

# **Gear selection**

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## **Gillnet selection**

### **Introduction**

The fundamental objective of any responsible fishing operation is to give maximum return to the fishermen with minimum efforts on the fish populations and the environment. Minimizing effects of fishing on the environment and fish population is much more difficult for quantification. This is because of complex interaction between the fishing process, fish and the environment. Over the years, improvements to fishing gear and fishing techniques have made fishing more effective with little consideration given to their effects on fish population and fish habitat. The effect of fishing on the population could be considerably reduced by making the gear selective.

### **Selection Process and Selectivity**

According to Parrish (1963), selection in fishing can be defined as “any process that gives rise to differences in the probability of capture among the members of the exploitable body of fish”. Such a general definition allows for the consideration of both between and within species selection during the different stages of the catch process.

In fact, the catch process (and hence selection) can be thought of as being divided in three distinct phases:

- probability that the occurrence of fish belonging to a single or different species coincides in time and space with the use of the fishing gear;
- probability that fish belonging to a single or different species encounters the fishing gear provided they are present when and where the gear is used (i.e., that fish are accessible to the gear);
- Probability that fishing gear retains fish belonging to a single or different species provided they have encountered it. (i.e., that fish are vulnerable to the gear).

The first two phases are essentially dependent on fish distribution and behavioural patterns, while in the latter the specific characteristics of the fishing gear play a fundamental role.

When between-species selection is considered, capture will depend mainly on the behaviour displayed by each species towards the fishing gear, while in the case of within-species selection the retention of a fish will be driven by its specific characteristics (age, length or girth). In this case, selection is often taken as synonym of length selection, in spite the fact that where meshes are concerned, selection is

essentially a girth/mesh-opening related process. Selectivity is no more than the quantitative expression of selection.

Unlike what happens for trawl codend selection studies gill-net selection studies have the drawback of the lack of knowledge on the structure of the population encountering the gear (with the obvious exception of the direct estimation studies). As a consequence, selectivity estimates are based on the comparative fishing with gillnets of different mesh sizes (the so-called indirect technique), while keeping constant the other physical characteristics of the gear. Furthermore, some basic assumptions are usually taken into consideration, the most important of which is the Baranov's "Principle of Geometric Similarity", which states that if selection depends only on the relative geometry of the fish and meshes then all selection curves are similar. Therefore, the selectivity will be the same for any combination of fish length and mesh size for which their ratio is constant (Hamley, 1975), that is to say that all meshes are equally efficient for the length class they catch the best.

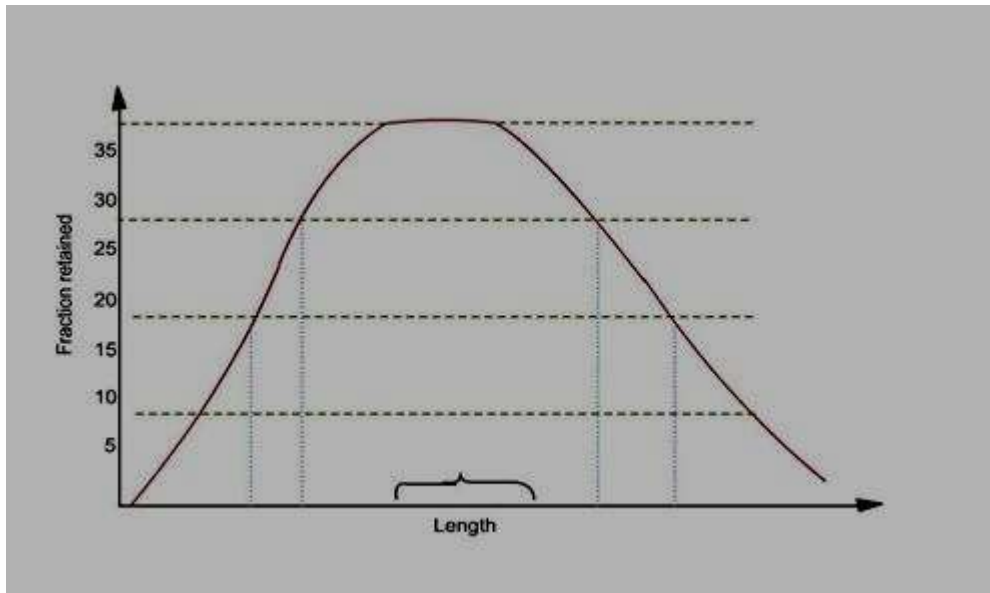
Fishing selectivity can be defined as the ability to target and capture fish by species, size or sex during harvesting operations, allowing all incidental by-catch to be released unharmed.

