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ENVIRONMENTAL SUSTAINABILITY AND INNOVATIVE TECHNOLOGIES IN SMALL-SCALE FISHERIES AND AQUACULTURE

MODULE 1

SMALL-SCALE FISHERIES

Compiled by
Zdravko Ikica, IBMK-UCG

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RWG Region of Western Greece
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MODULE 1: SMALL-SCALE FISHERIES

UNIT 1: GILLNET AND TRAMMEL NET SELECTIVITY

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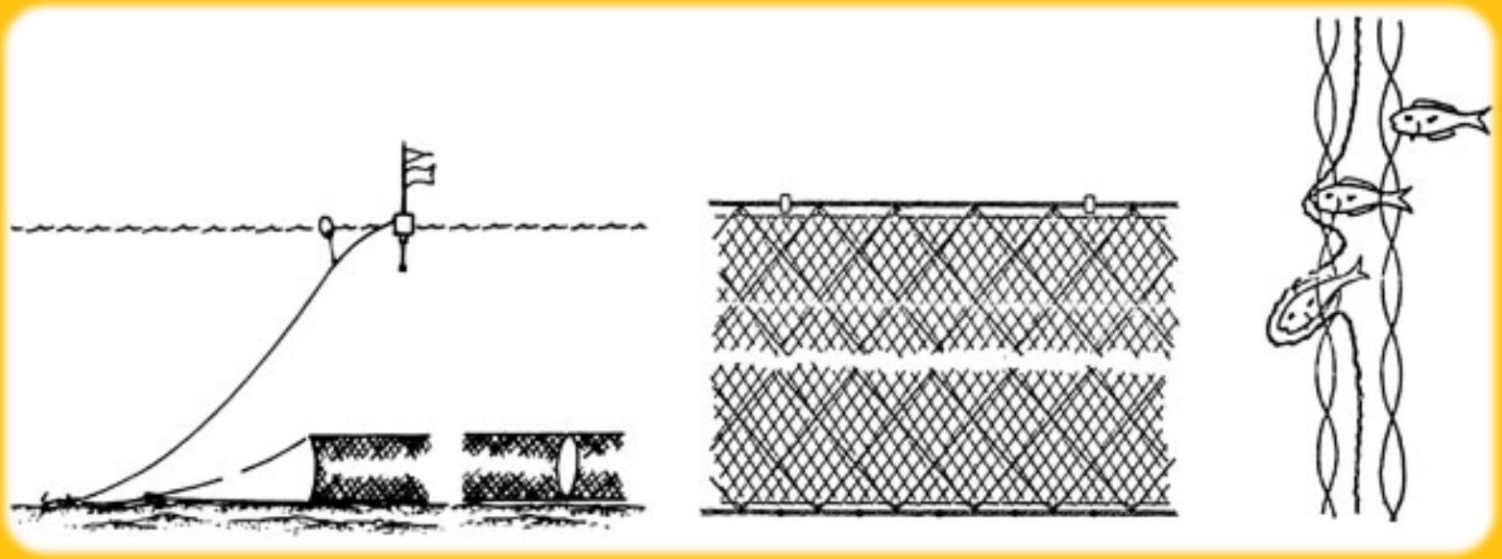
GILLNET AND TRAMMEL NETS

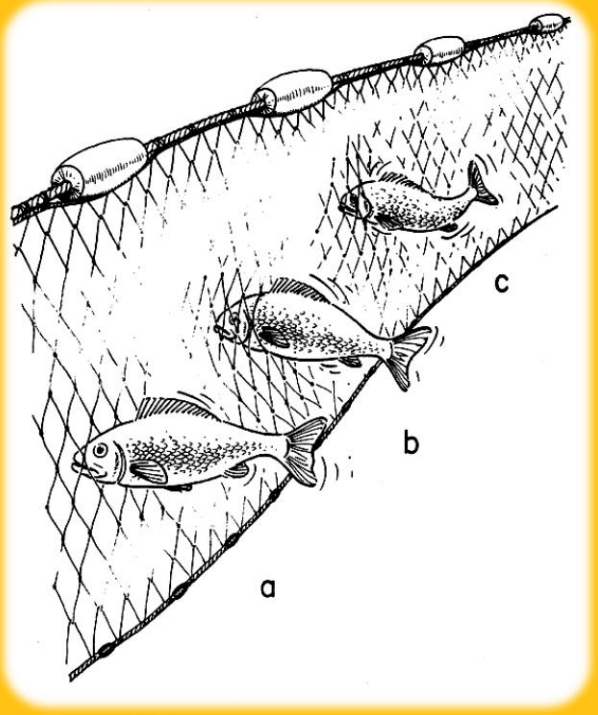
- Passive gears used most commonly in small-scale fisheries
- Both types of nets are typically long rectangular nets, with floats along the head rope and weights (sinkers) along the foot rope
- **Gillnets** are made with only one sheet of mesh, while **trammel nets** have three: two outer sheets with larger mesh size, and one with smaller mesh size sandwiched between the two outer layers

