INTERNATIONAL COUNCIL FOR
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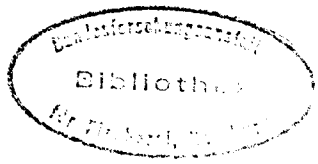

SELECTIVITY OF FISHING GEARS IN WIDER PERSPECTIVE

by

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Abstract

The major problem in fisheries today is that the catching capacity of fleets is well in excess of the optimum capacity required to harvest the available resources. There are several ways to create a better future. Such a future would imply healthy fish stocks, a resource adapted fishing effort, sound economic investments, ample employment opportunities, healthy and safe working conditions, good market and trade conditions, and last but not least valuable and desired products for consumers. In order to reach these targets the following combined strategies can be applied. **First** of all there is a need for restriction and adaption of fishing effort to present resources, which often means that the present effort will have to be decreased and stabilized at a lower level. The **second** strategy is to increase the efficiency to catch the target species and size. This calls for an improvement of the **selectivity** of fishing gears, thus leaving non-target species and sizes to contribute more to the bio-mass and recruitment of fish stocks. The **third** way is to increase fish production by hatchery or to increase the bio-mass by catching alive and letting grow further, thus creating more value out of the same resource. Introduction of **square mesh** is only a part of the problem and should not be over-estimated in its effects, but it does not seem to deteriorate the situation for most fisheries. Various ways to improve the size and species selectivity of fishing gears are mentioned with related problems concerning implementation. Existing technical measures with the aim to contribute to stock conservation are reviewed with problems of definition and legal aspects. Criteria for effective legislation are reviewed. Socio-economic aspects are mentioned like the attitude of the industry toward this problem and the specific structure of the fishing industry, being competitive in nature and harvesting a common-property open-access resource. Attitudes can be changed by education and instruction, change of actual behaviour needs clear **incentives**, mostly of economic nature. The role of scientific advice is described and the importance of credibility of stock assessments with current efforts to increase the accuracy of such estimates.

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1. INTRODUCTION.

It is generally accepted that the major problem in fisheries today is that **the catching capacity of fleets is well in excess of the optimum capacity required to harvest the available resources** [8]. We should realise however, that others within the fisheries may have quite a different opinion. Fishermen usually tend to ignore the long term problems and focus on the short term. It is essential that this problem is recognised by all players in the game. Not only scientists or fishery managers, but most of all the fishermen themselves.

Once the **problem** has been defined and acknowledged one can start to concentrate on finding possible **solutions**. Partial solutions do not solve the problem. Hope for solving can only be put into analysis of all its aspects and not by focusing on small parts and trying to solve these.

This paper has been written to contribute to discussions on the application of more selective fishing gears and to relate these topics to a wider view on the problem.

2. ANALYSIS OF THE PRESENT SITUATION

In many fisheries overcapacity exists in terms of fishing effort in relation to available resource stocks, which can be subdivided in numbers of fishing vessels, dimensions of these vessels and their gears and installed engine power, and time spent at sea. The situation may vary from place to place and have seasonal variance. Also it may be true for some target species but not for others. In many cases the problem of **mixed fisheries** exists where minimum landing sizes of different species require that a compromise in mesh size is taken. Technology progresses and with it our ability to catch more fish per unit of effort. The ever changing economic circumstances keep forcing enterpreneurs to aim for efficiency in order to maintain their business. Mostly this is translated in terms of **growth** in scale of operation and catch per unit effort. Bigger boats are built in many countries and the same applies to gear sizes. Sometimes the total number of vessels and the total number of people involved in the operation diminishes as in the Dutch midwater trawling branch. In other cases the numbers are allowed to rise too and the pressure on fish stocks increases steadily with the result of overfishing. In many countries restrictions have been set on vessel size or amount of horsepower installed. Economic set backs for example induced by a raise in oil prices have slowed down the growth at particular moments. After the initial shock the development has continued with greater emphasis on cost reduction. In some fisheries the result has only been that the unit size increased and the number of units and personnel decreased, but not the total fishing effort. In others the

