Size Selectivity of Towed Fishing Gears

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Content

- **I present**
- Towed gears
- Size selectivity
- Factors affecting selectivity
- Commercial uptake



- Aim to be simple

-I avoid

-Static gears

-Species selectivity

-Statistical analysis

-Modelling

What do we mean by selectivity?

Ability to retain

- Taget species (some of the non targets are highly charismatic)
- Target sizes (usually big, but some times only medium size fish)

while releasing the others,

What do we mean by selectivity?

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- Taget species (some of the non targets are highly charismatic)
- Target sizes (usually big, but some times only medium size fish)

while releasing the others,

if possible unharmed!

From Düzbastılar et al. (2012)

Why do we study selectivity?

- To reduce capture unwanted species and sizes in commercial fisheries,
- To better understand how we exploit the resources,
- To estimate the population length distribution of a fishery from commercial catch data, from which, age distribution can also be inferred,
- To correct potential bias of the sampling gear data collected during research vessel surveys,
- To be able to quantify the expected changes resulting from the implementation of a new gear or mesh size,
- Just for the sake of publishing something


Multi-species problem
136 Species
30 Species Marketable


Retained
W 48%
N 72%
Discarded

Discard in NE Med demersal tarwling

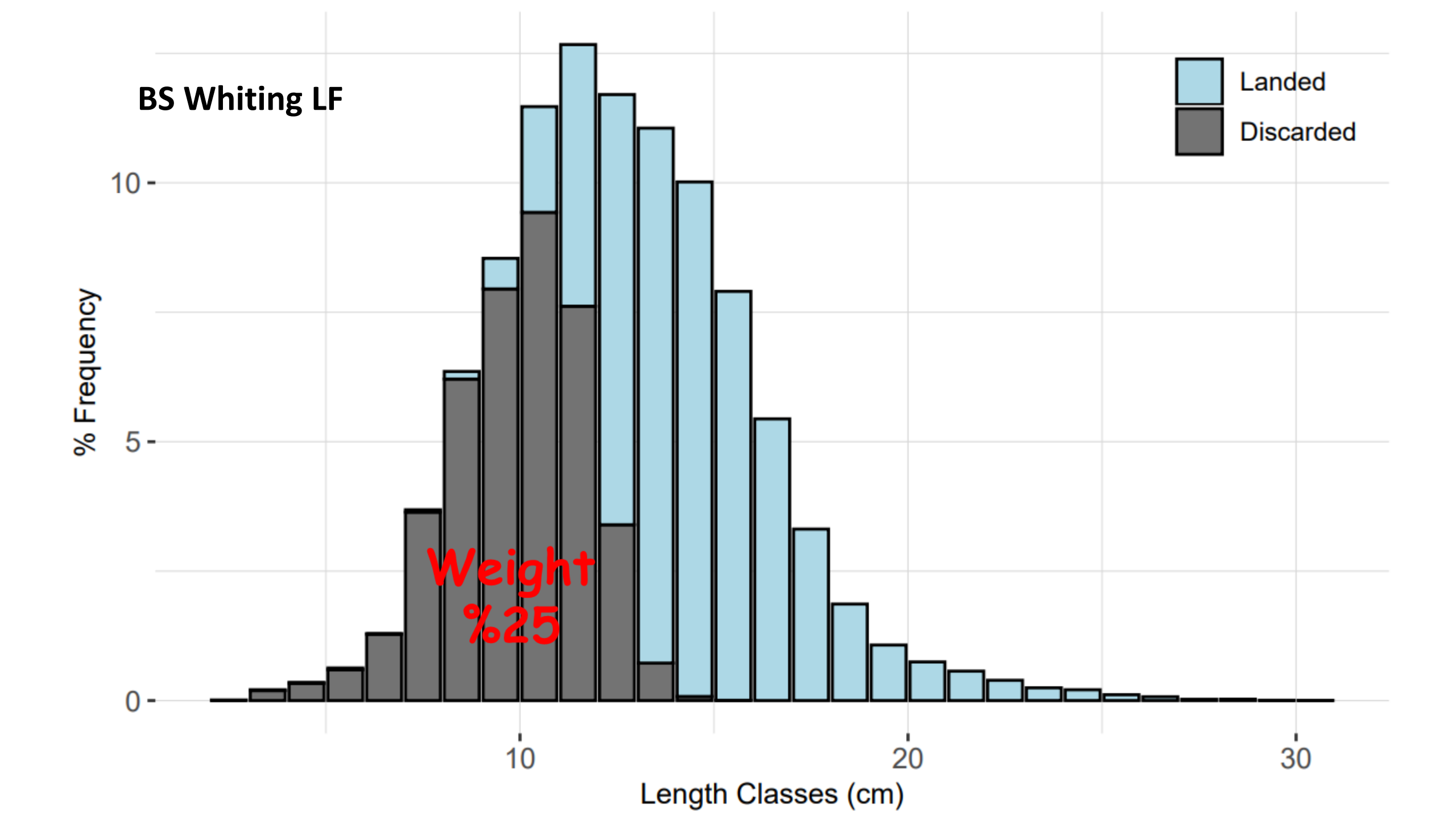
For 1kg of fish in the market, about 1kg

For 3 fish in the plate, about 7 fish or other marine animals

Observer: Süleyman ÖZDEMİR (Western Black Sea_Sinop)
Date: 01-08.09.2019
Fishing Trip ID: 29_T11_2019_09_01-08_SÖ

Sample Photo 1(Landing catch)

Sample Photo 2(Discard catch)


BS Whiting LF
Landed
Discarded
% Frequency
10
5
0
Weight
%25
10
20
30
Length Classes (cm)

Overall aim is to ensure sustainable stocks

- One of the management options
  - ➢ To improve selectivity
  - Ideally we want to catch the fish
    - ➢ Once they have had a chance to spawn
    - ➢ When they have reached the reasonable weight
    - ➢ Some times we may wish to release some larger individuals as well

Size selection?

- To retain large fish
- Allowing small fish to escape

- But its usually not a simple sieving proccess
- Most fish react to the gear
- And this reaction is variable for
    - Different species
    - Different sizes
    - Under different conditions

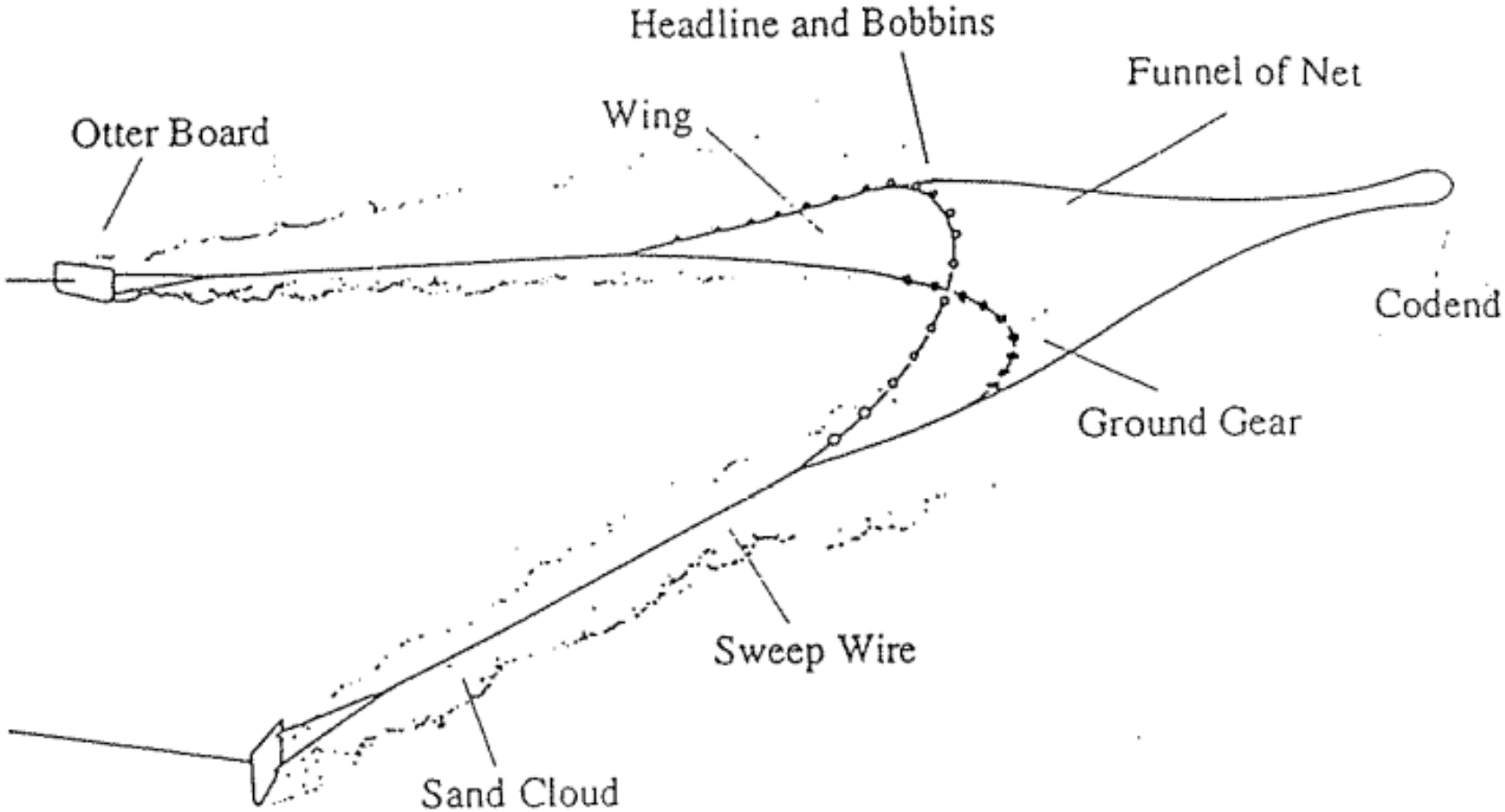


Figure 1. 3 Schematic representation of a demersal trawl in action. Components important in eliciting behavioural reactions of fish are shown (modified from Wardle, 1993 by Gosden, 1994)

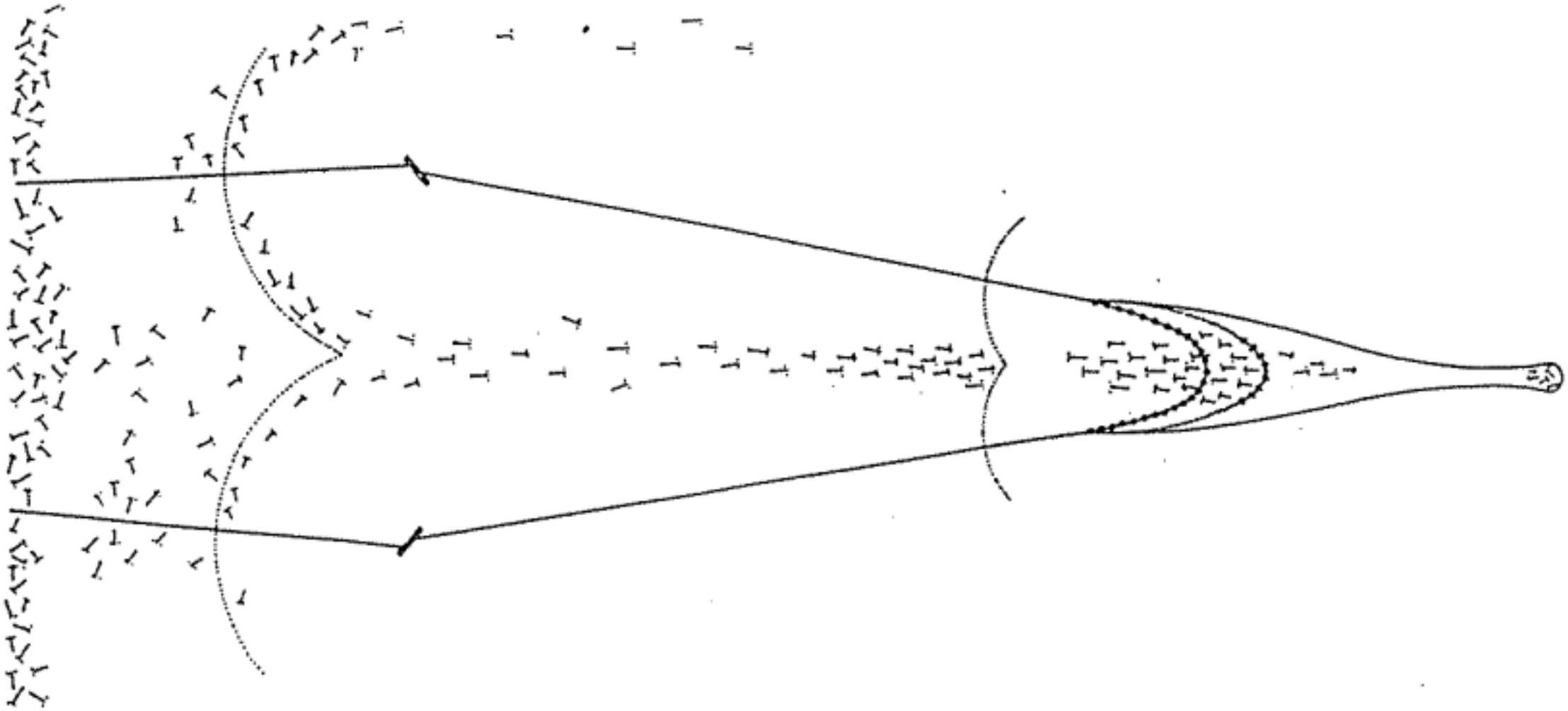


Figure 1. 4 Plan showing behavioural reactions of fish in response to components of a demersal trawl. Broken lines show reaction distances for fish with a visible sighting distance of approximately 16m (from Wardle, 1993).

Factors affecting behaviour in relation to fishing operation

- Size of the fish
- Condition of the fish
- Water temperature
- Visibility of the gear componets
- Towing speed

- And many others but probably in another seminar
- Important to know all these factors changes spatially and temporaly
- Knowing these effects gives us tools to better understand and improve selectivity (and catchability)

How do we estimate size selectivity?

- There are several methods
- But the principal is the same, you are trying to learn
  - What enters (population)
  - What retains (catch)
    at each size class

Z. TOSUNOĞLU, Y. DOĞANYILMAZ ÖZBİLGİN, H. ÖZBİLGİN

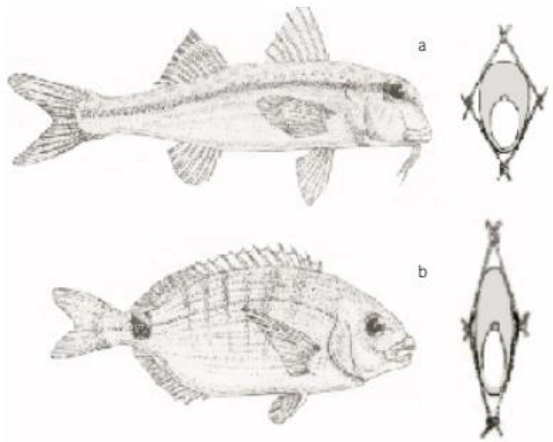


Figure 11. Lateral and crossectional views of red mullet (a) and annular sea bream (b).

Tosunoğlu et al., 2003

Özbilgin, 1998

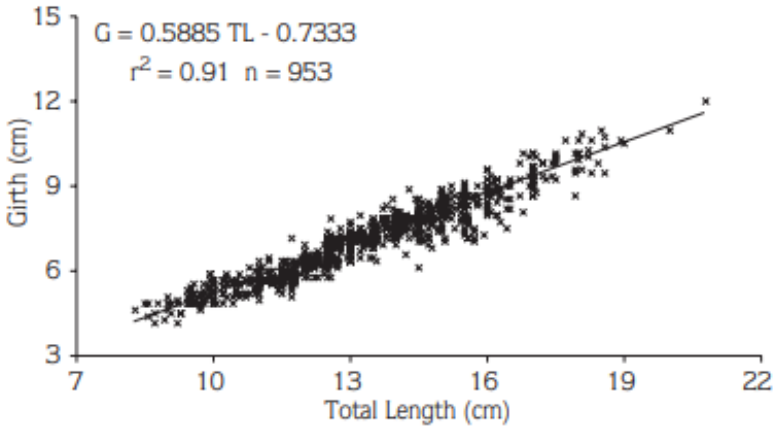


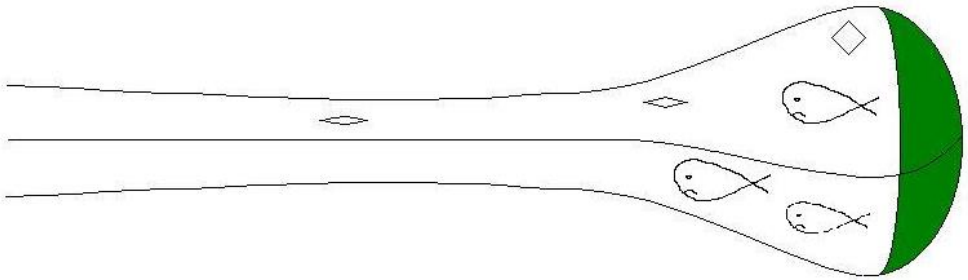
Figure 4. TL-G data points and linear regression line for red mullet.

Tosunoğlu et al., 2003

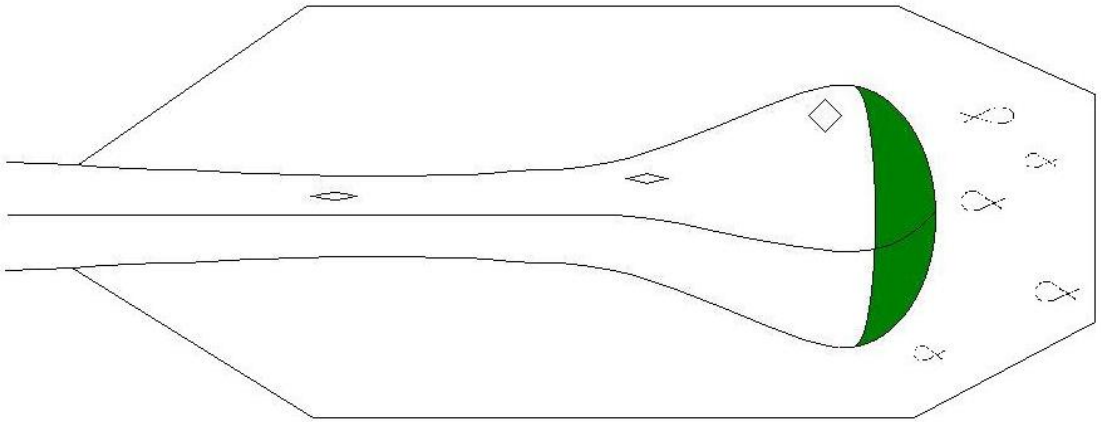
Incase of demersal trawls we focus on the codend And most commonly use the 'covered codend method'

How to estimate selectivity parameters?