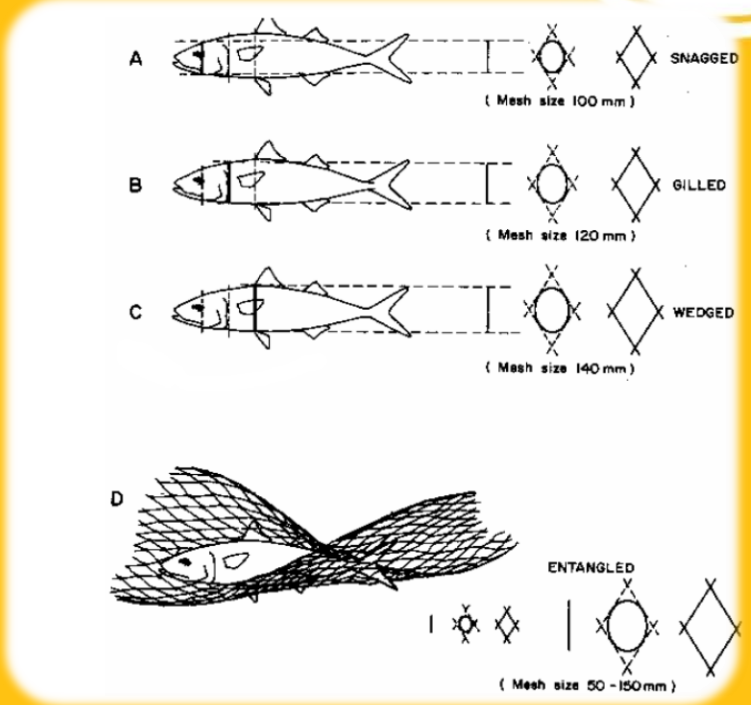
GILLNET AND TRAMMEL NETS



Photos: FAO

GILLNET AND TRAMMEL NETS





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GILLNET AND TRAMMEL NET SELECTIVITY

Net characteristics

- Mesh size
- Hanging ratio
- Vertical slack
- Twine characteristics
- Floatation and weight
- Soaking time
- Arrangement of nets in a gang – sequence and joining
- Other parameters (fish, fishing operations, environmental parameters)

1. MESH SIZE

- One of the most important parameters affecting selectivity
- Actual **mesh size** often differs from nominal value declared by the manufacturer

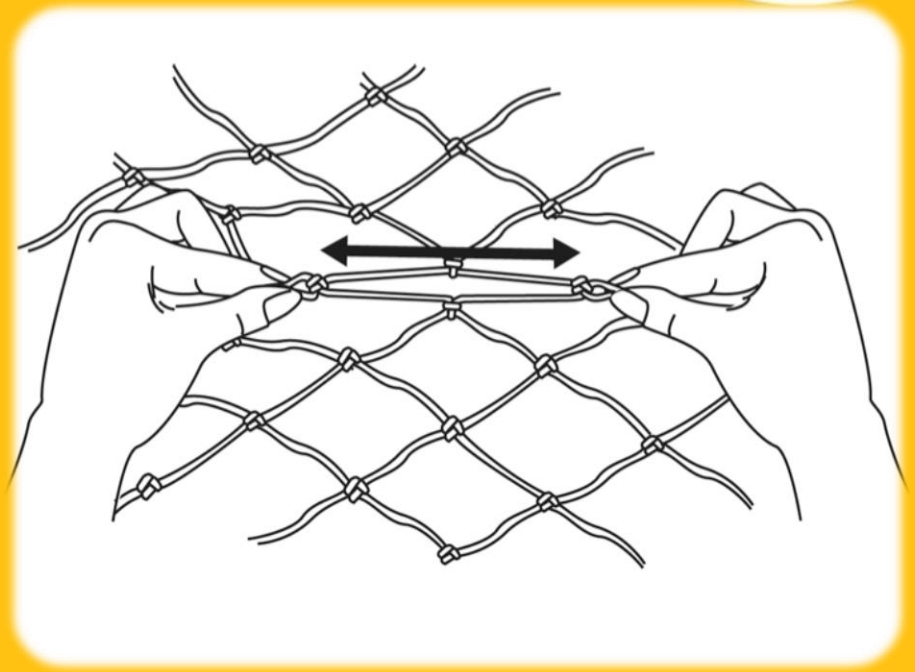

Image from ISSF Guidebook „Observer Training"
<http://www.issfguidebooks.org/observer-2-07>

