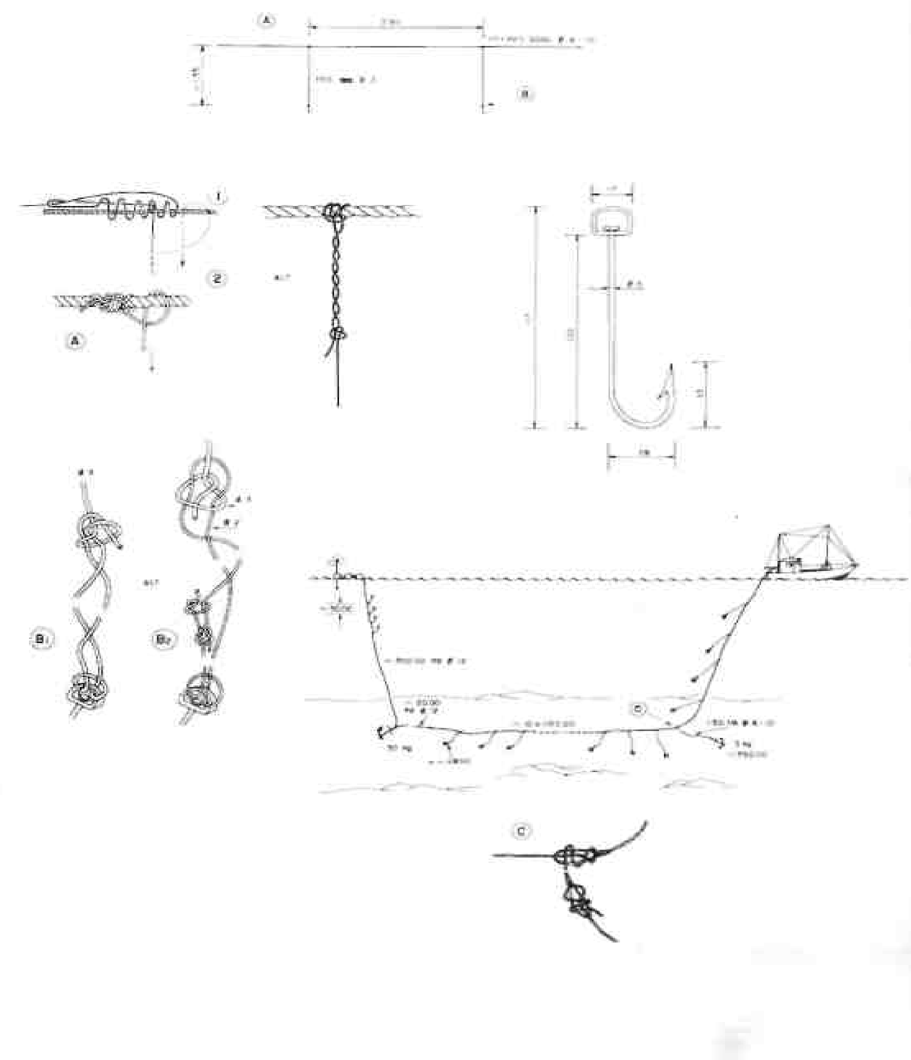


Plan and rigging of bottom longlines: an example

Longline for dogfish, rays, conger, ling
Channel, France

Boat

Length	14-15 m
TJB	20-30
Hp	150



Longline components

A longline consists of a main line, to which a number of branchlines (also called snoods or gangions) are attached. A hook is attached to the end of pnch branchline.

The material and diameter of the mainline will depend on the target species, the type of longline (bottom or mid-water), and gear-handling methods (manual or mechanical hauling). The diameter and breaking strength must take into account not only the weight of the fish, but also the displacement (and therefore, inertia) of the vessel.

As a general rule, one can choose a mainline whose breaking strength (dry, unknotted, in kg) is ;

— both greater than 10 times the tonnage of the vessel, and greater than the square of the vessel's length (in metres).

— at least 10 times the weight of the largest fish one expects to catch.

***For example**:*

What would be the minimum breaking strength for the main line of a longline used by a 9 m, 4 t vessel, catching sea bream and gurnards?