- CODEND
- Measure each fish
- Count number N of fish at each length

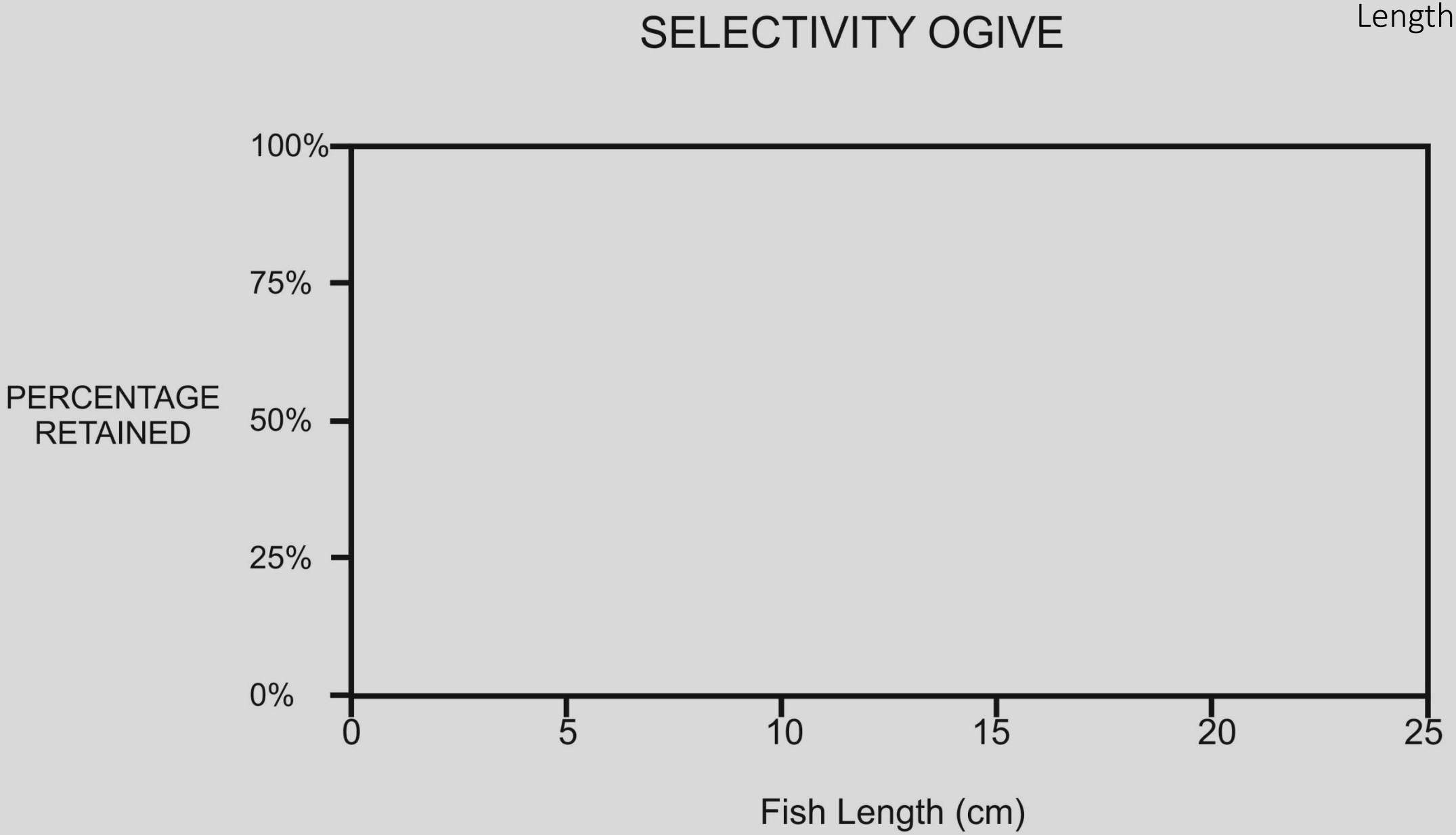


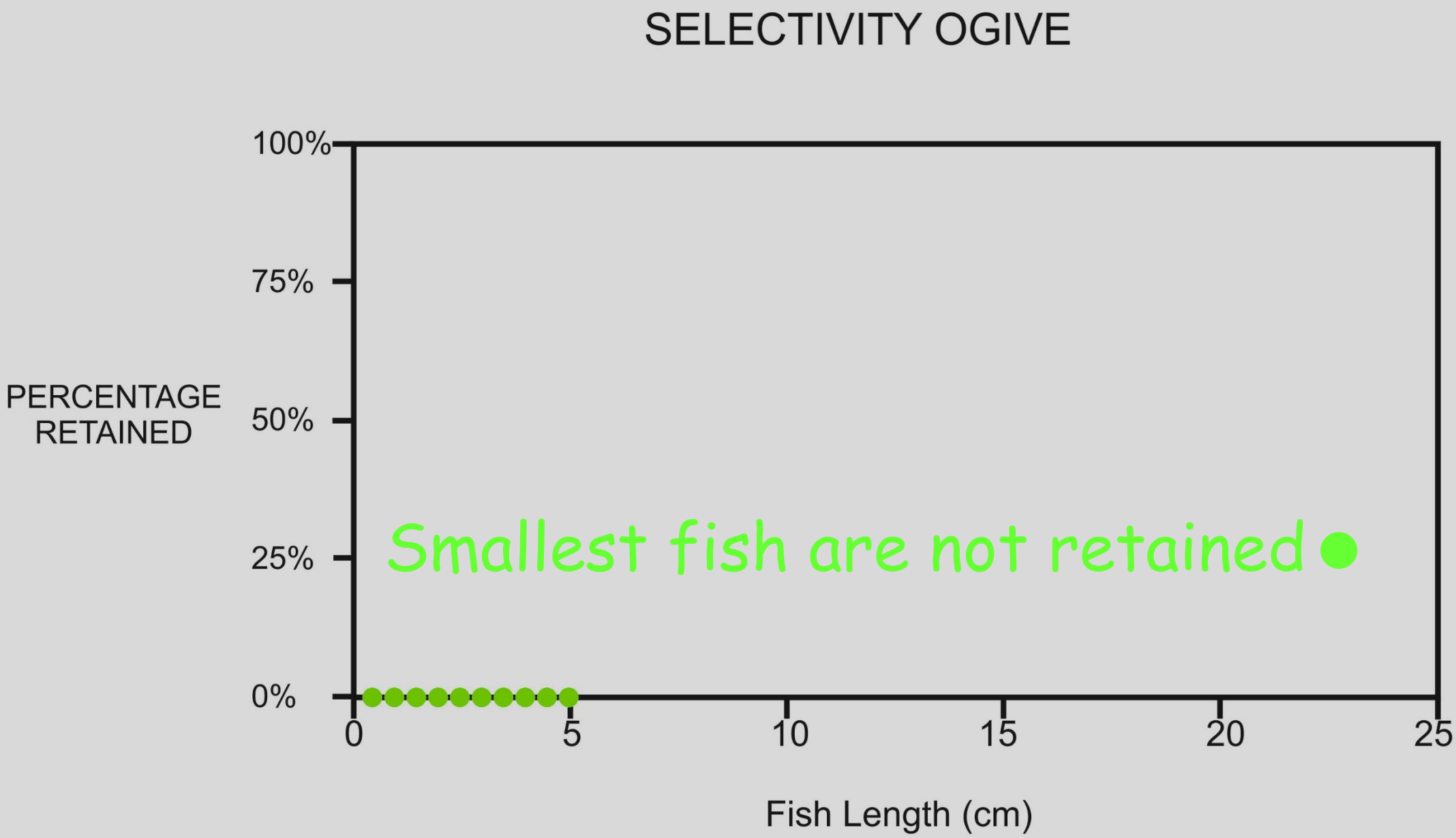
- COVER
- Measure each fish
- Count number n of fish at each length

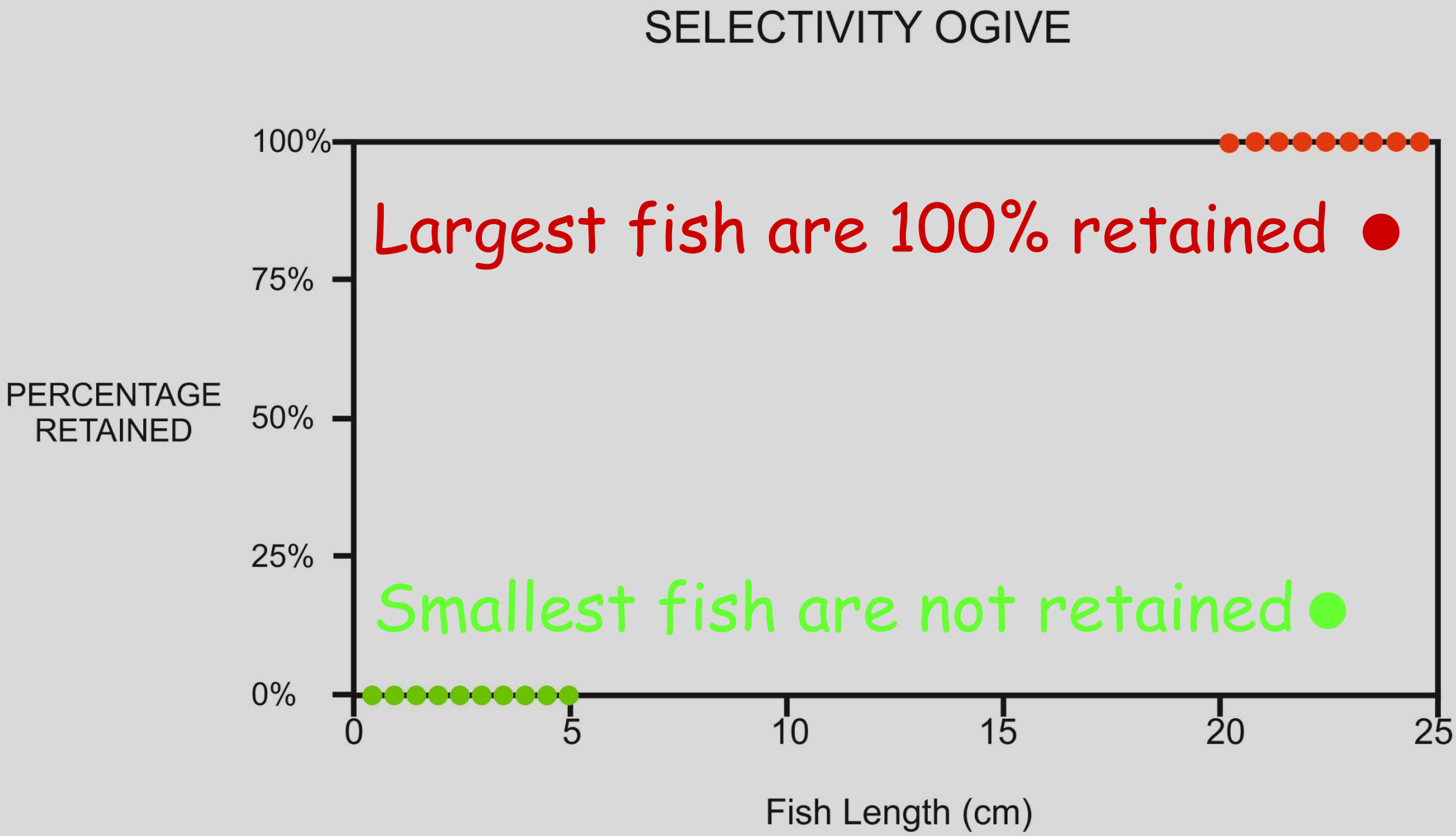


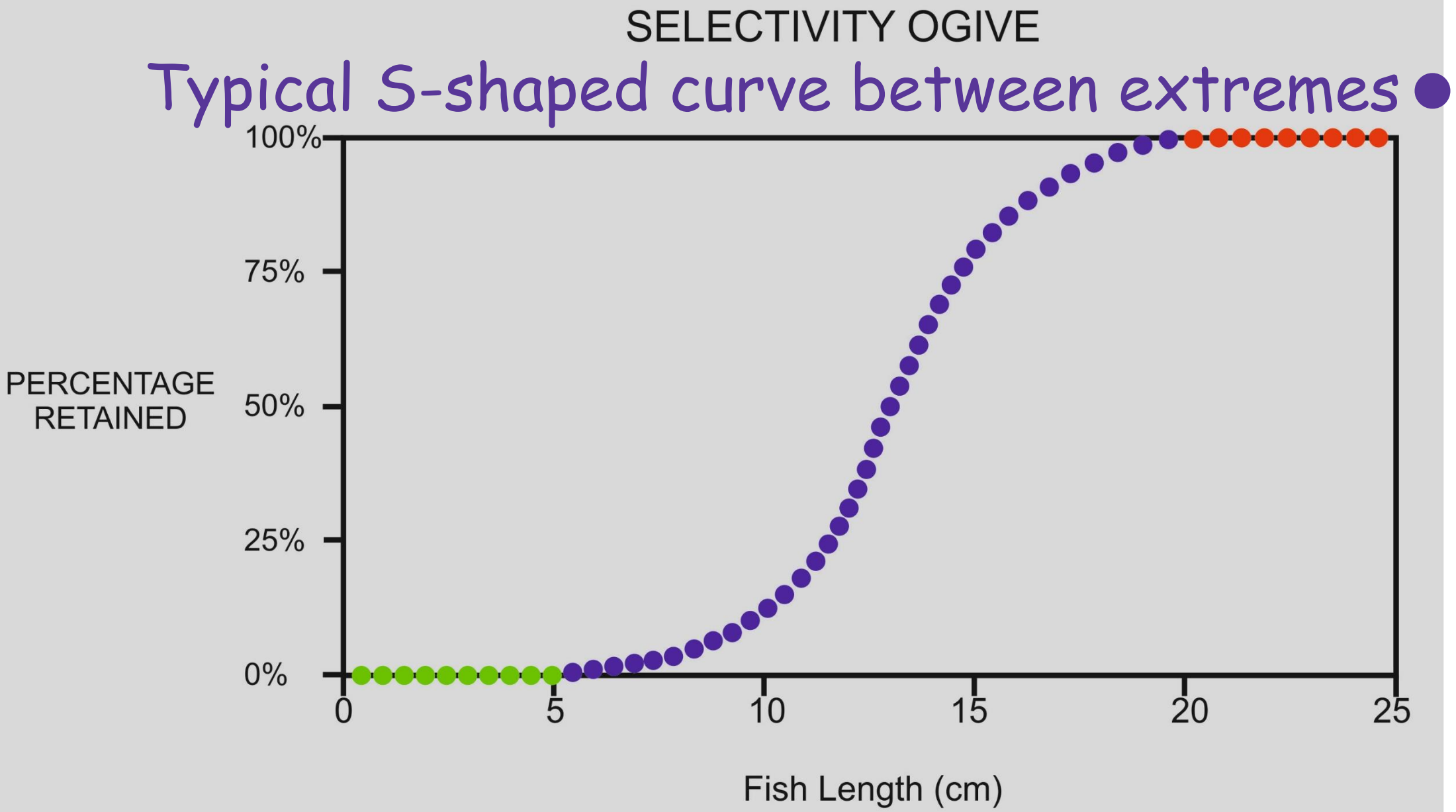
Proportion retained = N/(N+n)

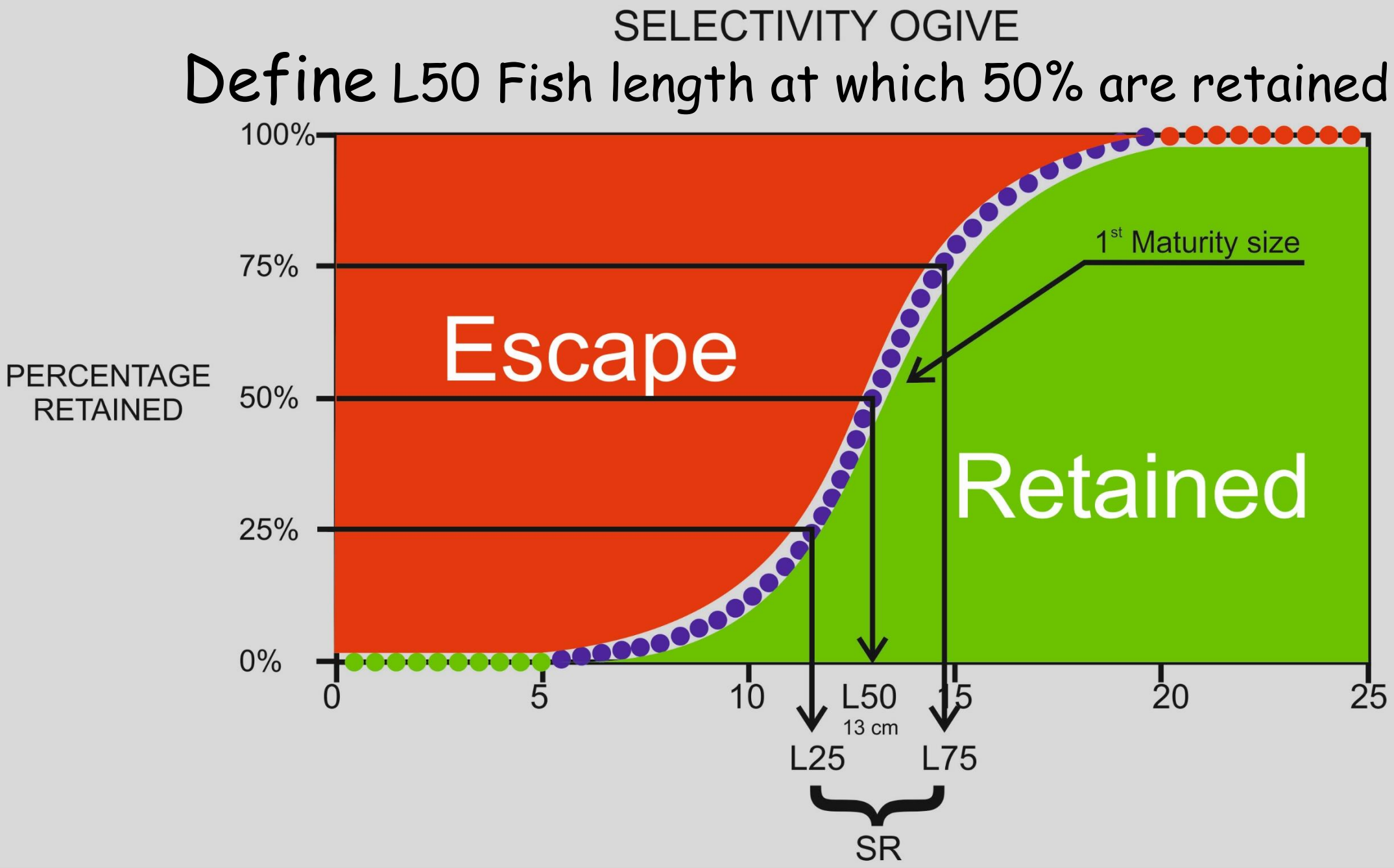
Length based

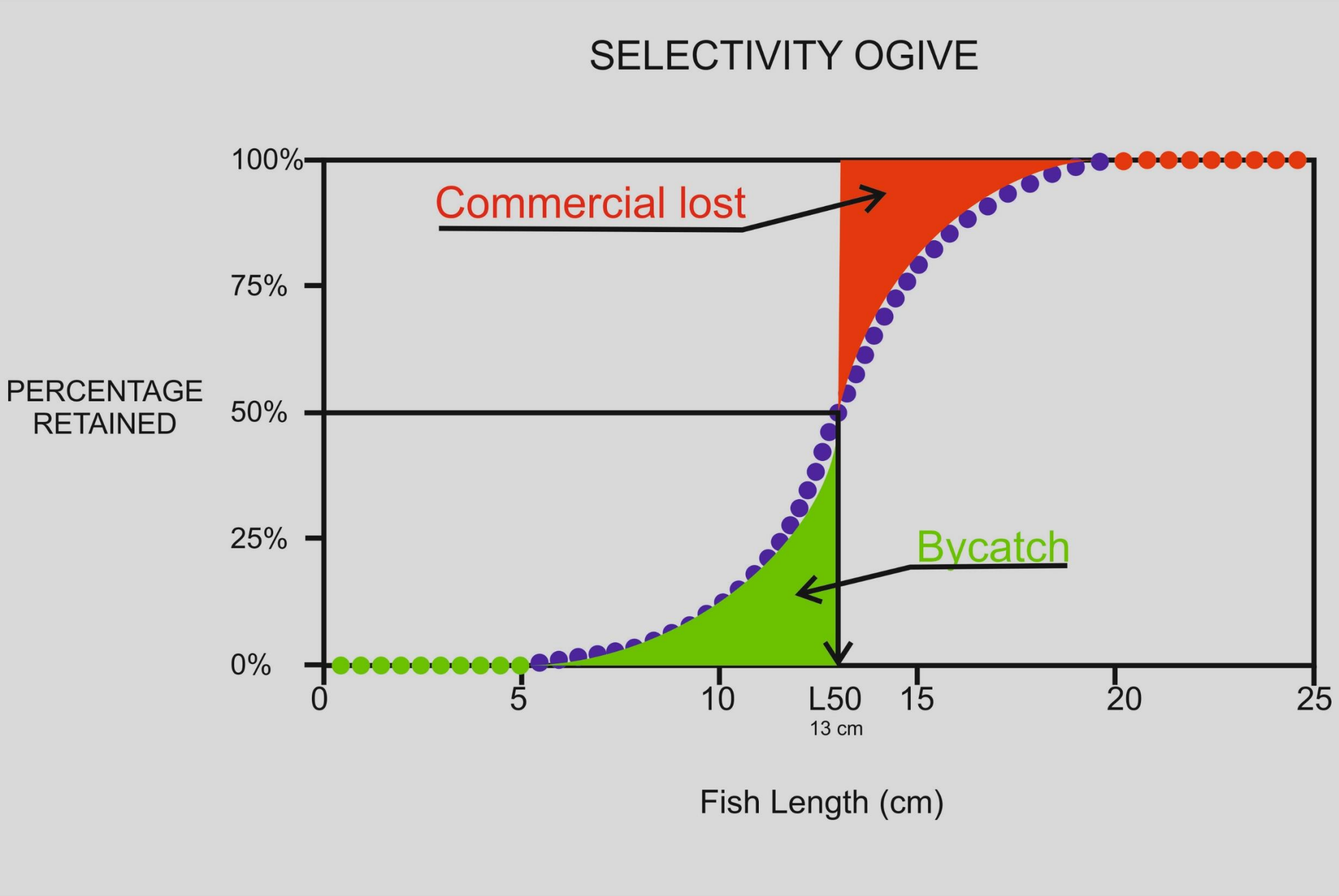



SELECTIVITY OGIVE
PERCENTAGE RETAINED
100%
75%
50%
25%
0%
0
5
10
15
20
25
Fish Length (cm)
Smallest fish are not retained