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2. HANGING RATIO

- Parameter can strongly affect selectivity
- For same mesh size, mesh opening varies with the hanging ratio
- When netting is attached to lines, it should be longer than the lines so as to have a proper looseness

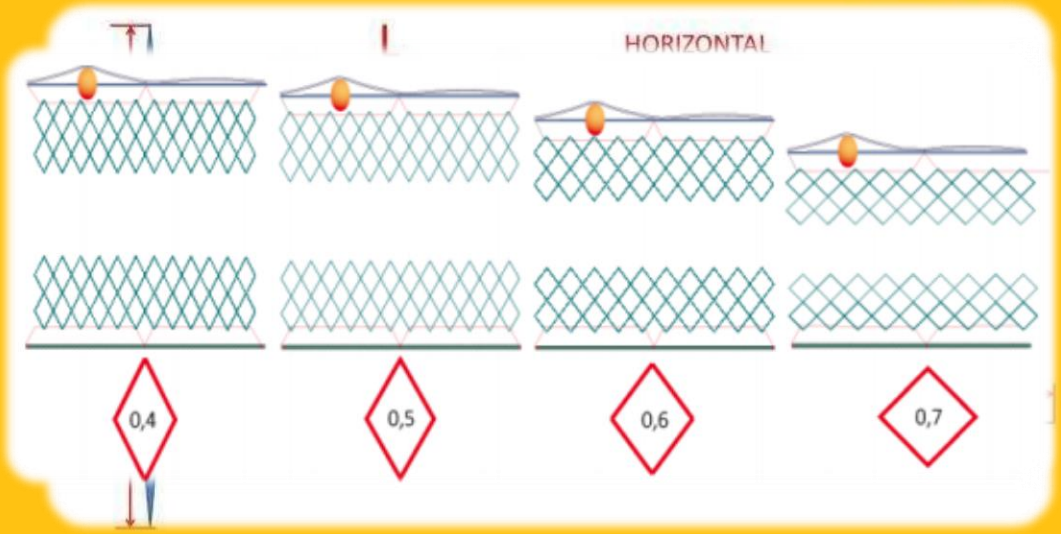

Image from A. Lucchetti, M.T. Spedicato, A. Conides, M.Sbrana, G. Bugliotti (2012) *Estimation of maximum net length of trammel nets, gillnets and combined bottom set nets by using the volume or the mass of the net* (Acronim. Archimedes). DOI: 10.13140/2.1.2157.7285. FAO

3. VERTICAL SLACK

- Ratio between the stretched length of the inner and outer netting in trammel nets
- Trammel nets with vertical slack of 1:1 have the same selection curve shapes as gillnets with the same mesh size
- Increase of vertical slack can increase net efficiency, but only until certain point, as too much slackness can increase visibility and lower efficiency
- Vertical slack san be controlled by height of walls in a trammel net

Image from htt[illegible]

Image from ACCOBAMS, *Mitigation measures for protected species*.

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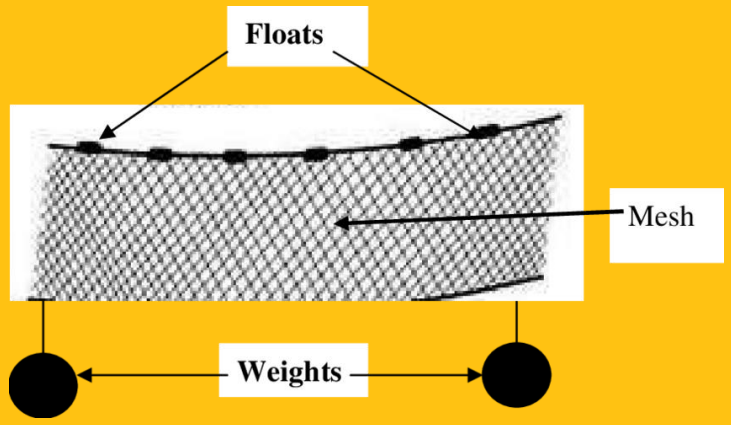
4. TWINE CHARACTERISTICS

