Behaviour of Fish in Relation to Fishing Gear and Methods

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Knowledge of the behaviour of fish in relation to fishing gear and fishing methods is a requisite to design, construct and operate fishing gears effectively. Few studies have been made in this line mainly due to difficulties of making underwater observations and measurements in the vicinity of fishing gears, especially in deeper waters. Light meters, and other instruments for measuring the stimuli produced by fishing gears and the fish themselves have been of major significance to study fish behaviour.

The importance of visual stimuli and vision in the behavior of fish in their natural environment is well established. Particular attention is paid to the difference in the response of fish to visual stimuli in day-light and darkness. The importance of vision in the reaction of fish to drift nets and trawls has been studied elsewhere. Study of the reactions of herring to stationary nets or barrier nets during day light indicated that difference in the thickness of the material and size of the herring caused considerable variation. Experiments in tanks at low light intensities and in darkness showed that when the light reached a certain low value fish started to pass through the netting. Of all the materials used monofilament nylon was definitely the most difficult for herring to see and they swam into it even in day-light.

Reactions of herring, whiting, cod, haddock, and flat fish to moving nets like trawls to study the herding effect of warps, ground ropes, wings, sweeps floats, chains and panels of netting point to the importance of vision in the response of fish to moving devices. Experiments at low light intensities and in darkness revealed that herding in all species gradually reduced as the light intensity dropped. Thus, various experiments suggest that, of all the types of stimuli produced by stationary and moving fishing gears, the visual ones are the most important in determining the efficiency of fish capture.

Experimental studies on the comparative importance of the properties of gill net materials have shown that in clear water the visibility is the most important factor. Materials should have low visibility, giving little or no contrast to the back ground and be transparent like synthetic monofilaments (eg. Nylon). Nylon monofilament gill nets yield the best catches both in fresh water and marine.

The softness of netting was found to be only secondary importance. The diameter of the netting material influences the catch efficiency as thicker twines are more visible than thinner ones.

The hanging of webbing determines the shape of the meshes, the distribution of the forces (tension) in the net and the looseness in the netting.

Gillnets are selective so that by adopting a proper mesh size only fish of the desired size range are caught, while undersized fish can normally pass through the meshes unharmed. Therefore, gill nets are particularly suitable for conservation measures and stock regulations.

Following are the properties of fishnet materials influencing the catching efficiency:

i) Visibility
ii) Softness
iii) Diameter
iv) Elasticity
v) Breaking strength

i) **Visibility:** It is essential that for gill netting in clear waters the net material should be as transparent as possible. Hence polyamide (Nylon) monofilament is the least visible of the net materials and yield the best catches.

ii) **Softness:** The softest net yielded the best catches. It was then assumed that as soft nets are poor reflectors of pressure waves and they provoke less reaction from the side line (Lateral line) organs of fish than stiff nets.

iii) **Diameter:** Catching efficiency of gill nets decreases with increasing diamter (thickness) of the net twines. It is assumed that thicker twines are better recognizable by the side line (lateral line) organ of fish than soft and thin materials.

iv) **Elasticity:** The elasticity of the net materials is of importance for the gilling process and for retaining gilled fish in the meshes. Suitable materials are of polyamide (Nylon) monofilament and multifilament twines.

v) **Breaking strength:** Breaking strength is of high importance. The selection of the net materials, especially for gill nets, is a compromise between the higher breaking strength needed for trouble free operation over a longer period and the most desirable diameter to obtain a minimum visibility. The strength of the fish only needs consideration. High tenacity materials, therefore, are essential for gillnets because of operational and visibility considerations.

The influence of the construction on the catching efficiency of gill nets:

Constructional properties of gill nets which influence the catching efficiency are:

i. **Mesh size:** With true gilling nets the mesh size delimits the size of the fish caught. Such gill nets are very selective, catching only a small size range of fish. Smaller and larger fish may, however be entangled if the net is loosely hung.

ii. **Hanging:** Hanging determines the shape of the meshes and the distribution of the forces in the net. It may also influence the selectivity. The hanging defines the looseness of netting. Very often it is desirable to have loose netting so that the fish can be entangled as well as gilled.

iii. **Farming lines:** Gill nets used in reservoirs are normally provided with a complete frame of lines (Framed gill nets).

iv. **Floats and Sinkers:** Floats and sinkers give the net the desired vertical position in the water. They must be distributed along the lines uniformly. Undue tension may be avoided in the netting.

v. **Net height:** Bottom set gill nets in inland fishing are usually of small height, say, 1.0 m to 1.5 m. Experiments showed that an increase in net height does not normally result in better catches.

