The tragedy of the commons model and the revisionist criticism. An assessment on basis of an analysis of flat fish sector regulation in the Netherlands

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Abstract

This paper addresses the adequacy of the Tragedy of the Commons model and the policy recommendations that are based upon this model. In its explanation why commonly owned natural resources like fisheries are easily prone to overexploitation, the Tragedy of the Commons model focuses on the Prisoner's Dilemma type of situation the users of commonly held resources are facing. Therefore the model recommends individualisation of user rights, preferably the introduction of individual transferable quotas, as the most effective and efficient means to prevent overexploitation in fisheries.

This model, that seems to be the dominant economists' approach, is challenged by the revisionist school, mainly but not only supported by sociologists and anthropologists. The revisionists stress that individualisation of rights and individual quota systems cut through the social bonds and linkages on community level that often form good bases for sustainable managed fisheries.

On basis of an analysis of the cutter fleet regulation in the Netherlands since 1976, when a system of individual quotas was introduced, the Tragedy of the Commons model and its criticisms are assessed. It is concluded that neither the ToC model nor the revisionist alternative is satisfactory in explaining the problems that have occurred in regulating Dutch flat fish fishery. However, the recent development in Dutch fishery policy to include fishermen's organisations in managing the resource can be considered as a recognition that the revisionist critique cuts some ice. The paper, therefore, stresses the need for more multidisciplinary research that takes into account the social embeddedness of economic action.

1. Introduction

The built-in tension between individual rationality and collective rationality is one of the great attractions for scientists from various disciplines to study fisheries. A constrained exploitation of this renewable natural resource will lead to a sustainable stream of fish. However, if too much of the fish is taken in the short run, the fish stock is affected and future proceeds will diminish. On the one hand there seems to be an obvious need for management. On the other hand fisheries are known as 'stubborn' economic sector, in which managers are confronted with difficult problems and in which management inter-

ventions often fail. The ‘problem’ of managing fisheries can be considered as a prime example of the problems that governments nowadays has to deal with when trying to regulate a highly complex and diversified society, in which sectors and social fields seem to follow their own paths (to have their ‘*Eigendynamik*’) that is difficult to influence from the outside.

Not only is fisheries management the example *par excellence* of managing renewable natural resources, many of the problems of regulating economic sectors, of creating welfare, of balancing equity and efficiency and of the limits of government intervention come together in fisheries management. Therefore fisheries management is not only challenging for those who have to manage fisheries or those whose jobs and lives are dependent on adequate management of the resource, but also for those studying fisheries, fishermen, fish and management of fisheries. The complexity of fisheries makes it a seemingly endless goldmine for scientists to develop and test their new ideas, theories and models. Ideas, theories and models, that have a broader scope than fisheries alone. Within economics, some even argue that fishery economics has become 'almost unique in the breadth of its demands on modern economic concepts' (Quirk and Smith cited in Conrad, 1996, p. 405). I would add to this statement that the problem of fisheries management, is maybe not unique, but an illuminating example of the problems that governments face in regulating modern, complex society and its various, diversified sectors.

In scientific, especially economic analyses of the problem of overfishing and the question how to regulate fisheries, the ‘Tragedy of the Commons model’ (ToC model) is dominant (Feeny et al. 1996). The model is essentially a combination of economic and biological insights in the dynamism of renewable natural resources, held in common (common-pool-resources, see E. Ostrom 1990). The collective character of the fish stocks causes the threat to overexploitation. According to the model, fishermen, similar to the utility maximising herdsmen in Hardin’s (1986) pastures, are forced to concentrate themselves on harvesting as much fish as possible, in as short time-span as possible, with the anticipated but unavoidable exhaustion of the fish stocks. On basis of the model it is established that regulation or management of fisheries is necessary, but also that the fishermen cannot do the regulation themselves: they are trapped in the well-known Prisoner’s Dilemma. Government intervention by rules or by privatisation is necessary (Cunningham et al. 1985; Anderson 1986, Neher 1990, Hannesson 1993).

The ToC model is popular because of the connection between a clear explanation of the overfishing problem and clear directions for solution. It is a real ‘policy theory’, a scientifically based theory that gives recommendations as to how to direct and implement policies. However, the model and its policy recommendations have been criticised. Especially sociologists and anthropologists from the revisionist common-property-resource (CPR) school have not been hesitant with giving their objections. In their view, fishery communities have been in the past and are at present very well capable of managing their fish stocks (Berkes ed. 1987; McCay & Acheson eds. 1987; Pinkerton ed. 1989). In the revisionists’ opinion, overfishing is not caused by the common-property character of the resources, but rather results from state interventions and continuous commercialisation that have disturbed traditional social bonds (Feeny et al. 1996; McCay & Jentoft 1996). There-

fore, revisionists often plead for more involvement of fishermen in managing the fishery (Jentoft 1989; Crean and Symes 1996).

This paper analyses the adequacy of the ToC model and the revisionist critique on the power to comprehend and to explain the problem of regulation of the Dutch flat fish fleet since the introduction of the first harvest-limiting measures in the seventies. Section two discusses the ToC model. Section three comprises the revisionist position. Section four is an analysis of the twenty years of flat fish regulation in the Netherlands. Section five concludes with some observations on the ITQ /revisionism debate and stresses the need for multidisciplinary research that takes into account the social embeddedness of economic action.

2. The tragedy of the commons model

Scientific analyses of fishery management problems are dominated by the ToC model, as it is presented in the fishery economics textbooks (Anderson 1986; Cunningham 1985; Pearce & Turner 1990; Neher 1990; Hannesson 1993). I discuss two, in my opinion the most important, as they both highlight the 'Weltanschauung' that is behind the ToC model, namely the 1954 article of H. Scott Gordon and the 1968 article of Garrett Hardin. The first article forms the basis for the economic view on fisheries management; the second one has played an important role in disseminating the discussion on common property resources to a broader intellectual community.

'The economic theory of a common property resource' (1954)

In this important article Gordon (1954) reaches the conclusion that the 'biological' or 'traditional' methods for conservation of fish stocks does prevent overfishing in a biological sense, but are not a solution for overfishing in an economic sense. The traditional methods, then popular and in use for some decades, were directed to the limitation of catch of small fish and the maximising of the *total* allowable catch (TAC) each year. The fish stock is in this way saved from extinction, but the fishery itself is still confronted with an extreme input of capital and labour, and, often, a living in poverty. Gordon wants "to demonstrate that the 'overfishing problem' has its roots in the economic organisation of the industry" (Gordon 1954, 128). He criticises traditional management methods because these do not take into account the specific economic dynamism in the fishery sector. In his opinion these methods pass by the economic actions of fishermen that use a common pool resource. '(T)he fish in the sea are valueless to the fishermen, because there is no assurance that they will there be for him tomorrow if they are left behind today' (Gordon 1954, 135). The fish caught by one fisherman cannot be caught by another one. Every fisherman is therefore induced to catch as much fish in the shortest possible time, before others do that. The result is de notorious *race for fish* in which every fisherman is forced to increase its efforts and to buy vessels with increasing capacity. In case of a collectively defined TAC that includes a threat with early closure of the fishing period, the intensity of the *race* increases. The Prisoner's Dilemma situation tends to get the characteristics of a Gold Rush or Fire Panic (see Burns et al. 1985, 87). The collective result is overcapacity (and too much capi-

tal) and a strongly reduced fish period. Gordon refers to the pacific halibut fishery that decreased from six months in 1933 to one to two month in 1952. Hannesson (1993, 125) states that the fishery now has decreased to a few days.

The solution for this problem, sketched this way, is to bring fishing grounds under public or private control with "a unified directing power" (Gordon 1954, 135).

'The Tragedy of the Commons' (1968)

In this article Hardin describes the tragedy that is (or will be) the result of individual profit maximising strategy of herdsman that herd their cattle on freely accessible pastures (the 'commons'). As the herdsman receive individual profits from an increased stock and the collective supports the disadvantages, they will all increase their herds. After a while, the total amount of cattle will be above the capacity of the commons, so that these will erode and finally destroyed. According to Hardin the destruction of an unregulated commons is inevitable. In his famous words: 'Each man is locked in to a system that compels him to increase his herd without limit - in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all' (Hardin 1968, 1244). In his opinion the tragedy-thesis is applicable to issues like pollution, freedom of the seas and population increase.

Hardin's solution for the problem is abandoning this freedom and the creation of coercive social institutions that make an end to this freedom. He presses that an appeal on conscious alone will not stop the free use of the commons. In opposition, responsibility is created by institutions that are based upon force. Although Hardin's analysis is sometimes somewhat ambiguous, the message of his contribution is that these threatening tragedies are stopped only by depriving the freedom to manoeuvre from the user of commonly held resources by means of the creation of private property or strict public control.

In the nineteen seventies and eighties the analyses of Gordon and Hardin are used/formalised into the modern standard fishery-economic analysis. An analysis, that more-and-more is directed to the development of solutions that are based upon the theory.
The fishery management problem is considered to be the result of market failure, that is the result of the common character of fish stocks that are exploited by fishermen that go for individual profits. A fishery is considered as a typical example of a collective action problem of rational actors (in an economic sense), using common property. A rational, profit maximising fisherman is not capable to forgo short-term proceeds and profits in favour of long-term proceeds and profits. The combination of the absence of property rights and the (by necessity) short term profit maximising strategy *cause* overfishing in a biological and an economic sense. As the Gordon-Schaefer model shows, the equilibrium point of an unregulated open access fishery is in a position in which less fish is caught with more effort (in terms of input of factors of production) and less profit than, in principle, is possible. The outcome is a sector that is collectively less well off than possible because of the individual strategies of fishermen. In the ToC model government intervention is necessary to protect the fishery sector against itself. Intervention can take place in two ways. (1) The establishment and implementation of rules that directly prescribe who, when, where and

how fishermen are allowed to fish (=direct correction because of market failure) and (2) Privatisation so that the correct workings of the market is restored.

1. The first way intervention exist of measures like licenses, fish periods, fishing days, obligations when go offshore or land fish, maze width regulation, maximisation of vessel BRT, length, motor capacity, net size and rules per vessel for the amount of and kind of catches to land. These measures are in use in different combinations all over the world (OECD 1997). In most cases there exists government regulation based upon TACs in combination with direct regulations as mentioned above.
   However, direct government intervention does not take away the tension between public and private interest. In practice, we witness that fishermen are quite capable of circumventing government regulations. Limitation of the length of a vessel, is answered by the design of more broad vessels. Rules concerning maze width, motor capacity and others are often difficult to monitor and easy to circumvent. Also there is, like other economic sectors, capacity increasing technological development, that is difficult to regulate. In the fishery sector, just like other parts of society, it applies that traditional ways of government intervention are 'implementation intensive' and 'enforcement expensive', and therefore often fail (Dunsire 1993, 24).
2. In the perspective of the ToC model privatisation is a better solution, because the gap between private and collective interest is closed. Privatisation in fisheries often take the form of the introduction of ITQs. The ITQ system or 'Rights-Based Fishing (Neher 1990) becomes increasingly popular in the eighties under fisheries economists and finds response in organisations such as OECD and the FAO. Above all ITQs are introduced in countries like New Zealand, Iceland, Canada, Australia, and more-or-less by accident in demersal fisheries in the Netherlands.
   Given the dominance of the ToC model as explanation for overfishing, the popularity of ITQ systems is understandable. With the introduction if ITQs a right on the exploitation of a part of the fish stock is created, that approximates an individual property right. With the introduction of ITQs, the owners of the quota rights are capable of escaping the 'race for fish'. Fishermen are independently of each other decide how, when, and where they run their business. Each fisherman is now capable of using his means/factors of production in the way he likes most and is the most efficient. Also, there will develop a trade in rights that stimulates that the least efficient fishermen towards the most efficient fishermen will sell the rights. The final outcome will be that sustainable fishery management goes hand in hand with a fishery that is economically efficient on micro as well as macro level.

The revisionist criticism

The explanatory power of the ToC model for the problem of overfishing and the solution based upon the model, the introduction of ITQs, did not stay uncriticised. Hardin's (1968) view on the destruction of communal lands has been contested on empirical and historical grounds. On basis of an extensive list of case-studies of communal managed grazing land, fisheries, forests and water resources, the revisionist *common property resource* (CPR) school that the ToC model does not 'accurately describes' and not actually 'predicts' over-

exploitation of natural resources. The CPR school holds the opinion that adequate management of commonly held natural resources is possible indeed (Feeny et al. 1996, 198; see also Dubbink 1996). De central revisionist criticism can be summarised in two points.

The ToC model has a wrong and very limited focus (McCay & Jentoft 1996). In its centre of interest is the behaviour of fishermen who are not capable of optimising the harvesting process. The attention for other social, economic and political actors and processes that have an interest in fisheries and have an impact on the behaviour of fishermen fades away. The role of the government as an external power to stop the race for fish, the internationalisation of the food market, the behaviour of other actors in the fish supply chain and financial institutions, all fall outside the scope of the ToC model. Also there is very limited attention for the interaction between other user groups and functions of the sea and fisheries. The influence of fisheries on other ecological values of the sea and, in return, the influence of waste dumping, recreation, oil and gas exploitation on fisheries cannot be analysed with the ToC model.

The ToC model mixes up and confuses common property, in which individuals have a right of entry to the resource as members of a group with 'open access' in which the resource is no-ones property (Gibbs & Bromley 1989, 24). For as far as the ToC model pays attention to communal and local based forms of management it is considered to be a first step into the direction of private property (for example Hardin 1977; Pearse 1994). The atomistic, non-communicating and selfish herdsmen in the ToC parable rule out the concept of community (Fife 1977). This means especially that there is paid no attention at all towards the capacities of communities to develop their own management mechanisms based upon communication, social sanctions and mutual control, although this often is the case (Berkes 1987; McCay & Acheson 1987; Pinkerton 1989).

Berkes' analysis of the behaviour of the Cree in the Great Lakes area in North America can be considered the contra-exemplar of the CPR school against Hardin's profit maximising herdsmen. In principle, the Cree are very well able to regulate beaver hunting within sustainable limits. However, when from the 18th century onwards, there are different periods in which white fur hunters enter the territory. When for instance after the development of a new rail road, hunters (partly for recreational objectives) enter the area in the second decade of this century and the Cree loose control over the area, they themselves participate knowledgeable in a further exhaustion of the beaver population 'rather than letting outsiders take them all' (Berkes 1989, 83). Only after intervention of the government, the Cree are in the position to re-build their own management system and is the beaver population restored in one to two decades.

In answer to the ToC model, McCay & Jentoft (1996) develop the 'working hypothesis' that the over-exploitation of commonly held natural resources is not caused by market failure, but the result of 'community failure': "A working hypothesis is that the social conditions required for tragedies of the commons may result from processes of 'disembedding' where resource users find themselves without the social bonds that connect them to each other and to their communities. If so, the Tragedy of the Commons is the product of social disruption and anomie rather than a 'natural' outcome of individual rational behaviour (ibid, 18).

In this view, fishery communities are capable of managing their fish stocks but external circumstances such as internationalisation, state intervention and commercialisation could have the effect that the social bonds within the community are undermined and the preconditions for collective action are eroded. McCay and Jentoft, therefore, recommend the recovery of communities in which economic oriented action is embedded. The management system should create conditions that makes it possible for the users of natural resources to bear common responsibility for the sustainable exploitation of the resource. Options are, for example, the creation of property rights for local communities or co-management in which fishermen, public authorities and public interest groups co-operate (McCay & Jentoft 1996, 11,30).

The ToC model and the revisionist criticism have different *explanations* for overexploitation of natural resources, especially fisheries, and give different *recommendations* for an adequate regulation of fisheries. How the model and its criticism hold in the practice of Dutch flat fish regulation, is shown in the next section.

4. Regulating the flat fish sector in the netherlands [1]

Since the invention of the double beam trawl technique at the end of nineteen fifties, the Dutch fleet fishing on flatfish has expanded rapidly. Expansion-oriented fishermen on the one hand and a growing export market on the other have led to a small but rather prosperous fishery sector that is specialised on flatfish. In comparison with other fishing industries in Europe, it can be described as economically healthy, highly competitive and affluent. Due to a high capital and technical intensity relatively high incomes are generated and in deviation to the rest of Europe's fishing fleet, the fleet expanded till late in eighties in terms of capacity, supply and value of fish and employment (Salz 1991, 186-187).

At present, the Dutch North Sea flatfish sector contains 457 beam trawlers with a total capacity of 490000 HP that is specialised in fishing sole and plaice. The fleet employs some 2100 fishermen directly. The total value of its landings is 630 million guilders (of which approx. 2/3 is flatfish), most of which is exported to other countries within the EU, fresh or frozen (data 1995 on basis of LEI, 1996). As other North Sea fisheries, the flat fishery is regulated on the basis of the European Union's Common Fisheries Policy (CFP). The Netherlands holds a significant share of the Total Allowable Catch (TAC). The Dutch beam trawler fleet controls 75% of North Sea sole en 38% of North Sea plaice.

Introduction of ITQs

In 1976 sole and plaice fishing rights were allocated to individual vessels in the Netherlands. Although at first bound to vessels, later on they became freely transferable. Since then the Dutch flatfish fleet is regulated on basis of an *Individual Transferable Quota* (ITQ) system (Tweede Kamer, 1987, p. 12 ff, De Wilde, 1993, p. 1,2).

[1] This section presents a case-study-in-progress. Earlier versions are parts of publications elsewhere: Marine Policy 1997, OECD 1997, Symes, 1997, Beleid & Maatschappij 1998.

The introduction of IQs, later ITQs came about as a result of agreements within the EC to reduce the fishing effort on the North Sea (which were later on replaced by the CFP). Because Dutch fishermen had heavily invested in fleet capacity and these quotas were far less than fishermen had caught in the years before the quota-introduction, most were confronted with a dilemma. Fishermen 'felt on one shoulder the hand of the banks that told them to keep on fishing, and on the other shoulder the hand of the government that told them to quit fishing'.

Most, if not all, fishermen decided to continue fishing. The ITQs were introduced in a hurry. Their legal status was not well defined, monitoring, controlling and enforcement measures were weak and fines were low. In short, the weight of the government's hands was not very heavy. On the other side, the economic incentives for continuing and increasing fishing effort were strong, and kept strong till far in the nineteen eighties.

- The existence of a strong demand for 'Dutch' flat fish in some EC partners caused good and upward moving prizes.
- In the eighties, for plaice as well as sole some strong year classes were produced, so that catches could remain high for a longer period.
- Investments in modernisation and increase of fleet capacity were stimulated by fiscal measures such as investment premiums.

Because fishermen faced with these favourable economic conditions but were uncertain about ecological conditions, the market situation and European or national government intervention in the future, most of them decided that investing in new and stronger vessels was the best they could do to safeguard their business in the long term, for themselves or their heirs. The collective consequence of these individual decisions was a continuation of the growth of the Dutch flat fish fleet. Between 1975 -the year before the introduction of IQs- and 1987 -when the total HP capacity was finally maximised- the capacity of the beam trawl fleet increased from 327000 HP to 560000 HP (LEI 1991, p. 187).