- Small diameter twine ordinarily has a better catching power than larger diameters
- Decrease in diameter decreases the twine mechanical breaking point
- Increase of twine diameters should follow increase in mesh size
- Ideally, there should be a constant mesh size/twine diameter ratio, but this is difficult in commercial netting, where twine diamter is increased in steps or kept constant
- Elasticity changes with twine type, and this could be one of reasons for differences in catching power
- Visibility of twine and capacity to pick up dirt are also related to twine type
- Same twine colour should be used throughout the gang

5. FLOATATION AND WEIGHT

- Affect the vertical slack and drift of bottom nets over ground
- Increased slackness can lead to more (mostly large) fish entangled
- Drif over the ground can increasecatch (esp. Flatfish), but can be problematic on hard bottoms
- Smaller mesh size sheets tend to be heavier and might require more floatation and/or weight



Wakjira, M. (2011) Fisheries and Aquaculture.

6. SOAKING TIME

- Effect of soaking time on net efficiency is significant
- Saturation effect: once a fish has been caught in a mesh, the surrounding ones are not capable of catching other fish
- Presence of struggling fish makes net more obvious, as do the dead fish already cuaght in the net
- Escapement of fish from the net generally within 40 to 90 minutes after being caught

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7. ARRANGEMENT OF NETS IN A GANG

- Affect the vertical slack and drift of bottom nets over ground

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8. OTHER PARAMETERS

- **Fish** Catching process depends both on the mesh size and the body shape of the fish, i.e. girth and cross-sectional shape
- **Fishing Operations** Net handling techniques, as rougher handling can dislodge loosely caught fish
- **Environmental parameters** such as light levels, seabed type (through turbidity and visibility), etc.

SELECTIVITY CURVE

- Selectivity expressed as ratio → **selectivity coefficient**

$$\text{Selectivity Coeffient} = \frac{\text{Fish caught in the fishing gear}}{\text{Fish population exposed to the gear}}$$

- Fish population exposed to the gear can be estimated by use of a non-selective gear, which catches all the fish that come in contact with it or through various assumptions
- Fishing gears selectivity can generally be described through either the normal (i.e. bell-shaped) curve or the sigmoid (i.e. *S*-shaped) curve
- Passive gears usually have bell-shaped selectivity curves

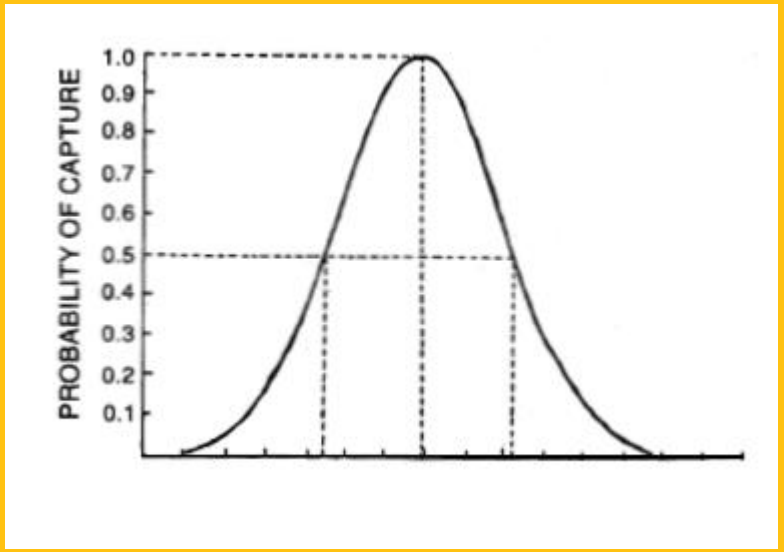
SELECTIVITY CURVE

- Gill nets and trammel nets have the bell-shaped selectivity curve, which can be described via the following formula:

$$S_L = e^{\left[\frac{-(L-L_m)^2}{2s^2}\right]}$$

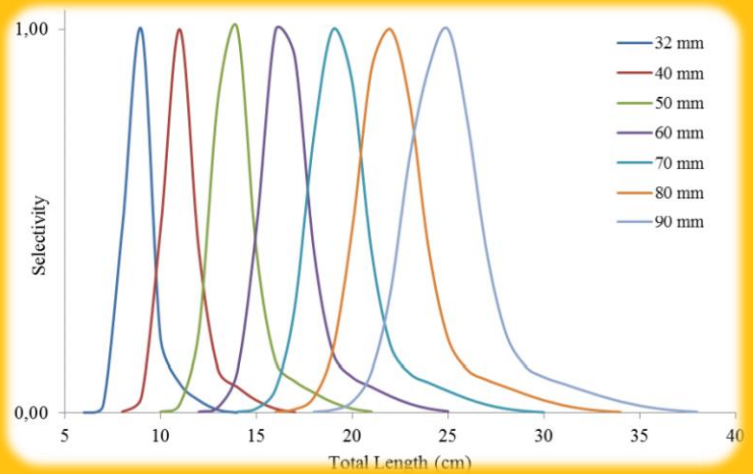
- Where S_L is length-based gear selectivity, e is the mathematical constant (Euler's number) approximately equal to 2.71828, L is the length interval mid point, L_m is optimum length for being caught, and s is the standard deviation normal distribution.

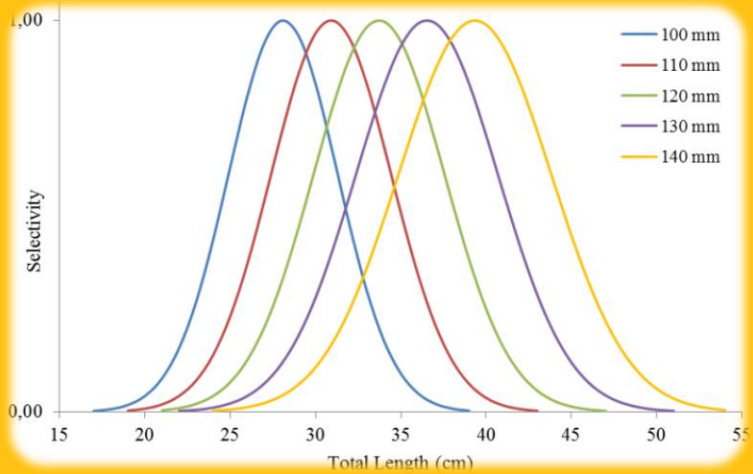
SELECTIVITY CURVE



SELECTIVITY CURVE

- Selectivity curve „moves” to the right as mesh size increases
- Gillnet selectivity curve can be assymetrical (left)





M. Cilbiz, Z. Hanol, N. Cilbiz, Ş. Çinar, S. Savaşer (2014) Multifilament Gillnet and Trammel Net Selectivity for the Silver Crucian Carp (*Carassius gibelio* Bloch, 1782) in Eğirdir Lake, Isparta, Turkey. Turkish Journal of Fisheries and Aquatic Sciences 14: 905-913.

MODULE 1: SMALL-SCALE FISHERIES

UNIT 2: REDUCING THE COMPETITION BETWEEN FISHERS AND WILD ANIMALS (DOLPHINS)

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DOLPHINS

- Marine mammals, not fish!
- Competition with fishers, especially in SSF, for the same resource: fish
- Nowadays beloved by just about everyone, but in past seen as threat to fishermen
- Culling campaigns in different countries, in former Yugoslavia in the 1950s and 1960s, with rewards for each dolphin killed
- Common dolphin (*Delphinus delphis*) effectively regionally extinct in the Adriatic since early 1970s because of culling, only now beginning to reappear
- Dolphins in the Adriatic: bottlenose dolphin (*Tursiops truncatus*), striped dolphin (*Stenella coeruleoalba*) (and common dolphin?)
- Bottlenose dolpin prefers shallower waters, up to 200 m depth, the most common dolphin encoutnered by SSF fishers
- Striped dolphin only rarely comes to areas with depth less than 200 m

INTERACTION BETWEEN DOLPHINS AND SSF

- Increased fishing pressure on fishing resources limits the amount of prey left for natural predators (such as dolphins), which results in dolphins looking for food through other available means, e.g. fishing nets
- One of indicators of reduced availability of food for dolphins is increased presence during trawling operations (not SSF) – dolphins follow bottom trawls along the seabed collecting fish that try to escape.