result has been a steady increase in fishing effort leading to a structural excess. The economic incentive of keeping business profitable will of course always exist. In many fisheries a large amount of unreported by-catch is discarded at sea, which is regarded as loss of valuable proteïn and bad practice. Would this not have been the case then these fish would create more bio-mass and value by growth and contribute more to the recruitment of the stock. It can also be interpretated as an economic loss. **It is generally believed that the present situation is non-sustainable in the far future** and some workers forecast a disasterous outcome for the fisheries with ever continuing stock depletion when policies remain unchanged.

3. FUTURE PROSPECTS.

Of course no one agrees that this should happen in the long run and there is great concern not only among fisheries biologists. Similar trends can be seen in other industries. In fact environmental awareness has grown rapidly over the last decade leading to new political choices. In this respect the fisheries may serve as a very good **example** to other industries of how to ensure a sustainable development, if we succeed. More than in most other industries fishery depends on a sound approach to the limits set be the eco-system.

Targets set for the future may involve:

- Healthy fish stocks of ample size that reproduce themselves.
- A resource adapted fishing effort.
- Sound economic investments.
- Ample employment opportunities.
- Healthy and safe working conditions.
- Good market and trade conditions.
- Valuable and wanted products for consumers.

The problem we face today is how we can get from the present situation described above to the future we would like to create. We can at least hope to identify which type of action is leading to this kind of future and which type of action will definitely not contribute in this direction. Being scientists, we are in the position to state views independent of direct economic links. In the industry this luxury does not exist. In addition we claim or hope to have more knowledge of the various interactions and some more fundamental insights.

4: STRATEGIES FOR THE FUTURE.

Let us try to identify what is needed to reach the goals mentioned before. The major emphasis should be put on **restriction and adaption of fishing effort to present resources.** In most cases this means that the present effort will have to be decreased and stabilized at a lower level. In fact many actions are already taken along this line. In the future the resources may grow and fishing effort restrictions may be loosened. Fleet reductions have been stimulated at many times in the Dutch fishery. Size restrictions of fishing vessels were legally enforced for inshore fishing grounds. Problems of definition of installed engine power and size of a fishing vessel in terms of hold volume were tremendous. Vessel designers could find ways to circumvent the 'esprit de loi' with associated problems of sea-keeping performance and safety. Moreover some boats were designed with high engine powers with the motive that the engines were derated when fishing took place within the twelve mile limit and more power is needed for fishing outside this limit. Needless to say this will provide temptations to cheat the rules. For this reason more emphasis has been put on restriction of effort through allowed time at sea lately. This measure is far less complicated and easier to control. Many **technical measures** mentioned in Chapter 5 are related to this strategy.

An additional strategy would be to **increase the efficiency to catch the target species and size** or in other words to avoid catching what we do not want. This calls for **an improvement of the selectivity** of fishing gears, based on the premises that juvenile fish and non-target species that escape have good chances of survival. Recent research done on survivability gives evidence to support this. [9] In Chapter 6 this strategy will be explained in more detail as it concerns fishery science and technology to a great extent.

A third approach would also contribute in a positive way. This is to increase the bio-mass by directed action, to the extent that we are able to. We can **hatch fish or let them grow and gain more weight and value. Aquaculture** has growing importance, especially in Scandinavia. A recent initiative in Norway is to **catch fish and store** then alive in the fishing vessel after which they are transferred to fish pens where they are fed to grow further and reach augmented value. **Artificial shelter** can be created and enable fish to live where they could not before. It is known that fish are abundant among wrecks. It should be born in mind that when we shift off from the natural environment there are undoubtfully also penalties to pay. Mono-cultures are more vulnerable and fish hatched artificially that escape into the environment may affect natural stocks by inter-breeding. This approach will not be dealt with in this paper in more detail.