Although it was common knowledge that quota-rules were circumvented with ease in the flat fish sector since the end of the seventies, it became a growing political concern halfway the eighties. In 1983 the Common Fisheries Policy (CFP) went ahead, in which the Dutch government itself became responsible towards it EC partners for the enforcement of the quota-system. One became aware that public toleration of illegal behaviour no longer possible and acceptable. In consequence, monitoring and enforcement actions were intensified. However enforcement proofed to be difficult and the stricter application of the rules leaded to increasing conflicts between fishermen and enforcement officers.

Additional command-and-control measures

The Ministry of Agriculture realises that the introduction of ITQs was not sufficient. The opinion that it should not be a government's concern whether the fishermen harvest their quota with a 'Mercedes' or a 'deux chevaux', did not stand the test and was abandoned (Tweede Kamer, 1987, p. 195). It realised that additional measures should be taken.

Between 1985 and 1988 additional *command-and-control* measures were introduced[1]. In 1985 a compulsory catch registration is introduced, in 1986 a licensing system for the sector was introduced, which maximised the total fleet capacity and in 1987 a maximum engine capacity of 2000 HP for new ships was set. Other capacity-related measures included a days-at-sea limitation (based upon the relation between individual vessel capacity and catching rights), a compulsory temporary lie-up regulation and a limit of the ship's beam width to twelve meters (Tweede Kamer, 1986; LEI-country study 1995). The exit options for vessels were enhanced by means of EC and Dutch decommission grants.

The outcome of these measures together was that the fishing sector became better under control. Fishermen who did not own enough catching rights in comparison to the capacity of their vessel were forced to buy extra ITQs or to sell their vessels and catching rights and to leave the sector. The capacity-limiting measures induced some fishermen to internationalise their business. Some of them *re-flagged* to Belgium, Germany or the United Kingdom (For an analysis of the quota-hopping strategy I refer to Ellen Hoefnagel (1997). Between 1988 and 1992 quota trading in the Netherlands was high. Catching rights were transferred for prices far above the net present value of future proceeds (Davidse & Beijert 1995). It suggests that fishermen wanted to stay in business against high costs. The selling and buying of quota's and the total capacity reduction led to a situation in which catching capacity and catching rights at the level of individual vessels were more balanced. On the whole, the measures resulted in a reduction in ships and in total capacity from 1988 onwards. In 1993 the beam trawler fleet was reduced to 473 vessels, 491000 HP capacity and 2168 persons to stabilise afterwards (LEI, 1994).

However, the disadvantages of the command-and-control system that had developed incrementally, became clear to the Ministry of Agriculture as well as to the fishery sector. It seemed as if the ministry was running the sector, and in many aspects it was. The Ministry had become highly involved in decisions and daily affairs of the sector. The fishermen felt that they had lost control over their own business and had lost the capacity to react effectively on the changing conditions at sea and in the market. Strategic decisions like investments in vessels and quota-rights but also tactical and operational decisions like leasing additional ITQs for a year, or the kind of fish to search for, or how many days to fish, needed the approval of the public authorities. The relation between the Ministry and the fishery sector remained adversarial. The interaction between enforcement officers and fishermen easily went out of control. Quota-regulations were still violated by some groups of fishermen. The way in which the ministry and the sector had become interwoven was not only an administrative and costly burden for both parties, but also politically explosive. In 1990 these tensions led to a political crisis in fisheries policy when the Minister of Agriculture was forced to resign. This crisis made clear that a TAC/ITQ system based upon command-and-control regulation + adversarial relations between government and the fishing industry did not work out.

In a policy-document in 1993, the Ministry analysed the way in which government and industry were interwoven and their responsibilities were mixed. It came to the conclusion

[1] The development of these additional measures was stimulated by the results of a parliamentary commission that examined the failures in quota-enforcement in 1987 (Tweede Kamer, 1987).

that the costs of controlling fisheries without support of the fishing sector itself were too high.

'The long term vision that forms the basis of economic fish conservation management collides with the short term interests of the fishermen, although also the sector should have an eye for its interests in the long run. This directly results in a difficult enforcement of the regulations. Enforcement-measures, however intensive, cannot offer enough counterweight. The curious situation has come about wherein the government tries to reach a sustainable, profitable fishery, while the fishery sector hardly wants to co-operate' (own translation policy document 'Fishing in Balance' (1993), p. 42).

Restructuring management responsibilities

The Ministry of Agriculture felt that it has become too much involved in the management of the fisheries sector. For this reason a beginning was made with a *co-management* system in 1993. Between the public authorities and the individual fisherman, 'management groups' were constructed. These groups, consisting of 50 to 100 vessels, got the task of controlling and managing the quota of the individual members on the group-level. Two objectives were formulated:

1. Effective and efficient quota-compliance that was supported by the fishing sector itself
2. Improvement of the economic performance within the quota-limitations.

The main task of the management groups is to control the quota of their members in a flexible way. Giving extra days-at-sea to the groups stimulated participation in a management group. Within the group they can easily and on short-term buy, sell or lease quotas and 'days-at-sea', this in the event that they have a shortage or a surplus. In this way the individual fishermen gain more short-term flexibility and have more options to react to unexpected events. Fishermen have to deliver a 'fish plan' to the board. In the individual fishing plans is put forward how each fisherman wants to spread his days-at-sea and his catches over the year. In addition, group members have committed themselves to sell their fish by public auction only. This should ensure that quantity and price of landed fish can be controlled at all times and information is freely available. It was expected that these measures would lead to more evenly spread landings over the year. This should to higher price-level and therefore higher annual revenues *ceteris paribus*. Some steps are made in the direction of collective management within the fishermen's group. However, government control is still strong. The Fisheries Directorate determines the conditions under which the groups are allowed to manage their own affairs. The new system gives cause for some satisfaction. Fishermen appreciate the increase in flexibility they have at present. Some of them experience that "*fishing has become a rational calculation*" (Dubbink et al., 1995). Fishing is no longer an uncertain activity in which the fish must be caught as much and quickly as possible. Fishermen could make a start with thinking on strategic and operational issues such as: 'What is the best way to spread the catching of my individual quota over the year,' and 'How much capacity do I need for my quota?' For the first time since the start of the quota-regulations in 1976, there is administrative and political stability in and around the sector. The main participating parties seem to have an interest in continuation of the new system. The Ministry of Agriculture, because the North sea fishery is no longer a source of political unrest and crisis,

the fishery sector because it can work in a more secure situation and is de-criminalised, and the enforcement agencies because they can do their job under less threatening circumstances.

However, there are some serious 'clouds in the sky' that could have a negative impact on the viability of the groups-system. Fishermen were persuaded to participate in the new system with the prospect that the profitability of the sector would increase under the new system. This, in the first place, as the result of a better average price. In practice neither the higher prices nor the increase in economic results occurred. For various reasons, both the flatfish sector and the related industries are in an economic *malaise* and the prospects for the coming years are bleak. The prices as well as the quantities of landed fish (especially plaice) decreased, something which resulted in decreasing (real value) gross proceeds since 1987 (LEI country report, 2). Biologists argue that the low supply of fish is the result of the ample quotas in the previous years. Some biologists cynically suggest that compliance and the political-administrative rest are bought off with far too lenient TACs. This could have a very negative impact on future proceeds. Dutch fishermen are gradually becoming aware of this effect. The continuing quota-reductions since 1990 for flatfish are considered as a major threat to the welfare and viability of the beam trawler fleet and the adjacent processing industry. The co-management system has still to proof that it can adequately cope with periods of economic stagnation.

1976	1983-87	1987-90	1991-1992	1993 =>
Introduction of I(T)Qs	CFP: Additional direct regulation		stricter enforcement short-term stabilisation leading to 'governability crisis'	steps towards co-management

Figure 1 ITQ regulation of the flatfish fleet in the Netherlands (1976 onwards)
(Van Vliet, 1998, 73).

5. Conclusion

Under the influence of decreasing fish stocks the flat fish fishery in the Netherlands was regulated in the seventies. The output measures to control catches soon ended up in an individual transferable quota system. In the course of a decade, it became clear that privatisation alone could not regulate the fishery sufficiently. The creation of quasi-property rights did not reduce the task of the government but only shifted it (see also Dubbink & Van Vliet 1996). Additional measures were taken that controlled the fishery but were a burden for the government and the sector. The Ministry of Agriculture became heavily involved in daily business decision making and the flexibility of the sector was strongly decreased. The criticism, ventilated by Hodgson: "*The 'property rights' theorists (...) fail to see that the extension of 'well-defined property-rights' does not provide a means of reducing the role of the state, but on the contrary by extending formal property relations the state becomes ever-more deeply involved in the daily intercourse of social life.*" (Hodgson 1988, 152) applies for the introduction of ITQs in the Netherlands as well.

The not foreseen but necessary increase in involvement of the government in regulating the sector did lead to a governability crisis in which the government temporarily lost legitimacy towards the fishery sector as well as the general public. The political crisis of 1990 created room for a readjustment of the management responsibilities between the ministry and the sector. The 'Biesheuvel' co-management system developed a basis on which fishermen can bear common responsibility for the core of the current fisheries policy, the management of the quota rights.

The analysis of flat fish sector regulation in the Netherlands in the last twenty years shows that neither the ToC model nor the revisionist alternative is capable to explain the genesis and development of the sector. Therefore the recommendations are not applicable directly.

The revisionist criticism on the wrong and limited focus of the ToC model is applicable to the Dutch flat fish sector. The strong growth of the sector in the post-war period is the result of the economic and social conditions that were at work in and around the sector. The growth was made possible because of the convergence of a growing market, new technological possibilities and investment stimulating incentives from outside the sector. These growth-stimulating factors were still there when the first harvest-limiting regulation was introduced. The contradictory nature of the incentives and signals towards the sector, placed the sector in a somewhat schizophrenic position and increased the uncertainty in the sector. The increased uncertainty reinforced the short-term orientedness of many fishermen. The consequence was a continuation of the race for fish with vessels that increased in size as long as possible.

Also the revisionist CPR explanation falls short. It is unjustified to blame the failures in controlling the fishery to an n undermining of the social bonds in the Dutch fishery communities. The growth of the North Sea flatfish sector created a new economic sector with new problems. The 'free' character of the North Sea was not a problem as long as technical options and motor capacity remained limited. It seems unlikely that the traditional fishery communities could autonomously solve the problems associated with a large-scale and technological highly developed fishery. The implementation of the Biesheuvel co-management system shows the importance of the revisionist criticism. The co-management system tries to pull down the circumstances that forced fishermen to intensify the race for fish and tries to create conditions for common responsibility of fishermen for management of the fishery. It has become clear that neither the state nor the market alone is capable of creating economical and ecological sustainable fisheries. State processes as well as market processes do not take place in a vacuum. They are embedded in social structures and processes. The outcome of regulatory processes –either positive or negative- depends on the relationship and the interaction between state intervention, market processes, processes of social and human self-organisation and ecological processes. The various scientific disciplines that study fisheries and fisheries management are biased towards one of these processes. By focussing on the world views and biases of economic as well as sociological perspectives, this paper contributes to the insight that fisheries management research could benefit from multidisciplinary research. In writing this paper I benefited from discussions within the ESSFIN network, chaired by David Symes and from discussions around the preparation of 'Creative Governance, Opportunities for Fisheries in Europe' (ed. Jan Kooiman, Martijn van Vliet, Svein Jentoft), a book that will be published later this year.

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Factors affecting compliance with fishery regulations: a UK case-study 1

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Abstract

Conventional economic models of regulatory compliance focus on an instrumental determination of individual behaviour in which the decision to comply or violate depends upon the perceived monetary costs and benefits. This suggests that compliance can only be achieved by ensuring that the expected costs are greater than the expected benefits, in other words by employing a deterrent effect. The policy implication is that desired levels of compliance must be achieved through enforcement, which is costly. More complete models of compliance behaviour take into account non-monetary factors such as social influences, moral norms and the perceived "legitimacy" of regulations and the regulatory authority. The paper describes a current investigation into the influence of non-monetary factors in determining compliance with quota restrictions among UK fishermen and discusses some preliminary results from the study.

Introduction

If fishery management regulations are to achieve their intended objectives, compliance is crucial. To the extent that quota limits are violated, for example, agreed TACs and desired levels of fishing mortality will be exceeded. Economic approaches to fisheries management, designed to correct market failure in the exploitation of fishery resources, also require compliance in order to be effective: quantitative rights-based systems such as ITQs, for example, depend for their success upon respect for individual quota holdings (eg. Squires *et al* 1995). Where incentives exist to violate regulations, considerable resources may have to be devoted to enforcement. Within the European Community, for example, the total annual cost of monitoring and enforcement is estimated to be around ECU 300 million (Commission of the European Communities 1997). It is often difficult, however, to measure the extent of violation and hence the productive value of enforcement expenditure (Sutinen and Hennessey 1986).

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In comparison with the extensive literature on the design and implementation of fisheries management instruments and policies, relatively little attention has been paid to the question of compliance and enforcement. Most economic studies of the enforcement problem in fisheries have moreover been theoretical rather than empirical, focusing on the impact of costly and imperfect enforcement on optimal levels of exploitation in a regulated fishery (eg. Sutinen and Andersen 1985, Milliman 1986) and on the selection of efficient regulatory instruments (eg. Anderson and Lee 1986, Anderson 1989, Mazany *et al* 1994)[1].

In these analyses, and in some empirical studies as well (see below), individual agents are implicitly assumed to make the rational decision to comply or violate according to a narrow utility function in which the anticipated benefits of illegal activity are directly compared to the anticipated costs (as a function of the subjective probability of detection and prosecution and the likely fine). In other words, a simple *deterrence* model of violation behaviour is employed, of the type originally formulated by Becker (1968)[2]. Although such models do not require that all agents have an equal propensity to violate under a given set of conditions, the fact that non-monetary influences over behaviour are effectively ignored means that aggregate changes in levels of compliance (or in the 'supply of violations') can be related only to changes in the costs and benefits of illegal behaviour. The implications for policy can therefore be formulated only in terms of marginal changes in the probability of detection and prosecution (ie. the level of enforcement effort) and/or changes in the severity of sanctions in order to increase deterrence.

Empirical studies on individuals' compliance with fishery regulations have been reported by Sutinen and Gauvin (1989), Furlong (1991) and Kuperan and Sutinen (1995). Both Sutinen and Gauvin (1989) and Furlong (1991) explicitly recognise factors other than those directly related to the costs and benefits of violation in the determination of compliance behaviour, but their influence is not fully explored. Furlong (1991) includes in his theoretical compliance model a vector of variables to capture "personal and household" characteristics. In his estimation of the model using data from a survey of Quebec fishermen he includes variables for age, the proportion of the family currently unemployed and the proportion of family income derived from fishing: these are designed to serve as proxies for individual differences in "tastes" such as attitudes and proclivities towards violation. Sutinen and Gauvin (1989), in their study of compliance in the inshore lobster fishery of Massachusetts, similarly hypothesise that the incentive to violate is influenced by personal characteristics such as age, years in the fishery and income dependence.

Sutinen and Kuperan (1995) note that conventional deterrence models do not adequately explain relatively high observed levels of compliance (eg. Sutinen *et al* 1990) nor do they convey realistic policy prescriptions with their focus on the quantity of (costly) enforcement. Implicitly building upon the broader set of 'bases' of compliance proposed by Young (1979) (see Sutinen *et al* 1990), these authors develop an extended model to include social influence and moral obligation alongside the standard monetary incentive and deterrence factors. A moral obligation to comply is considered to depend on the individual's level of 'moral development' and the legitimacy accorded to the regulation and to the

1 See Mazany (1993) for a review.

2 See, for example, Pyle (1983) for a review.

regulatory agency. Kuperan and Sutinen (1995) use this model to examine compliance with fisheries zoning regulations in Malaysia. From an analysis of survey data they concluded that non-monetary factors are important in determining levels of compliance, which cannot therefore be explained entirely in terms of a rational cost-benefit calculus.

The present study was designed to examine the importance of non-monetary factors in determining compliance with quantitative landings restrictions (quota limits) among fishermen in the United Kingdom. We were specifically interested in whether the sort of findings reported by Kuperan and Sutinen (1995) might be observed in the complex political and regulatory environment of a European fishery, and in particular in the extent to which perceptions of the legitimacy of the regulations and the regulatory authorities might have a measurable impact on levels of compliance.

We will leave to one side the question of the 'correct' economic interpretation of non-monetary factors, although their incorporation into a neoclassical utility function is not straightforward. Etzioni (1988), for example, argues that while moral norms and self-interest may act together to determine an individual's actions, they should be considered in terms of two entirely separate and irreducible utilities (in the extreme, morality may be thought of as tightly constraining the choices which an individual may make). Sutinen and Kuperan (1995) provide a short discussion of the definition of morality and social influence in the compliance context from the perspective of other disciplines, including psychology and sociology. Sociological theories of compliance, for example, include both instrumental models (equivalent to neoclassical deterrence models in economics but more readily incorporating informal sanctions such as peer group pressures) and normative models which focus on personal morality and on legitimacy - the belief that the law ought to be obeyed (Tyler 1990).

Modern views of legitimacy begin with Weber (1947) (see Sternberger 1968) and suggest that acceptance of the legitimacy of an authority will encourage compliance with its laws even where those laws conflict with individuals' own self-interest. In other words, legitimacy represents a perceived obligation to obey that is necessarily linked to political authority and is distinct from the influence of moral norms (indeed personal morality and legitimacy may conflict). The separation between legitimacy, morality and self-interest, however, is not an easy one, nor is legitimacy a singular or absolute concept. To the extent that legitimacy is enduring it may approach the normative status of morality, for example, whereas legitimacy judged contemporaneously in terms of outcome (see below) may in some cases be said simply to reflect self-interest (Tyler 1990).

Our approach to investigating the role of legitimacy is based on that employed by Tyler (1990) in his 'Chicago study' of US citizens' compliance with the law. Legitimacy is assessed with primary reference to a particular regulation and the regulatory system rather than to an authority in general terms, so that the obligation to comply is measured more or less directly. Where appropriate, attention is focused separately on *process* and *outcome* and on *fairness* and *efficiency* (or effectiveness): in other words, is the regulation effectively and fairly enforced, and is the regulation itself effective and fair in the results it produces? Like Kuperan and Sutinen (1995) we attempt to construct an econometric model to explain the observed pattern of compliance in terms of a number of non-monetary variables.

Data collection

The study population was the fishing industry of the *X* region of England,[1] including all vessels of over 10m in length and subject to quota restrictions. Vessels of 10m or under in length were excluded, since these are not normally subject to quota restrictions under the UKs quota management system. Vessels of over 10m which do not target quota species were also excluded. Three sub-populations were identified: vessels belonging to producers' organisation *A*, those belonging to producers' organisation *B* and vessels based in the region which do not belong to a producers' organisation (so-called 'non-sector' vessels). Sampling was done on a stratified random basis within each sub-population. PO vessels were stratified by vessel size (10-20m and over 20m) and by fishing method while the smaller number of non-sector vessels was stratified by size only. The final sample size and composition is summarised in table 1 below.