Duration of fishing:

Catch efficiency of gill nets decreased when the fishing time is increased and with an increase in the number of fish gilled.

Relation between the twine of gill netting and the moving power of gilled fish:-

Consider the following factors:

i. elongation of the twine (elasticity) length of a gill net mesh,
ii. contraction of the girth of an inserted (gilled) fish body.
iii. When the perimeter length of mesh is 1.00, the most probable girth length of the fish is about 1.15 for common fish such as Salmon/Trout. The perimeter length of the mesh is elongated from 1.00 to 1.04 by the fish body. On the other hand the girth of the fish body is contracted from 1.15 to 1.04 by the reaction of fish body to the net twine. It is in relation to the body weight of fish and it varies with fish activity.

Leader net and auditory sense of fish:

Effects of leading fish by any fixed shore net are due to the avoidance of netting by visual sense of the fish. For example, even if the mesh size of the leader net is too

large to be a barrier to swimming through it, shoals of fish are led into the main trap of a fixed net. The auditory sense may be involved on dark nights. The auditory sense of fish is more sensitive to low frequency vibrations than high frequency ones.

It is known that ropes and twines in water current vibrate just as whipped rod in air. When a current presses the leader net, the twine of the net may be vibrated in frequencies. If fish swim up to the leader net, the vibration should be detected of its axis of movement. Then, the fish may swim, avoiding the net, and fish is led to the main trap of fixed net (set net).

Colour of the light of attracting fish lamp:

The most effective kinds of coloured light for attracting fish are white green, and cobalt and blue and day light white. Orange light must not be too intense and blue light must not be too weak.

Sense of smell and taste for baits in line fishing

Highest fishing rate in tuna long lining and pole and line fishing is achieved by using live bait (as in the case of skip jack fishing in Lakshadweep waters). Live baits produce gleaming effect in their swimming state thus produce flashing.

Fishing ground and water temperature

Thermal stimulation

Reactions (behaviour) of fish to moving gear (trawl)

Bottom fish/demersal fish react to the arrival of the trawl, first the door then sweeps/bridles, and wings of the trawl and swim away into the path of the net. The accepted best angle of a trawl bridle is about 16 degrees. The fish can swim away

only so far in the time that elapses between being scared and being trapped by the wings of the net.

Light attraction:

Fish lamps: above water and under water, incandescent and fluorescent.

Two kinds of fish lamps: One to lure fish to boat's side, and the other to guide the attracted fish to the other side of the boats where the net is ready for hauling eg. Japanese dip net/lift net.

Reactions of fish to water temperature

Fish can detect the temperature variations through sensors located on both sides of their body as well as on their head. Many fish, depending on their physiological condition, prefer certain temperatures This optimum temperature, which can alter during the life of a fish, is a significant factor in the successful catching of fish.

Shallow water fish live on the continental shelf of tropical and sub tropical waters can withstand a much greater variation range of temperature (They are *Eurotherm fish*). Deep water fish that live in polar seas, is influenced by even minor temperature variations *Stenotherm* fish.

Influencing fish movement: A combination of light and sound, food and electric shocks are being used to influence fish movements.

Bubble curtains: used for influencing fish movements.

Electrical fence: used for influencing fish movements.

Importance of mechanical stimuli in fish behaviour, especially to trawls:

Mechanical stimuoit are (I) sounds (II) "damming phenomena" and (iii) tactile (touch). Sound transmission in sea water is in the velocity of 1500 m/s almost five

times the speed in air, which could provide a useful early warning employ an echolocation system as in the case of Bats. Marine fish have relatively poor hearing ability. The organs of the lateral line enable a fish to locate moving objects by virtue of the damming phenomena. Complex stimuli produced by turbulent flow in a net and very low-frequency vibrations would stimulate the lateral-line organs. Mechanical stimuli influence the behaviour of fish in relation to trawls.

Mechanical disturbances are produced by the movements of objects in a medium (water) and are divided into three types:

1. Sounds which are propagated waves produced by a vibrating body.

2. "damming phenomena" produced with constant velocity and

3. tactile(touch) stimuli.

These disturbances stimulate the mechanical sense organs - ear, lateralline and touch receptors.

Fish behaviour in relation to trawls:

Noises associated with fishing vessels and pelagic trawls frighten pelagic species and cause them to dive into deeper water. The use of sweeps increases the catch. This is attributed to the herding effect of sweeps. Other boards would have the greater effect of herding.

The use of air-bubble curtains as an aid to fishing:

The air-bubble curtain was used to intercept the movement of herring *(Clupea harengus)* and lead them to stationary traps, set nets, weirs etc. The method has been used in menhaden fishery. But the air bubble curtain has proved ineffective as a barrier to sharks.