5. LEGAL ASPECTS.

The conservation of resources is one of the objectives of the Common Fisheries Policy of the European Community, that came in action on 25 January 1983. This policy may serve as an example of measures already taken to stimulate a sustainable development. It is based on two corner stones. The annual fixation of so-called **Total Allowable Catches (TACs)** for all the major fish stocks in community waters and on **Technical Measures**. The latter category basically aims at minimizing the capture of juvenile fish.

The Dutch beam trawl fishery for example is subject to a vast set of rules, restricting:

- Engine power
- Days at sea
- Codend mesh size
- Minimum landing size for various species
- Individual or group quotas
- By-catch
- Gear size
- Fishing area and season (boxes).

In addition an incentive has been created to decrease the fleet size by premiums to stop fishing based on vessel power. A system of **licences** has been created to limit access to the fishery. **Logbooks** containing information on catch size and composition with reference to position of the fishing grounds are also required by many authorities.

In spite of all these measures it is recognised that the enforcement of these technical measures is extremely difficult and effort control is very hard to achieve, although the growth in effort has indeed slacked off. Brugge [8] explains very clearly that these **legal aspects** should not be under-estimated and effective legislation must be:

- Clear and unambiguous.
- Controllable.
- Enforceable and stand up in Court of Law.

A legally watertight **definition** of fishing gear and its components is necessary and at the same time extremely difficult. Almost any rule can be circumvented by the industry, and one can argue whether solutions should be sought along this line at all. Proper control would require an inspector on every boat at all times. Apart from the costs there is

an ethical point to this. We do not want to create a police state. There should be room for innovation and personal freedom. A contrary approach to setting rules is to **educate** and to **create incentive**. Incentive can result if the person in question sees benefits, either in terms of economic gain or in terms of improved working conditions. This is not impossible as can be illustrated by the views of fishermen volunteering to use more selective gears as expressed during the workshop on the application and selectivity of square mesh netting in trawls, St. John's Newfoundland, 25 November 1988.

6. IMPROVING SELECTIVITY OF FISHING GEARS.

6.1 Technical solutions.

An improvement of the selectivity of fishing gears is the second way to contribute to our objective. It cannot be seen at the solution to the problem. It should not be regarded as more than a contribution. Many research has been dedicated to the use of square mesh in trawls and positive results in the release of young roundfish has been reported to a great extent by many workers [7]. It has also been recognised lately, that not only the codend mesh size determines the selectivity properties of a gear. Other net design features such as the **width** and **length** of the codend also play a role [1, 2]. The criterion is the opening angle of meshes and many ways exist to increase these angles over a net or to decrease the angles deliberately for that matter. For instance **codend attachments** can be used for this purpose and officially defended to serve other functions such as improving strength or endurance. For this reason restricting rules are set for such attachments. Some workers state that the objectives met with the use of square mesh can also easily be achieved by an increase in the minimum diamond mesh size. This will of course be a much more simple solution both from a legal point of view as from a costs point of view. However, we unfortunately have to acknowledge the fact that minimum mesh size regulations are often violated. The solution will only exist on paper. Brugge [8] states very clearly that there is no reason to believe that the industry will respect square mesh legislation, any better than the present minimum mesh size regulations. Other possible solutions are suggested such as **shortened riblines** in codends all subject to the same considerations. But the concept of selective nets is worth striving for. Good results are found in the shrimp and Nephrops fishery. **Separator panels, grates, extra funnel contructions** and other devices have been tried out successfully. Enforcement by law is however extremenly difficult, but some examples of successful implementation exist for instance in the Norwegian fisheries [4, 5]. Here a clear incentive was created. The fishermen were allowed to fish in certain closed areas with the separator panel providing the number of juvenile roundfish did not exceed a certain percentage of the catch of shrimp.