Table 1 Sample details

Population	Population size	Sample size
PO *A* vessels	115	34 (30%)
PO *B* vessels	75	23 (31%)
Non-sector vessels	45	12 (27%)
All vessels	235	69 (29%)

All data were collected by means of face-to-face interviews with the skippers of the selected vessels during the winter of 1997/98. Structured questionnaires were used in order to record respondents' perceptions about the effectiveness and fairness of quota restrictions, the effectiveness and fairness of enforcement, the authority of management institutions, the involvement of fishermen in the management system, the compliance behaviour of others, personal experience of enforcement and conviction, as well as own compliance behaviour. Additional questions were designed directly to elicit perceptions of moral obligation to comply with quota restrictions. The age of the skipper, his length of involvement in the industry, his owner/employee status, the size of the vessel and its gross annual turnover were also recorded.

It should be noted that the regulatory environments under which the non-sector and PO vessels operate are somewhat different. Non-sector vessels must comply with the monthly quota restrictions (set directly by the Government) which are specified in their licences. PO members, on the other hand, are subject only to the restrictions imposed by their own PO [2]. Non-sector vessels commit an offence if they land more than the quantity

1 Because of the sensitive nature of the data the study region is not identified.

2 Hatcher (1997) describes the management of quotas by producers' organisations in the UK.

specified in their licence within a calendar month. No such offence applies to PO members since if they exceed their restrictions they are merely infringing the (private) rules of their PO. In practice, however, all violations are hidden from both the Government Sea Fisheries Inspectorate and the POs' officers by falsifying landings declarations which are monitored by the POs as well as by Government. Whereas the logbooks required to be kept at sea allow a 20% margin of error in recording quantities of fish retained on board, landings declarations must be accurate. Despite the legalistic differences, therefore, in practice the act of violation is the same for all vessels: violation means exceeding quota restrictions and falsifying logbook records and/or landings declarations (certainly the latter) [1].

Results

Of the 69 respondents interviewed, only one refused to answer questions about his own compliance record. Of the remaining 68 respondents, 18 (26%) stated that they did not exceed quota restrictions in the previous year, 30 (43.5%) stated that their landings were over-quota by 10% or less, while 20 (29%) admitted that their landings had been over-quota by a margin of 25% or more (see table 2).

Table 2 Over-quota % of landings

Response	%	Frequency
0%	26.1	18
10% or less	43.5	30
25%	13.0	9
50%	8.7	6
75%	5.8	4
100%	1.4	1
Refused	1.4	1
Total	100.0	69

Similarly, 18 respondents (26%) stated that none of their gross earnings in the previous year were attributable to over-quota fish, 24 (35%) stated that 1-2% of their earnings came from over-quota landings while 26 (38%) said that 5% or more of their earnings were due to over-quota landings (see table 3).

1 The statutory maximum penalty in UK law for submitting a false landings declaration is £50,000.

Table 3 % gross earnings from over-quota fish

Response	%	Frequency
0%	26.1	18
1-2%	34.8	24
5%	10.1	7
10%	10.1	7
20%	10.1	7
30% or more	7.2	5
Refused	1.4	1
Total	100.0	69

Considering those respondents who reported no over-quota landings as *compliers* and those who reported significant (ie. greater than zero) over-quota landings as *violators*, the following cross-tabulations of responses to a selection of the questions provide an overview of the results from the survey.

Probability of detection

Table 4 If you were to retain on board and land over-quota fish, what would you consider to be your overall chances of getting caught?

Q36	Compliers		Violators	
Response	Freq.	%	Freq.	%
Very high (50% or more)	3	16.7	4	8.0
High (25%)	5	27.8	10	20.0
Quite possible (10%)	4	22.2	8	16.0
Moderately low (5%)	1	5.6	17	34.0
Very low (1% or less)	5	27.8	11	22.0

Legitimacy of the regulation: effectiveness

Table 5 Quota restrictions are effective in conserving fish stocks

Q1	Compliers		Violators	
Response	Freq.	%	Freq.	%
Agree strongly	0	0.0	1	2.0
Agree	5	27.8	5	10.0
Disagree	7	38.9	21	42.0
Disagree strongly	6	33.3	23	46.0

Table 6 Quota restrictions would be effective if fishermen complied with them

Q2	Compliers		Violators	
Response	Freq.	%	Freq.	%
Agree strongly	0	0.0	3	6.0
Agree	11	61.1	15	30.0
Disagree	5	27.8	21	42.0
Disagree strongly	2	11.1	11	22.0

Legitimacy of the regulation: fairness

Table 7 Would you say that the quota restrictions that apply to your vessel are generally

Q6	Compliers		Violators	
Response	Freq.	%	Freq.	%
Very fair?	1	5.6	2	4.0
More fair than unfair?	5	27.8	12	24.0
Slightly unfair?	7	38.9	15	30.0
Very unfair?	5	27.8	21	42.0

Legitimacy of the regulation: respect by others

Table 8 Do you think that most, many, a sizeable minority or just a few fishermen in the region regularly land over-quota fish?

Q26	Compliers		Violators	
Response	Freq.	%	Freq.	%
Most	3	16.7	19	38.0
Many	5	27.8	12	24.0
A sizeable minority	6	33.3	13	26.0
Just a few	4	22.2	6	12.0

Legitimacy of the regulatory process: effectiveness

Table 9 Overall, how well do you think that quota restrictions are enforced on UK vessels? Are they

Q9	Compliers		Violators	
Response	Freq.	%	Freq.	%
Well enforced?	5	27.8	11	22.0
Adequately enforced?	7	38.9	21	42.0
Not adequately enforced?	2	11.1	12	24.0
Hardly enforced at all?	4	22.2	6	12.0

Legitimacy of the regulatory process: fairness

Table 10 In general, how fair do you think fishery inspectors are in deciding whether or not to inspect a particular vessel? Would you say that the pattern of inspections is on the whole

Q15	Compliers		Violators	
Response	Freq.	%	Freq.	%
Fair?	14	77.8	42	84.0
Not very fair?	4	22.2	6	12.0
Very unfair?	0	0.0	2	4.0

Legitimacy of the regulatory authority

Table 11 The UK government has a duty to restrict catches because it is a member of the EU

Q19	Compliers		Violators	
Response	Freq.	%	Freq.	%
Agree strongly	1	5.5	0	0.0
Agree	8	44.4	25	50.0
Disagree	6	33.3	20	40.0
Disagree strongly	3	16.6	5	10.0

Involvement in the regulatory system

Table 12 How big a say do you think you have in the design and operation of the quota management system? Are you

Q24	Compliers		Violators	
Response	Freq.	%	Freq.	%
Very involved?	1	5.6	3	6.0
Quite involved?	3	16.7	3	6.0
Involved a little?	4	22.2	7	14.0
Not involved?	8	44.4	31	62.0
Actively ignored?	2	11.1	6	12.0

Compliance behaviour of peers

Table 13 Considering the skippers of other vessels in your PO or other local non-sector vessels, would you say that

Q44	Compliers		Violators	
Response	Freq.	%	Freq.	%
All comply with quota restrictions most of the time?	5	27.8	2	4.0
Most comply with quota restrictions most of the time?	11	61.1	17	34.0
A large minority regularly land over-quota fish?	2	11.1	9	18.0
Many regularly land over-quota fish?	0	0.0	8	16.0
Most regularly land over-quota fish?	0	0.0	14	28.0

Peer attitudes to violation

Table 14 Among other skippers in the PO or other non-sector skippers, is landing over-quota fish generally regarded as being

Q45	Compliers		Violators	
Response	Freq.	%	Freq.	%
Very wrong?	1	5.6	2	4.0
Basically wrong, but understandable every so often?	2	11.1	4	8.0
Basically wrong, but an economic necessity?	10	55.5	36	72.0
Neither wrong nor right?	1	5.6	2	4.0
Fine if you can get away with it?	4	22.2	6	12.0

Moral obligation to comply

Table 15

Q47, Q49, Q50, Q51	% Compliers		% Violators	
	Agree	Disagree	Agree	Disagree
Quota restrictions should be complied with because they are the law	55.6	44.4	36.0	64.0
Quota restrictions should be complied with because otherwise you are taking more than your fair share	38.9	61.1	18.0	82.0
Quota restriction should be complied with even if you think they are not effective in conserving fish stocks	38.9	61.1	26.0	74.0
Quota restrictions should be complied with even if you think they are unfair	55.6	44.4	24.0	76.0

In summary, a descriptive analysis of the raw data suggests the following:

1. *Probability of detection:* Compliers perceive the probability of being caught to be somewhat higher than do violators.
2. *Legitimacy of the regulation: effectiveness:* A higher proportion of compliers regard quota restrictions as effective in conserving fish stocks, particularly in principle (ie. if all fishermen complied with them).
3. *Legitimacy of the regulation: fairness:* There is little difference in the perceived fairness of quota allocations under the UK's quota management system between compliers and violators. Most regard their allocations as more or less unfair.
4. *Legitimacy of the regulation: respect by others:* Compliers perceive quota restrictions to be respected by a slightly greater proportion of the region's fleet.
5. *Legitimacy of the regulatory process: effectiveness:* There is little difference in the perceived effectiveness of the enforcement of quota restrictions. In general the regulations are considered to be adequately or well enforced.
6. *Legitimacy of the regulatory process: fairness:* Most respondents regard the pattern of inspections as fair.
7. *Legitimacy of the regulatory authority:* Under the existing political framework, the duty of the UK Government to restrict catches is acknowledged by around half of all respondents.
8. *Involvement in the regulatory system:* A slightly higher proportion of compliers regard themselves as being involved in the regulatory system.

9. *Compliance behaviour of peers:* Compliers have a higher estimation of the level of compliance among their peers.
10. *Peer attitudes to violation:* Most respondents think their peers regard landing over-quota fish as either basically wrong but necessary or not wrong. There are no clear differences evident between compliers and violators.
11. *Moral obligation to comply:* A higher proportion of compliers perceive an obligation to comply with quota restrictions despite a conflict with self interest and/or perceptions of effectiveness and fairness.

The Econometric Model

The likely simultaneity between the perceived probability of detection and the decision to violate (and therefore the self-reported violation rate) has been recognised in the literature (Sutinen and Gauvin 1989, Kuperan and Sutinen 1995). Furlong (1991) did not estimate simultaneous equations due to non-availability of appropriate data. Conclusions based on such studies should be read with care due to possible simultaneity bias.

The dual latent variable binary (probit) model we estimate in this study is that developed by Maddala (Maddala 1983, Greene 1995, 1997). The two simultaneous equations in the system are

$$y_1^* = {}_1 y_2^* + {}_1' x_1 + {}_1$$
$$y_2^* = {}_2 y_1^* + {}_2' x_2 + {}_2$$

We therefore assume a bivariate normal distribution with zero means. The reduced forms, in which X (see Table 16) is the union of x_1 (a vector of explanatory variables) and x_2 (a vector of explanatory variables) are

$$y_1^* = {}_1' X + v_1$$
$$y_2^* = {}_2' X + v_2$$

The starred y variables are latent variables. Their counterparts are y_1 and y_2. Both y_1 and y_2 satisfy the assumptions of the probit model and take values of 0 or 1. In our model, y_1 is specified as a dummy variable: it has a value of zero if the perceived probability of detection is zero and 1 if the probability is higher than 0. The second dependent variable y_2 also has a value of zero if a fisherman is a complier and 1 if he is a violator. A two step procedure [1] is used to estimate the two reduced form equations by the maximum likelihood estimation (MLE) method. This gives rise to efficient estimates.

[1] William Greene pers. comm. We are also grateful to Prof. Richard Harris for his advice.

Estimation Results

Table 16 defines the variables used in the deterrence and violation equations [1] [2]. In this paper we will present only the results of the violation/compliance equation (y_2). Table 17 gives the results of the equation estimated using two-step MLE. Most of the coefficients have the expected signs. The perceived probability of detection coefficient has the correct negative sign and is significant, which confirms the hypothesis that deterrence has a negative influence on the probability of violation. This was also found by Kuperan and Sutinen (1995) using similar methodology, although our findings cannot directly be compared with other studies which have utilized different types of dependent variable (eg. illegal landings, net gain etc) (Sutinen and Gauvin 1989, Furlong 1991).

It was found that as the level of gross earnings increased, the probability of compliance increased. The probability of compliance was higher if fishermen considered that quota restrictions should be complied with even if they were thought to be unfair. If the fishermen considered that his peer group in the same area regularly landed over-quota fish then the probability of violation increased. Possibly the most interesting finding is that the probability of compliance increased if fishermen considered that they had a significant involvement in the design and operation of the quota management system. Other variables were not significant in this preliminary analysis.

Cross-sectional analysis of such behavioural (subjective) variables may yield misleading conclusions if there are unobserved individual fixed effects which are correlated with other personal characteristics, unidentified other factors or the reported violation rate itself. This problem could for example be addressed using panel data. Here this problem has been partially taken care of by using the latent variables simultaneous equations system proposed by Maddala (1983). Two other problems have been reported in the literature. One is a measurement error problem and the other is the question of causality in the relationships exhibited. We believe that the technique we use here takes care of these problems and that the results are unbiased, efficient and consistent.

[1] Means and standard deviations are not reported here but are available from the authors.

[2] Note that no variable was included to measure directly the incentive to violate due to the difficulty of obtaining reliable estimates.

Table 16 Definition/description of variables

Dependent variables	
D	Perceived probability of detection (positive = 1; zero = 0)
V	Violators = 1; compliers = 0
Explanatory variables	
R	Gross earnings coded 1 to 12, from less than £50,000 (= 1) to £800,000 or more (= 12)
A	Age of skipper
Y	Years in fishing
E_1	Coded 1 if landings have been checked by an inspector never or just once in 12 months)
E_2	Coded 1 if no experience of conviction in 10 years
M_4	Coded 1 if disagree that quotas should be complied with even you think they are unfair
S_1	Coded 1 if a significant number of peers are considered to land over quota fish
S_2	Coded 1 if peers not thought to consider over-quota landings as very wrong
L_1	Coded 1 if disagree with the effectiveness of quotas in practice
L_4	Coded 1 if most or many fishermen in region are thought to land over-quota fish
L_5	Coded 1 if quotas are considered not adequately enforced
L_7	Coded 1 if disagree that Government has a duty to restrict catches as an EU member
L_8	Coded 1 if considered not involved or actively ignored in the regulatory system

Table 17 Simultaneous Probit Model

Variable	Coefficient	t-values
D	-0.383*	-1.710
R	0.388*	1.740
Y	0.012	0.411
M_4	1.329**	2.220
S_1	2.587***	2.798
S_2	-1.297	-1.563
L_1	0.750	0.995
L_4	-0.256	-0.441
L_5	-0.156	-0.274
L_7	0.221	0.438
L_8	1.594***	2.412
Constant	-2.727***	-1.764

Log-likelihood = -19.84; zero-slopes ^{2} (11) = 38.91; % correct predictions = 82%
*** significant at 1% level; ** significant at 5% level; * significant at 10% level

Discussion

In the predominantly social sciences literature on local management, participatory management or 'co-management' approaches to fisheries governance, it is often suggested (implicitly if not explicitly) that greater involvement of fishermen in the management process will lead to increased levels of compliance with regulations because those regulations will be accorded greater legitimacy (eg. Jentoft 1989, Pinkerton 1989, Nielsen 1994, Jentoft and McCay 1995, Ostrom 1995, Dubbink and van Vliet 1996, Nielsen and Vedsmand 1997, Symes 1997). While theory, intuition and even circumstantial evidence might argue the case, there appears to be little in the way of direct empirical evidence to support or refute such a notion.

Preliminary findings from the present study certainly support the view that non-monetary factors influence the compliance behaviour of fishermen in the UK. The fact that most of the 'legitimacy' variables were not significant in our initial violation model may of course reflect generally poor perceptions among all respondents about many aspects of the existing management regime. We have, however, found a significant effect from variables for aspects of moral obligation, perceived behaviour of others and involvement in the system.

Refinements of the data analysis described are being undertaken and some additional data not presented here have yet to be analysed. There is some evidence, for example, that perceptions of the legitimacy of fishermens' own producers' organisations are quite different to those of the EU or the UK Government. There is also evidence that perceptions would be significantly different if there were, for example, greater autonomy over fishing within national limits (although not all fishermen appear to interpret such a scenario in a similar fashion).

Further analysis of the data from this study may clarify some of the findings. At this stage, however, it seems clear that there is potential for more work in this area.

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Fisheries conflict and fisheries management in the Normand Breton Gulf (ICES VIIE) A multidisciplinary approach [1]

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Abstract

This paper presents a multidisciplinary analysis of the fishing activity in the Normand-Breton Gulf (ICES VIIe). Combining the approaches of biology, law and economics, it focuses on the numerous conflicts that plague this complex fishery. The argument of the paper is that these conflicts, despite their diversity, are boosted by a common factor which is growing overcapacity. Tackling with this phenomenon is a key to solving the fisheries conflicts in the Normand-Breton gulf, which up to now have been treated mainly by the sharing of fishing areas between fleets.

Key words: Interdisciplinary research, fisheries management, use conflicts, overcapacity, Normand-Breton gulf.

Introduction

AMURE is a French interdisciplinary research program dedicated to the study of management systems of the marine and coastal resources and ecosystems. It involves research teams from IFREMER and UBO (University of Western Brittany, Brest), in the fields of biology, law, economics, geography and sociology. The topic of the program is the question of the adaptation of institutional mechanisms of management to new conditions of use of the resources and ecosystems, in the context of increasing scarcity due to the growth of anthropic pressure on a limited natural environment. The area selected for the study is the French coastal zone of the western part of the English Channel (ICES VIIe).

A sub-program of *AMURE* is dedicated to the management of professional fishing activities within the Normand-Breton gulf, or gulf of St-Malo. It is jointly operated by biologists of IFREMER and by economists and jurists of the CEDEM (UBO). The study is still in progress, and this paper should be regarded mainly as an illustration of the way specialists of three different disciplines can work together with the aim of better understanding a problem of fisheries management.

[1] The study presented in this paper was funded by the French Ministry of Agriculture and Fisheries. The elaborating of the paper was made possible through the precious help of Jean-Paul Troadec, Loïc Antoine and Clara Ulrich. We of course remain sole responsible for the results and opinions it contains (the authors).

During the recent years, the fishery of the Normand-Breton gulf has been plagued by a conflict between French fishermen and the Authorities of the Island of Guernsey, under UK sovereignty. Though less acute, problems also exist with the Island of Jersey, also under UK sovereignty. Taking the form of a diplomatic dispute concerning mainly the sharing of fishing areas, the conflict also reflects a problem of cohabitation between different gears. Inside the French fleet operating the fishery as well, frequent problems of cohabitation arise between fishermen. Though these conflicts display various features, the hypothesis supported in this paper is that they are boosted by a common phenomenon, which is the existence of a global disequilibrium between the fish resources of the area and the fishing capacities implemented to exploit them. If this hypothesis is relevant, the attempts to solve the fisheries conflicts in the gulf mainly by the sharing of fishing areas are clearly short.

In this paper, we shall first present the main features of the Normand-Breton gulf fishery and of the conflicts within this area. Then we shall examine the overcapacity hypothesis, and finally discuss its consequences as regards the management of the fishery.

1. Conflicts in a complex fishery

The diversity of fisheries conflicts inside of the Normand-Breton gulf (1.1) reflects the complexity of the fishery (1.2) and of its management system (1.3). Nevertheless, arguments exist to consider the Normand-Breton gulf as an interesting area for new management approaches (1.4).