Selectivity play a major role in the development of a sustainable and economically viable fishery. The results of selectivity experiments can be befitted to the fishermen to

allow them to capture only targeted fishes and ensures the essential return of juvenile fishes. Most fishing gears, for example, trawl gears are selective for the larger sizes, while some gears (gill nets) are selective for a certain length range, only thus excluding the capture of very small and very large fish. This property of fishing gear is called “Gear Selectivity”.

## Bell shaped selection curve

Bell shaped curve is important for the analysis of selectivity for most of fixed gears. The width of the selection curve provides the selection range of the gear and the highest point in the curve corresponds to the optimum size of fish caught by the gear.



## **Sigmoid shaped selection curve**

In the fixed gear, the entry of larger fish is prevented but it permits the escapement of smaller fish in relation to size. By contrast, mobile gears allow all the smaller size fish to escape through meshes and larger fish become more susceptible to selection. As size of fish increase, the percentage of fish retained also increases. The selection process produces “S” shaped selectivity curve.

The point where 50% of the fishes are retained and 50% escape, is known as the 50% selection size ( $L_{50}$ ). The steepness of the curve indicates the efficiency of the selection access. A shallow curve that gradually changes between  $L_{25}$  and  $L_{75}$  depicts a poor selection access, whereas a curve that very quickly changes from 0% to 100% selection (a vertical line) indicates optimum selection. The small selection range produces a vertical line selection and this is said to approach “Knife edge” pattern.

## Gill Net selectivity

A gill net is made up of a long rectangular web of netting which is set in the water to a vertical wall. A buoyant headrope and a weighted foot rope ensure that the net wall remains in a vertical position.

### Catching process

Fish are caught in a gill net in one of three ways.

- **Wedging:** a fish is held tight around the body by a mesh.
- **Gilling:** a fish enters the net but it is too large to pass through and is prevented from retreating by twine that catches the fish behind its gills.
- **Tangling:** The fish has not necessarily penetrated a mesh but is caught in the net by teeth, maxillaries or other projections.



# Gill net selectively

**A**   Snagged  
(mesh size 100mm)

**B**   Gilled  
(mesh size 120mm)

**C**   Wedged  
(mesh size 140mm)

**D**   Entangled  
(mesh size 60-150 mm)

## **Factors influencing the selectivity to Gill nets**

Planning an experiment involves prior knowledge of the factors that can affect gear selectivity. Some of them, as those related to the gear, are easy to control, in opposition to those related to the fish or to environmental conditions.

### **Gear parameters**

- Gang and net dimensions
- Mesh size (Use the given one) - The smallest fish caught has a maximum girth equal to the perimeter of the mesh, the largest fish caught has a head girth equal to the perimeter of the mesh. Fish between these two sizes are caught.
- Hanging ratio
- Vertical slack (defined as the ratio between the stretched length of the inner and the outer netting, in trammels and semi - trammel nets). It can be controlled by the height of the walls in a trammel net.
- Twine characteristics (material, construction, thickness, colour, flexibility...)
- Floatation and weight

- Soaking time
- Arrangement of nets in the fleet - sequence and joining between nets; interaction between nets

### **Parameters related to the fish**

- Fish abundance
- Fish availability to the net
- Fish behaviour towards the net
- Fish size
- Fish shape (girth at different body points)
- Presence of by-catch
- Presence of predators (can reduce the soaking time)
- Net saturation
- Patchy distribution in the net (includes attracting effects by individuals caught)

## **Parameters related to the fishing operations**

- Dimension of boats (low-lying vs. high-lying boats)
- Net handling techniques
- Environmental parameters
- Light level
- Sea state and currents
- Seabed type
- Depth
- Occurrence of water/bottom debris

## **General information needed**

Before starting the work at sea, preliminary information must be collected regarding the fishery. Information on the following points should be collected:

- Fish populations (species composition, distribution and abundance, seasonal variations, by-catch)
- Fishing grounds (location, fishing yields, type of bottom, presence of other static gear in the area)
- Types of vessels used (main characteristics, bridge and deck equipment)
- Net handling techniques
- Duration of fishing trips

The main sources for this type of information are the fishermen themselves, the fish landings at local ports, or historic information from national databases. Scientific information, if available, must also be collected regarding these parameters and others, such as:

- Fish growth for the main species

- Fish behaviour towards the gear
- Characterisation of the area in terms of environmental conditions

# Trawl net selectivity

## Introduction

Trawl is a bag like net dragged on the sea bottom or through water column to capture fishes. Otter boards attached by long cables, keep the mouth of the net open horizontally during operation. Vertical opening of the net is achieved by floats and sinkers in the head and foot ropes respectively. The fishes are retained in the codend at the back of the net that consists of strong meshes.

## Selectivity

Since the practice of trawling started, there have been concerns over trawling's lack of selectivity. Trawls may be non-selective, sweeping up both marketable and undesirable fish and fish of both legal and illegal size. Any part of the catch which cannot be used is considered by-catch, some of which is killed accidentally by the trawling process. By-catch commonly includes valued species such as dolphins, sea turtles, and sharks, and may also include sublegal or immature individuals of the targeted species.

Size selectivity is controlled by the mesh size of the "cod-end"—the part of the trawl where fish are retained. Fishermen complain that mesh sizes which allow undersized fish to escape also allows some legally-catchable fish to escape as well. There are a number of "fixes", such as tying a rope around the "cod-end" to prevent the mesh from

opening fully, which has been developed to work around technical regulation of size selectivity. One problem is when the mesh gets pulled into narrow diamond shapes (rhombuses) instead of squares.

The capture of undesirable species is a recognized problem with all fishing methods and unites environmentalists, who do not want to see fish killed needlessly, and fishermen, who do not want to waste their time sorting marketable fish from their catch. A number of methods to minimize this have been developed for use in trawling. Bycatch reduction grids or square mesh panels of net can be fitted to parts of the trawl, allowing certain species to escape while retaining others.

Studies have suggested that shrimp trawling is responsible for the highest rate of by-catch.

Selective trawl gear ensures the escape of small and / or unwanted fish during towing. Examination of this capture process reveals the importance of mesh shape, size and towing speed. Cod-end design is the selectivity of the gear.



## **Factors affecting the selectivity of trawls**

Mesh size and shape have been widely used as the traditional means of affecting selectivity in trawls. At high towing speed, diamond shaped mesh openings tend to become elongate and close altogether regardless of their size.

## **Methods of measuring the selectivity of trawls**

### **1) Covered cod-end**

To determine the size and distribution of the total fish population that comes in contact with the gear in a particular fishing area, attach a small mesh cover over the experimental net's cod-end. The small mesh cover retains the small fish that escape from the cod-end and so the combined catch of the gear and cover of the cod-end provides, a measure of the total population encountered. If series of different experimental cod-ends are performed with a small mesh cover, this gear design will enable the estimation of selectivity of cod-ends of different sized meshes and shapes.

### **2) Twin Trawl**

Two trawl nets are dragged by a single trawler simultaneously. One trawl is composed of a small mesh cod-end used to obtain an estimate of the total population. The other trawl is used as an experimental gear. The selectivity of the test cod-end is determined

by analysing the length frequency distribution of the catches from both the test cod-end and small mesh cod-end. Biasness is comparatively less in these methods.

### **3) Trouser Trawl**

A standard trawl is divided into two sections by a vertical panel. Two cod-ends are attached, one on each side of the panel. Comparison of the length frequency distribution of the fish in each codend allows calculations of codend selectivity.

### **4) Alternate Hauls**

This method requires identical hauls to be made alternatively with an experimental trawl and a control trawl. To ensure the validity and reliability of the data, each pair of hauls must be similar in all aspects and in the number of hauls made.

### **5) Parallel Hauls**

This method requires that two vessels fish on the same ground at the same time. The experimental gear is towed by one vessel and the control gear is towed by the other vessel.