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DOLPHINS IN THE ADRIATIC

- Short-beaked common dolphin (*Delphinus delphis*) effectively regionally extinct in the Adriatic since early 1970s because of culling, only now beginning to reappear
- Once the most common dolphin in the Adriatic
- Length 150-180 cm, 100-136 kg
- Livce up to 35 years (22 in the Black Sea)
- Congregate in large groups, in some areas from 1,000-10,000 individuals
- Feed on fish and cephalopods, generally up to 200 m in depth

Photo by Netspy, CC BY-SA 3.0

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DOLPHINS IN THE ADRIATIC

- Bottlenose dolphin, *Tursiops truncatus*, prefers shallower waters, up to 200 m depth, the most common dolphin encountered by SSF fishers
- Can reach lenghts of just over 4 m, weigths of over 300 kg, and typically lives over 40 years
- Consume 10-15 kg of fish per day
- Considered one of the most intelligent animals, known to use tools
- Feed on a wide range of fish species, squids, eels, etc.

Photo by NASA (Public domain)

DOLPHINS IN THE ADRIATIC

- Striped dolphin (*Stenella coeruleoalba*) only rarely comes to areas with depths less than 200 m
- About 2.5 m in length and 150 kg in weight
- Can dive up to 700 m
- Social, gregarious, live in large groups (in Pacific Ocean, up to several thousand individuals, smaller in the Atlantic and Mediterranean)

Photo by Marcos90, CC BY 2.0

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DOLPHIN DISSUASIVE DEVICE – DDD („PINGE

- Devices based on using ultrasound
- Dolphins use high-frequency echosounder to navigate in water
- DDDs emit ultrasounds at certainfreequencies the dolphins find uncomfortable, and will try to avoid
- Many different models available on the emarket by various manufacturers

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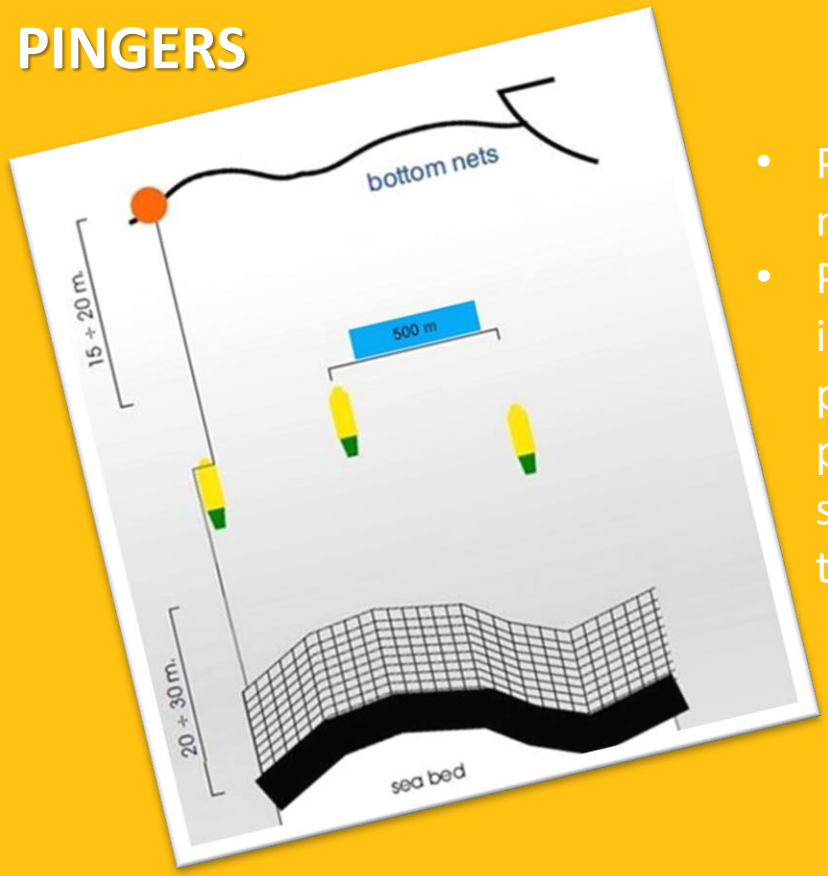
PINGERS



- Pingers are attached to the nets according to manufacturer's instructions
- Possibility exists that dolphins, being highly intelligent creatures, will realise that presence of pingers implies presence of nets, and, therefore, potential food, in which case the DDDs would start to ***attract*** dolphins, as opposed to turning them away.

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FUTURE

- The use and effects of DDDs need to be studied further, preferrably on a longer time scale, in order to precisely understand the effects of a prolonged use of pingers on cetaceans, i.e. primarily to determine whether they – in long term – act to dissuade the dolphins from approaching the nets, or, rather, mark the potential availability of food;
- Provided the studies confirm the beneficial effect of DDDs against dolphin predation and damage to fishing gears, their use should probably be regulated through legislative acts.

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Thank you for your attention!