1.1 Overview of the fisheries conflicts in the Normand-Breton gulf

Conflicts between fishermen in the Normand-Breton gulf are not really new: drawings from the previous century remind us that cohabitation between Normandy and Jersey oysters dredgers have been difficult at a time when the resource became scarce. A similar situation has occurred in the recent years and the gulf fishery is not only plagued by a conflict between French and Channel Island fishermen, but also by conflicts between French fishermen themselves, whether they use different gears or not. The following conflicts can been sorted, as examples, among a longer list:

Fishing in unauthorised waters, around Guernsey for instance (the sovereignty of the zone being itself the bone of contention in some cases), but also trawling within the 3 coastal NM, which is forbidden in France.

Conflicts for space between trawlers and fixed gears, sometime when two activities, or *métiers*1, are targeting a same species (cuttle fish targeted by trawlers and by potters in April-May), but more generally independent of any interaction through resource. It is quite clear that, on the one hand the increase in pots number and the extension of fishing season for potters, and on the other hand the increase in days at sea combined with more efficient material (rockhoppers,) make clashes inevitable. It sometimes implies French trawlers or dredgers with Channel-Island potters or netters but it also occurs frequently within fishermen of a same nation. The risk of damage on fixed gears caused by mobile gears most frequently results in a withdrawal of fixed gear but it also prevents the practice of some types métiers, even when the resource exists (i.e. whelk potting in the Bay of Saint-Brieuc, in the south of the Normand-Breton gulf).

Conflicts for space between a same *métier* with fixed gears. For instance the introduction of parlour pots, first in Jersey then in Normandy and in Brittany, which allowed potters to use twice or three times more pots than previously, created a lot of local problems in the fishery and a great deal of concern about the future of the resource, with dissension between Authorities in charge of proposing management rules, at a national level as well as at a regional one.

1.2 Biological and technical complexity of the fishery

The fishery of the Normand-Breton gulf at first looks quite complex. This complexity has a biological and technical basis, which is the diversity of its fauna and of the *métiers* it shelters. The study of the fishery is not made any easier by the difficulty to get an accurate knowledge of the state, to say nothing of the evolution of the fishing activities.

1.2.1 Diversity of fished species

As a consequence of hydrological and sedimentary characteristics, biodiversity is higher in the Normand-Breton gulf than in other parts of the Western Channel. Benthic populations, specially, are very important. These diversity and abundance also characterise exploited species. In the last century, dredging of flat oyster *Ostrea edulis* was the basis for fishing activity of many boats. Warty venus *Venus verrucosa* and scallop *Pecten maximus* have been deeply exploited since 1950. Queen scallops *Chlamys opercularis* also support fishing activity. Biomasses of the clams *Glycymeris glycymeris*, *Ruditapes rhomboïdes* and *Spisula ovalis* are very high. Beside of these suspension feeders, others molluscs are the basis for important fishing activity, such as the whelk *Buccinum undatum* (most of French landings come from the Normand-Breton gulf) and the cuttle fish *Sepia oficinalis* which comes annually, in spring, for reproducing in shallow waters.

The mixture of soft and rocky grounds is also favourable to crustaceans and Normand-Breton gulf is the French most important production area for lobster *Homarus*

[1] A *métier* is the use of a certain type of gear for targeting a certain type of species (or group of species) in a certain area.

gammarus and spider crab *Maja squinado*. Although they are of lesser importance, velvet crab *Necora puber*, edible crab *Cancer pagurus* and common prawn *Palaemon serratus* are fished by many potters.

Many species of finfish also find favourable grounds in the gulf, specially for nurseries. The most important species in the landings are the rays *Raja clavata* and *R. naevus*, common sole *Solea solea*, red gurnard *Aspitrigla cuculus*, sea bream *Spondyliosoma cantharus*, sea bass *Dicentrarchus labrax*.

1.2.2 Diversity of fishing activities

The Normand-Breton gulf is operated by Channel-Islands and French boats.

At the beginning of the 90', the Channel-Islands fishing fleet was composed of approximately 670 inshore boats and 35 offshore boats (Tétard, Boon et al, 1995). The inshore boats operate only inside the gulf. Most of them are potters and handliners, small-sized (4 to 11 metres), and many are operated by non-professional fishermen with only a seasonal activity. The offshore fleet is composed of potters, trawlers and longliners. These boats range from 9 to 21 metres and operate mainly out of the gulf.

In 1994 there were about 650 French professional1 fishing boats operating inside the gulf (Berthou et al., 1996). Though the majority comes from harbours bordering the area, some boats of external ports are met seasonally, targeting scallop, cuttle fish or spider crab. Most of the boats operating inside the gulf are strongly dependent of this area: 50 % operate in the gulf all the year round, and 35% between 6 and 10 months a year.

The French fleet operating inside the gulf is basically a small scaled (average length: 10.8 metres) but the number of boats over 16 metres is increasing. Boats under 13 metres operate mainly in the coastal parts of the gulf. Boats between 13 and 18 metres are more scattered in the gulf and, with a few exceptions, the largest boats (18-25 metres) operate only part time this area.

More than 20 *métiers* were observed in 1994, and each French boat operating inside the gulf was involved in 2,1 *métiers* per year on average. There are 3 main *métiers*: crustaceans potting, scallop dredging and bottom trawling. Each one concerns 30 % of the total fleet and together they represent a number of months of activity amounting to 60 % of the total activity of the French fleet in the gulf. Five secondary *métiers* (whelk potting, small mesh netting, warty venus dredging, spider crab netting, cuttle fish potting) concern 10 % of the boats each, and represent 30 % of the total activity. The total French fleet may be split into 7 subsets according to the main important fishing strategies:

[1] Unlike UK non-professional fishermen, French recreational fishermen are not allowed to sell their landings. Their activity, which is in principle strictly non-commercial, is out of the scope of the present survey.

Table 1 Description of the French fleet operating the Normand-Breton gulf in 1994

Type of boats	Number of boats	Mean length (m)	Mean HP (kw)	Remarks
Trawlers	76	19.4	372	Mainly bottom trawlers, but also a few midwater trawlers. Boats operating only part time inside the gulf. 24 boats coming from outside the gulf (district of Caen)
Trawlers-dredgers	118	12.3	174	Boats involved both in dredging (scallops, warty venus) and inshore trawling.
Dredgers	63	9.4	102	Boats specialised in dredging *métiers* all the year.
Dredgers + fixed gears	110	10.0	118	Dredgers completing their activity with various activities, mainly crustacean *métiers* and bass longlining.
Crustacean potters	150	8.5	79	Some of these boats complete their activity with other fixed gears.
Whelkers	65	8.5	100	Full-time whelk potters.
Miscellaneous	70			Spider crab netters (11), finfish netters (22), aquacultors (9), small handliners and longliners (28).

1.2.3 Importance of the interactions between *métiers*

The numerous *métiers* operated in the Normand-Breton gulf interact in three different ways. The first type of interaction is a relation of complementary, when the same boat operates several *métiers* (see above). The two other types connect different boats, and are generally of negative character: they concern the use of space and the exploitation of fish resources.

The space interactions (table 2) are due to technical incompatibilities between the use of different gears in the same area and at the same time. They are usually not very important between the towed gears, can be more developed between the fixed gears but reach a climax between towed and fixed gears:

Table 2 Main space interactions between métiers

	1	2	3	4	5	6	7	8	9
1. Crab and lobster potting	**X**			**X**				**X**	
2. Whelk potting		**X**					**X**	**X**	**X**
3. Small mesh netting			**X**				**X**	**X**	
4. Spider-crab netting				**X**				**X**	
5. Cuttlefish potting					**X**			**X**	
6. Bottom longlining							**X**	**X**	**X**
7. Scallop dredging									
8. Otter trawling									
9. Warty venus dredging									

The resource interactions (table 3) are due to the fact that some *métiers* target the same species as others, or discard species which are targeted by others. Few resource inter-

actions are generated by the *métiers* using fixed gears (with the exception of small mesh finfish netting). Between the *métiers* of mobile gears, the bottom trawl is the most interactive in the area ; it interacts on the 8 species selected (see frame below). Discards of spider crab, bream, rays, gurnards and red mullets are important. The midwater trawling interacts on sea bass and bream (the later being partly discarded).

Table 3 Main resource interactions between métiers

Species caught Activity	Spider-crab	Scallop	Sea-bream	Sea-bass	Sole	Skates	Gurnard	Red mullet
Crab and lobster potting	L							
Whelk potting	D							
Cuttlefish potting								
Small mesh netting	l d		l	L	L			L
Spider-crab netting	L							
Bottom longlining				L				
Scallop dredging	L d	L						
Warty venus dredging								
Otter trawling	l D	L	l D	L	L d	L D	l D	L D
Midwater trawling			L D	L				
Recreational fishing	L			L				

Key: L or l = landing; D or d = discarding; Upper or lower case letter refers to major or minor interaction.
Note: In the table above, midwater trawling and recreational fishing were added to the 9 main *métiers* in the gulf, because the interactions which they generate are substantial for certain species.
The by-catches of some species used as baits for other activities were classed as discards.

1.2.4 Obstacles to a quantitative knowledge of the fishery

On the French side, the fleet is well known but the landings data network is not complete. There are a lot of landings spots, and the majority of fishing boats operating the fishery are too small to have a European obligation to fill log-books. The French fishermen have a legal obligation to weight and declare their landings, but the enforcement of this rule is variable.

The statistical knowledge of the landings is variable as regards species and *métiers*.

The landings of molluscs (except whelks), as well as the landings realised by trawlers, are generally well known because most of them are commercialised through auction markets. In the case of crustaceans and, more generally, in the case of products of potting and netting activities, the landings are mainly commercialised directly by the fishermen. As a consequence and because of the lack of declarations, official statistics are often underestimated with a year-to-year variable degree of uncertainty.

Another problem for the quantitative study of the fishery is the difficulty to sort out, in some cases (mainly finfish), the catches realised inside and outside the gulf.

Finally, there is no complete (international) database of the fisheries of the gulf, and the present paper does not encompass the fishing activity of the Channel Islands.

1.3 Complexity of the management system of the fishery

The complexity of the fishery also stems from the impressive variety and overlapping character of the legal rules concerning its management. The remarkable complexity of the legal status of the Normand-Breton fishery has several origins : the variety of species targeted and of *métiers* (see above), but also the coexistence of two different national jurisdictions (France and UK) and, within each jurisdiction, the multiplicity of administrative competencies implied in the management of the fishery.

1.3.1 The international question

The Normand-Breton gulf is entirely within the 12 NM zone, but it is characterised by the cohabitation of two different State jurisdictions: France and the UK, who has the sovereignty over the Channel Islands (the two main of which are Jersey and Guernsey). The intricacy of the maritime zones under the jurisdiction of the States bordering the gulf has for long necessitated the setting up of mechanisms of international co-operation. Though both Jersey and Guernsey are under UK sovereignty, the cases of the relations between France and each of these two islands are different (Prat, 1996).

Between France and Jersey, the so-called 'bay of Granville' regime (convention of August 2, 1839) is still valid. It recognises to French and UK fishermen equal fishing rights between the 3 NM line of Jersey and a so called 'AK' line which limits the exclusive fishing zone of the French, thus creating, between these two lines, a 'common sea'. The London convention on fishery of March 9, 1964 confirms the existence of this regime. There is a claim of the UK to extend the limit of its territorial waters between Jersey and France, which should not question the basis of the existing regime (agreement of January 28, 1994). Nevertheless, the conclusion of a new fisheries agreement will probably imply an alteration in the 'bay of Granville' regime.

The case of the relations between France and Guernsey is more difficult. The present regime derives of the convention of 1964 between France and the UK. Before this date, the international common law applied (freedom of fishing beyond the 3 NM exclusive zone). The convention of 1964 recognises an exclusive right of fishing and an exclusive jurisdiction to the coastal State in the 0-6 NM zone. In the 6-12 NM zone, the right of fishing belongs to the coastal State and to the other contracting parties, whose boats have been usually fishing in the zone between 1953 and 1962 (there is no *numerus clausus*, but the boats are supposed to direct their fishing effort towards stocks and fishing places that they used to exploit before the convention). The coastal State has the power of jurisdiction in the 6-12 miles zone. The implementation of this convention West and North of Guernsey raises no major problems. East of Guernsey, the *statu quo ante* has remained until 1992, when an agreement (July, 10) has recognised to Guernsey the right to set rules ant to implement them in the zone. But frustrations and problems have grown between the French fishermen and the Guernsey Authorities, and the conclusion of a so-called *modus vivendi* in 1994, which was denounced by the UK in 1996, has not improved the situation.

1.3.2 The multiplicity of administrative competencies

The coexistence of two different State jurisdictions within the gulf is not the only factor complicating the legal status of its fishery. A multiplication of administrative competencies creates a very intricate legal situation (Curtil, 1996).

Being inside the EU fishing zone (even for the part bordering the Channel Islands), the gulf fishery is subject to the general regulations which apply to this zone (legal sizes of catches, European quotas, etc.). But since it is entirely inside the 12 NM zone (territorial sea), the access to the fishery may be, in the present state of the CFP (up to 2002) reserved by the coastal States to their nationals, and the management of its 'strictly local' stocks (important in the area) is delegated to these States.

As regards France, the Minister in charge of the fishing activities is the authority entitled with the administrative power over maritime fisheries (decree of January 9, 1952). In the interior and territorial waters the minister may impose fishing licenses (in principle by species and not by gear) or fix TACs and split them into quotas between individual boats or groups of boats. A recent law (*Loi d'orientation sur la pêche*, November 18, 1997) specifies that licenses and quotas are not transferable.

The Regional Prefects are in charge of the administrative competence in their region. As the Normand-Breton gulf is bordered by two different regions (Brittany and Lower-Normandy), this is a non-negligible cause of heterogeneity in the management system of the fishery.

This factor is amplified by the role of the so-called 'Interprofessional Organisation of Maritime Fisheries' in the management of fisheries. This organisation, which exists at the national, regional and local levels, is composed of representatives of the fishermen and of other professions involved in the fishing industry, and may take decisions (formally, at the national and regional levels only) that the State Authorities (Minister or regional prefects) have the faculty to make compulsory. The regional committees manage, for instance, the license system.

On a local scale, the fishermen themselves create cohabitation agreements between *métiers*, the status of which is informal.

The fishing activities of the Gulf are thus submitted to an inflation of norms coming from various authorities. The resulting confusion certainly does not help the implementation of the rules.

1.4 Nevertheless, an interesting field for management

Though the Normand-Breton gulf is a rather complex fishing area, arguments exist to consider it as an interesting zone for new management approaches:

- It is nearly an ecological entity, closed by coasts on two sides and relatively isolated from the rest of the Western Channel by the currents.
- Several stocks among the most interesting for local fishermen are totally included in the Normand-Breton gulf (spider crab, lobster, scallops, whelks, partly cuttle, ...), some of which being sedentary or low mobile resources.

- Several *métiers* operated by local fleets target only one or two species.
- The zone is entirely comprised within the 12 NM of either France or Channel Islands.

2. The equilibrium between fishing capacities and resources

Whatever the complexity of the fishery of the Normand-Breton gulf, it is suspected that the various conflicts affecting this fishery are boosted by a common factor which is the existence of an overall excess fishing capacity in the area (this does not mean, of course, that the acuteness of the problem is the same in every component of the fishery, or that overcapacity is the only cause of the conflicts). We shall first justify the overcapacity hypothesis (2.1), and then present some empirical indications of the phenomenon in the Normand Breton gulf (2.2).

2.1 The overcapacity hypothesis

Basically, overcapacity means an inefficient balance between fish stocks and the amount of anthropic factors used to catch them. It results in a loss of social welfare (the global net income generated by the fishery is not as high as it could otherwise be, whoever the beneficiaries are), because too much capital and / or labour is used in the catching of a given fish stock. This loss can be worsened if the anthropic pressure upon natural resource results in an excessive reduction of the stock, and / or an inefficient exploitation of its age-structure (recruitment overfishing, growth overfishing).

Though it is defined in terms of efficiency (Pareto optimum), overcapacity has a direct relationship with considerations of equity : when there is no clear definition of the individual rights to the resource, the increase of capacity by one fisherman is a threat to the other fishermen exploiting the same common-pool resource (or other resources interacting with it), and this is a major cause of fisheries conflicts.

As long as appropriate institutional mechanisms fail to appear, there is strong economic ground for the development of overcapacity in fisheries (2.1.1). In the case of the Normand-Breton gulf, the weakness of the institutional mechanisms (2.1.2) leads to suspect the presence of the overcapacity syndrome.

2.1.1 The economic mechanism leading to overcapacity

In a fishery where exploitable stocks are scarce resources and institutional limitations of fishing capacities (whether direct or indirect) are seldom, economic theory predicts that overcapacity should be regarded as the rule rather than as an exception. Let us briefly recall the main steps of the argument :

The legal status of fish stock is usually that of *res nullius*, which means that they do not belong to anybody before they are exploited : fish normally belong to the one who catches them. Obviously, this feature is not synonym of free access : if the access to fish

stocks has most frequently a collective character, it may be - and indeed is, in most cases - restricted to some groups of users. The lack of individual property of fish resources has historical reasons, and also technical reasons (Troadec, 1994): it is not so easy to allocate fish stocks between individual users as to enclose pieces of land or to mark wandering cattle (this is one major technical obstacle to sea-ranching). This legal status of fish stocks does not mean that they belong to the economic category of public goods, as defined by Samuelson (1954) : if the *ex ante* private property of fish stocks is quite often difficult to implement, the consumption of these economic goods is by no mean collective, and every individual catch is a subtraction to the total amount which may be caught by others. As soon as they enter the economic world of scarce resources (which means that their marginal productivity or utility is not zero at equilibrium), fish stocks belong to a category which is frequently called 'common-pool resources', defined by the coexistence of non-exclusivity, or lack of *ex ante* individual property, and subtractibility, or rivalry in the exploitation of the resource.

The common-pool character of fish stocks creates mutual negative externalities among fishermen: their individual production functions are interdependent, as the amount of catches realised by some fishermen influences the amount that may be realised, with a given fishing effort, by others. These stock externalities may be furthered by crowding externalities caused by competition for the use of space (another common-pool resource, as far as sea is concerned).

As usual, externalities create a gap between public and private marginal benefits of the activity: part of the income that one fisherman gets from the increase of his effort, *caeteris paribus*, is balanced by a reduction of income for other fishermen exploiting the same common-pool resource or other resources interacting with it. In such conditions, it is rational for each fisherman to increase his own effort to a point which is excessive when considered at the level of the whole fishery: in the equilibrium situation, the marginal cost of the fishing effort overlaps its marginal social benefit.

Fishing effort is supposed to be an index of the use, during a certain period, of the means of production combined by fishermen to catch fish (capital and labour)[1]. Thus, two types of factors may be used to increase the fishing effort: the growth of fishing capacities[2] and the increase in time of use of these capacities during the period considered[3]. Because

[1] The rigorous building up of such an index raises important difficulties. As there is often a high degree of substitutability between the various anthropic factors of the production function in the fishing industry, it requires rather strict mathematical conditions which are not necessarily met in practice (Hannesson, 1983). This problem is not without consequences for fisheries management, since it frequently relies on the so-called 'control of fishing effort'.