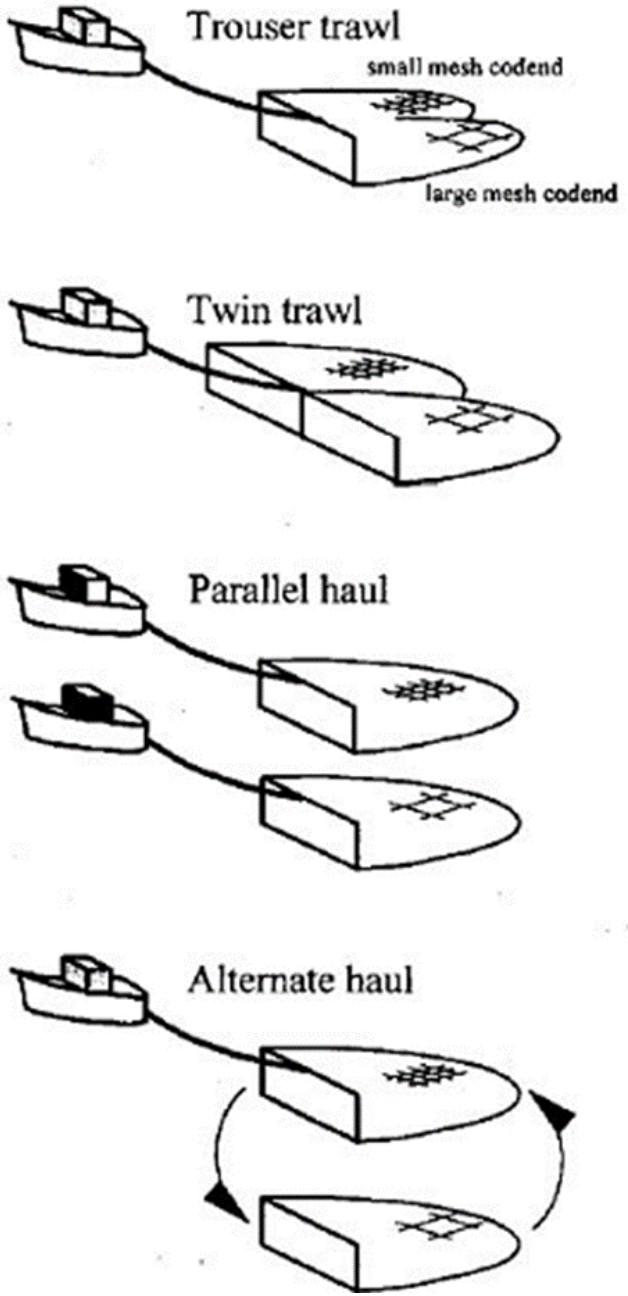

SELECTIVITY OGIVE
100%
75%
50%
25%
0%
PERCENTAGE RETAINED
Largest fish are 100% retained
Smallest fish are not retained
0
5
10
15
20
25
Fish Length (cm)


SELECTIVITY OGIVE
Typical S-shaped curve between extremes
100%
75%
50%
25%
0%
PERCENTAGE RETAINED
0
5
10
15
20
25
Fish Length (cm)


SELECTIVITY OGIVE
Define L50 Fish length at which 50% are retained
100%
75%
50%
25%
0%
PERCENTAGE RETAINED
Escape
Retained
1st Maturity size
0
5
10
L50
13 cm
15
20
25
L25
L75
SR


SELECTIVITY OGIVE
100%
75%
50%
25%
0%
PERCENTAGE RETAINED
Commercial lost
Bycatch
0
5
10
L50
13 cm
15
20
25
Fish Length (cm)

Paired Gear Methods

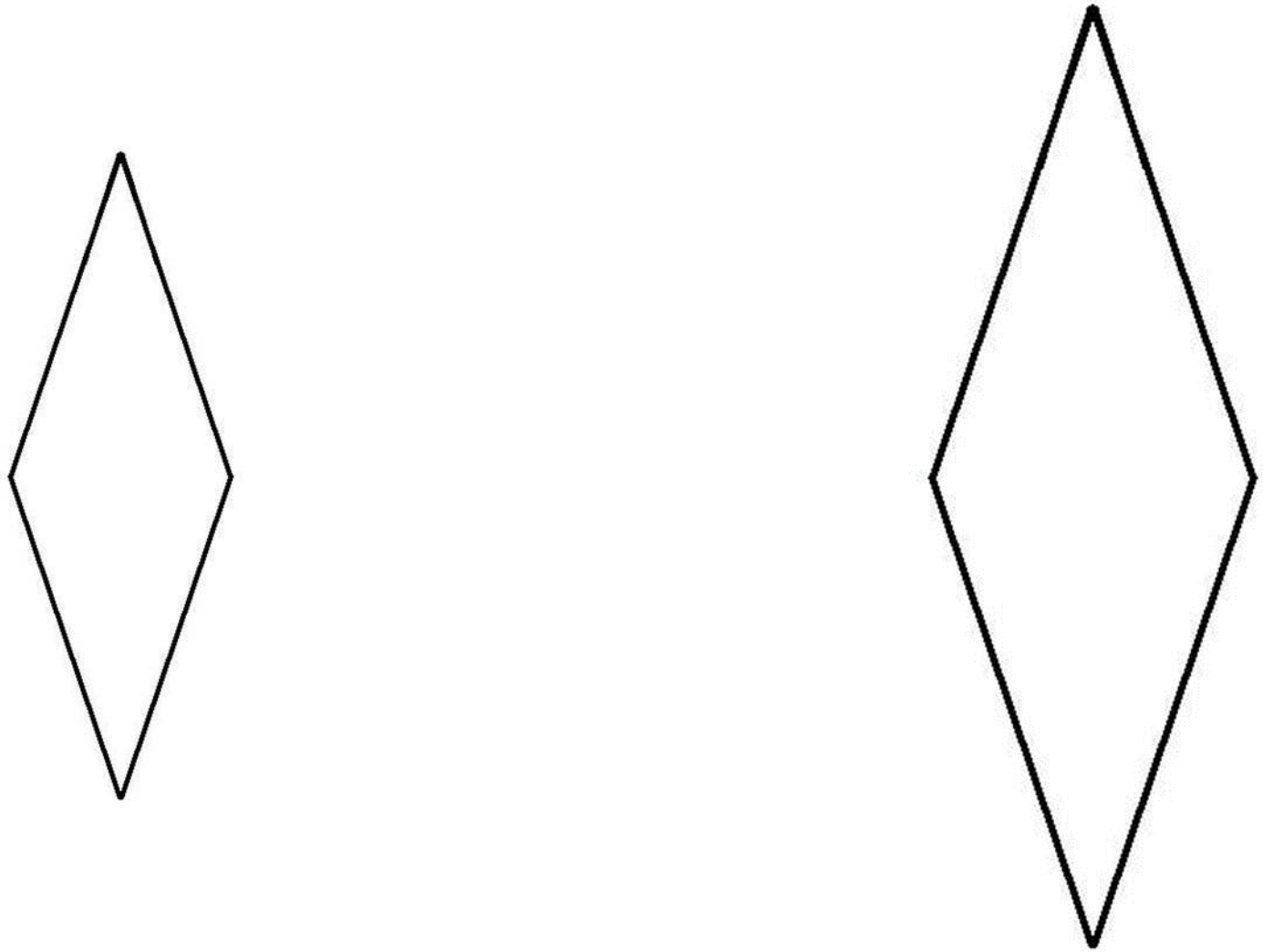


Also allow catch comparisons

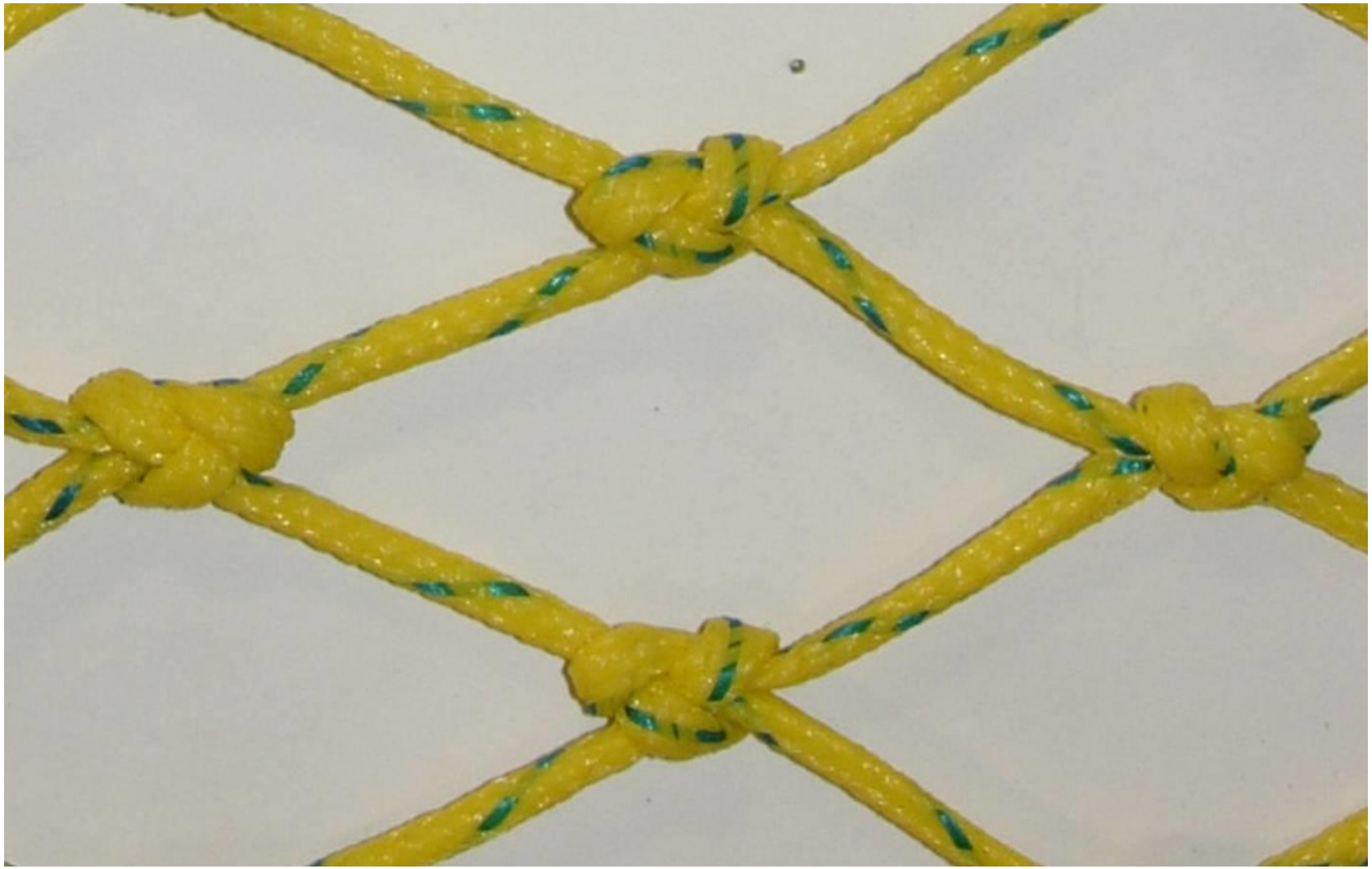
Effect of codend design on selectivity

Mesh size
Mesh shape
Square mesh codends, panels or windows
Twine diameter
Knot type
Meshes round circumference
Strengthening/Protection bag
Twine materials
Double codends
Grids

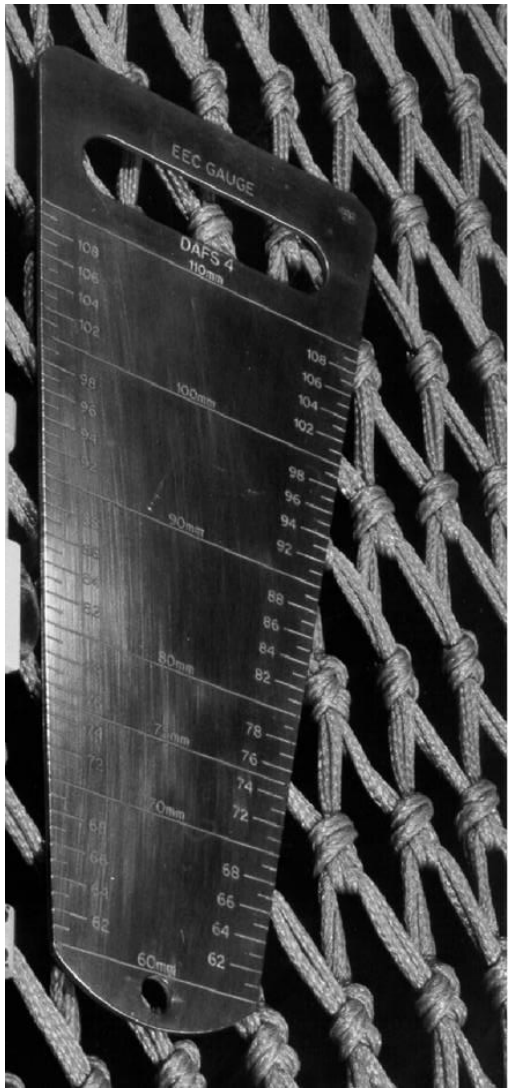
Mesh size increase



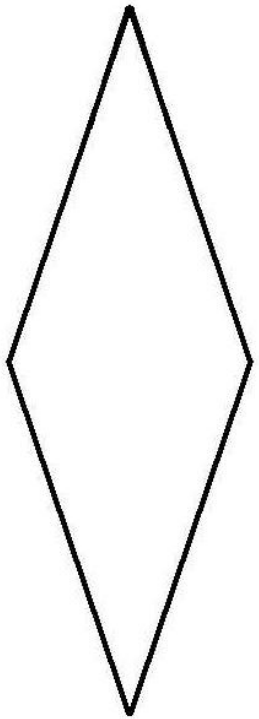
How to measure mesh size?