Breaking strength must be greater

than 4 x 10 = 40 kg

or 9x9 = 81 kg

But, if one expects to catch individual fish weighing 10 kg, it is necessary to calculate

10 kg x 10 = 100 kg

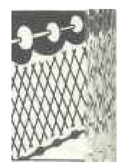
Therefore, the line could be twisted or braided nylon (PA), 2 mm diameter (breaking strength 130-160 kg); or nylon monofilament 170/100 (breaking strength 110 kg); or polyethylene (PE) 3 mm diameter (breaking strength 135 kg).

Branchlines (snoods or gangions) should be as close as possible to invisible in water, but sometimes of steel (for example, in some tuna and shark fisheries).

Breaking strength of branchlines (wet, with knots) should be at least equal to twice the weight of the fish one expects to catch. (The breaking strength of the main line should equal 3 to 10 times that of the branchlines.)

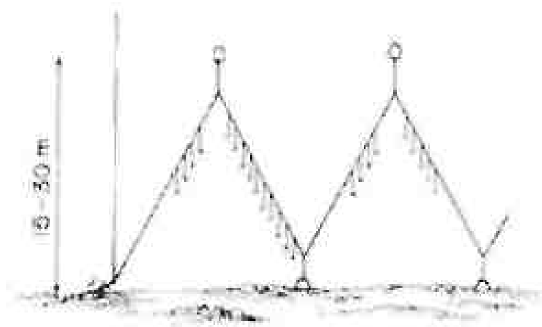
The length of a branchline is usually less than half the distance between branchlines, in order to avoid tangling.

Hooks are usually chosen by experience, according to the size and behaviour of the target species; hooked fish should stay alive (for species which can live when hooked), but should not come unhooked.