[2] In principle, the increase in the fishing capacities may concern the labour inputs as well as the capital inputs. Practically, because of the tendency to substitute capital to labour which affects fisheries as well a other industries - all the more when shipbuilding and modernisation is highly subsidised - the increase in fishing capacities concerns mainly capital inputs : according to official statistics, between 1973 and 1995, the global engine power of the French fishing fleet was increased by about 10% (and its global fishing power undoubtedly increased at a higher rate, because of technical progress), and in the same time the global number of French fishermen was divided by two approximately (CCPM 1977, FIOM 1996).

[3] The measure of fishing time, and thus of fishing effort, raises special problems as regards fixed gears (nets, long-lines, pots).

this last factor is obviously limited (by physical, if not legal considerations), the growth of fishing capacities must be regarded as a major mean of increasing fishing effort. As soon as fish stocks become scarce resources, the overaccumulation of fishing capacities is thus a natural consequence of the externalities related to their common-pool character.
Overcapacity does not only mean that too much capital and labour are used for catching a given quantity of fish. Because fish are living resources, overcapacity may lead to overfishing : too many fish may be caught as regards the renewal capacity of the stocks (recruitment overfishing)[1], or fish may be caught when they are too young as regards an efficient exploitation of each cohort (recruitment overfishing). Recruitment and growth overfishing, when they occur, create additional factors of unefficiency in the operation of the fishery.

Established initially in the simple case of a one-gear / one-species fishery, this classical diagnosis does not loose any of its relevance in the case of a complex fishery such as the one of the Normand-Breton gulf: the externalities between fishermen targeting the same species with the same type of gear are furthered by externalities between fishermen using different gear (and this frequently increases the space problem), and/or targeting different interacting species (a species targeted by some fishermen may be regarded as a by-catch, or may be discarded by other fishermen).

2.1.2 The weakness of the institutional mechanism regulating the fishing capacity in the Normand-Breton gulf

Because of the mutual externalities generated by the exploitation of the common-pool resources of the fishery, one cannot rely simply on the functioning of the market mechanism to get an efficient and approximately peaceful equilibrium between fishing capacities and fish stocks. The curbing of the tendency to overcapacity is normally a major case for fisheries management. In the Normand-Breton gulf, it appears that the institutional mechanism has important weaknesses as regards the prevention of overcapacities.

The limitation of fishing capacities may be either direct or indirect. The direct limitation relies on a restriction of the number of boats authorised to operate the fisheries, and of some of their characteristics regarded as relevant in terms of fishing capacities (length, engine power, number and type of gears...). The indirect limitation relies on economic mechanisms aimed at counteracting, or even neutralising, the tendency to overcapacity. These mechanisms are basically a tax-system or a system of individual catch quotas : the tax-system is intended at bringing individual benefits closer to social benefits, thus internalising the externalities in the Pigovian tradition (Pigou, 1920) ; the individual quotas

[1] Recruitment overfishing does not imply necessarily that the fish stock is doomed to collapse: it may result in a situation where the stock is stabilised at a level which is simply too low from an economic point of view. In practice, this topic is complicated by the fact that, for most fish stocks, it is hardly possible to isolate a significant statistical relation between the importance of the spawning stock and the importance of the recruitment. Though it strongly reduces the practical scope of the elegant self-regenerating models which are the basis of a large part of fisheries economic theory, this phenomenon does not eliminate the relevance of the 'precautionary approach' in fisheries management: the probability of low recruitment gets higher when the stocks fall below a certain level (Myers and Barrowman, 1996).

system is more in accordance with the Coasian approach (Coase, 1960), since it creates a substitute to the individual property rights who are regarded, in this approach, as a necessary condition of efficiency [1].

The indirect capacity limitation mechanisms are very few in the French management system of the Normand-Breton gulf. The taxation of the fishing industry is generally quite low in France, and is not used as an economic instrument of fisheries management. As regards quotas, the situation looks paradoxical:

A global catch quota (in fact a TAC) is enforced in the scallop fishery of the bay of St-Brieuc (south side of the Normand-Breton gulf), but it is not split into individual quotas, and thus may by no means be regarded as an instrument of control of the fishing capacity : on the contrary, this system is a strong inducement to increasing individual capacities, since every fisherman will try to catch as much fish as possible before the global quota is reached.

Individual daily quotas are theoretically enforced in some cases of shellfish dredging or potting[2], but they are not linked to any TAC. They limit the amount of daily catches on the basis of the number of men onboard, and their purpose is mainly to regulate the time-flow of landings. Their impact on fishing capacities thus depends on the existence of other (direct) limitation mechanisms.

Only a very limited number of fishing activities are regulated both by a TAC and individual quotas. These activities (sea diving for abalone and small bivalves[3] dredging) are very different as to the fishing technique used and as to the unit weight-value of the product. They have in common to be new fisheries (at least from a legal point of view : unlawful abalone catching is a traditional activity in Northern-Brittany).

The limitation of fishing capacities mainly relies on direct mechanisms:

First, the fleet operating the fishery is subject to the global limitations created by the European CFP (reduction of the GRT and HP involved by the subsequent POPs). But of course this type of global limitation does not guarantee, by itself, the limitation of the fishing capacity of the fleet operating one particular fishery.

A further limitation stems from the fact that the gulf is entirely inside the 12 NM line. In the present state of the European CFP (up to 2002), this means that the access to the fishery is, in principle, restricted to the vessels of the coastal states.

As regards French law, the direct capacity control mainly relies on limited entry licenses. Since the 70', such licenses have been established, for several species of molluscs on a local basis (by bed) : the prototype of this system was set up in the scallop fishery of the bay of St-Brieuc, in the south of the Normand-Breton gulf. More recently, a limited entry license has been established for large crustaceans (edible crabs, spider crabs and lobsters altogether), but on a national basis.

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[1] This substitute is incomplete as long as quotas are non-transferable. The French law prohibits the transferability of quotas or licenses (*Loi d'orientation sur la pêche*, 18 November 1997).

[2] scallop dredging in the district of St-Malo and in Lower-Normandy, warty venus dredging and whelk potting in Lower-Normandy.

[3] *Spisula*, *Ruditapes*.

The limiting of the number of boats authorised to operate the fishery is completed by restrictions concerning the length and/or HP of the boats, and the number and characteristics of the gears.

However, these restrictions are weakened by several features:

The scope of the system is incomplete. No license has been established for activities targeting finfish, and no capacity limitation applies to the boats having this type of activity (mainly trawlers). The only limitation to otter-trawling is the prohibition of this type of gear within the 3 NM line (6 NM line for the so-called « large vertical opening » trawls), but this restriction is weakened by derogations for seasonal cuttle fishing. The weakness of the limitations concerning trawlers is noticeable, since trawling is the least selective fishing activity inside the Normand-Breton gulf, and also the most interactive one because of the competition for resources and space it generates with other activities (see tables 2 and 3 above).

The level of the restrictions is such that their function is mainly to protect the statu quo. When a limited entry license system is established, the constraints are usually fixed at a level high enough not to be binding for the fishermen already operating the fishery. This feature, whose political background is obvious, implies that the system may prevent a further development of overcapacity, but is of little help to reduce a possible existing overcapacity.

The system lacks homogeneity. Due to the multiplication and overlapping of the regulating authorities (see above), the regulations often vary from one place to the other, without technical or economic reason. For instance, parlour-pots, spring-loaded dredges or midwater-trawls are prohibited in Brittany (with derogations), but not in Lower-Normandy. The system lacks time-stability. The changes in the regulations are frequent, and sometimes contradictory. For instance, in the case of the scallop fishery of the bay of St-Brieuc, the maximum authorised length of the boats was changed from 13 to 16 metres in the 80', and brought back to 13 metres a few years later. The boats between 13 and 16 metres who were licensed in the meanwhile received a derogation for continuing their activity.

The enforcement of the rules is perfectible. Effective control of the landings, of the number and characteristics of the gear used, of the fishing areas and fishing time is often unsatisfactory, and the deterrent character of the penalties may be questioned. The high difference in the frequency of controls and in the levels of penalties imposed by French courts and courts of the Channel Islands is a subject of unrest among some French fishermen[1]. In the same time, one can notice a strong demand for a better enforcement of the rules in the whole area by a large number of French fishermen operating the Normand-Breton fishery.

2.2 Empirical indications

The economic analysis of common-pool resources and the survey of the legal mechanisms of fisheries management in the Normand-Breton gulf lead to consider the overcapacity hy-

[1] The question of the legal procedure applied by the Guernsey courts is also a subject of dispute.

pothesis as a plausible, even if partial explanation of the recurrent fisheries conflicts in this area. Due to the statistical problems mentioned above, it is not so easy to gather empirical evidence of the overcapacity syndrome. However, some facts may be regarded as reasonable indications of the relevance of the hypothesis.

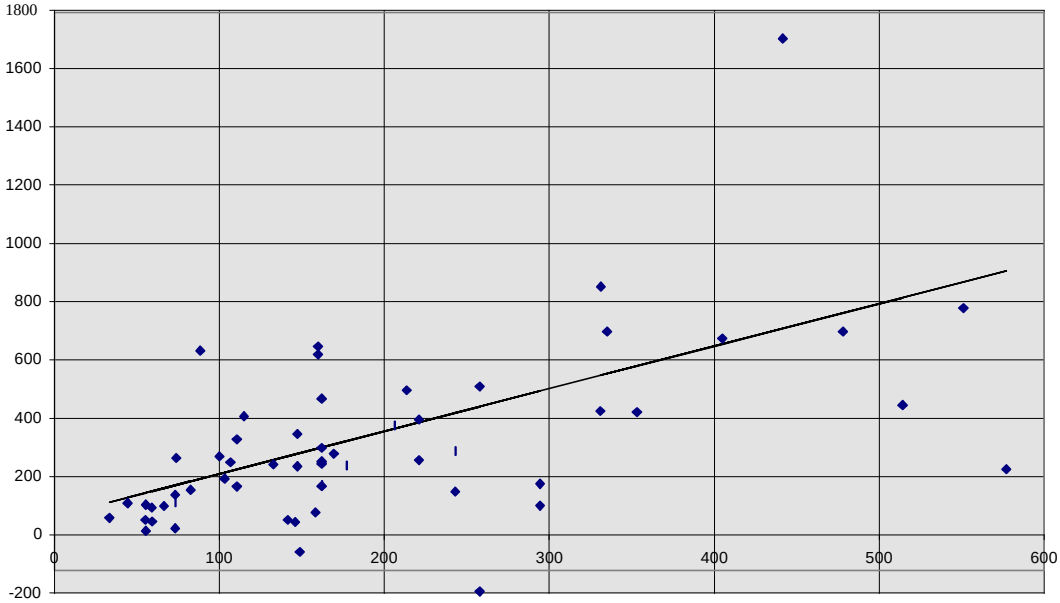
2.2.1 The economic stimulus to increase the fishing capacity

The economic argument for overcapacity relies on the idea that increasing fishing capacities is individually profitable, even if not socially desirable. Some indications of the individual profitability of larger fishing capacities may be found in the results of an economic sample survey of the French fishing fleet operating the Normand-Breton gulf in 1997 (Boncoeur and Le Gallic, 1997).

Among other economic performance indicators, this survey leads to the calculation of an indicator called 'net income of the skipper-owner', defined as the sum of his net incomes stemming both from the crew-share, and from the owner-share[1]. A linear regression analysis conducted on the segment of the sample using towed gears (dredges and trawls) displays a somewhat fuzzy, but significantly positive correlation between the boat HP and the net income of the skipper-owner:

[1] All the boats operating the Normand-Breton gulf fishery belong to the 'artisan fishing sector', which means that the remuneration of the crew, including the skipper, is based on the so called share-system, where wages are calculated as a part of the value of the sales, after deduction of some 'common-pool expenses'. In this system, the skipper-owner is rewarded both through the channels of the crew-share and of the owner-share. For various reasons, these two channels may not be simply assimilated to the economic categories of labour income and capital income respectively (Boncoeur, Bailly and Le Floc'h, 1997). The net income of the skipper-owner presented here is calculated as the gross operating surplus, plus the net income received by the skipper through the crew-share, minus an economic estimation of the capital depreciation allowance (different from the accounting amortisation allowance) and capital opportunity cost (rate of interest 5,7%, which is the long term interest rate on public titles, and close to the rate at which money may be borrowed for the buying of a fishing boat).

fig.1 Boat HP and net income of the skipper-owner
Trawlers and dredgers, Normand-Breton gulf.



$y = + 1{,}46.x + 63{,}75$
where:
x is the engine power of the boat (in kw)
y is the net annual income of the skipper-owner (in thousands of French francs)
with :
number of observations : 57
adjusted r^2 : 0,40
t-student (factor a): 6,01
95% probability interval for factor a: [0,97 ; 1,94]

For boats using towed gears (56% of the total number of French boats operating the Normand-Breton gulf fishery in 1994), there is a clear relation between the fishing capacity and the engine power. The above correlation thus suggests that usual economic motivations create a stimulus to increase the fishing capacity, even if this factor is of course not the only explanation of the level of income (the adjusted r^2 is only 0,40). For boats using only fixed gear, the connection between fishing capacity and engine power is not straightforward, and it would be necessary to use an index such as the number and characteristics of gears used, in order to check a correlation similar to the one presented above. The rapid development of the use of trap-pots in the recent years suggests that individual economic motivations create the same type of stimulus as for towed gears.

2.2.2 Evolution of fishing capacity and of landings

The lack of reliable data concerning the Normand-Breton gulf is a considerable obstacle to the testing of the overcapacity hypothesis. The problem has several sides. For some species (mainly crustaceans), the level of knowledge of the landings is poor. For other species (mainly finfish), the geographical origin of the catches is not known with enough accuracy. As regards the fleet, there are time series (not fully homogenous) concerning the boats registered in the maritime districts bordering the gulf, but this set of boats does not fully corresponds to the fleet operating the gulf fishery. We thus have to rely on partial, approximate and indirect indications in order to check the plausibility of the overcapacity hypothesis.

Table 4 *Evolution of the landings and of the fishing fleet in the 4 maritime districts bordering the Normand-Breton gulf* between the mid 70' and the mid 90'*

Value of landings (constant francs)**	+ 3 %
Number of boats registered***	- 48 %
Average HP***	+ 119 %
Cumulated HP***	+ 27 %

* Districts of Paimpol, St-Brieuc, St-Malo and Cherbourg. ** Average 1991-95 compared to average 1974-78. Products of far-away fishing, mussels and sea-weeds excluded. ***1993 compared to 1976. Vessels under 25 meter long. Source: CCPM 1975-79, 1992, CNPM 1993 and FIOM 1994-96.

The above table shows an overall stability of the global value of landings (in constant francs) in the harbours bordering the gulf1 over the two last decades, to be compared with a division by 2 of the number of boats, but with an increase of ¼ in the cumulated engine power of the fleet, due to the fact that the average HP of the boats has more than doubled during the period. This suggests that, irrespective of the sharp diminution in the number of boats (and of fishermen), the fishing capacity around the gulf has significantly increased during the period, and this conclusion is of course strengthened by the taking into account of the technical progress factor. A conventional widespread estimation of the effect of this factor leads to a yearly 2% increase in the fishing power of the fleet, *caeteris paribus* (in the present case, this rate may be regarded as a minimum). If we combine this estimation with the increase of the engine power, we obtain an increase of cumulated fishing capacity of approximately 75% over the two decades, to be compared with the overall stability of the value of the landings. The available data allow a more precise description of landings for the period starting in the mid 80'.

[1] In this table, data that could clearly be regarded as having no connection with the gulf fishery have been excluded.

Table 5 *Main species targeted in the Normand-Breton gulf*. Evolution of landings in the 4 bordering maritime districts, 1986-94 (indexes basis 100 in 1986)*

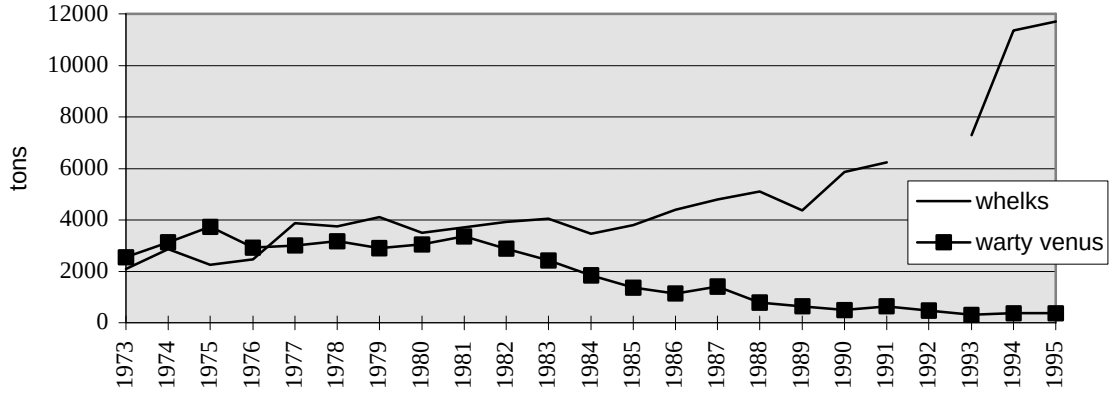
	1986	1991	1994
1 Number of tons landed	100	115	134
2 Value of landings (constant francs)	100	87	82
3 Average price of landings (constant francs)	100	75	61
4 Synthetic index (Laspeyres) of the prices of the landings (constant francs)	100	90	85
5 Effect of the change of the structure of landings. [5] = 100.[3] / [4]	100	83	72
6 Synthetic index (Paasche) of the volume of landings. [6] = 100.[2] / [4]	100	106	97

* By decreasing order of the value of landings (in 1991): common scallop, spider-crab, whelk, warty venus, cuttle, sea-bass, sole, rays, pollack, lobster, sea-bream, red gurnard (the total amounts to 60% of the value landed in 1991 in the 4 districts bordering the gulf, boats over 25 meters excluded). Source : *Affaire maritimes*.

The above table is dedicated to the landings, in the maritime districts bordering the gulf, of the 12 main species targeted in this area. As for shellfish, the landings generally correspond to catches realised inside the gulf. The situation is not so clear with finfish: rays, for instance, are caught inside the gulf, but also outside. At least, the panel depicted in the above table eliminates the influence of species which, though representing a significant part of the landings in the bordering districts, are poorly represented in the gulf (sharks in the district of Cherbourg for instance).

The table shows a growth of 1/3 approximately in the weight of the landings during the period 1986-94, altogether with a decrease of almost 20% in their global value (in constant francs). The meaning of the drop of the average price of landings during the period (around 40%, in constant francs) is not simple because two different phenomena may interact: a change in the individual prices, and a change in the structure of the landings. To separate this two factors, a Laspeyres price index has been calculated, i.e. a synthetic index of the prices of the different species landed, under the hypothesis of a constant structure of landings (the structure of 1986). The calculation indicates that, if individual prices (in constant francs) have generally decreased during the period, only a minor part of the drop in the average price of landings can be attributed to this cause : the major part is due to a structural effect, i.e. the degradation in the structure of the landings as regards their individual unit-value. This is due to the tendency of the Normand-Breton fishery to replace the exploitation of high value resources by lower value resources as the former ones get progressively exhausted. The replacement of warty venus by whelks is an example of this phenomenon:

fig.2. Landings of warty venus and whelks in the district of Cherbourg, 1973-95 (source : *Affaires maritimes*)



The taking into account of the Laspeyres synthetic price index allows the calculation of a synthetic (Paasche) volume index of the landings, which depicts the evolution of the value of the landings assuming given individual prices (in constant francs). The result shows a global stability of the volume of the landings during the period 1986-94, to be compared with the evolution of the fleet in the 4 maritime districts bordering the gulf in the same period.