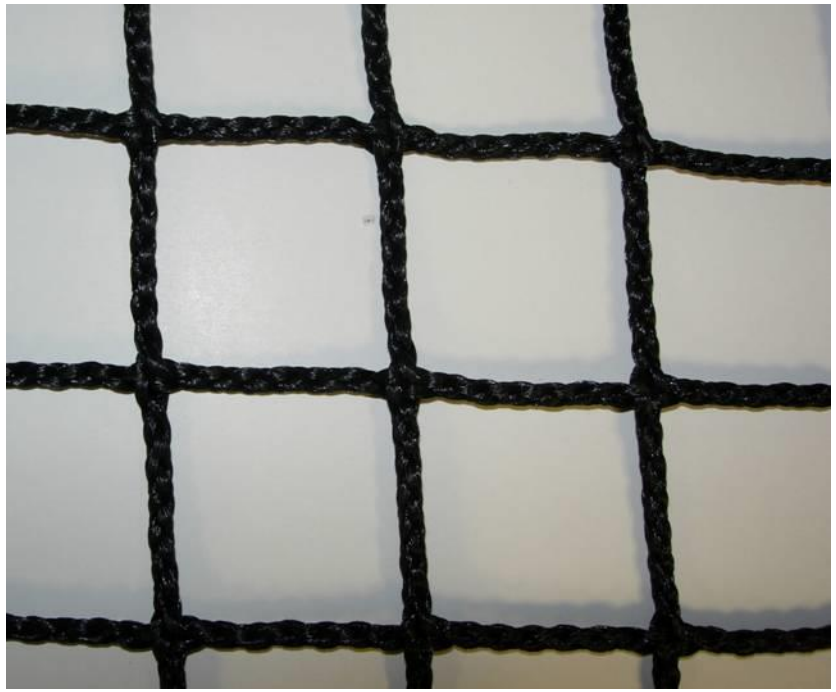
Wedge gauge and OMEGA

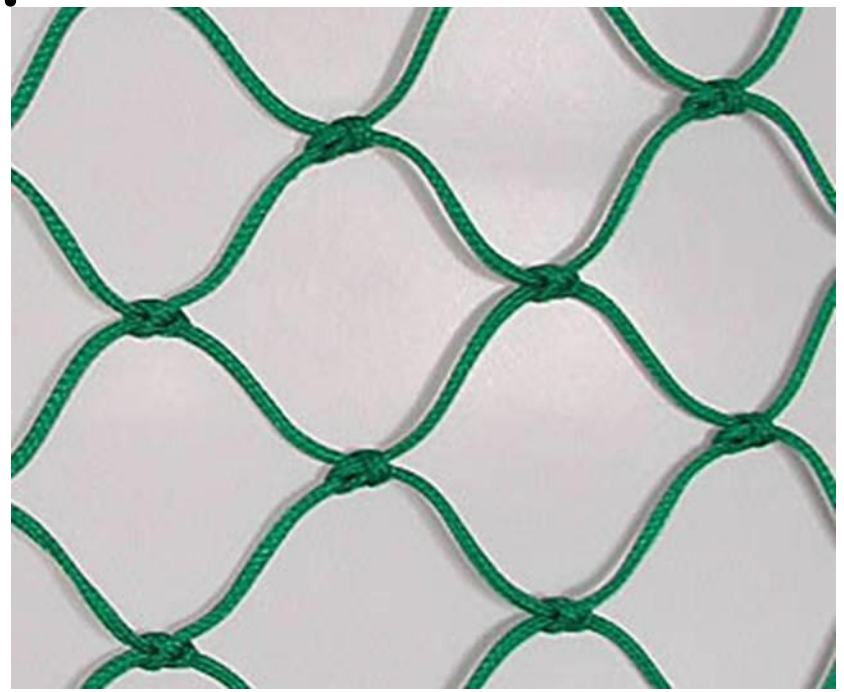


Mesh shape



Mesh shape



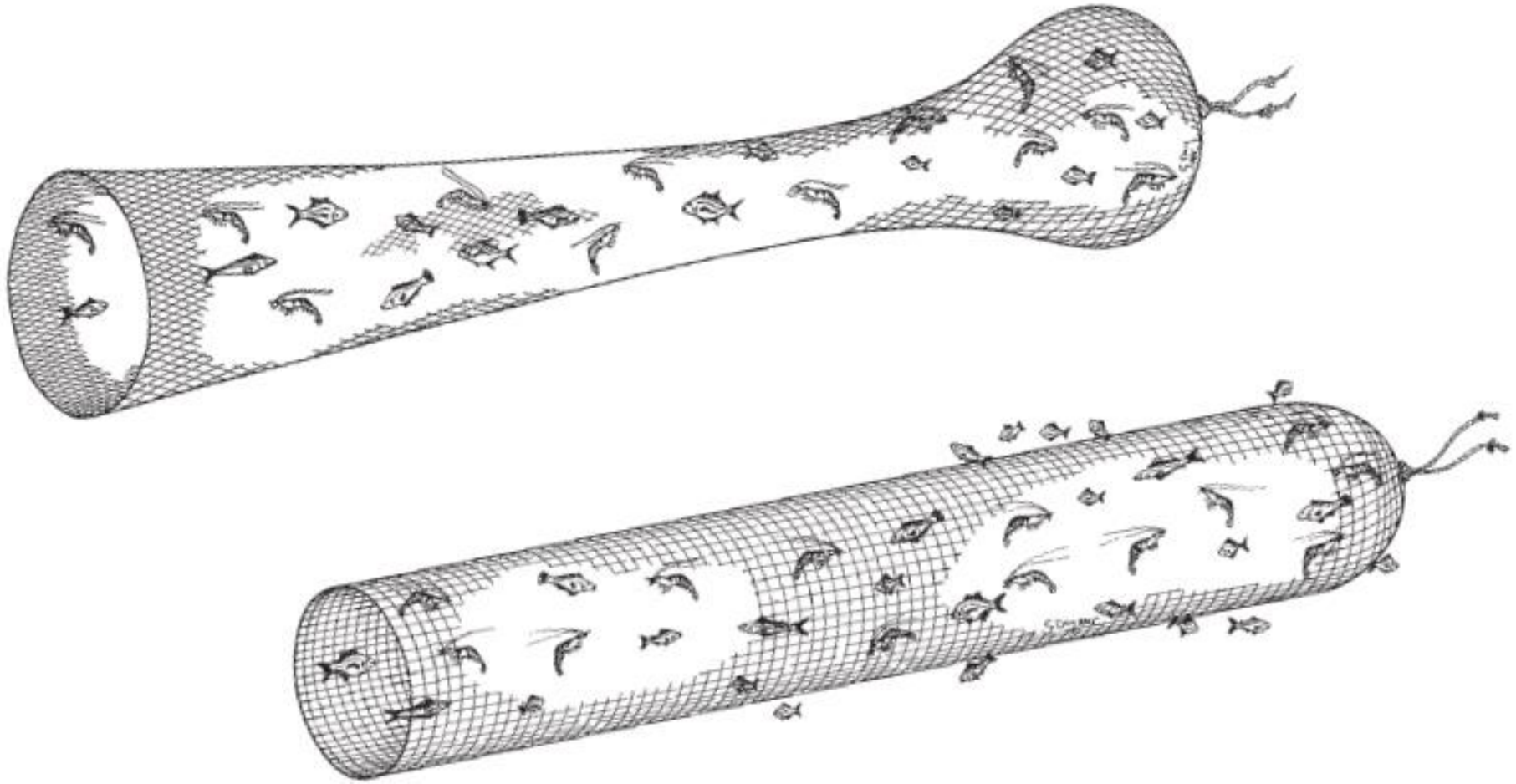


Towing Direction

- Square mesh
- Turned 45°

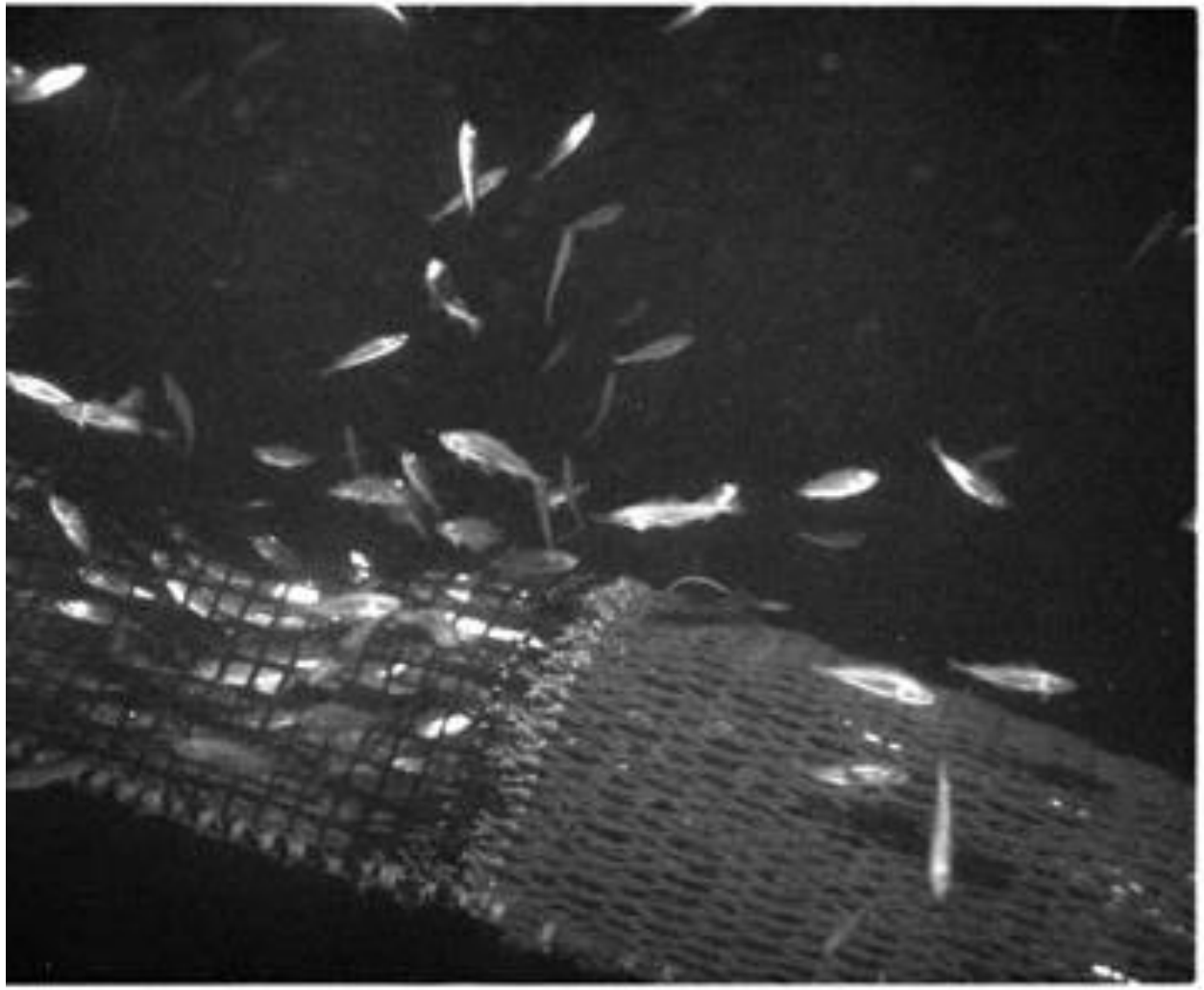
- T90 mesh
- Turned 90°

Diamond and square mesh codends



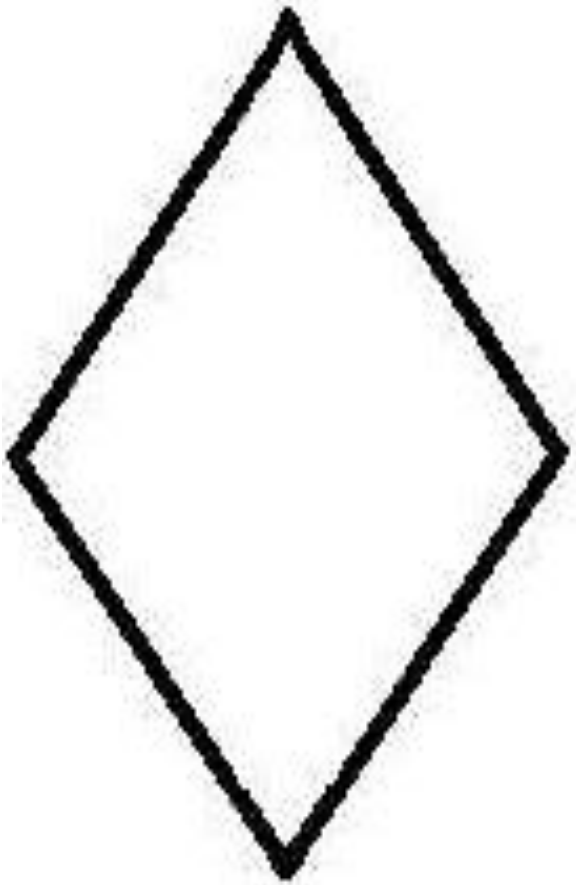
Square mesh panels

- Square meshes (left) are open
- Diamond meshes (right) are closed
- Small herring are escaping



From Ferro, 2006

Wider angle of mesh



Mesh shape should suit fish shape

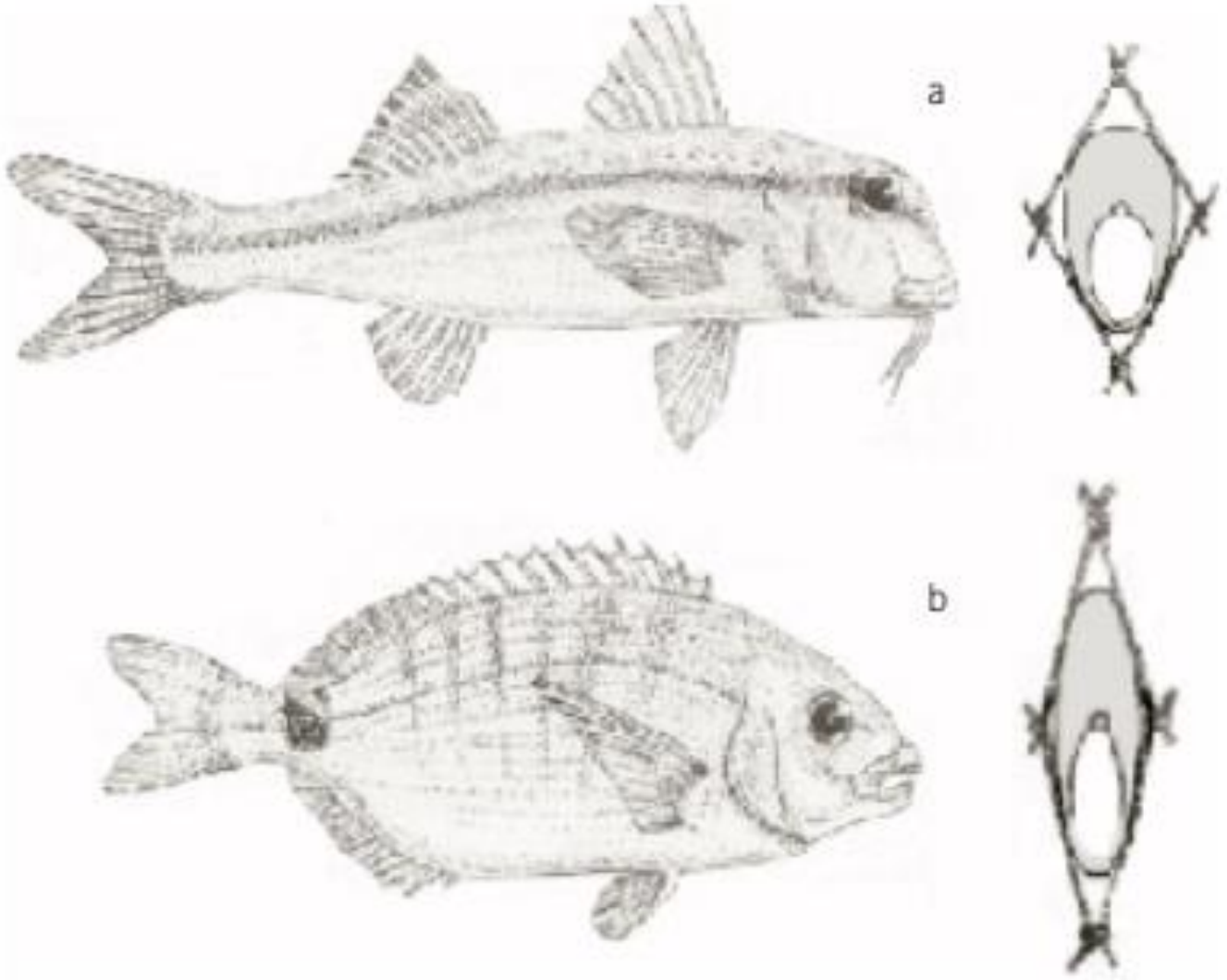
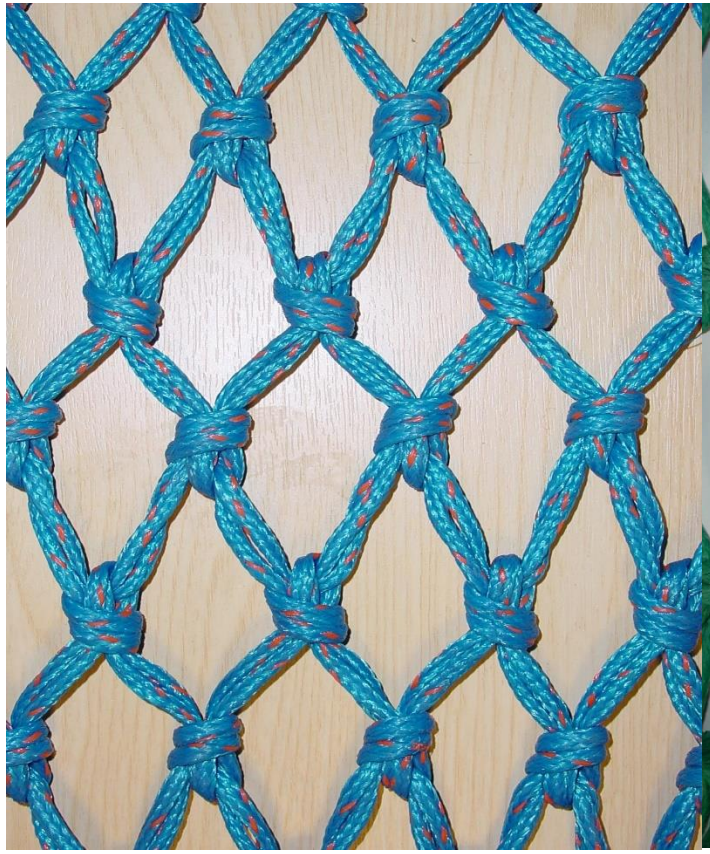
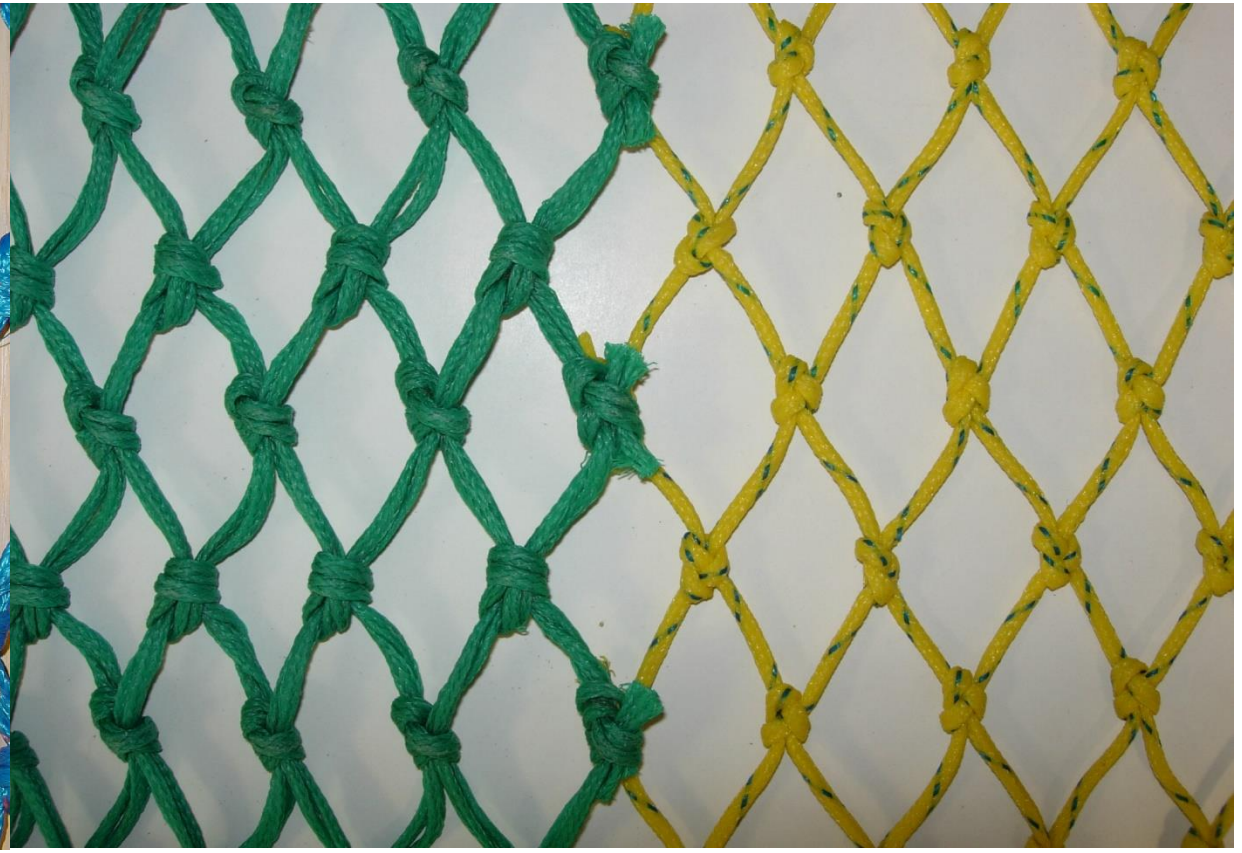


Figure 11. Lateral and crossectional views of red mullet (a) and annular sea bream (b).