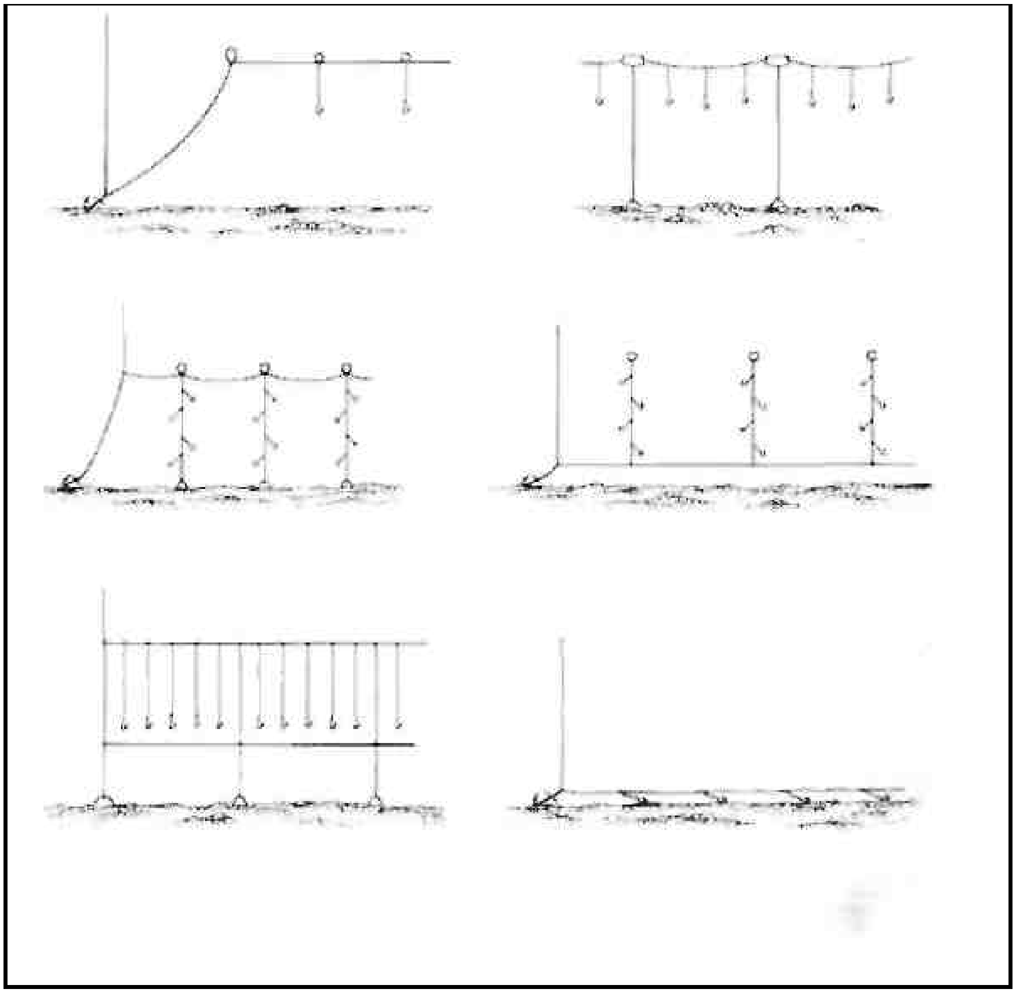


Set longlines: various rigs in use

■ **Semi-pelagic longlines**

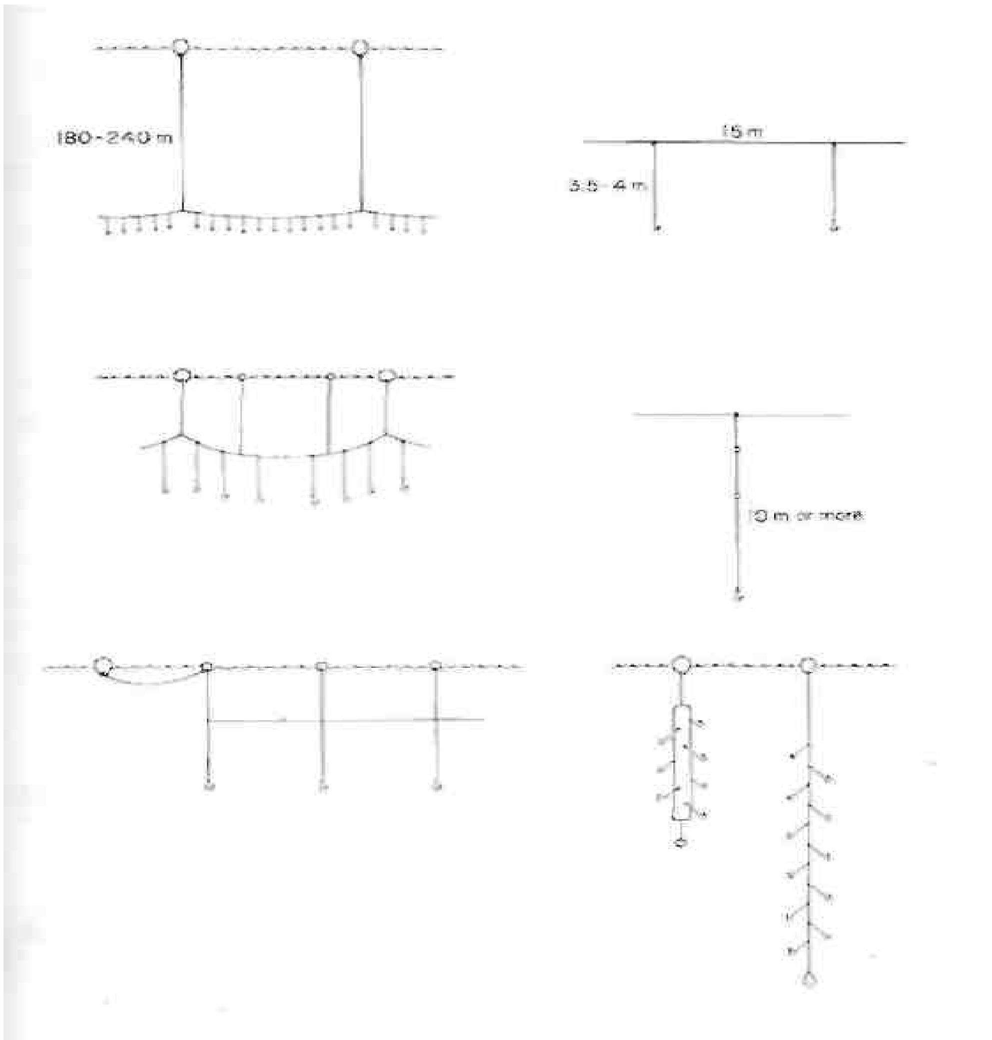


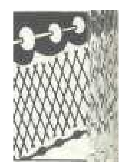