Table 6 *French fishing fleet registered in the 4 maritime districts bordering the Normand-Breton gulfe evolution 1986-94 (indexes basis 100 in 1986*

	1986	1990	1994
Number of boats	100	92	77
Average GRT	100	128	148
Average HP	100	141	160
Cumulated GRT	100	118	114
Cumulated HP	100	130	123

Source: Affaires maritimes.

Here again, the growth in the cumulated horse power (and gross registered tonnage) of the fleet underestimates the growth in the effective fishing capacity, because of the technical progress which has been particularly important during the period (especially as regards electronic detection devices). To sum up, the historical outlook suggests the following tendencies over the two last decades:

- Sharp decrease in the number of boats registered in the districts surrounding the gulf.
- Significant increase in their cumulated fishing capacity.
- Stability of the global volume of the landings.
- Degradation of the structure of these landings as regards their unit weight-value.

It is important to stress that, 1) due to the lack of accuracy of some data, the tendencies here depicted are only very rough, and 2) because official statistics, as well as a good many boats and fish ignore the border-line, it is difficult to sort out precisely what is happening inside the gulf and outside.

2.2.3 Misexploitation of the resources

Though misexploitation of the resources is distinct from overcapacity, it is frequently related to it, because of the « race for fish » that is boosted by overcapacity. In the case of the Normand-Breton gulf, several evidences of misexploitation of the fish resources can be displayed. The misexploitation takes mainly two forms : 1) catching and landing of individuals which are too young as regards their economic value (this phenomenon seems to be particularly important in the cuttle trawling activity), and 2) discards with a high death rate of juveniles (sea-bream, sole...) or of individuals without immediate economic value (by-catches of soft spider-crabs by trawlers). The bioeconomic studies of these phenomena is still in progress, and the case presented in the following table, depicting the social cost of discards of spider crabs by trawlers, is given just as an illustration[1].

Table 7 Cost-benefit analysis of trawling in the Normand-Breton gulf during the months of August and September, considering the social cost of discards of spider crabs by this activity (millions of francs)

	Abundance of the recruitment of spider crabs		
	1. normal*	**2. high****	**3. low*****
[1] Turnover of trawlers in the gulf during August-September			
a. Small trawlers	13.3	13.3	13.3
b. Large trawlers	4.9	4.9	4.9
[2] Variable cost of trawlers in the gulf during August-September			
a. Small trawlers	4.2	4.2	4.2
b. Large trawlers	1.8	1.8	1.8
[3] = [1] - [2] Surplus of trawlers in the gulf during August-September			
a. Small trawlers	9.1	9.1	9.1
b. Large trawlers	3.1	3.1	3.1
[4] Loss of netters and potters surplus (absolute value)	8.6	13.7	5.4
[5] Loss of consumers surplus (absolute value)	6.1	9.6	3.8
[6] = [4] + [5] Social cost of spider crabs discards	14.7	23.4	9.2
[7] = [3] - [6] Global balance			
a. including large trawlers surplus ([3.a] + [3.b] - [6])	- 2.5	- 11.2	+ 3.0
b. large trawlers surplus excluded ([3.a] - [6])	- 5.6	- 14.3	- 0.1

* probability of higher recruitment = 0.50. ** probability of higher recruitment = 0.05. *** probability of higher recruitment = 0.95.
Source: authors calculations.

Comment
Spider-crab is targeted by netters and potters of the Western Channel with a high rate of exploitation (75 to 80%). The fishing period takes place in winter and spring, and between

[1] The bio-economic model which is the basis of the simulation presented here is described in Boncoeur, Fifas and Le Gallic, 1998.

80 and 85% of the catches correspond to the recruitment. At the end of the summer, coastal otter-trawling induces a massive destruction of spider-crabs which, at this time, are concentrated on the nurseries of West-Cotentin and St-Brieuc and are particularly fragile because of the process of molting. As a result, around 25% of the individuals recruited each year are destroyed by coastal trawling in the months of August and September. This represents, on an average, a loss of catches of 1100 tons a year for the netters and trawlers (this loss is at very short term: a few months later).

Under different scenarios concerning the abundance of recruitment[1], it is possible to calculate the social cost of spider-crabs discards by trawlers. The first component of this cost is the loss of surplus of crabers, equal to their loss of turnover under the hypothesis of a constant fishing effort. The rate of loss is less important for turnover than for quantities landed, because landings of spider-crabs in the 4 maritime districts bordering the Normand-Breton gulf represent 70 to 80% of the national landings for this species, which makes the price of these landings sensitive to the quantities landed[2], and therefore higher than it would be if there were no discards by trawlers. The same phenomenon induces a loss of surplus for the consumers, which is the second component part of the social cost of discards. With a normal recruitment, this social cost amounts to 14.7 millions of francs. It may reach 23.4 millions of francs in case of a high recruitment, and is unlucky to fall under 9.2 millions of francs in case of a poor recruitment.

The social cost of spider-crabs discards by trawlers operating the gulf fishery during the months of August and September is to be compared with the surplus generated by this activity. The only surplus to be taken into account here is the producers surplus (turnover minus variable cost, exclusive of crew wages[3], since the quantities of the various finfish species landed by trawlers operating the gulf fishery have no significant impact on the prices (this is probably due to the fact that they represent only a small part of the quantities of the same species landed at the national level). It is necessary to distinguish the case of small coastal trawlers, the activity of which is concentrated inside the gulf, and the case of large offshore trawlers which, generally, have the main part of their activity outside the gulf (the above figures encompass only the part of their activity inside the gulf): for the boats of the first category, the discontinuation of trawling inside the gulf during two months would certainly create more problems than for the boats of the second category, which can easily trawl outside the area. The surplus of small trawlers operating inside the gulf has been estimated to 9.1 millions of francs on average for the months of August and September, and the equivalent surplus for large trawlers to 3.1 millions of francs[4].
Comparing the surplus realised by trawlers inside the gulf during the months of August and September with the social cost of their discards of spider-crabs in the same period consid-

[1] These scenarios are based on the results of recruitment assessments campaigns realised by IFREMER during 11 years.
[2] The price-quantity relation has been tested over the years 1973-95. It displays a coefficient of elasticity of price to quantity landed equal to -0,41.
[3] According to the system of remuneration implemented in artisan fisheries (so called 'share system'), the crew wages do not depend of fishing effort, but of revenue.
[4] Figures derived from a sample survey of the boats operating the gulf fishery in 1997 (Boncoeur et Le Gallic, 1997).

erably deteriorates the global economic balance of this activity, and even makes it usually negative: the incomes trawlers get from their activity inside the gulf during August and September are, in most cases, not high enough to compensate the losses of surplus their discards generate, supposing they would have to pay for it.

This result would be strengthened if the simulation integrated the fact that, supposing a discontinuation of inshore trawling during August and September, a significant proportion of the fish targeted by trawlers and usually caught and landed during these two months would be caught and landed a few months later.

3. Discussion and conclusion

Behind the biological, technical and legal complexity of the Normand-Breton Gulf fishery, it seems possible to distinct a common factor to the various conflicts which affect this area: this factor is the overcapacity phenomenon. It is due to well known economic mechanisms, which are not curbed by appropriate institutional mechanisms.

The various authorities in charge of the gulf try to solve the fisheries conflicts mainly by sharing the space between groups of users, according to nationality, region, or *métier* (Prat and Curtil, 1997). Spatial regulations are undoubtedly necessary, if only because of the strong space interactions existing between the different *métiers*; spatial regulations may also be useful in the case of some problems linked to resource interactions, as suggests the above example concerning spider-crabs discards (a seasonal and local prohibition of trawling would certainly improve the overall efficiency of the fishery[1]). However, this type of regulations has no effect on the overcapacity situation and thus, in the long run, may not be regarded (if taken alone), as an efficient remedy against conflicts. Fishermen are aware of this problem, as shows the present tendency towards a generalisation of limited entry licenses (LEL), favoured by fishermen organisations.

One may wonder if the adoption of a LEL system is the best way to solve the over capacity problem. According to some authors, individual transferable quotas (ITQs) are the one-best-way to manage efficiently a fishery (Arnason, 1998). In the French law, transferability is forbidden, and thus non transferable IQs might be regarded as a second best solution. The theoretical advantages of I(T)Qs are well known (one of them being its powerful action against overcapacity). In real fisheries however, the practical difficulties of the implementation of this system may overtake its theoretical advantages (Copes, 1997). Let alone the question of transferability, the main problems with IQs are linked with the question of the controllability of landings, but also of discards (highgrading, problem of implementation in multispecies fisheries). The difficulty of determining *ex ante* a sound TAC also has to be considered.

[1] The main obstacle against the adoption of this technically simple measure is the question of its distribution effect: though the improvement in efficiency makes it possible to set up a system of financial compensations, it may be difficult to find an agreement on such a system because there is no clear definition of the legitimate resource users (being *res nullius*, fish are supposed to belong to no one before they are caught, and this legal definition is usually interpreted by various groups of users as themselves being the legitimate owners of the stocks).

In the case of the Normand-Breton gulf, the intensity of these problems would probably vary according to the fish stocks. The main difference is between finfish and shellfish.

As for finfish, the controllability of landings is rather good as most of these landings are sold through auction markets. However, an IQ system seems difficult to implement for finfish at the gulf scale, because the mobility of the stocks makes it irrelevant to fix a TAC at this scale1, and because the main gear used for catching finfish, which is trawl, is a source of many by-catches and generates high discards (Berthou et al., 1996). The setting up of IQs would probably badly worsen the phenomenon of discards by trawlers, which is already serious in the gulf.

The situation is almost symmetrical with shellfish. On the one hand, the two main obstacles against IQs for finfish are not met with shellfish: due to their low mobility, most stocks of the gulf may be considered as resident, and the risks of increasing mortality by discards is negligible because the gears are very selective and the discarding under normal conditions is not a factor of mortality. In the present situation, the weakest point as regards the possibility of implementing an IQ system for the shellfish of the gulf is certainly the controllability of the landings. Scallops and others bivalves are mainly sold through auction markets, but unlawful landings of scallops are already non negligible, and the high weight unit value of the meat, once separated from the shell, makes it easy to smuggle. Crustaceans are generally not sold through auction market and the knowledge of the quantities landed is poor. However the examples of abalone and small clams already locally under IQs suggest that, in some cases at least, this problem may be tackled with : for abalones, which have a quite high weight unit value, the solution has been to tag each individual shell. This method could be extended to lobsters.

If the principle of transferability is rejected for the time being by French fishermen organisations and by French law, the question of control by inputs (LEL), by outputs (IQ), or by mixed solutions is still open. In the case of the Normand-Breton gulf, it probably does not admit a uniform answer. Whatever the system adopted, it will work efficiently and fairly only if two conditions are met: a serious improvement in the transparency of landings and an equally serious improvement in the enforcement of the rules. The fact that fishermen become increasingly aware of the necessity to limit overcapacity by controlling the access to the resources should make these conditions easier to fulfil by the public authorities in charge of the fishery.

[1] With the possible exception of sea bream.

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Productivity and Profitability of the Icelandic Fisheries

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Abstract

Since 1991, the fisheries management system in Iceland has almost totally been based on Individual Transferable Quotas (ITQs). It has been debated whether this scheme has led to the results in efficiency within the industry, which were predicted at the beginning of the ITQ era. Examination of their effects has mostly been expressed in logical or verbal terms and lacks the necessary empirical foundations. In this context, this paper attempts to shed some light on the issue by applying traditional methods of productivity and profitability to the fisheries industry.

Keywords: ITQ, productivity and profitability.

1. Background

The Icelandic economy is heavily dependent on fisheries and for a long time there has been a consensus for the need of conservation of marine resources. The first steps had already been taken in the 1930s, mainly with gear restrictions and juvenile fish protection. Then in 1948, legislation for scientific protection of the fish stocks was passed by the Icelandic Parliament. The first set of specific regulations regarding fisheries management was set in 1967 and between 1984 and 1990, most of the demersal fisheries were managed using a combination of effort and catch quotas or share quotas on an individual vessel basis. The present fisheries management system went into force in 1991. This is a comprehensive system covering all fishing operations and is based on individually transferable quotas (ITQs). The system is therefore referred to as an ITQ system and its main characteristics are as follows:

- Nearly all fisheries are subjected to vessel catch quotas.
- The system is comprehensive and includes nearly all decked fishing vessels.
- The individual quotas are allotted as percentage shares of the total allowable catch (TAC) for each year.
- The share quotas are permanent and divisible.
- The quotas are transferable with minimal restrictions.

The last two points are intended to transform the quota rights into quasi-property rights to solve the common property problem of the free access fisheries of former days.

The fisheries management system in Iceland has two main objectives:

- To promote prudent biological management of the fish stocks to assure sustainable harvesting of the renewable marine resources.
- To increase efficiency and reduce the size of the fishing fleet in order to improve the economic performance of the fisheries sector.

The purpose of this paper is to evaluate the economic benefits, which are assumed to have been generated under the fisheries management system. Two approaches will be applied.

1. Productivity growth in the harvesting sector is measured for the period of 1980-1995 in order to estimate changes before and after the introduction of a complete uniform ITQ system in Iceland.
2. Changes in efficiency and profitability will be evaluated and analysed over the period 1990-1996 in order to assess the economic and financial performance of the fisheries management system.

Minimal research has been done in this area and it is expected that this study will contribute to the discussion on the ITQ system in Iceland.

2. Productivity

One of the main objectives of the ITQ system in Iceland is to promote sustainable and efficient utilisation of the marine resources around the country. Since 1991 a complete uniform ITQ system for all fisheries has been in force. It is important to know how successful the system has been, but available, authentic, empirical information about economic results of the system is almost non-existent. Hence there is a need for empirical information to answer vital questions about the performance of the system.

2.1 Methodology

According to Arnason (1993), direct estimates of economic benefits of the ITQ system should include the following items:

- Reduction in fishing effort.
- Reduction in the cost of fishing effort.
- Improvements in the quality of the catch.

Theoretically, the system should minimise the cost of inputs and maximise the value of the fisheries outputs. It is desirable to measure the total net economic benefits, which the ITQ system has generated, but clearly this is not a straightforward task. Other factors, which can influence economic results of the fisheries, such as fluctuation in fish stocks and changing technology, have to be considered.

One way to approach the problem is to measure the productivity growth of the fisheries sector, i.e. the operation of the fishing fleet. In a wide perspective, measured productivity is a realistic indicator for the performance of the ITQ system because it includes changes to both inputs and outputs of one parameter. Labour productivity (LP) and fishing capital productivity (KP) are measured as single factor productivity and, furthermore multi (total) factor productivity (MFP) is also measured. The equation for MFP is derived from neo-classical production function. Relevant equations are as follows:

$LPt = (Qt/Qt-1)/(Lt/Lt-1)$
$KPt = (Qt/Qt-1)/(Kt/Kt-1)$
$MFPt = \ln(At/At-1) = \ln(Qt/Qt-1) - wK(\ln(Kt/Kt-1)) - wL(\ln(Lt/Lt-1))$

where Qt denotes output (value added) in constant prices (double deflated) in year t; L is labour (man-years); K is fishing capital in constant prices, A is multi factor productivity and wL and wK are cost share weights. The weights are the mean of the cost shares in two adjoining years, i.e. $wI,t = 0,5(si,t + si, t-1)$, and s is the cost share of factor i in year t.

Of course the fisheries management regime isn't the only factor which could affect the MFP: others include technological progress; skill level of the fishermen; natural conditions, and legal and institutional factors beyond the ITQ system.

2.2 Findings

The period of 1980-1995 (see Appendix A) is examined and the productivity growth in the fisheries in Iceland is divided into two periods during that time; before and after the introduction of a complete uniform ITQ system.

Table 1 Productivity in the harvesting sector, average annual growth during 1980-1995

Period	LP	KP	MFP
Before uniform ITQ system 1980-1990	0,74%	-0,13%	0,56%
After uniform ITQ system 1991-1995	1,53%	1,30%	1,48%

According to table 1 productivity growth is significantly higher after the introduction of the complete uniform ITQ system, which indicates that there are other factors besides growth in labour and fishing capital affecting the economic performance of the sector. On a year to year basis we can see up to 20% change in the MFP. Taking this into account, the content in Table 1 will be different if we change the base year from 1991 to 1990, in the second period. This would lead to a substantial fall in the average annual growth rate in the MFP from 1,48% to -0,9%.

2.3 Other Indicators

Besides productivity, it can be illustrative to study other indicators related to production when dealing with the performance of the ITQ system.

Table 2 Fishing fleet, catch per day and fuel consumption in the harvesting sector

	1985	1989	1992	1996
Fishing fleet in ,000 GRT *	111	120	121	127
Catch per day at sea, tons				
Trawlers 201-500 GRT	11,3	10,5	8,3	7,8
Boats 21-200 GRT	2,9	3,3	2,5	3,3
Fuel consumption in ,000tonnes	177	223	250	274

*) Open boats are not included.
Source: National Economic Institute and Statistics Iceland.

The limited indicators in table 2 do not indicate increased efficiency in the harvesting sector, to note e.g. that fuel consumption has increased by 55% between 1985 and 1996. At the same time the value of the catch increased only by 23% at constant prices. As table 2 indicates, a fall of 31% in the trawlers catch per day at sea and 14% growth in GRT of the fishing fleet does raise questions as to whether the fishery management system is on the right track.

3. The Financial Performance and the Methodology of Financial Ratio Analysis

In assessing the capabilities of the Icelandic fisheries management system (FMS) it is necessary to understand its economic and strategic potentials. The financial and economic performance of the fisheries sector in Iceland since implementation of the present fisheries management system in 1991 must therefore be assessed. Strengths and weaknesses of the system are outside the scope of this paper; rather we attempt to evaluate the economic and financial end-results by implementing a financial analysis based on the methodology of financial ratio analysis (FRA).

FRA analysis is a widely used technique interpreting financial results of companies, both individually and in groups. It becomes possible to summarise in a brief and concise way the underlying relationships and results that are crucial to an appreciation of economic performance.

Implementing the FRA method on a systematic, comprehensive and comparable basis will illustrate trends and indicate significant changes in the financial data used in this research.

In the analysis, a sensible basis of comparison must be constructed and financial ratios must be augmented with information of a non-financial nature to deliver a meaningful analysis. In this paper a carefully selected set of ratios is calculated over the period 1990-1996. An attempt is made to identify the main characteristics and trends indicated by these

ratios in order to assess the financial performance of the fisheries sector under the fisheries management system in Iceland. This is done by relating indicators of profit to other indicators such as turnover, assets, and capital employed.

3.1 Data

Basically, the data used in this research is retrieved from annual reports of fishery companies in Iceland. The data is assumed to have a high degree of comparability and consistency owing to standardised accountancy practices in Iceland.