Tosunoğlu et al., 2003

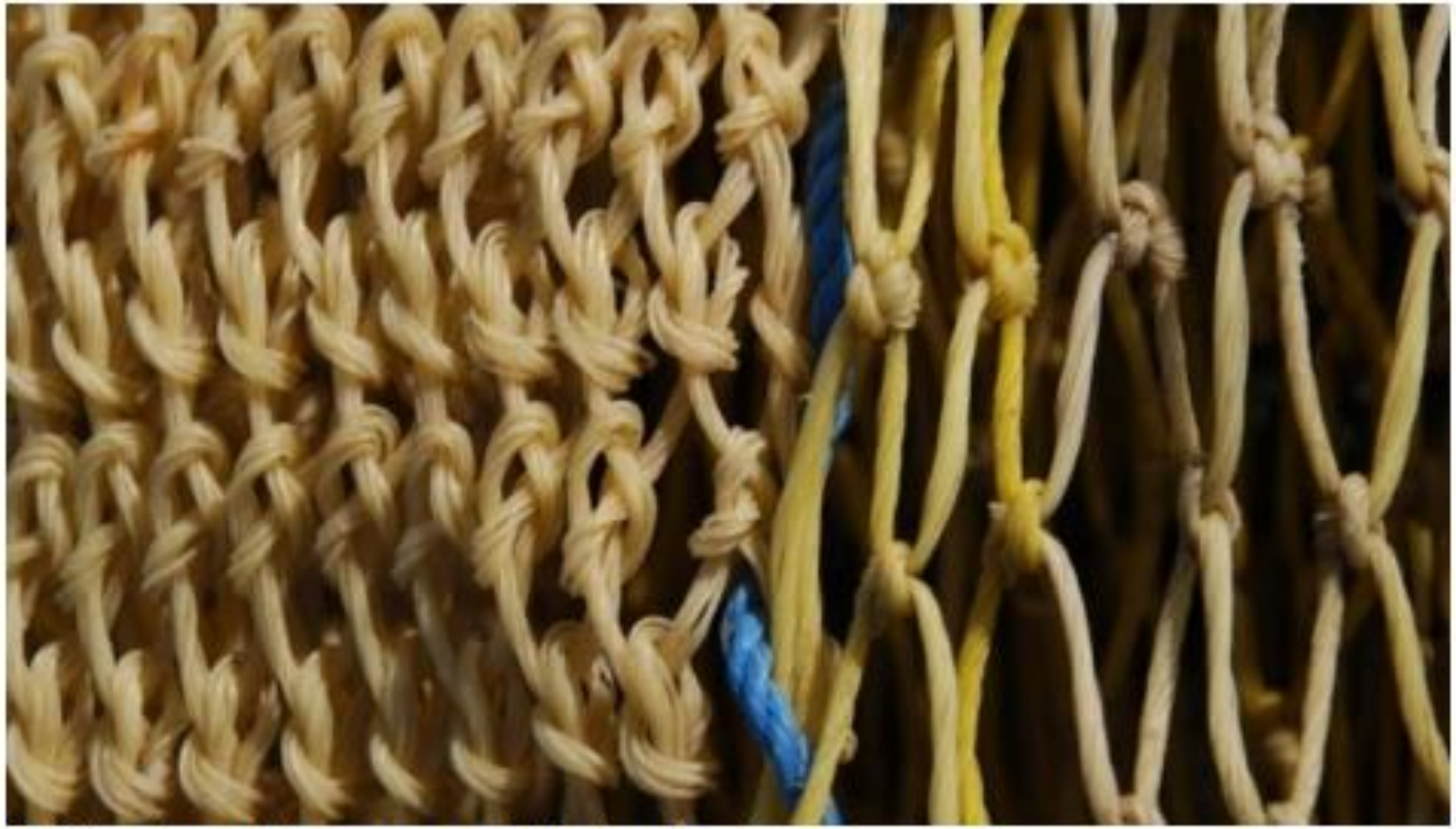
Twine diameter





From Ferro, 2006

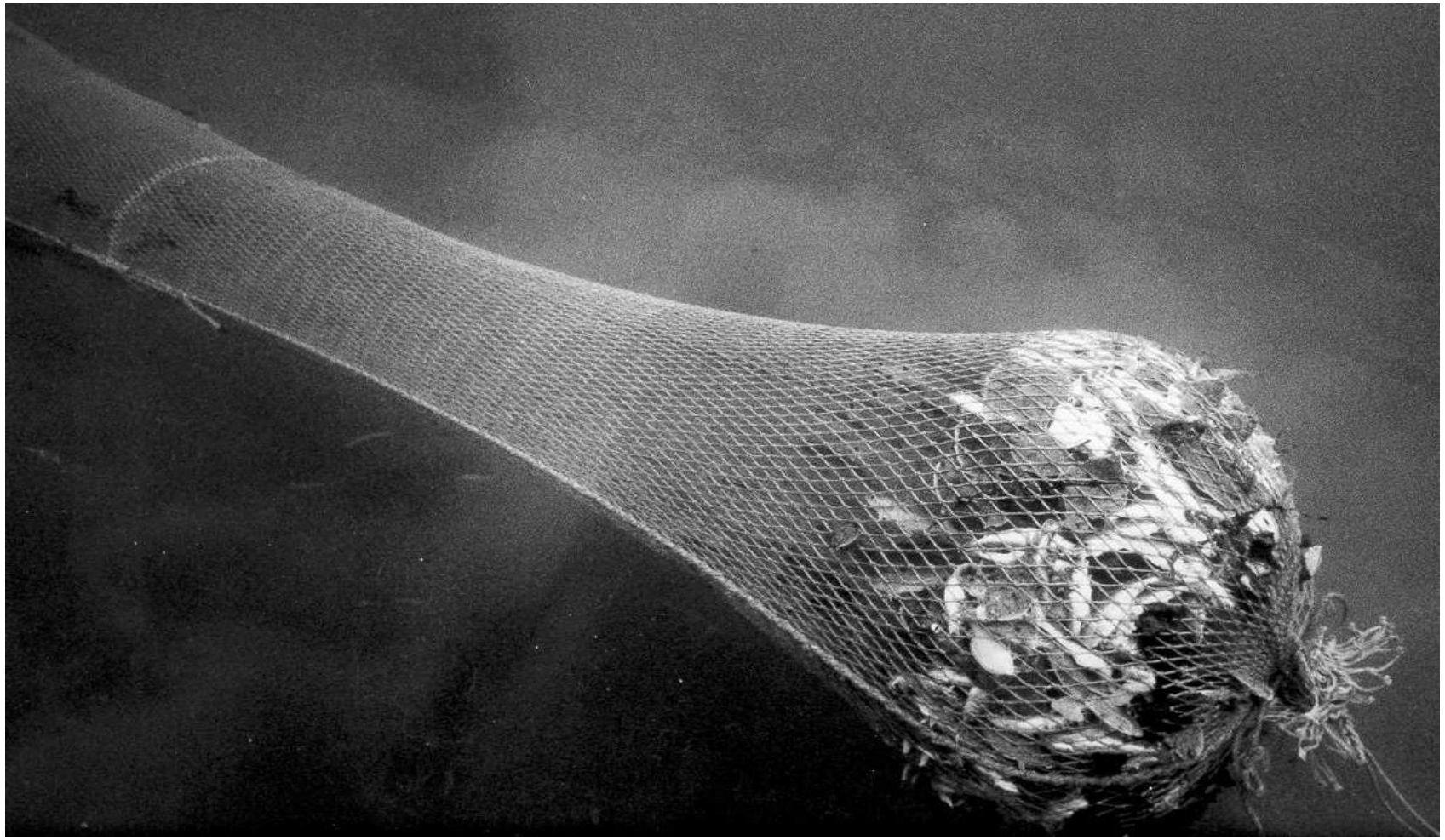
Knot type



. Hand-woven (left) and machine-woven (right) codends.

Eryaşar et al., 2014

Meshes round codend circumference

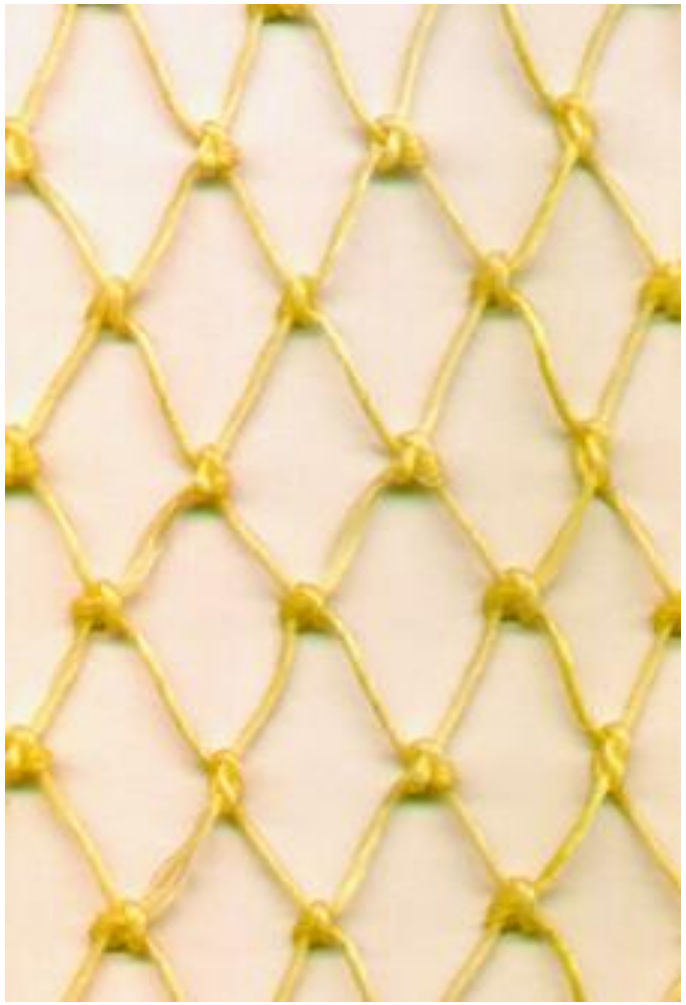


Main and Sangster (1990)

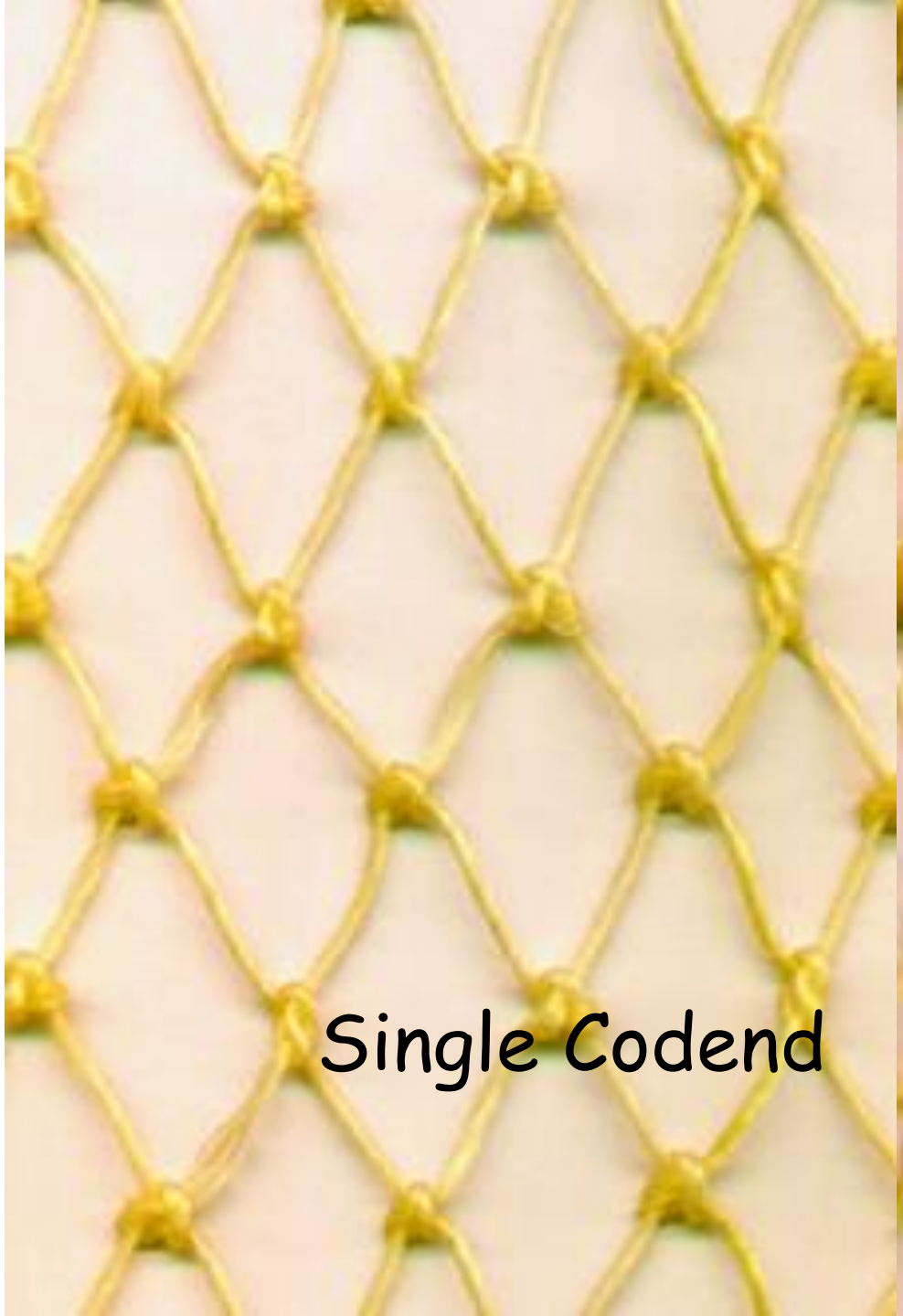
Strengthening bag

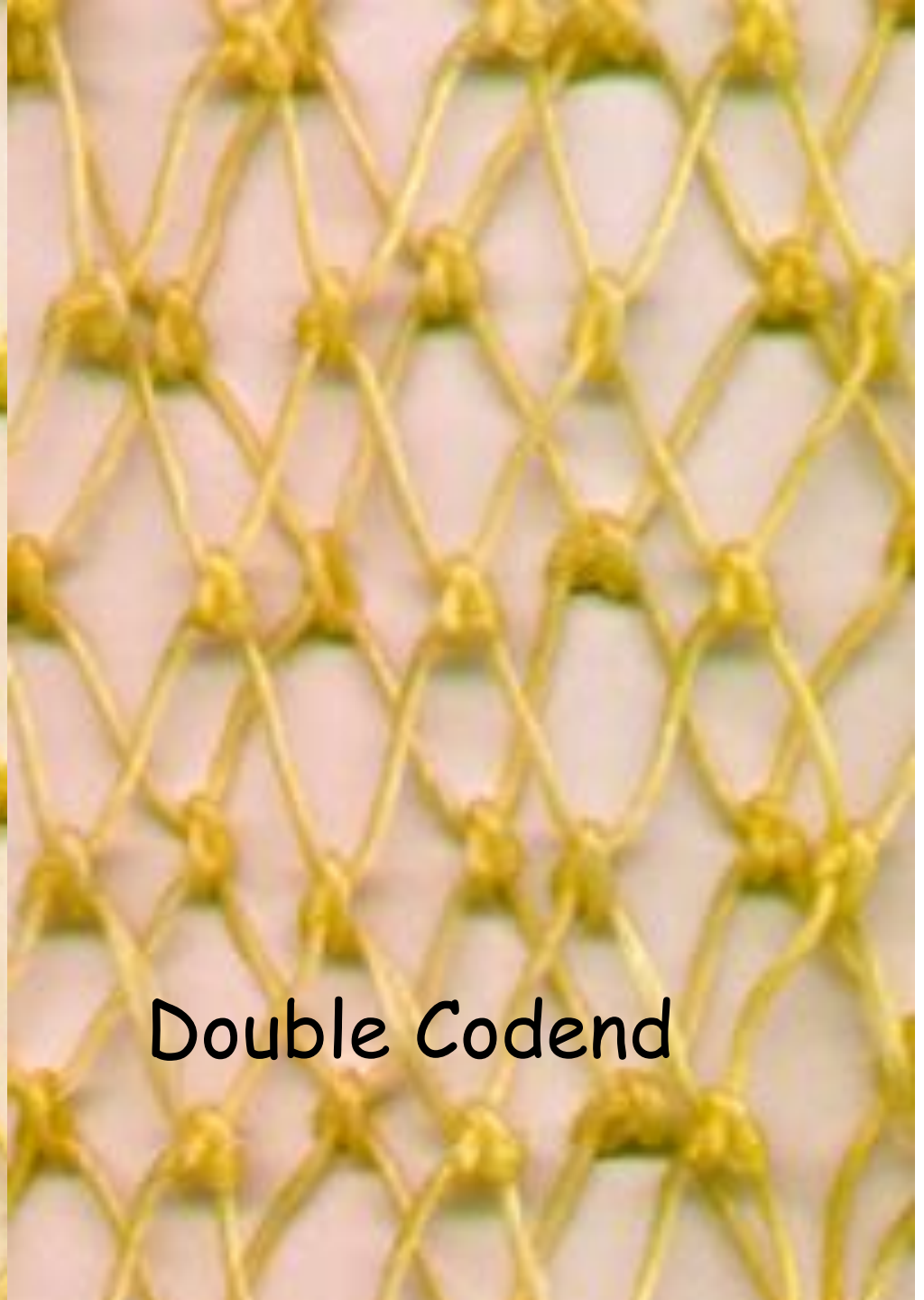
Netting material

Poliamid (PA, soft)



Polietilen (PE, stiffer)


Single Codend


Double Codend

Factors effecting selectivity

Take away messages

- If only some are controlled by laws, fishermen can manipulate the others
- Because they will want to minimise the commercial loss
- Therefore, it is important to know commercial loss while studying selectivity
- Because it also changes with
  - Fishing ground
  - Season
  - Market conditions
  - Enforcement

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Size selectivity of hand and machine woven codends and short term commercial loss in the Northeastern Mediterranean

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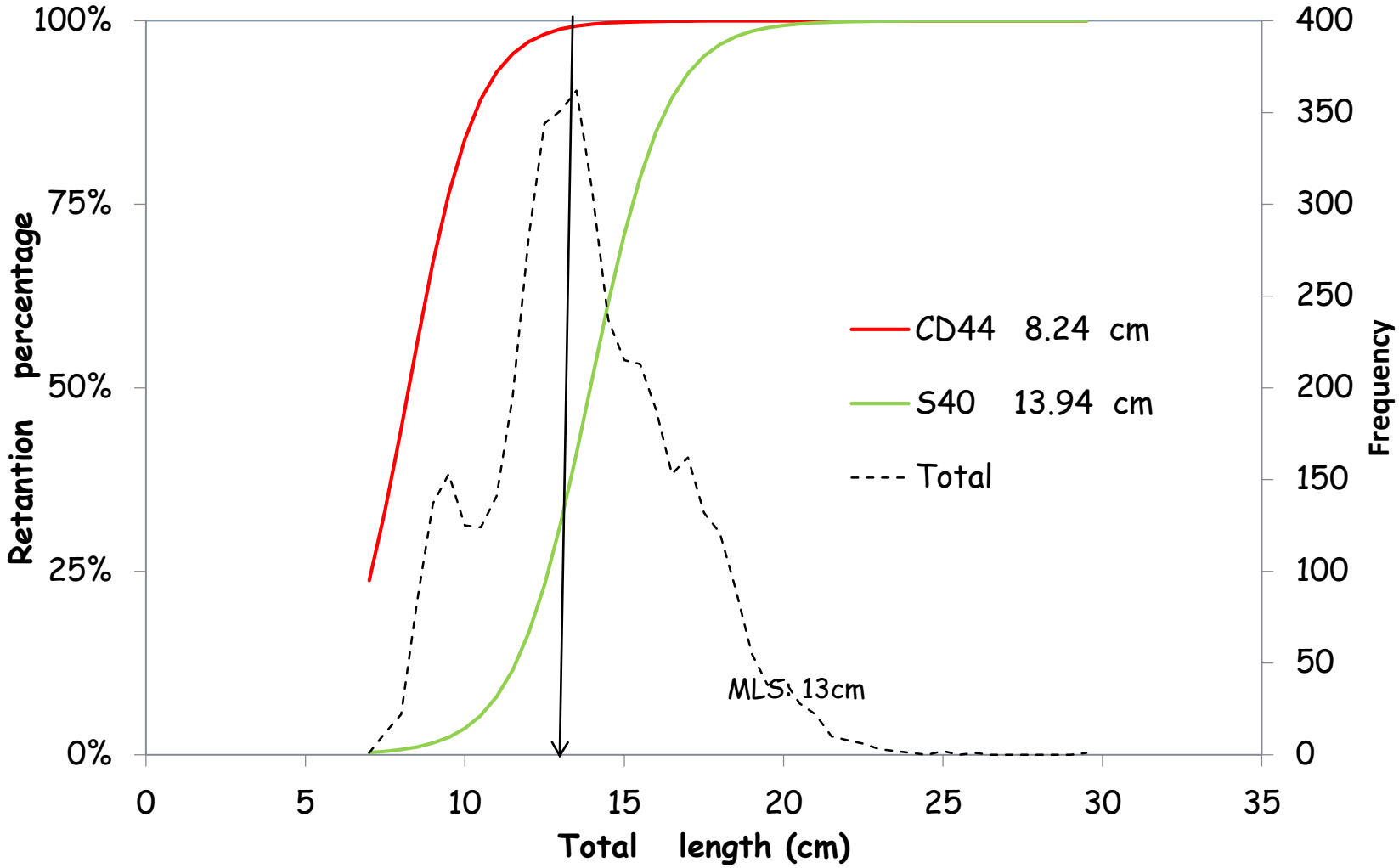
ABSTRACT

Poor selectivity of demersal trawls targeting fish, crustaceans and cephalopods in Mersin Bay, Turkey, (and more broadly for most Mediterranean demersal trawlers) is a significant concern. The majority of the boats working in the Mersin Bay trawl fishery use traditional gears with 44 mm mesh size hand-woven slack knotted codends in which approximately 50% of the catch by weight and 70% by numbers are discarded. The present study compares size selectivity of a commonly used hand-woven codend and three alternative machine woven codends (40 mm square mesh; 44 mm and 50 mm diamond mesh) for seven commercial species: red mullet (*Mullus barbatus*); brushtooth lizardfish (*Saurida undosquamis*); common pandora (*Pagellus erythrinus*); goldband goatfish (*Upeneus moluccensis*); Randall's threadfin bream (*Nemipterus randalli*); green tiger prawn (*Penaeus semisulcatus*); and speckled shrimp (*Metapenaeus monoceros*). A total of 87 hauls were conducted using a covered codend method in 2011. Short term commercial loss for 31 marketed species resulting from switching from the commercial codend to each alternative codend, was estimated. Results show that size selectivity of the commercial codend is rather poor for almost all the marketed species. The 40 mm square mesh codend is the best alternative for the majority of the marketed species in terms of releasing juveniles. We estimate a commercial loss of 17% in landing values if this codend is used.