■ **Bottom longlines**



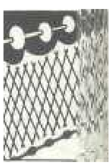
Drifting longlines: various rigs in use

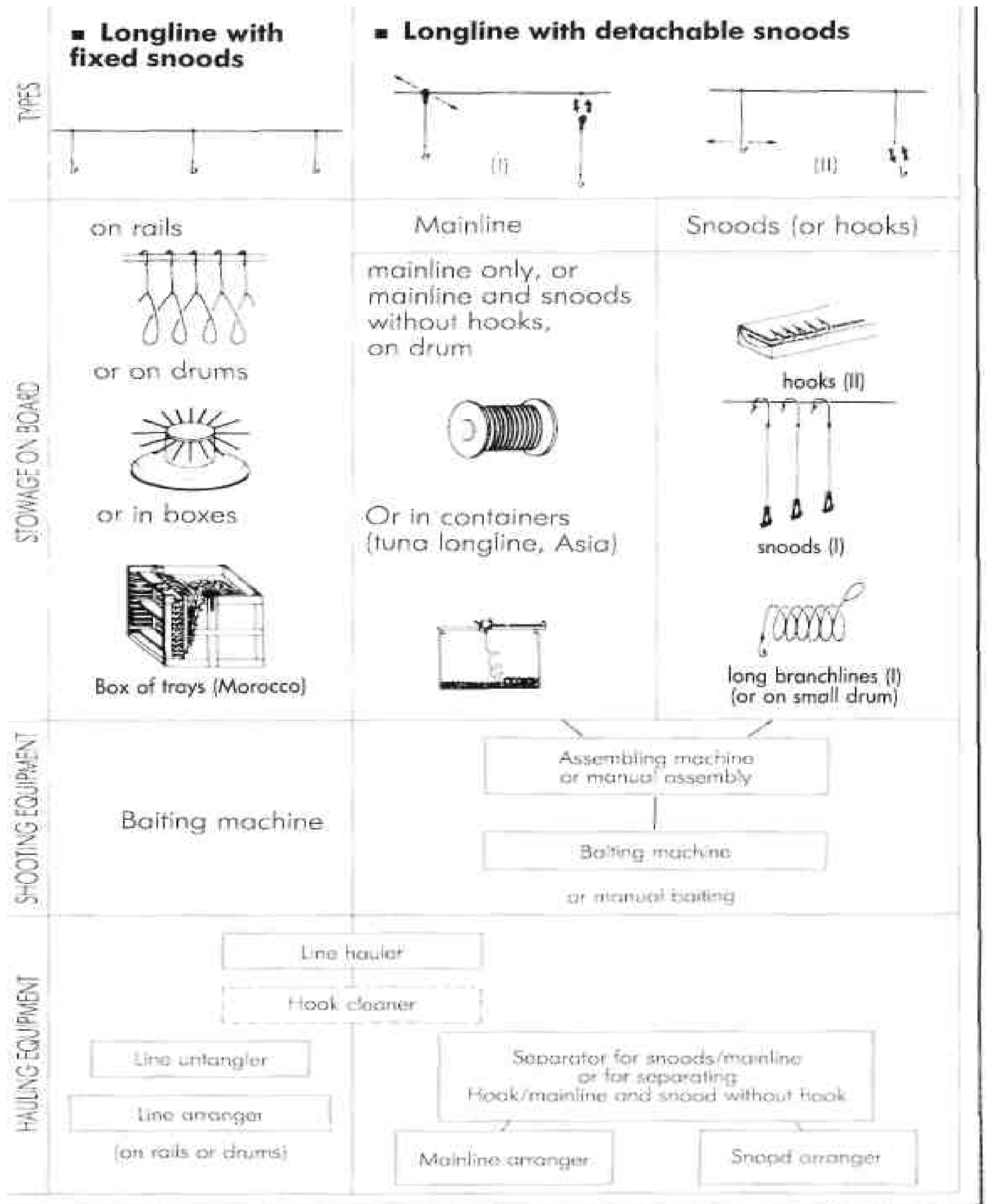
Some examples:



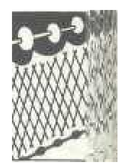


Longlines: automation of operations

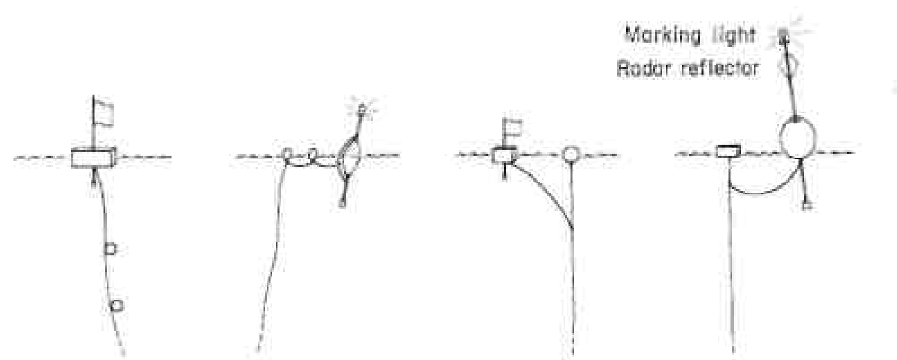




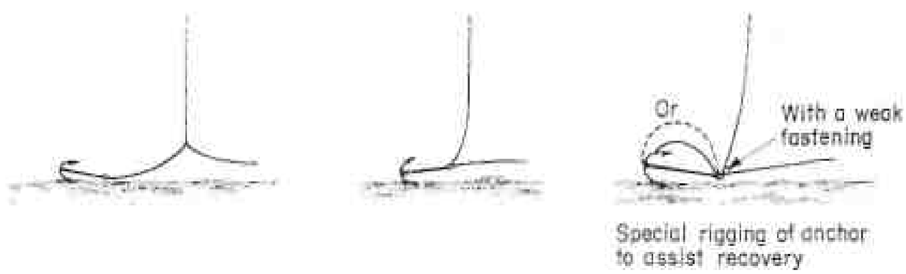
Marking bouys and anchors; for nets, traps and lines



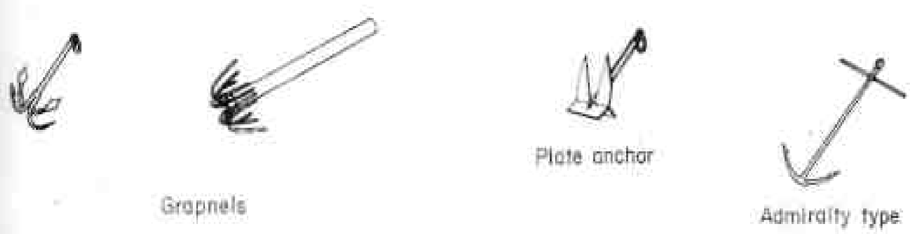
■ **On the surface**



■ **On the bottom**

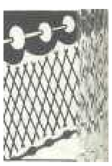


■ **Some types of anchors**



Dredges

DREDGES



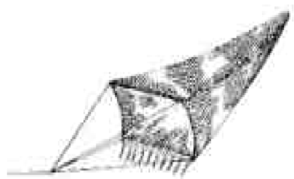
■ **Characteristics**

Rigid fishing gear for pulling over the bottom (types for soft bottom, types for very hard bottom)

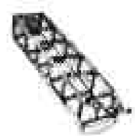
Sizes (usually the width is less than 2 m, exceptionally up to 5 m) Height is always less than 0.5 m

Heavy (to scrape the bottom)

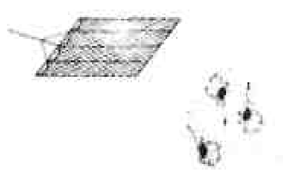
■ **Examples of different types**



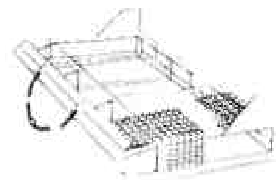
Dredge for small fish
Weight: 30 kg



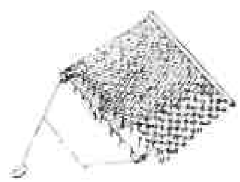
Rigid dredge with teeth for venus clam
Weight: 200-300 kg



Dredge without bag for whelks. The shells entangle in the netting
Weight: 20-25 kg



Industrial shellfish dredge
Weight 500-1000 kg



Dredge with teeth, on the lower edge of the frame and with depressor flap on the upper edge Weight 70-100 kg

Shellfish rake

■ **Power required**

1 hp per 2 kg of dredge

■ **Towing cable**

(one)

■ **Amount of warp depends on the depth of water and the speed**

(The warp paid out will need to be increased with the speed). In general, 3 to 3.5 x depth (at 2-2.5 knots)

■ **Speed of dredging** :

2 to 2.5 knots

■ **Rigging, some examples**