The data used in this research has two sources:

1. An aggregative summary of annual reports of Icelandic fishery companies as published by the National Economic Institute, which covers the entire fisheries' sector.
2. Summary from the annual reports of the publicly listed fisheries companies in Iceland. There are 11 firms in this sample, which covers one third of the total export turnover of the fisheries sector.

The reason why a ratio analysis is applied to the two different data sets is to discover whether there is a significant difference in outcome, between the larger sample, which covers the entire fisheries sector, and the smaller sample, which includes the leading fisheries companies in the sector.

The divergence regarding financial performance and economic strength is quite high among the fisheries companies in Iceland. Also it has been assumed that the overall performance should be better in the larger companies with a high degree of vertical integration. Therefore, comparison between the fisheries sector as a whole and its leading companies add an important insight to the analysis.

3.2 Financial Ratios Used

It is important to be selective in the use ratios: They must be relevant and have a strategic perspective to serve the purpose of the analysis and research carried out. Their purpose is to identify changes in efficiency and profitability in the fisheries' sector. In other words, ratios will be used to demonstrate the financial performance of the companies in this sector. The main aspect of companies' performance of relevance in this context, is the financial efficiency i.e. of earning power of the business operation. Ratios on financial efficiency focus on the relationship between:

- Profitability of sales or the ratio of profit to turnover.
- Asset utilisation ratio or assets turnover ratio.
- Return on capital employed.

3.2.1 Ratio of profit to turnover (sales)

The profitability of the turnover or total sales is assessed, as the efficiency of the business is critical in generating profit. In this research, operating profit and net profit will mainly be used. This ratio is usually expressed as:

$$\frac{\text{Profit}}{\text{Turnover}}$$

3.2.2 Asset turnover ratios

In a capital-intensive business such as the fisheries industry, the asset utilisation is of high importance as low level of asset utilisation usually means low profitability. The asset turnover ratio is intended to indicate the intensity with which the assets are employed to generate income. Changes in this ratio reflect changes in the efficiency of the assets employed. The asset turnover ratios indicate the rate of utilisation of the assets, but a higher rate of utilisation is one of the main goals of the FMS. Asset turnover ratios are usually calculated as:

1. Total assets turnover = $\frac{\text{turnover}}{\text{total assets}}$

2. Fixed assets turnover = $\frac{\text{turnover}}{\text{fixed assets}}$

3.2.3 Return on capital employed (ROCE)

This ratio is an indication of how efficient the use of capital is in generating income and is therefore central in assessing efficiency and profitability of the fisheries management regime in Iceland. This ratio can be calculated in different ways, but two versions of ROCE will be used:

1. Return on assets = $\frac{\text{operating profit}}{\text{total assets-current liabilities}}$

2. Return on fixed assets = $\frac{\text{operating profit}}{\text{fixed assets}}$

3.3 The Aggregated Fisheries Sector

3.3.1 Ratio of profit to sales (figure 1)

The first component in calculating returns on capital employed (ROCE) is the ratio of profit to total sales. A significant increase in profitability in the fisheries sector, measured

as gross operating profit to sales and in the ratio of net profit to sales, can be detected from 1992 to 1994.

3.3.2 Asset turnover ratio (figure 2)

The second component for calculating ROCE is the asset turnover ratio. This is a valuable indication of the rate of asset or capital utilisation, revealing the intensity with which the assets in business operations are utilised to generate income.

Main types of property rights

The paper considers property not as an asset in the stock of fish but as a resource flow. Subject of the research are protected rights to a benefit stream, generated with fishing. Rights are considered as 'property rights' when they are exclusive.

Three types of property rights can be distinguished: 1) state property 2) private property and 3) common property. Open access can be seen as a situation of non-property. The decision of the EU in 1976 to establish a coastal zone of 200 miles meant an end of open access for non-EU vessels. The subsequent start of the Common Fisheries Policy (CFP) in 1983 resulted in limiting measures in the framework of the common conservation-, structure- and market policy. Gradually, these measures have evolved into more or less valuable rights in the EU fishing countries.

The Danish fishery is characterized by a flexible, multi-purpose fleet, which relatively easily can move from one fishery to another. Moreover, many of the fisheries are multi-species fisheries. There is an overall limited access to the fishery by the vessel licence and by the requirement to be recognized as a commercial fisherman. These two entitlements are a form of property right, giving access to the benefit stream.

TACs are divided in Denmark into quarterly quotas which secure a spread of fishing activities over the year. These quotas are allocated to individual vessels through rations for a given period. The permissions, specifying the rations, are not fully exclusive so that they have not the character of a property right in the sense of the above mentioned definition.

Some experiments with respect to effort regulation and individual transferable quotas have been conducted but it remains unclear whether these, for the Danish case new management measures, will be implemented in future.

In the Netherlands, the different national TACs have been transformed into individual quota for sole and plaice (in 1976), entitlements to fish on cod and whiting, and permits for the herring- and mackerel fishery. The MAGP has led to a capacity limitation in the form of horsepower licences. All these limitations have evolved towards tradable, valuable private property rights. At the end of 1996 all output rights were transformed into individual transferable quotas (ITQs) and moreover, three types of input rights existed, i.e. horsepower licences, shrimp permits and entitlements for the coastal zone, derived from the EU vessel file registration. The ITQ holders pool their rights since 1993 in eight co-management groups, which are responsible for compliance with the totals of the individual member quotas. The beam trawlers, targeting for flatfish, form the most important segment of the cutter fleet, owning some 85% of the horsepower rights.

The UK had a tradition of virtually open access to fisheries until CFP was established. After that, gradually more and more fleet segments and species were brought under restrictive licencing schemes. Currently the UK approach varies by species and sector with the licences giving access to the fisheries reflecting this. Licences are issued in five main categories depending on the fact of the stock is under pressure and/or under quota. All licences are subject to Ministerial discretion which means that uncertainty remains about the quality and duration of this property right.

A large part of the UK-TACs is managed by the POs on behalf of their members. Quotas are therefore not vested individually (except for the pelagic sector), although track records give some kind of right to a share of the PO-quota.

National capacity management with respect to MAGP requirements has not been effective so far. Only since 1992 under the Sea Fish (Conservation) Act all fishing vessels must be licenced while before that vessels of 10 metres and under were not under any licence scheme. Current national measures deal with the requirement to take out more capacity (120%) in case of replacement of vessels.

Economic characteristics of property rights

Property rights that are exclusive will create scarcity and therefore economic phenomena, such as trade and price formation, may occur.

In the Danish fishery the rights, in the form of limited access, are only weak entitlements. Hence, they have not influenced the development of the fleet significantly. The licence value depends on volume of catch, type of technology used and the quality of the right, including the possibilities of new entrants. The market for licences is difficult to separate from the market for vessels and therefore not very transparent. In general however the decommissioning scheme sets the minimum market price for a vessel licence.

The rations, setting the allowed catch quantity per time period, are not tradable and have therefore virtually no economic value.

Property rights have become a separate production factor in the Dutch cutter fishery. Effective enforcement of the individual quotas has lead to a scarcity of this production factor since 1988. Hence, high prices for ITQs and for other rights were paid. The price of a combined sole/plaice ITQ (a 'permanent' share in the Dutch TAC) rose to a level of NLG 100-130 per kg. in the early nineties, which is at least four times the auction price per kg. for these species. Investments in rights exceeded those in vessels in this period. Most of these purchases of ITQs have been done by the owners of larger (>1500 HP) beam trawlers with the intention of adjusting the rights to the capacity of their vessels.

Investments in these property rights have increased the production costs of the vessels. On the other hand, future profits that may arise from a successful fish stock management can not be dissipated by the entrance of newcomers.

The development of the regulations in the eighties and nineties show an increase of individualisation and flexibility of the rights to meet the economic interests of the industry more adequately.

In the UK, the predominance of the larger vessels is very marked, with vessels over 10 metres catching 95% of the total landed, though they number only a third of the total of vessels.

Property rights generally are not considered to be a significant entry barrier for newcomers in the industry. There are some exceptions however in the pelagic and beam trawl sector where licences can be worth around 30% of the value of the vessel. The pelagic vessels have the most highly valued licences due to the good and stable mackerel and herring quotas as well as the very efficient technology involved.

The existence of the necessary licences is taken by bankers as a pre-requisite in allowing loans but the value of the licences (except when realised in a sale of the vessel) is generally not regarded as part of the capital structure by them or the accountants and consequently not by the tax authorities. The bankers are guided in this respect by the fact that the licences are only issued on an annual basis.

Property rights in agriculture

Property rights in the form of production rights also exist in other industries. The study explores briefly one of the specific agricultural production rights, i.e. milk quota, to consider whether lessons for the fishing industry can be drawn.

In Denmark, one central agency has been established which is responsible for the reallocation of milk quotas between farmers. Quotas are only transferable along with land in cases of sale, inheritance or tenancy. Several (subsidy) schemes have been successfully implemented to help farmers out of the industry and reallocation of their quota by the agency has resulted in concentration of quota-ownership in the Danish dairy industry.

In the Netherlands, a rather extensive trade in individual milk quotas has arisen whereby prices has reached relatively the same level as in the fishery sector, i.e. four to six times the producer (kg) price. Trade has led to some concentration of milk quotas, as the average milk quota per farm rose by 26% in the period 1984-1992. This increase in scale of production has been less than in Denmark where the average quota per farm went up by 90% in the period 1984-1994. However, the Danish farmers could get the additional quotas mostly for free, whereas the Dutch ones had to buy the extra quantities.

In the UK, milk quotas were allocated on an individual basis but managed on a national level through the marketing board areas. Surpluses of individual farmers were partly or fully offset by under supply by others. Quotas can be traded freely and this has resulted in 8% of the national quota being leased and 2% being sold. Quotas are now of significant economic value and have become an important entry barrier.

Evidence on structural changes in UK dairying as a result of quotas is present. There is a continuing migration of quotas away from farms with better ways of using their land to those whose qualities do not allow alternatives

Generally spoken, there are similarities between the property rights in fisheries and in agriculture with respect to high prices of individual rights and acceleration of concentration tendencies. The fishery sector could consider some solutions implemented in the dairy sector, such as facilities for newcomers in the Danish dairy industry and fiscal allowances for valuable production rights in case of succession in the Dutch agriculture industry.

Structural implications of property rights

The implementation of a decommissioning scheme in 1987 has had a major influence on the structure of the Danish fleet, rather than the property rights mentioned before. The fleet

has decreased by 20% in the period 1986-1992 as a result of this scheme and also caused by the bad stock situation for some of the main target species. Especially the fishery for cod has declined with major consequences for some of the trawler segments. The relatively old Danish seiners fleet has taken benefit from the decommissioning scheme.

The structure of the Dutch cutter fishery has changed importantly since 1983, whereby private property rights has had the following impacts:

- stimulation of decommissioning since the leavers could get extra proceeds by selling their ITQ;
- prevention of fleet expansion ;
- creation of barriers for newcomers;
- more aging of the fleet, since investments in rights may have partly absorbed the depreciations for new vessels;
- quota hopping, induced by lower prices of rights abroad;
- some concentration of rights i.e. ITQs. The rights are less concentrated compared with the situation in New Zealand and Iceland. For example, the 3% owners of the largest ITQs possess 47% of the national quota in Iceland (1994) whereas this percentage is 17.5% for the Dutch flatfish quota.

The UK experience seems to indicate property rights having relatively little influence so far on structural developments. The relevant factors appear to be technical changes, profitability and decommissioning payments. The loss of distant waters made much of the fleet of 70's redundant and subsequent investment, encouraged by government, changed both the structure and location of the fleet. The inshore sector grew and the location moved northwards in the UK.

One feature which does derive from UK property rights has been the reflagging of foreign vessels by acquiring UK licences.

Another feature related to property rights has been the increasing strength of POs. The share of important quotas managed by POs and number of vessels in membership has increased significantly.

Effects of property rights at enterprise level

In Denmark profitability of the vessels is, on average, at break-even level for most fleet segments. Profits use to fluctuate highly over the years and losses are no exception, especially for the trawler segments. The economic situation seems to be more positive for the Danish seiners .

Limitations in the fisheries for human consumption have resulted in more investments in industrial fisheries. The restrictions on extension of capacity add an extra cost to consider in investment decisions. These extra costs cause uncertainties for individual enterprises since future fishing possibilities are not secured enough by fishing rights.

Investments in Dutch flatfish ITQs can only contribute to profits through a marginal approach, when only variable costs are matched against the extra proceeds from the purchased ITQ. A net present value analysis points out that the pay-back period for these investments exceeded eight years in 1994. Thus, it is in the interest of the investors in ITQs that the individual rights remain beyond 2002, the year of a possible review of the CFP.

The gross margin (proceed minus the variable costs) resulting from the ITQ investments is too low to cover also the fixed costs of the vessel. The present (capitalized) value of a large, a 'full' ITQ would only be some 40 % of its purchase cost for the 1994 situation. This means that newcomers cannot enter the fishery, for example by taking over a second handed vessel with all the rights. On the other hand, this shows that existing ITQ holders have a strong preference to continue their enterprise. They could indeed sell their right and realize a much higher proceed than they would get from future fishing activities.

Purchased property rights are an important intangible asset on the balance sheet of Dutch enterprises in the cutter sector. Financing from banks has facilitated these purchases, whereby the ITQs may serve as a collateral for a loan. Property rights in fishing mostly meet the requirements for recognition as an intangible asset following the International Accounting Standards Committee (IASC). Therefore it is preferable to follow the IASC recommendations and to include costs for the rights (depreciation and interests) in profit calculations.

Valuable rights may hamper the transfer of the enterprise to the next generation or to other family-members. Fiscal allowances, in force for production rights in the Dutch agriculture, have partly been applied for fishery enterprises. However, barriers for succession still may remain and 'the transitional gains trap' (Parzival Copes, 1992) occurs in the Dutch fishery.

In the UK the most obvious effects of property rights at the enterprise level are in increasing the costs to new entrants and those vessel owners expanding their businesses. The returns from such investments would appear to be negative at the current cost of licences. Equally property rights have introduced a new economic dimension for those wishing to leave the industry. Besides of the vessel their assets now include the value of the licence. This value has increased over the years as tighter licencing rules and decommissioning have improved the balance between capacity and catches available. There is now an higher opportunity cost of remaining in the industry.

Succession of ownership has become more difficult. It contains more complicated effects where families or other close knit groups are involved.

Factors influencing property rights regimes

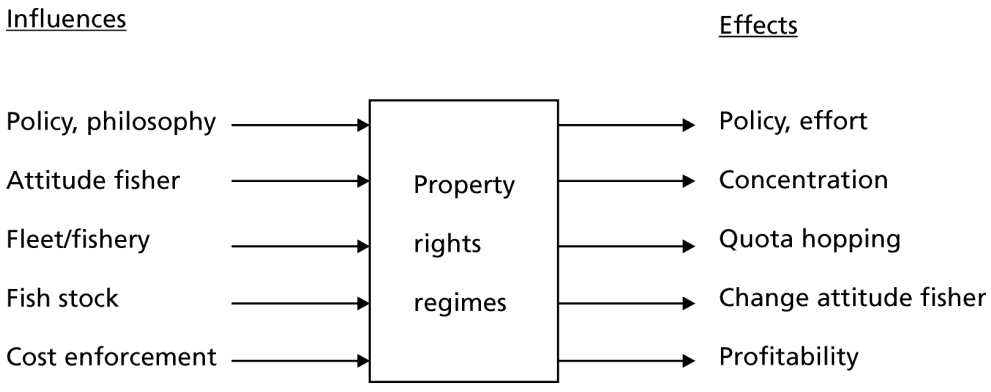
Comparison of different property rights systems could raise the question: which is the best system? F.T.Christy has a rather clear answer to this question. In his paper to the 8th Biennial Conference of the Institute of Fisheries Economics and Trade[1] he states in this respect: The transition to property rights regimes in fisheries is occurring with a speed which, I think, is not fully appreciated. The process is inexorable (p.3). The command and control system of fisheries management is a paradigm lost in his view and property rights regimes represent the paradigm gained. In this respect he quotes Hannesson (in press, 1996): 'The state would become redundant as a management authority and its only role would be the ultimate upholding of the rule of law and the honouring of contracts'.

[1] Paradigms lost: the death rattle of open access and the advent of property rights regimes in fisheries, Francis T. Christy, prepared for the 8th Biennal Conference of the Institute of Fisheries Economics and Trade, Marrakesh, Morocco, 1-4 July 1996.

From this point of view the Danish command and control system is more or less obsolete and would or should move to the Dutch regime of property rights. This regime meets rather well the 'new paradigm' of Christy since ITQs have been established for all quota species, managed by user groups and the government aims to reduce its role. However, the views expressed in Christy's paper can be critized by arguing that property rights systems cannot be considered in itself. There are several influencing factors which explain why the regulations are as they are:

- the policy of the government, that may not be in favour of property rights, as is the case in Denmark and also in countries like France and in Belgium. Policy makers may have the opinion that they lose too much control over the fishery when they allocate rights to individuals or organisations;
- the attitude of the fishermen, e.g. they may opposed against individual property rights because they fear concentration of rights amongst bigger enterprises;
- the fleet structure and the fishery, which may be more or less suited for the implementation of property rights such as ITQs. In this respect the rather homogeneous Dutch beam trawl fleet is less complicated than the more diversified British and Danish fishery;
- the situation of the fish stocks, e.g. a stock in danger that needs a severe reduction in TACs, compared with the open access circumstances, may have other consequences for limiting measures and rights than 'healthy' fish stocks.

Hence, property right regimes are to a certain extent dependant variables, beyond economic efficiency. On the other hand they may induce new developments when they have been implemented. Examples are quota hopping and concentration tendencies that have been accelerated because of trade in rights. Figure 1 intends to illustrate that property rights regimes cannot be considered in isolation but rather as a part of a comprehensive policy.



Selected influences on and effects of property rights in the fishing industry

Statements resulting from the EU FAIR study on property rights in the fishery sector

- A useful definition for property rights in fishing is (Bromley, 1991): 'Property is not an object such as land but is rather a right or group of rights to a benefit stream that is only as secure as the duty of all others to respect the conditions that protect that stream';
- this definition means for fisheries that the right can be defined in terms of harvest and not in terms of stocks;
- '..the duty of all others..' is a key element in this definition and this makes clear that the security of the rights importantly depends on enforcement;
- property rights in fishing are frequently confused with individual rights. It is however necessary to distinguish between three types of rights: state-, common- and private or individual property rights;
- fisheries management should firstly define the property rights and make a choice between these three types of rights, or combinations of them, and from this basic choice necessary measures can be taken;
- the coming review of the Common Fisheries Policy should be considered more from the viewpoint of property rights;
- management systems tend to evolve unavoidably into the direction of individual property rights regimes from the moment that a limitation has changed into a right and vested interests have arisen;
- non-transferable rights that create exclusivity will be transferred gradually;
- property rights do not have advantages in itself, but they have to be considered against a background of preferences and attitudes of policy makers and fishermen;
- an important advantage of ITQs mentioned in literature, stimulating management behaviour of fishermen, is supported by evidence in the Dutch beam trawl sector;
- under a regime of individual property rights effective protection of the rights leads to proper protection of the fish stock.