6.2 Technical problems.

Of course there are additional problems associated with these solutions. Material problems have been mentioned in the case of square mesh. The **strength** of codends will be different when hanging meshes on the square and **slippage of knots** can occur due to the different load on mesh bars. These can be overcome by using top panels of square mesh only and leaving the bottom panel of the codend diamond shaped, by introducing longitudinal strenghtening ropes, by applying braided knotless netting. **Repair** of knotless netting and lack of availability are reported as cumbersome. It has been suggested by one manufacturer to introduce panels that can be zippered into the trawl to enable easy repair. The availability will increase when the market requirements would increase. In a panel discussion at the workshop on the application and selectivity of square mesh netting in trawls in 1988 it was stated by the Icelandic manufacturer Hampidjan that **all practical problems concerning the use of square mesh panels were overcome successfully.** Scottish researchers report that no difficulties have been experienced with knotless Japanese netting in usage, strength and repair. Some **safety** problems were mentioned. Codends made of square mesh tend to roll easier on deck due to their cylindrical shape. This problem can be solved by forcing a non-circular cross-section of the codend. Apart from the technical problems mentioned in this Chapter there are severe problems concerning **legal** enforcement that are already mentiond in Chapter 4.2. **Socio-economic** aspects also play an important role. This will be explained in the next Chapter.

6.3 Socio-economic aspects.

Fishermen's **attitudes** toward the idea of stock conservation are at least critical, although many support the idea verbally. The result of stock assessments are often questioned and in many occasions it is stated that there is more fish in the sea than biologists can count. Sometimes real concern is expressed and often fisheries managers are blamed for setting rules that can not be obeyed without threathening business. In general fishermen do not form a coherent group but tend to act as **individuals** seeking their own interest. **The structure of the fishing industry with many competitive enterpreneurs harvesting an open-accessable common-property resource is not ideal for conservation orientated practices.** Mathematical models show that in such a fishery depletion of fish stocks and overexpansion of the industry follow, resulting in a decrease in social welfare [3]. Interesting are Dr. Clark's views on the method of **discounting** of future returns. This method places lower value on future returns depending on the discount rate or rate of interest and the time span between the expected return and the present. This concept is called **time value of money** and fundamental to economic

investment appraisal methods [6, 11]. High interest rates are recognised to have serious anticonservationist implications, especially for slowly growing renewable resource stocks. In other words the future is sold out for short term gain. We cannot hope to change the economic system at short notice, but it may help to be aware of this mechanism. Economic appraisal of the introduction of square mesh panels in trawls has only been rather speculative up to now. Costs and benefits are mentioned in [10]. Cost factors are the costs of replacing existing codends and extra maintenance costs, that may result from knot slippage, and of course the loss of more small fish that have a market value today. Benefits could be a saving in time resulting from less labour on sorting fish, some gain in value of the catch due to less debris and Benthos being caught at the same time, and in the long run added bio-mass and recruitment resulting in larger quotas and more fishing time allowed. It is emphasied in [10] that the long run benefits will in general not have much weight in the decision of fishermen.

Attitudes can be changed by growing **awareness**, which can follow from education and instruction. **It is even better to create a clear incentive to change behaviour.** Most effective will be an **economic incentive**. Positive rewards for using more selective gears help, heavy financial penalties for circumventing rules may prevent malpractice. To my view the positive rewards work better, but they cost money. One can think of **bonus rewards** or **increased fishing time** when using more selective gears. A problem of course is that the rules should not allow cheating or make fishing very unprofitable. **Shared ownership** and **responsibility** may change competitive behaviour. In many fisheries **licences** are used and are traded. In the Netherlands the introduction of licences based on engine power has led to a short boom in orders for new vessels. The procedure of implementation should not be disregarded. It may help to ease of the pressure put on fisherman by financers, but interest rates and contracts are mostly very strict and inflexible. **Loan relaxation schemes** in seasons with bad fishery may temper the incentive to increase effort in spite of the condition of the stock.