Commercial and 40 mm Sq mesh codends

Red Mullet- East Med



Commercial and 40 mm Sq Mesh codends

Upeneus molucensis (Goldband goatfish)

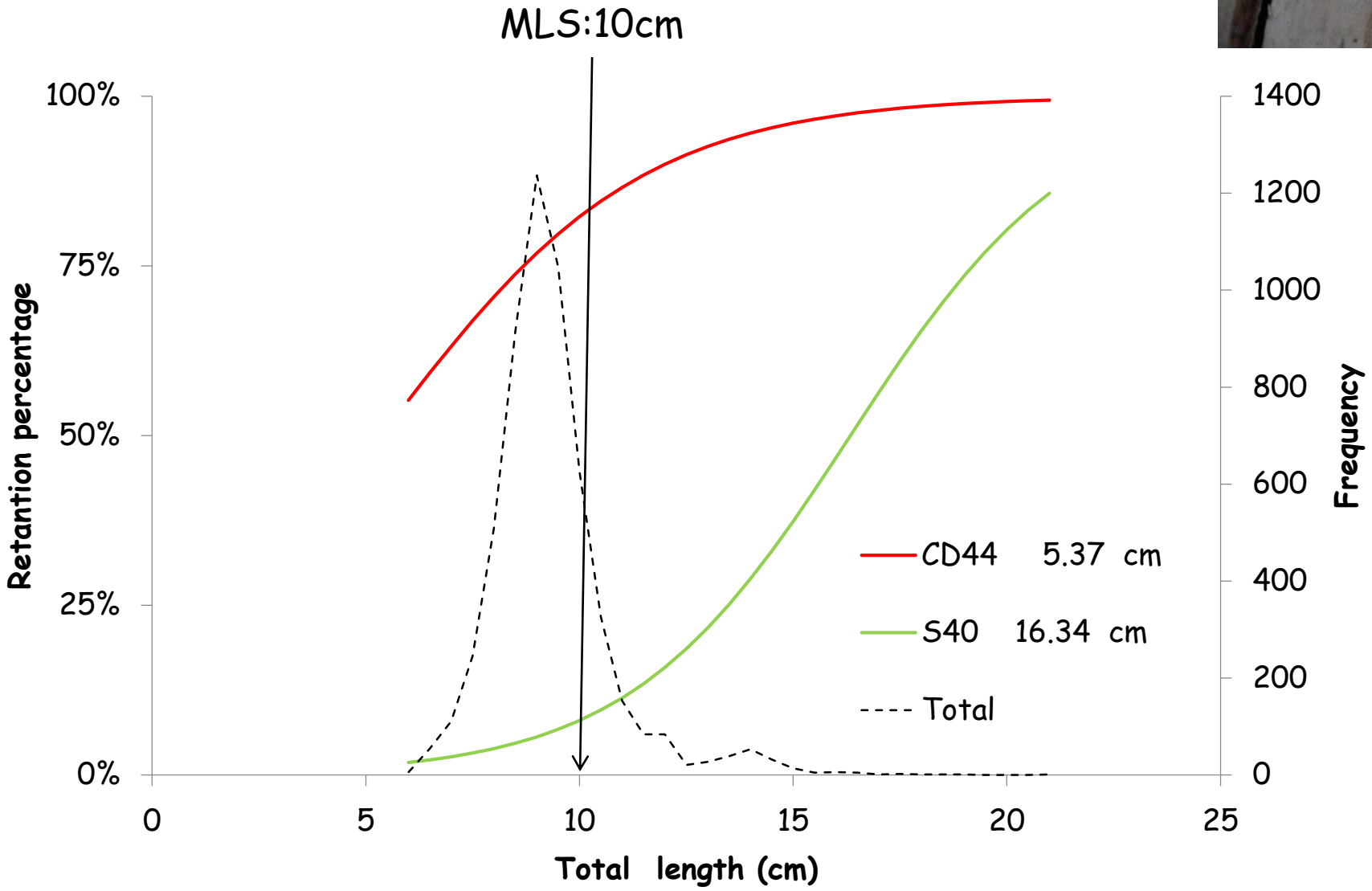


Table 4
Income (€) from commercial codend and economic loss in case a switch from commercial to test codends.

Marketed species	CD44			S40	
	Unit price (€/kg)	Weight (kg)	Income (€)	CRTCD44	Income (€)
Sepia officinalis	1.90	64.38	122.46	1.00	122.46
Saurida undosquamis	2.00	47.24	94.28	0.22	20.79
Penaeus semisulcatus	8.43	52.64	443.74	1.00	441.81
Mullus barbatus	3.93	44.37	174.46	0.69	119.88
Metapenaeus monoceros	2.96	14.79	43.80	0.60	26.35
Pagellus erythrinus	1.79	11.71	20.93	0.89	18.55
Upeneus moluccensis	2.64	7.57	20.00	0.05	1.03
Loligo vulgaris	4.46	9.44	42.10	1.00	42.10
Trachurus trachurus	0.82	5.9	4.85	0.34	1.64
Boops boops	0.62	6.32	3.93	0.37	1.43
Melicertus japonicus	5.12	5.1	26.11	0.97	25.43
Solea solea	3.59	4.51	16.18	1.00	16.18
Chelidonichthys lucernus	0.55	2.31	1.27	1.03	1.31
Sparus aurata	2.50	3.7	9.26	1.02	9.46
Spicara smaris	0.40	3.11	1.24	0.32	0.40
Merluccius merluccius	2.64	3.02	7.97	0.99	7.93
Lophius budegassa	2.74	2.78	7.61	1.00	7.61
Nemipterus randalli	1.86	1.58	2.94	0.13	0.39
Melicertus kerathrurus	5.12	2.15	11.01	0.86	9.42
Liza carinata	0.49	1.76	0.85	0.31	0.27
Liza ramada	0.43	1.18	0.50	0.90	0.45
Pagellus acarne	1.10	0.91	1.00	0.63	0.63
Pomatomus saltatrix	3.83	0.62	2.37	0.66	1.57
Chelon labrosus	0.43	0.54	0.23	0.66	0.15
Diplodus annularis	0.57	0.5	0.29	1.00	0.29
Sphyraena sphyraena	2.64	0.18	0.48	1.42	0.67
Mullus surmelatus	10.26	0.27	2.77	0.93	2.58
Dentex macrophthalmus	1.56	0.1	0.16	0.66	0.10
Upeneus pori	0.85	0.13	0.11	0.00	0.00
Serranus cabrilla	0.59	0.04	0.02	0.30	0.01
Scomber japonicus	0.85	0.02	0.02	1.00	0.02
Total value (€)			1062.92		880.90
Catch value per hour (€)			21.46		17.78
Loss (%)					17.13

	Commercial	40 Square	50 Diamond
Income	1000 TRY	828 TRY	792 TRY

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RESEARCH PAPER

Can Shifting Codend Mesh Shape and Mesh Size Increase the Size Selectivity of Red mullet (*Mullus barbatus*) in the Black Sea?

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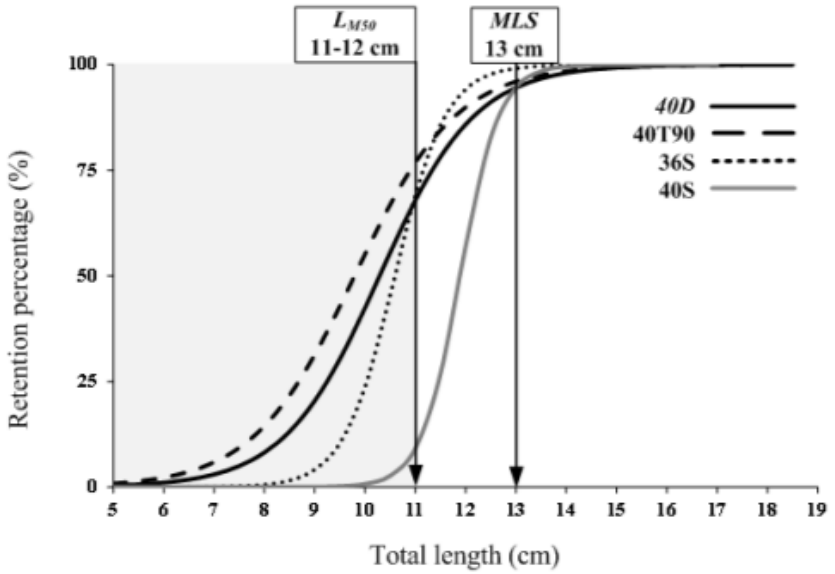

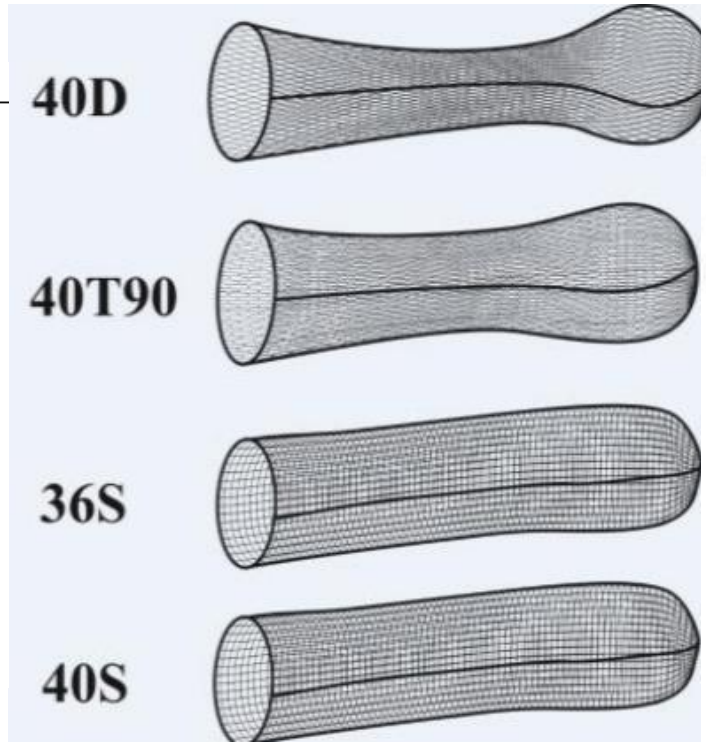

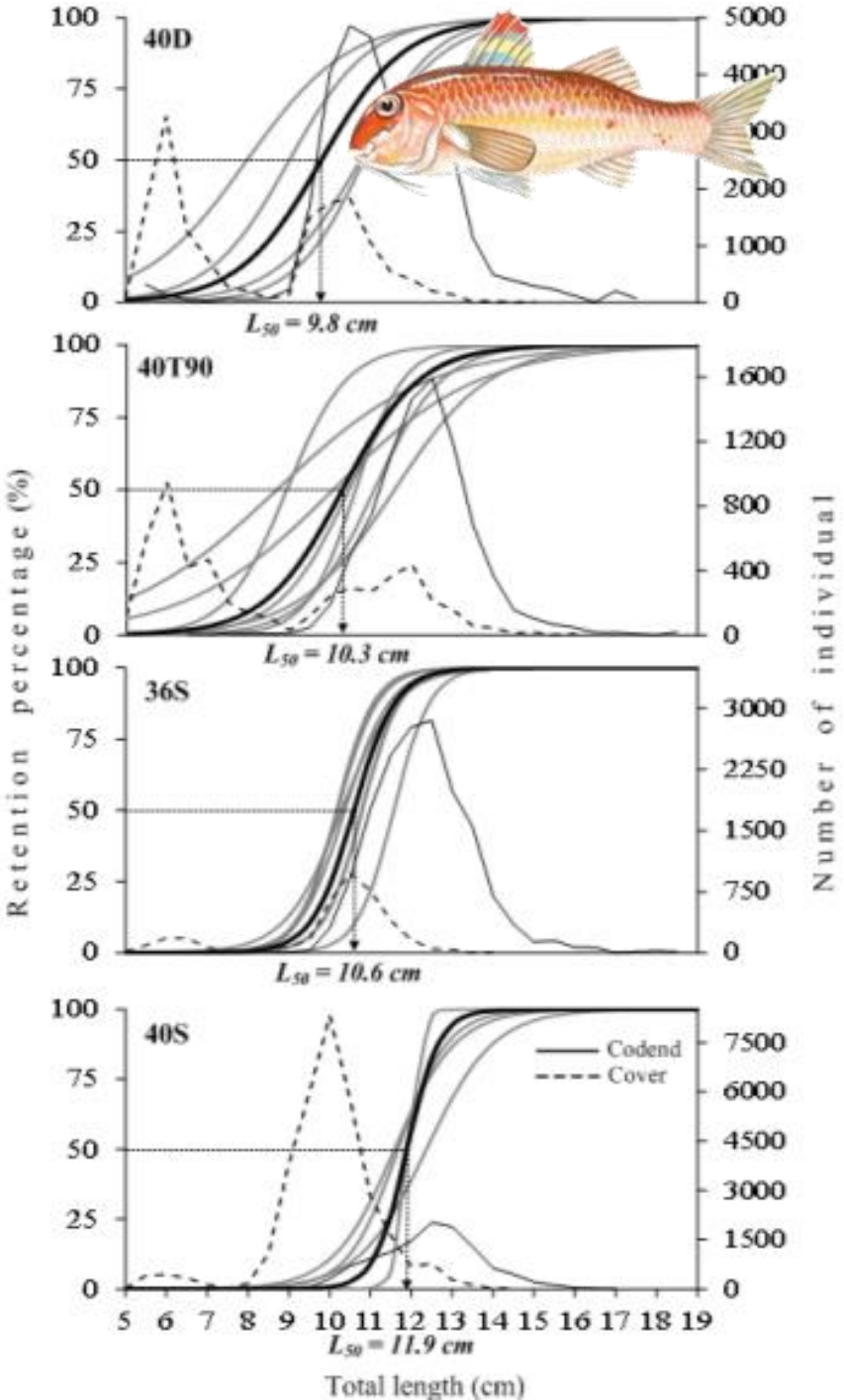

Table 4. Results of previous selectivity studies and the current work for red mullet in Turkey

References	Material	Mesh Size	Mesh Shape	L_{50}(cm)	SR (cm)	Study Area
Zengin et al., (1997)		36	D	12.54	2.34	Black Sea
		40	D	13.22	3.18	
		44	D	13.79	3.23	
Genç et al., (2002)		28	D	10.03		Black Sea
		40	D	10.91		
Özbilgin and Tosunoğlu, (2003)	PE	40	D	9.00	2.30	Aegean Sea
		40	D	10.10	2.30	
Özdemir, (2006)	PE	40	D	12.01	3.50	Black Sea
		32	SMP	11.64	2.93	
		36	SMP	12.32	3.21	
		40	SMP	12.91	3.20	
		44	SMP	13.37	3.94	
Kaykaç, (2007)	PE	40	D	11.80	3.00	Aegean Sea
		40	N	13.90	2.40	
		40	T90	15.20	1.80	
		40	RC	14.40	1.70	
Demirci, (2009)	PE	44	D	13.80	2.50	Eastern Mediterranean
		40	S	14.00	3.20	
		50	D	17.60	7.20	
Ateş et al., (2010)	PE	40	S	14.20	3.10	Eastern Mediterranean
Aydın et al., (2011)	PE	40	S	14.30	2.30	Aegean Sea
		50	D	15.30	4.40	
Özbilgin et al., (2015)	PE	44	DH	7.10	6.70	Eastern Mediterranean
	PE	40	S	14.10	2.60	
		44	D	8.40	5.20	
		50	D	12.10	4.70	
Current paper	PE	40	D	9.79	2.2	Black Sea
		40	T90	10.29	1.92	
		36	S	10.59	1.11	
		40	S	11.89	1.26	

[L_{50} (cm), length at 50% retention; SR (cm) selection range; PE, polythene; D, Diamond mesh codend; S, Square mesh codend; SMP, Square Mesh top Panel codend; N, Narrow codend; T90, 90° Turned-mesh codend; DH, diamond hand-woven codend; RC, Rigging Codend]

RESEARCH PAPER

Turkish Journal of FISHERIES and AQUATIC SCIENCES

Selectivity of Different Alternative Cod Ends and Radial Square Mesh Escape Panels (RSEP)

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Keywords
Selectivity
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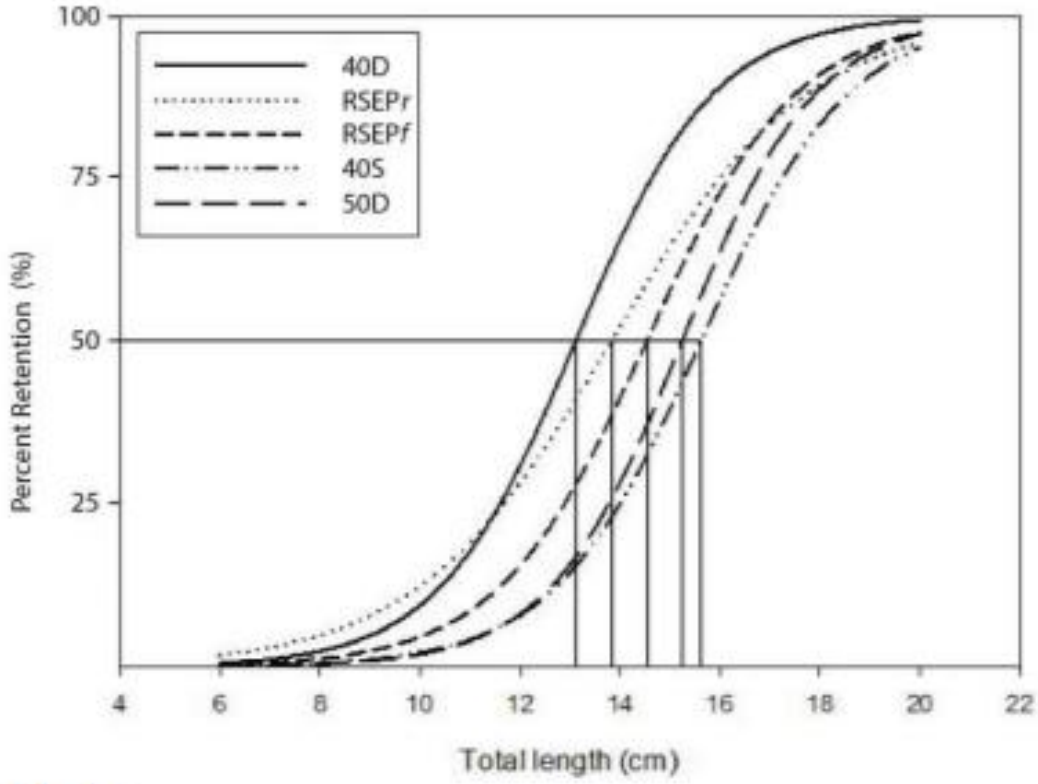
Bottom trawl
Mullus barbatus
Black Sea

Abstract

Bottom trawl fishery is carried out intensively throughout the season in the Black sea. For this reason, the selectivity effects of five codend with different mesh size, shapes and escape panels (commercial (40D), 50 mm diamond-shaped (50D), and 40 mm square-mesh (40S) and radial square mesh escape panels (RSEP) which were added to the front and back section of 40D) were investigated. Using a commercial fishing trawl, 44 valid hauls were carried out from August 23rd to October 24th 2016 on the Sakarya coast to the South west of the Black Sea. The L_{50} value of commercial cod end was calculated as was 12.9 cm for *Mullus barbatus* (red mullet), and was improved in cod ends with RSEPs. Further, the L_{50} values obtained from the other cod ends were found to be very high (40S: 15.62 cm, 50D: 15.24 cm). It was noticed that none of the cod ends showed sufficient selectivity for bluefish (*Pomatomus saltatrix*), which was caught as bycatch. The comparative account of the findings of current study with the previous studies advocates that the cod ends need to be made from PA netting and RSEP should be applied for more escape area.