The IJsselmeer fishery Management problems in a nutshell

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Abstract

The IJsselmeer (or lake IJssel) is the former Zuiderzee, by land reclamation reduced to two thirds the area of an ICES-rectangle. Its fishery, under constant threat of further public works, is an interesting example of a common property fishery with the accompanying management problems. This paper describes the history of the fishery, the various management measures taken and their sometimes unexpected and adverse affects. The management problems of this small scale fishery may be exemplary for those confronting the managers of the larger European fisheries.

Introduction

Holland has been conquered from the sea. Sometimes this involved just giving nature a little helping hand, but along with technical development of dike construction, wind mills and later on steam engines, active land reclamation became the preferred style. The last major projects in this field was the reclamation of the Zuiderzee, the large estuary penetrating deeply into The Netherlands from the Wadden Sea southwards.

Plans to reclaim the estuary, continuously threatening to flood the surrounding lowlands, came up as early as mid seventeenth century, but became more serious by the end of the nineteenth century. A flooding disaster in 1916 combined with the scarcity of food during WW I finally in 1918 led to the adoption of the 'Zuiderzee law', implying the closure of the estuary to the sea and the reclamation of the greater part of it.

The Closing Dike (as it is still called literally in Dutch) was closed in 1932, and the salt and brackish water gradually went fresh. Within the more protected lake without tides that was thus created and was called 'IJsselmeer', the construction of polders was started along the shores, by building annular dikes and subsequently pumping the enclosed water out. Gradually the water area was reduced from the original 300 000 ha to about 185 000 ha presently. During the seventies social resistance started to grow against construction of the last (and largest) polder of the original plans. The northern dike was constructed anyway for water management reasons, splitting up the IJsselmeer into a northern part still bearing that name and a southern part that is officially called 'Markermeer'. Eventually the government decided in ?1988? to leave it at that.

The Zuiderzee used to have an economically important fishery. In 1920 a total of 3670 professional fishermen were employed on 2030 boats, of which nearly 1550 were larger than 5 tons (Schaper, 1962). (Presently less than 3000 people are employed in the

Dutch salt water fisheries as a whole.) The main species caught were herring, anchovy, smelt, flounder, eel, shrimp and periwinkle. Most of the fisheries had a seasonal character, bringing about a great deal of seasonal employment as well, although most Zuiderzee fishermen were employed full time, but not only on the Zuiderzee. Particularly the fishery for anchovy used to attract also a lot of occasional fishermen in good years.

The fishing gears used were broadly divided in 'going' and 'standing' gears. Going (or active) gears were various types of trawls and seines; standing (or passive) gears were set nets, fykes, traps and long lines. Of old the diverging properties of these groups of gears have given rise to more or less serious conflicts. These conflicts also bore elements of cultural differences and regional controversy, as the fishermen of the Western shore had an inclination towards going gears and those of the Eastern shore towards standing gears. The resulting mutual mistrust is still working through today.

Evidently the closure of the Zuiderzee and the subsequent reduction of the available water area have greatly affected the fishery. The fishing opportunities were severely reduced, firstly by the transition from salt to fresh water and secondly by the reduction of the area. Herring, anchovy, shrimp and periwinkle disappeared completely and flounder almost completely. Only eel and smelt are still important species in the IJsselmeer fishery.

In view of the poor fisheries prospects, the government adopted a policy aiming at a drastic reduction of the number of fishermen and boats. After the closure of the dike in 1932, a permit was required for fishing on the newly formed IJsselmeer, but this was given free of charge to all boat owners wanting to stay in the fishery (for the time being). These permits were allotted annually and were strictly personal and not transferable. The Zuiderzee Aid Bill, that passed Parliament in 1923, provided for support and financial compensation for the fishermen and their families who immediately or eventually lost their livelihood by the works. A rather stingy compensation system as it has been considered from the outset by the people concerned as well of numerous outsiders. (The Government was originally of the opinion that the fishermen basically had no right to any compensation, so the Bill had to be considered as a favour.) (Bossaers, 1987; p 154)

By 1936, the year when the registry of permit holders was first completed, the number of permits (more or less equivalent to the number of companies and boats) was down to about 1350. From then on it went on according to the following table.

Number of IJsselmeer fishing permits

Year	1936	1946	1955	1970	1975	1980	1985
permits	1354	913	582	235	147	122	108

Sources: Schaper, 1962; Nagtegaal & Snel, 1985

Small as the fishery gradually has become, the management problems it has posed and still does are almost exemplary for what can happen in this field. Before going into these in more detail, I will first describe the present situation and, where necessary, how it became as it is.

Description of the fishery

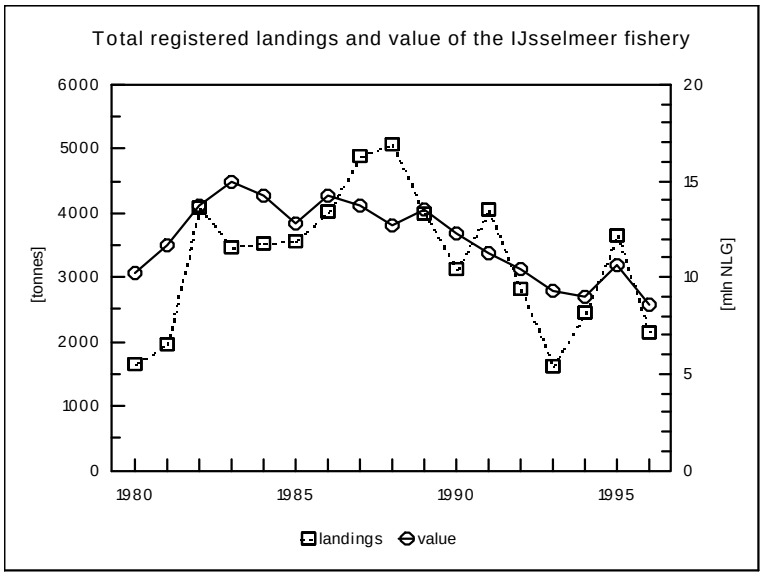
From a survey we made last year the following data and estimates are derived of the IJsselmeer fishery in 1996:

Number of permit holders	94
Number of boats	76
Number of fishermen	180
Estimated landings	
by weight	2 250tonnes
by value	10mln NLG (5 mln ECU)
Average fisherman's income	35 000NLG (17 000 ECU)

(Taal & de Wilde; 1997).

It should be noted that, contrary to what was indicated above, the number of boats is less than the number of permit holders. The reason for this is not that 18 permits are not being used, but that on a number of boats two permits are combined, in order to increase the earning potential. This is not without reason as the low average fisherman's income shows, being little more than what is considered as the social minimum in the Netherlands. I will return to this later on.

Apparently this is not only a small fishery, but also a poor fishery. On one hand this is partly the result of the problems in managing it, on the other hand it is a major reason for the demand for management.



The graph above gives a good impression of the decline of the fishery over the last decade (note that infation has not been taken into account). I will not try to explain the low (registered) revenues in the early eighties.

Now let us go into the fisheries for the main species in more detail. While doing this, some of the management problems will already pop up.

Eel

The European eel (*Anguilla anguilla*) is the mainstay of the IJsselmeer fishery; a katadromous species with a mysterious life cycle. Annually in spring, larvae of the eel enter the fresh water outlets like rivers and sluices as elvers. They grow up in the inland fresh water systems and when maturing, after about eight years or more, they change appearance from yellow-red-brownish to silvery grey and migrate to the sea again. Here the scientists until now have lost track, so it is still unknown where exactly and under what cicumstances spawning takes place and the new eels are born. What we do know, is that the earliest of seven stages of eel larvae has been found in the Sargasso Sea near the Bermuda's. From there on they drift, metamorphosing time and again, with the Gulf Stream towards the European (and North African) Atlantic coasts.

Since the early eighties the influx of elvers (or glass eels) has been substantially lower than during the decades before, with a decrease of the eel stocks as a consequence. As this reduction of recruitment is assuming a structural character, it is a matter of grave concern for biologists as well as fishermen. The latter tend to blame elver consumption in Spain and the use (and exports) of elvers for aquaculture; the former think more of climatic or oceanographic changes or too intensive fishing as possible causes. In fact it appears to be beyond human control presently and the only thing that can be done, is to take good care of the elvers and eels that are available.

Taking good care involves having a good minimum size and a not too high fishing effort. These are vague qualifications, but the present IJsselmeer eel fishery certainly does not meet them. The minimum size, set at 28 cm, is mainly based on commercial considerations and not on optimising the stock. Suggestions have already been made by biologists and fishermen to increase the minimum size to e.g. 32 cm, but this has not yet come about. In spite of restrictions on the numbers of gear per permit holder, the fishing effort is extremely high. We will discuss this more deeply later on.

The fishery for eel is seasonal, starting in April and ending in November, connected to the water temperature and thus the activity level of the eel. The prime seasons differ from gear to gear.

Four types of gears are being used for catching eel: set fykes, large fixed fykes, eel boxes and longlines, in that order of importance.

Escape of undersized fish from fykes is provided for by rings of a prescribed minimum diameter fixed in the webbing. Eel boxes have holes of the same diameter for this purpose. With longlines the size of the hook should do the trick. Fishermen have been caught not only using undersized rings or holes, but also having put them in positions preventing escape. This has been (tried to) overcome by further specification of the rules.

The set fykes are the main fishing gear of the IJsselmeer. They more or less replaced fishing by trawls since this was prohibited in 1970. They come two by two, with their

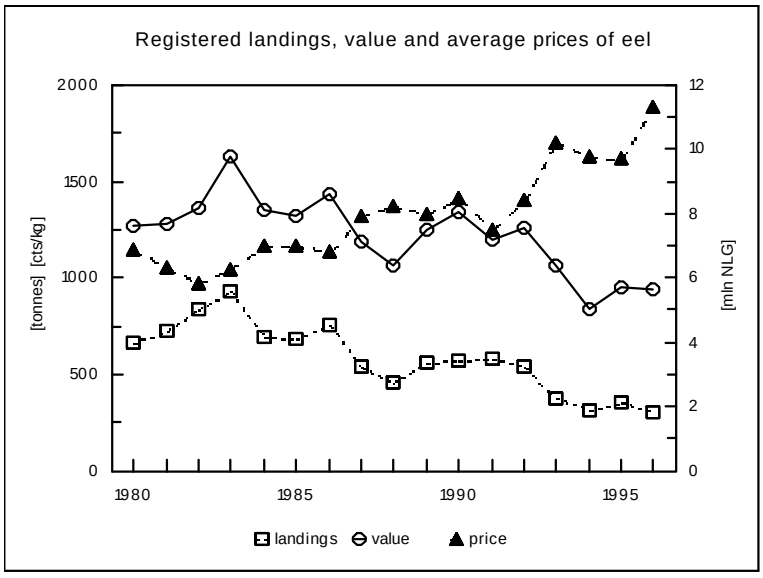
openings facing each other, and are set in long rows freely all over the lake, but of course mostly concentrated in places where good catches are expected. In 1996 a total of 9 272 couples of set fykes could be set by 72 permit holders.

The large fixed fykes are mostly set along the shores and dikes. Generally they are already set up at the start of the season, but their main purpose is to catch the valuable silver eel on their seaward migration. The fixed fyke positions are allotted annually to the entitled permit holders, without much variation. The total number of fixed fykes that could be set in 1996 was 1868 by 46 permit holders.

Eel boxes can be considered as the poor man's set fyke, as it is much cheaper and more easy to handle, but is supposed not to catch much less than a single set fyke. On the other hand it is more labour intensive, as it requires baiting, which also implies fishing (=trawling!) for bait. Like long lines the abt. 15 x 15 x 50 cm boxes are set on a long line at a spacing of 5 to 6 m. Such lines can have a total length of 30 km. In 1996 26 permit holders were allowed to set a total of 22 535 boxes.

Longlining for eel is done by only a dozen of fishermen, considered by their colleagues as the poor devils of the IJsselmeer, as their rewards are greatly out of proportion to their huge efforts: mechanised longlining is not allowed and the lines have to be prepared by hand, apart from baiting including attaching new hooks, before each set.

The next graph gives a picture of the registered landings, values and average prices of IJsselmeer eel from 1980 to 1996.



Declining landings since 1983 have only partly been compensated by rising prices, the more so as inflation has not been taken into consideration.

At this place it is worth mentioning that eel is the only species with a substantial home production, where imports are needed to cover our inland consumption. All other fish species caught by Dutch fisheries show a more or less substantial export surplus. This

may explain why, in spite of the rapid growth in recent years of cultured eel production to more than 2000 tonnes, the price of IJsselmeer eel is still rising.

Pike perch

The pike perch (*Lucioperca lucioperca*) could be the second most important species of the IJsselmeer, if recruitment was less volatile and management would be more succesful.

The original habitat of the species are the Central European lakes, where warm summers are normal. The year class strength appears to be highly dependent on the summer (water) temperature, so our country is not the ideal place for regularly getting strong year classes of pike perch. To this must be added the effect of the large bycatches of juvenile fish of the intensive fyke fishery for eel.

Given the volatility of recruitment, management could do a lot for stabilising the stock and improving the fishery. However, the present minimum size of 42 cm is in fact too small, as at the prevailing high fishing pressure this size allows the fish only one spawning season. Plans to raise the minimum size to 45 cm, allowing at least two spawning seasons, were never realised, as the increase in minimum mesh size of the set nets this would involve, would cost the fishermen the essential part of their perch catches.

An attempt to reduce the fishing pressure, started in 1990 by limiting the number of nets per permit holder to 60 monofilament and 80 multifilament nets, has not had the desired effect. The time won by having to set less nets was used by setting them more efficiently, e.g. no longer in six rows blinding each other, and sometimes even by shooting them twice a day. In the end stock monitoring revealed that the fishing pressure expressed as mortality had not been reduced.

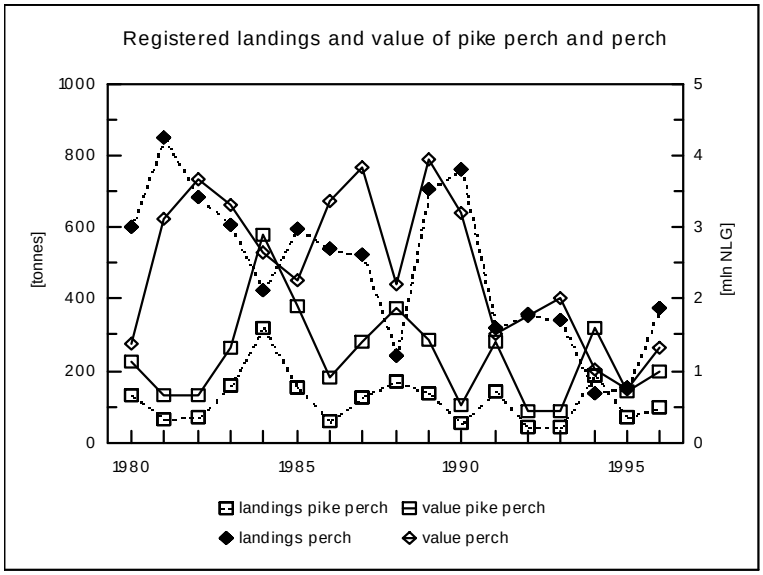
The main fishing season for pike perch is the fall, but nets start to be set as early as july and netting goes on until the closed season, from /// until /////.

Pike perch is generally filleted and frozen for export; inland consumption is practically negligible.

Perch

Most of the years perch (*Perca fluviatilis*) is the second most important and the most ‘normal’ of the species of the IJsselmeer fishery. Recruitment is relatively regular and the stock is rather sound, although the bycatches of juvenile fish by fykes also have negative effects for perch. The minimum size is ?? cm, but the fish caught are generally larger. This is because the same nets as for pike perch are used, with a preference for the monofilament type. The fishery is seasonal with its peak during the winter months, which is a problem in severe winters. With perch the restriction of the number of nets seems to have effectively reduced catches (see the following graph).

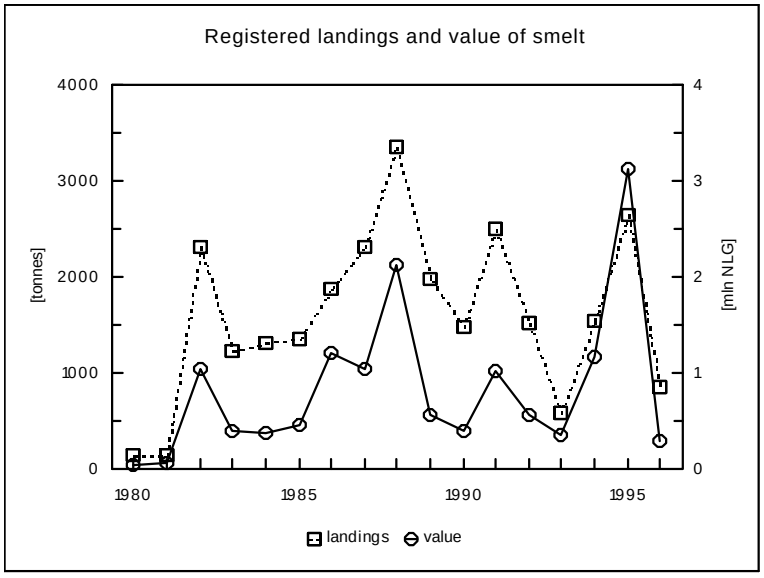
The problems with perch are primarily related to the market. Inland consumption is negligible and the main export markets Switzerland and Austria prefer rather small fish, so the larger sizes get a lower price. In addition to that competition from middle European countries puts prices under pressure. (The same goes for pike perch.)



Smelt

The smelt is a small sprat like fish, related to the salmonids, having its short spawning season generally in March. The fishery with set fykes is basically opened for three weeks as soon as catch rates in probe fishing reach an adequate level. Nowadays all permit holders are allowed to partake in this fishery and, as it offers a welcome supplement during the closed season, most of those having the necessary gear do. Overfishing of this short lived species is not a real problem, so management is aimed at practical aspects like good timing and giving the people interested a fair chance.

The market for sprat has been rather volatile over the last decade, with prices ranging from just a quarter to over one guilder per kg. Particularly 1995 was a bumper year with a good catch combined with a high price bringing a total revenue of more than 3 mln. guilders and making smelt the second most important species of that year.



Management problems

GENERAL MANAGEMENT MEASURES

LICENSES	*	PUBLIC RIGHT
	*	PRIVATE RIGHT
MINIMUM SIZES		
MESH SIZES	*	RINGS IN FYKES AND TRAPS
	*	SET NETS
TIME RESTRICTIONS:		
- SEASONS *		EEL
	*	PERCH AND PIKE PERCH
	*	SMELT
- WEEKLY & DAYLY		

SPECIAL MANAGEMENT MEASURES

BAN ON TRAWLING (1970)

FREEZING NUMBER OF FYKES	(1986)
REDUCTION OF EFFORT BY 50%	(1989)
GRADUAL REDUCTION OF EFFORT BY ANOTHER 50%, CONNECTED WITH SETTING UP OF P.O.	(1987-2000)
INTRODUCTION OF INDIVIDUAL QUOTAS BY P.O.?	(1998?)

CONCLUSION

IF MANAGING A VERY SMALL FISHERY LIKE THIS IS ALREADY POSING SUCH SEEMINGLY INSURMOUNTABLE DIFFICULTIES,

HOW CAN WE PRETEND TO BE ABLE TO MANAGE THE LARGE EU FISHERIES

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