We should be aware of the fact that many practices exist because the by-catch is not really unwanted and because a **market exists** for these fish and they are caught with profit. Undersized fish are sold in many places as a delicacy. The market or even the consumers should be made aware of the choices made by such practice. The penalty for doing so is loss of profit in the long run, higher fish prices and social costs, but who cares? What we see as a problem may not be seen so by others in this business. Views will generally divert depending on the personal interest of the individual in question. We can not hope to solve a problem to whom that do not recognise it as a problem. In addition many people acknowledge a problem in general terms but do not change their behaviour to

contribute to a solution. Such action may not be in their short term interest. Many fishermen are 'trapped' in the socio-economic system of open-access fishery and competition. We advertise the system of the free market and competition. Economies based on a socialist system are recognised today as less productive and less efficient. If incentive can not be created, **legal enforcement** with **control** and **penalties** is the only way it can be done, but we have already seen that this implies tremendous difficulties and very high costs. In many cases the industry has called upon authorities to set clear rules with no room for cheating. It is also true that fishermen that were willing to obey the rules set by the government were faced later with heavy competition by those that circumvented these rules and forced to close down their business.

7. THE ROLE OF BIOLOGICAL ADVICE.

Attitudes are dependent on the value of the advice given by fisheries scientists. If the fishing industry believes that stocks are flourishing and catch rates are good at the time, it is very hard to believe doomsday messages by biologists. Local clustering of fish resulting in high catch rates can easily distort the view. On the other hand, there is room for improvement of stock assessment techniques. Many initiatives are taken. Fish **larvae surveys** can be improved by standardisation of sampling techniques, **acoustic methods** of assessment are currently improved and **trawl surveys** are under question and suggestions given to improve these. Sampling gears are standardised to some degree and environmental factors influencing the result under investigation. The performance of nets can be monitored using acoustic linked sensors and fish behaviour can be observed using direct observation techniques. It is vital for the **credibility** of the scientific advice to improve the accuracy of the abundance estimates as far as possible. The last remark may serve as a justification for the existence of the working groups of the ICES Fish Capture Committee.

8. REFERENCES

[1] Robertson, J.H.B. & Emslie, D.C.
"Selection differences in narrow and wide trawl codends with the same mesh size".
Scottish Fisheries Working Paper No: 7/85, Nov 1985.

[2] Robertson, J.H.B.
"The selection of trawl codends with long and short extensions". Scottish Fisheries Working Paper No: 9/85, Nov 1985.

[3] Clark, C.W.
"Bioeconomic modelling and fisheries management."
John Wiley & Sons, Inc., USA 1985.

[4] Valdemarsen, J.W. & Isaksen, B.
"Further experiments with radial escape section (RES) as fish-shrimp separator in trawl."
ICES. C.M. 1986/B:29

[5] Karlsen, L.
"HH-separating panels in shrimp trawls. Status of the implementation in the commercial fleet and ongoing research projects."
Paper presented at the ICES Fish Capture Committee Working Group Meetings, May 1988, Ostend, Belgium.

[6] Van Marlen, B.
"A note on the investment appraisal of new fishing techniques."
ICES C.M. 1988/B:16

[7] Robertson, J.H.B & Stewart, P.A.M.
"A comparison of size selection of haddock and whiting by square and diamond mesh codends"
J. Const. int Explor. Mer, 44, 1988.

[8] Brugge, W.J.
"The application of square meshes in the waters of the European Economic Community"
Paper presented to the workshop on the application and selectivity of square mesh netting in trawls, St. John's Newfoundland, 25 Nov 1988.

[9] Main, J. & Sangster, G.I.
"Scale damage and survival of young gadoid fish escaping from the cod-end of a demersal trawl."
Paper presented to the workshop on the application and selectivity of square mesh netting in trawls, St. John's Newfoundland, 25 Nov 1988.

[10] Burke, L.
"An economic view of square mesh in otter trawls."
Paper presented to the workshop on the application and selectivity of square mesh netting in trawls, St. John's Newfoundland, 25 Nov 1988, re-issued Sep 1989.

[11] Cheesley, N.R. & Gates, B.P..
"Techno-economic evaluation of fishing system developments."
ICES C.M. 1990/B:48