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Ege Journal of Fisheries and Aquatic Sciences, 36(3), 301-311 (2019)

Su Ürünleri Dergisi (2019)
DOI: 10.12714/egejfas.2019.36.3.11

RESEARCH ARTICLE ARAŞTIRMA MAKALESİ

Comparison of selectivity of the trawl codends for whiting (*Merlangius merlangus euxinus*) in the Black Sea

Karadeniz'de Mezgit (*Merlangius merlangus euxinus*) avcılığındaki trol torba seçiciliklerinin karşılaştırılması

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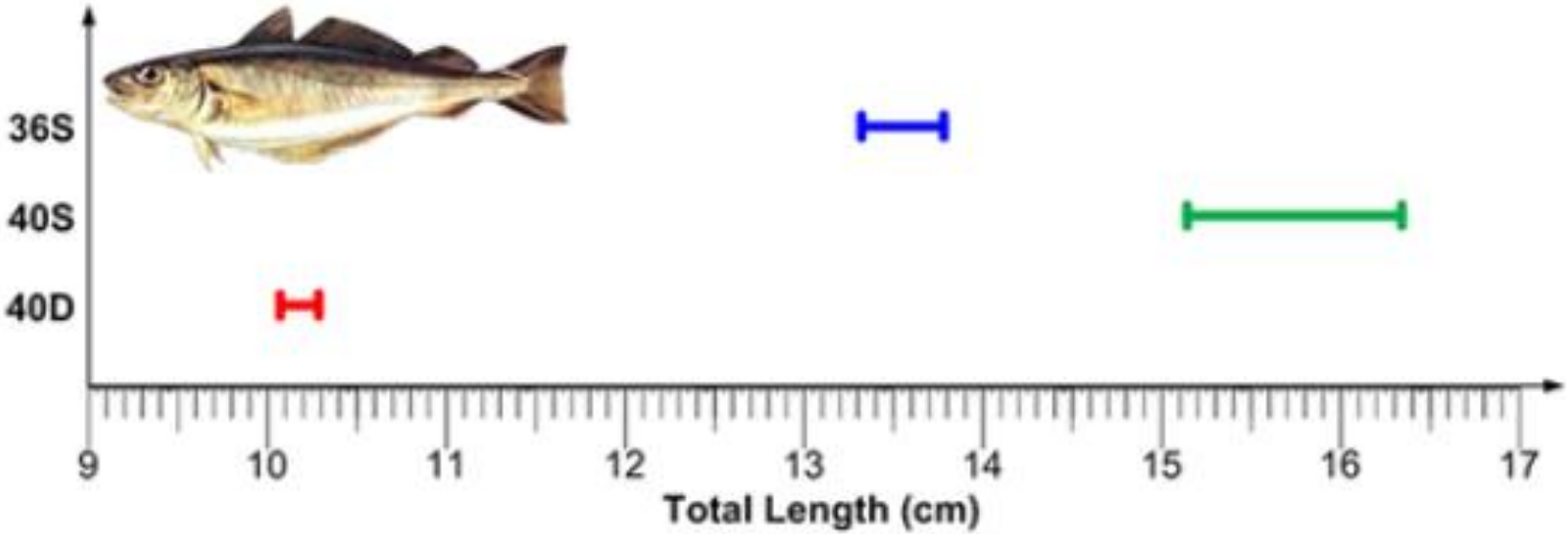

Figure 3. An illustration of the confidence intervals of the L_{50} values in the codends

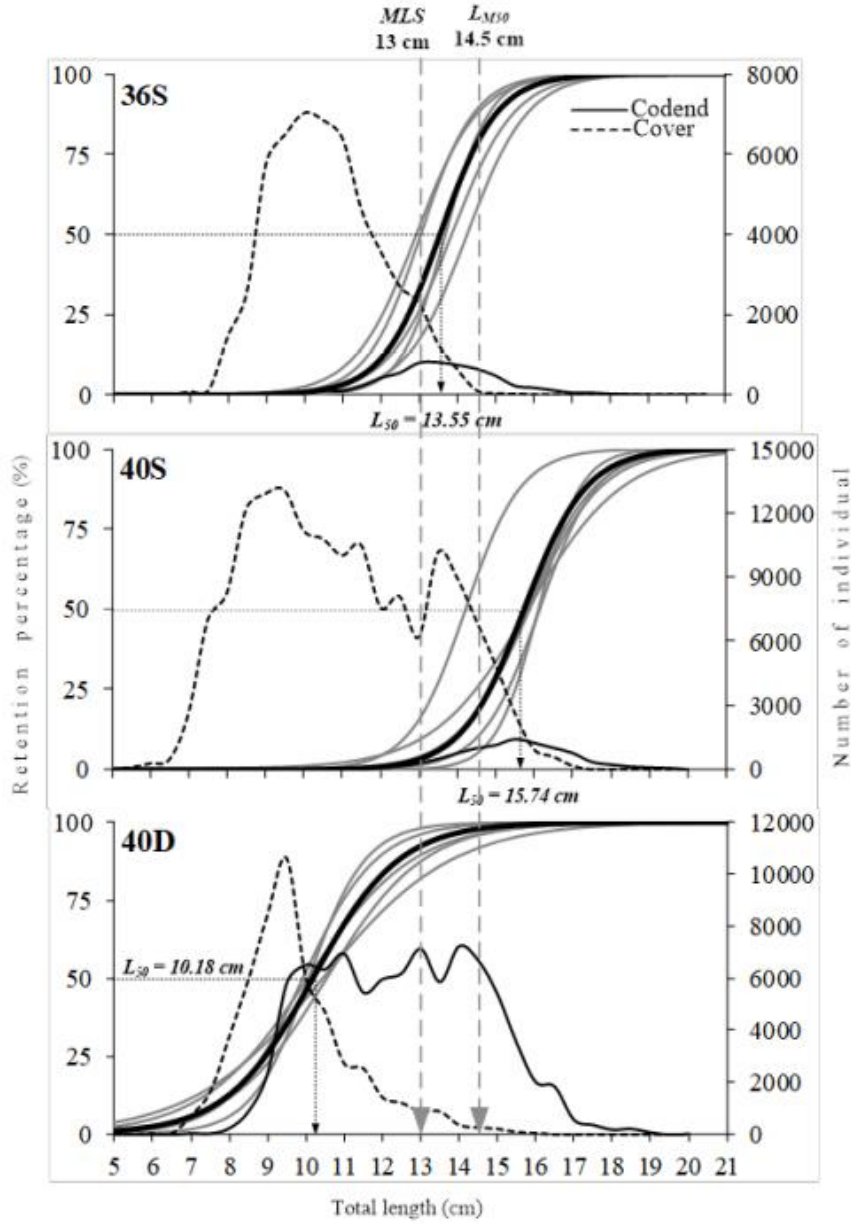

Figure 4. Individual (grey line) and mean selective curves (black line) with L_{50} values for codends, and length frequency distributions of whiting in codend and covers

Table 4. Results of previous selectivity studies and the current work for whiting in the B

References	Material	Mesh size	Mesh shape	L_{50} (cr	
Zengin and Düzgüneş (1999)	PE	36	D	13.1	5.10
	PE	40	D	14.8	4.20
	PE	44	D	15.1	4.20
	PE	40	S	15.4	3.90
Genç et al. (2002)	PE	28	D	10.76	3.43
	PE	32	D	12.68	5.42
	PE	40	D	13.54	3.32
Özdemir et al. (2012)	PE	40	D	12.57	3.45
	PE	38	S	12.71	3.12
	PE	40	S	13.55	3.70
Current study	**PE**	**40**	**D**	**10.18**	**2.59**
	PE	**36**	**S**	**13.55**	**1.61**
	PE	**40**	**S**	**15.74**	**1.81**

Turkish Journal of Fisheries and Aquatic Sciences 12: 407-410 (2012)
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ISSN 1303-2712
DOI: 10.4194/1303-2712-v12_2_29

The Determination of Size Selection of Whiting (*Merlangius merlangus euxinus*) by Square Mesh Panel and Diamond Mesh Codends of Demersal Trawl in the Southern Part of Black Sea

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[1] Sinop University, Fisheries Faculty, Fishing Technology Departmen

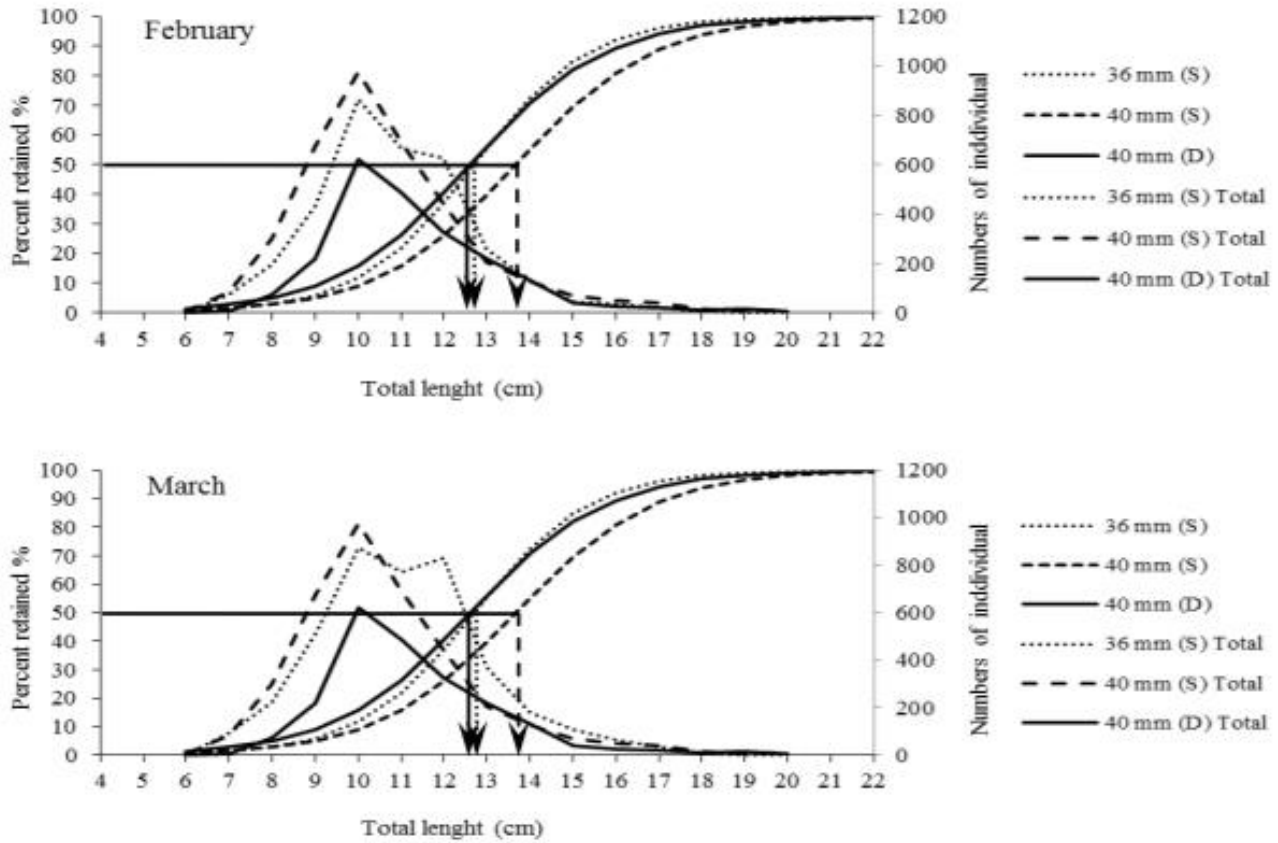
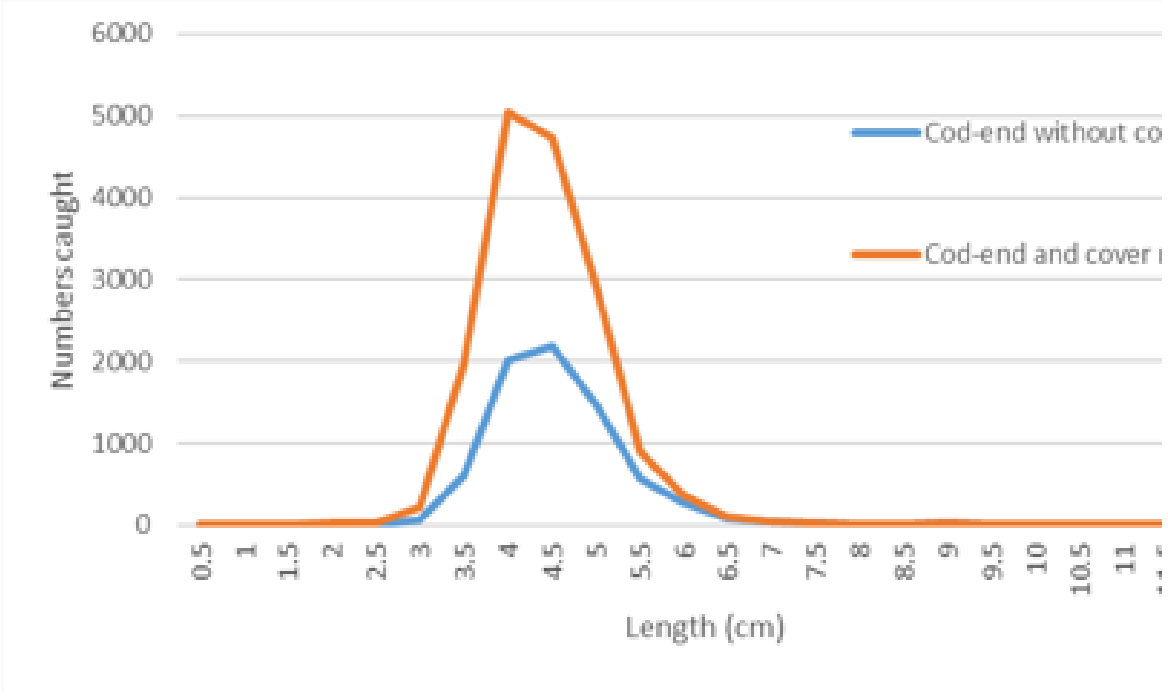
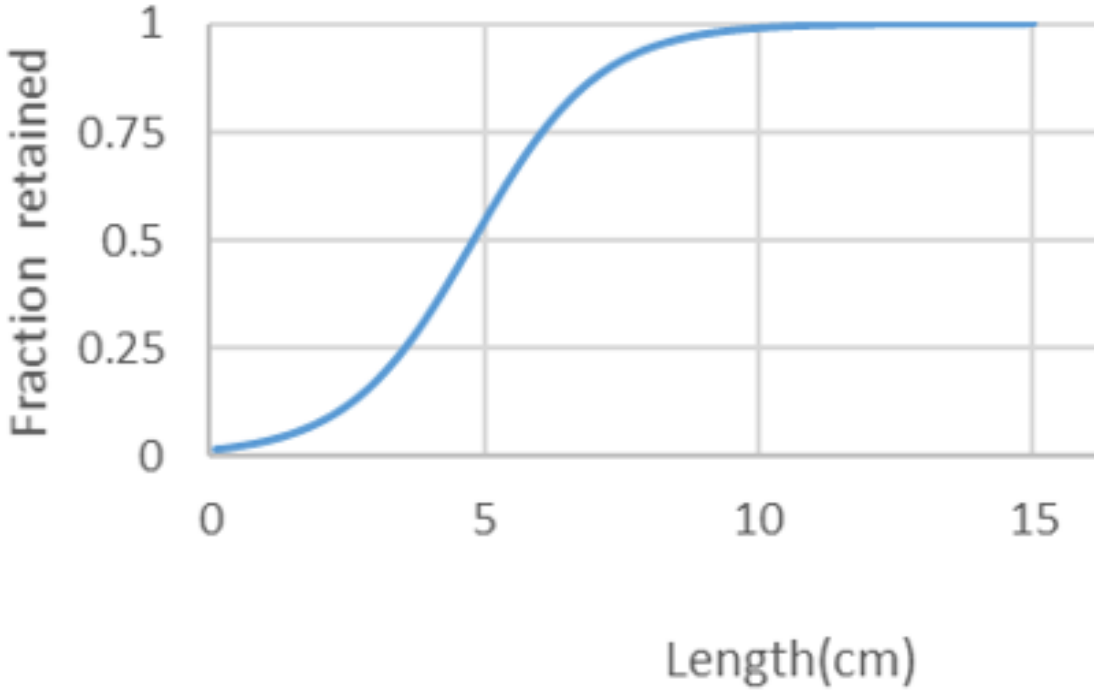


Figure 1. Individual and selection curves for square mesh panel installed codends and conventional codend in February and March. Length-frequency distributions of whiting that entered the codend and escaped are also in the figure.

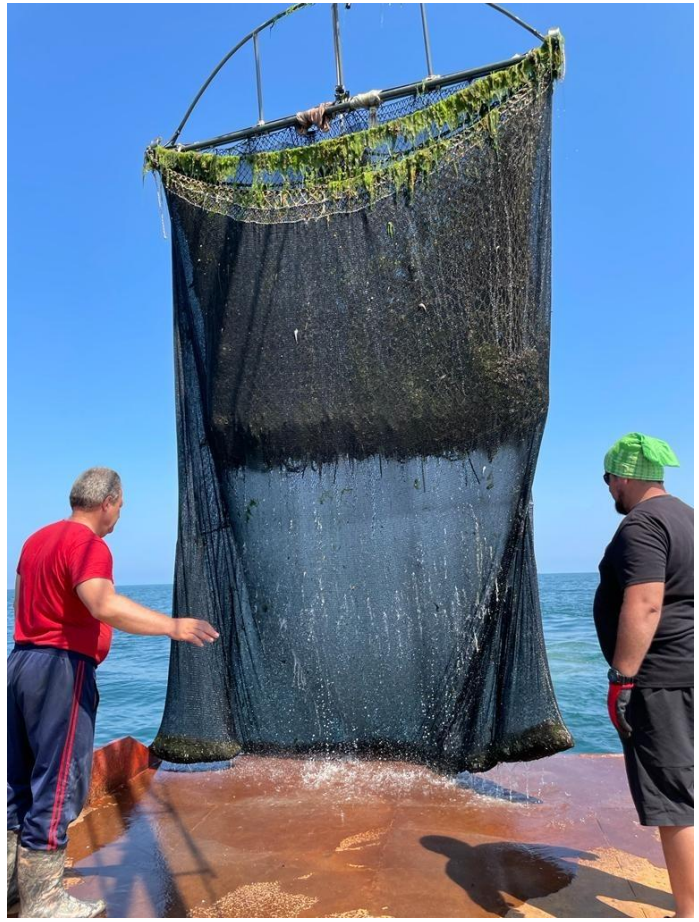
Black Sea Rapa BT Survey: Selectivity Study

- Conducted by SUMAE in Trabzon
- Survey gear 72 mm mesh size
- Cover net 11 mm mesh size
- 10 valid hauls hauls in Nov-Dec 2020

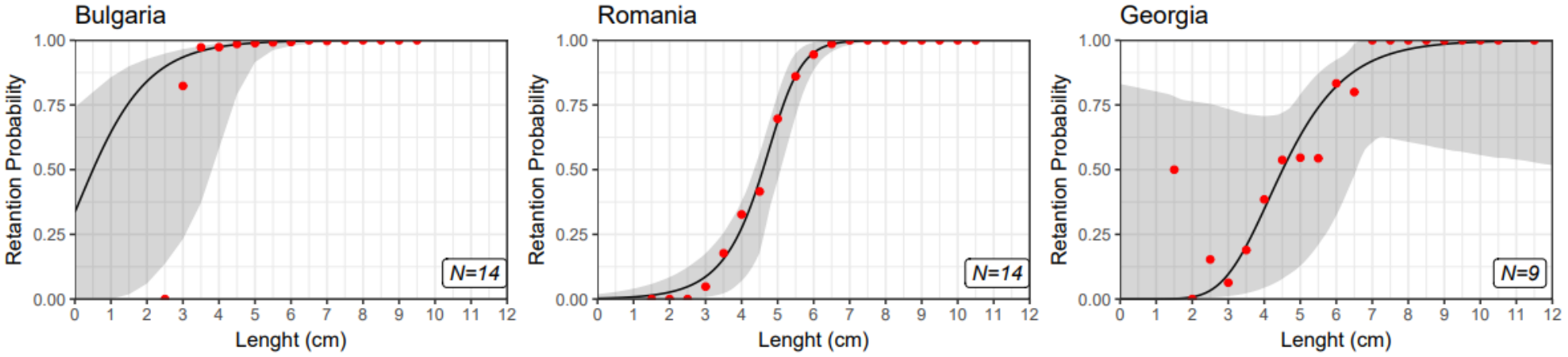


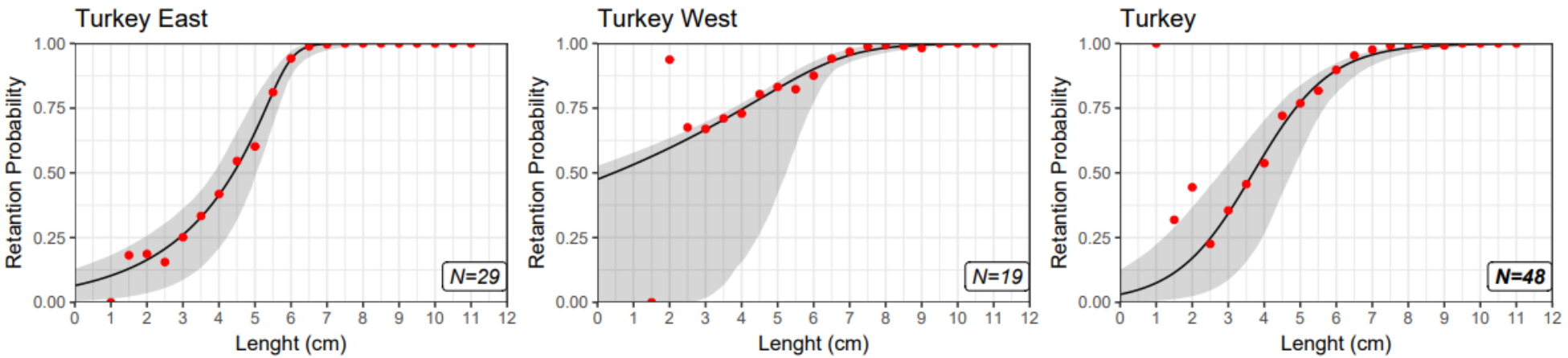


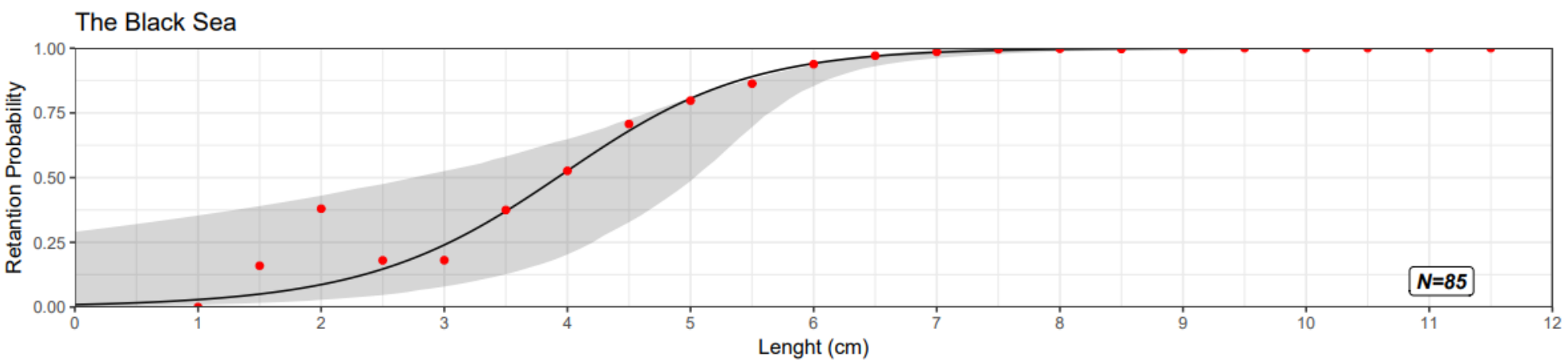
Black Sea Rapa BT Survey:Selectivity Study

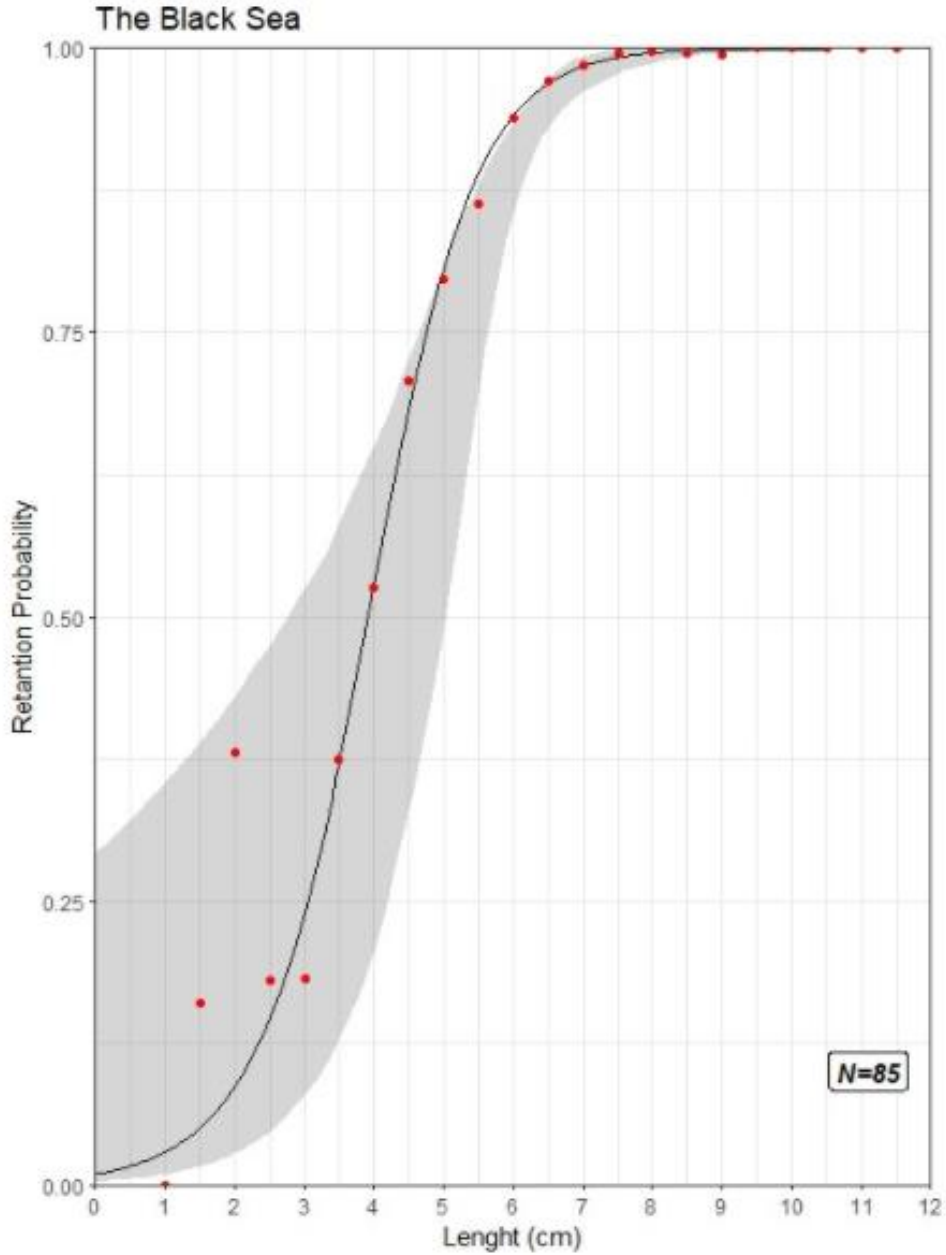


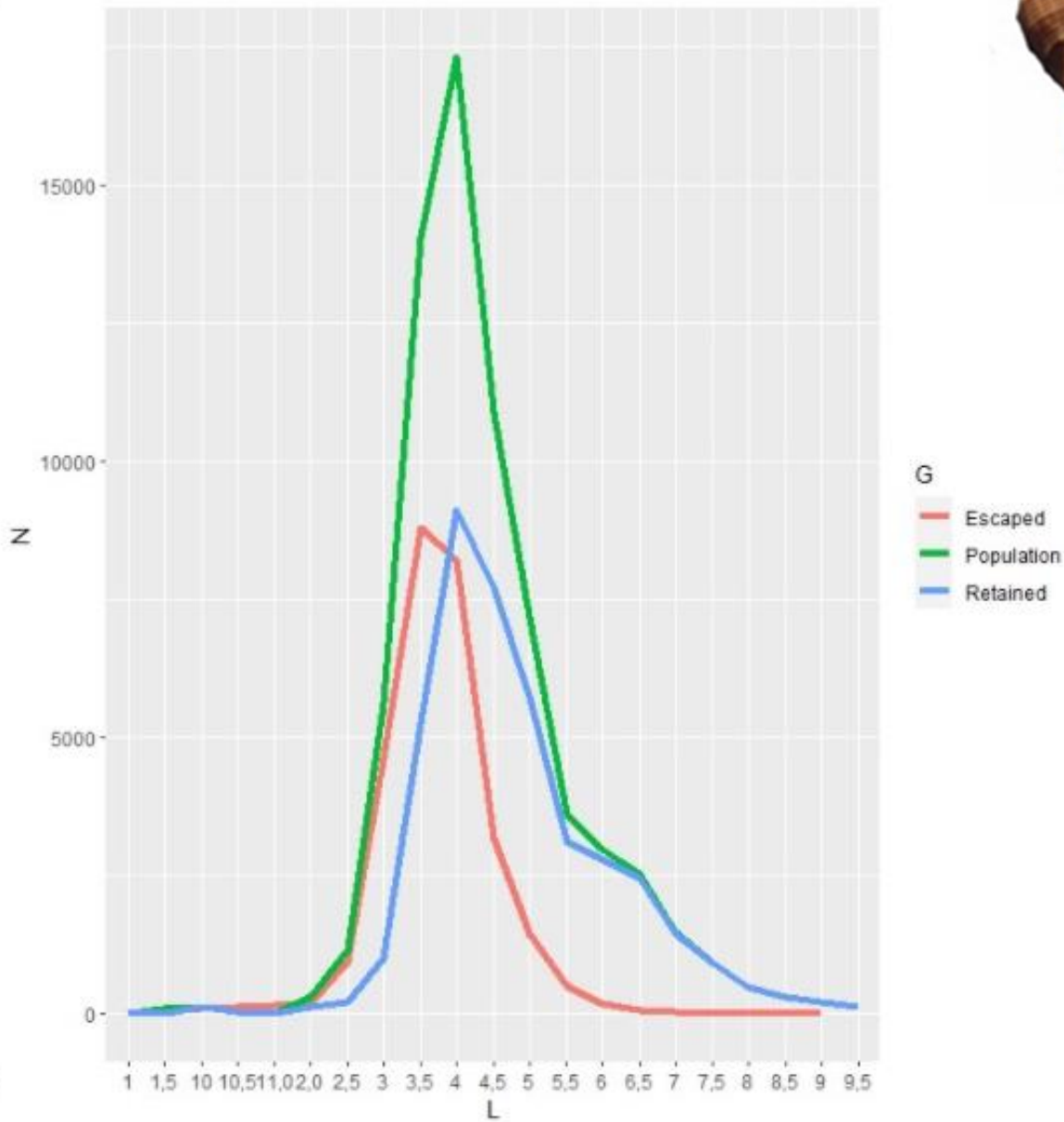
- Survey gear 72 mm mesh size
- Cover net 11 mm mesh size
- 85 hauls in Spring 2021 Survey


Bulgaria
Romania
Georgia
Retantion Probability
Lenght (cm)
N=14
N=14
N=9


Turkey East
Turkey West
Turkey
Retantion Probability
Lenght (cm)
N=29
N=19
N=48


The Black Sea
Retantion Probability
Lenght (cm)
N=85


The Black Sea
Retantion Probability
1.00
0.75
0.50
0.25
0.00
0
1
2
3
4
5
6
7
8
9
10
11
12
Lenght (cm)
N=85


N
15000
10000
5000
0
1
1,5
10
10,5
11
0
2
0
2,5
3
3,5
4
4,5
5
5,5
6
6,5
7
7,5
8
8,5
9
9,5
L
G
Escaped
Population
Retained

Mediterranean Marine Science
Indexed in WoS (Web of Science, ISI Thomson) and SCOPUS
The journal is available online at http://www.medit-mar-sc.net
DOI: http://dx.doi.org/10.12681/mms.15351

Research Article

A novel grid-net design to eliminate bycatch in beam trawl fishing for the veined rapa whelk in the south-eastern Black Sea

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Abstract

Beam trawl fisheries in the Black Sea target the veined rapa whelk (*Rapana venosa*) while other species of fish and crabs are returned to the sea dead or alive. Smaller bivalves and crabs are also packed with the catch without elimination. In this study, novel grid-net designs (GNDs) with two different bar spacings were tested to reduce the bycatch. Thirty hauls (15 hauls for each bar spacing) were carried out in the south-eastern Black Sea between 17 and 26 August 2017. Bycatch compositions were compared by towing a commercial diamond mesh and one of the grid-net beam trawls simultaneously onboard a commercial vessel. There were statistically significant ($p<0.01$, 78% and 83%) decreases in the mean bycatch weight for 20 mm and 30 mm grid-nets, respectively. The estimated commercial loss was 14% in the 20 mm GND and 39% in the 30 mm GND in the landing values as compared to the commercial gear. In conclusion, the use of grid-net design for beam trawl fishing in the south-eastern Black Sea can significantly reduce the bycatch of most benthic species. There is a trade-off between the reduction in the bycatch and some commercial loss, which could be offset with some compensation to fisheries, such as an extension of the fishing season.

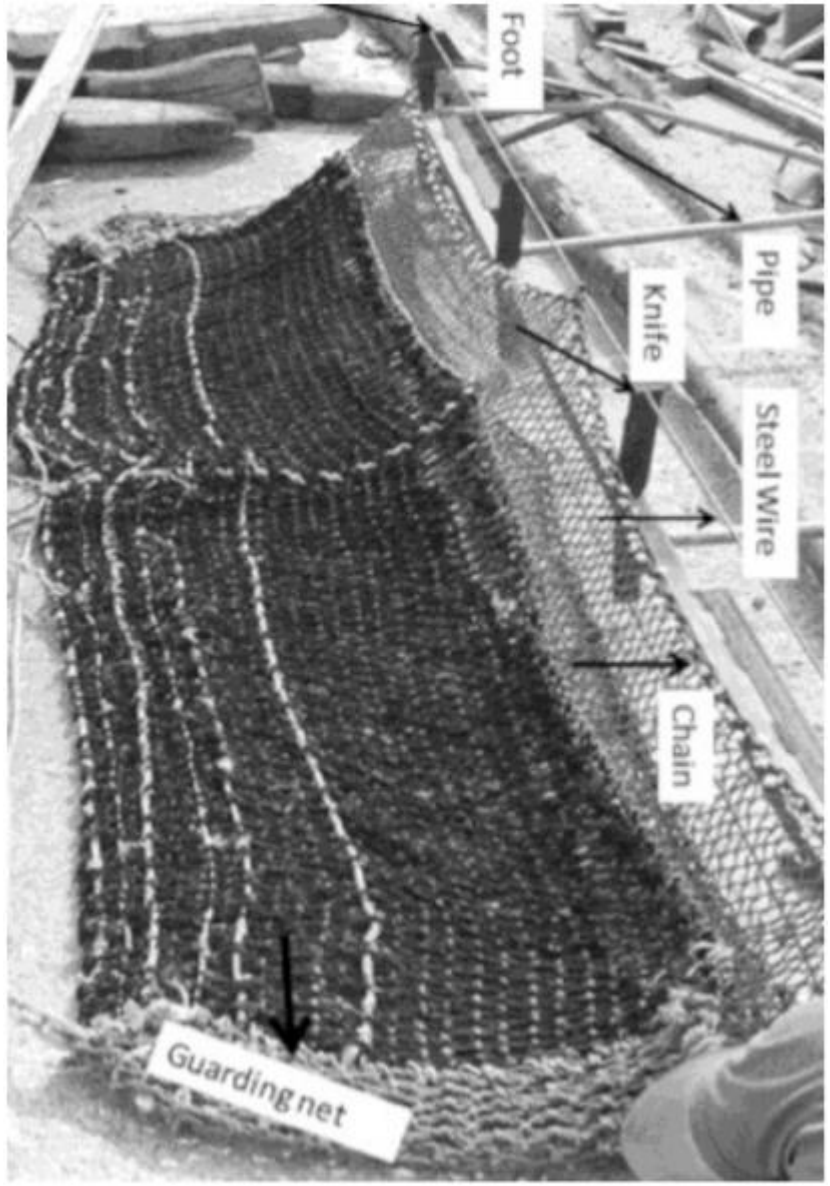

Fig. 2: Commercial beam trawl.

Fig. 3: Grid-net design.

20mm grid: 78% byctch decrease
14% commecial loss

30mm grid: 83% byctch decrease
39% commecial loss

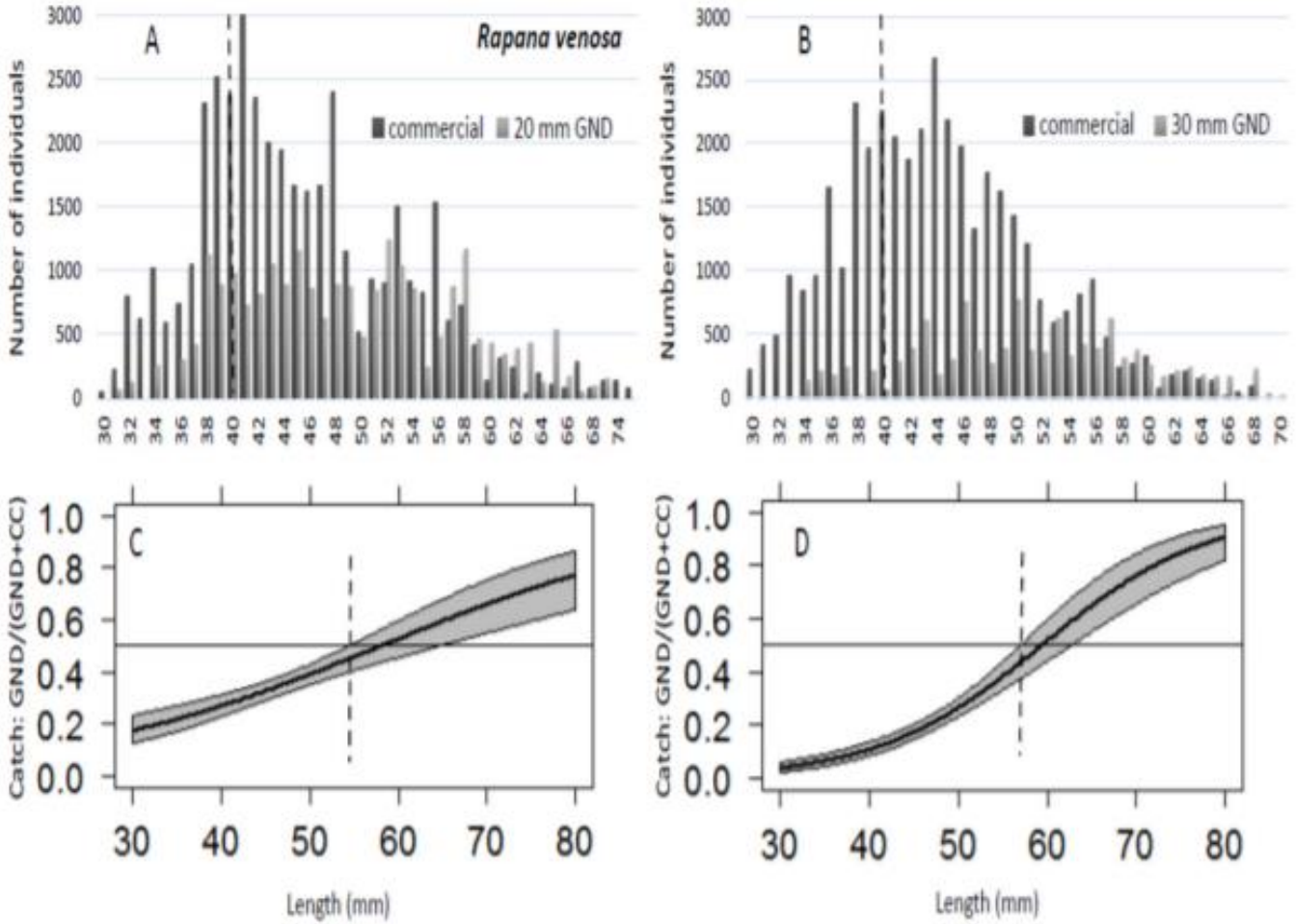

Fig. 5: Length-frequency distributions of the veined rapa whelk (*Rapana venosa*) for 20 mm GND (A) and 30 mm GND (B) with first maturity size (FMS (vertical line). GLMM modeling of the size of the veined rapa whelk for 20 mm GND (C) and 30 mm GND (D), showing differences in the catch at length. Catch ratio of 0.5 (horizontal line) indicates commercial and experimental gears catch at equal numbers. The solid line indicate the mean, the grey band is the 95% confidence level. The vertical line shows the length below which the reduction of the catch is significant.

CONCLUSIONS

Questions regarding commercial loss

- Are there enough large fish to catch with selective codends?
- Can the fleet be compensated for commercial loss?
- What happens to the escaping fish (issue of gear conflict)?

CONCLUSIONS

Methodology

To better understand the selectivity

- Many different methodology can be used in
  - ✓Research vessel
  - ✓Flume tanks
  - ✓Aquariums
  - ✓Computer models …

CONCLUSIONS

To improve selectivity

- Work with fishers (Design-Test-Develop together)
- Develop devices easy to handle and maintain, and cheep to install
- Do not penalise fishermen by reducing catches of marketablefish
- Increase the controls, make sure all the fleet complies.

- Remember !!!
- What works in one fishery, may not work in others
- What is acceptable to one group of fishermen may not be to another

CONCLUSIONS

- The problem

  can be solved

- Selectivity of the fishing gears can be improved
  - With cooperation between the industry and the researchers,
  - NGO's can provide significant contributions to increase
    - the recognition of the problem and
    - the advocacy of the solutions

Learn or hope

If escaping fish survives

BLACK SEA 4 FISH

PRESENTATION SERIES

TAKE-AWAY MESSAGES

- Involve stakeholders!
- There may be easier Ways to reduce fishing mortality!
- Take commercial loss into account!
- Do not assume all escapees will survive!