

The Economics of Fisheries Self-regulation: Analytical Issues and a Historical Case Study

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Abstract. Economic analysis of fisheries management often relies on the assumption that some form of authority exists which will be able to take up the recommendations of economists, using adequate regulatory instruments. The discussion of management measures implicitly assumes that an external intervention will be possible - usually by the State - either to regulate directly resource use, or to allocate and enforce private use rights in order for decentralised co-ordination systems to operate efficiently. At first sight, economic models developed to explain fisheries over-exploitation leave little hope for self-regulation to emerge from a competitive fishery. The paper focuses on the analytical issues underlying the on-going debate on the possibility for fisheries to be self-regulated. Based on the analysis of a historical case study - the development of management arrangements between whaling firms in the 1930ies and 1950-60ies - it shows that the absence of a central authority cannot be systematically associated to an absence of regulation, and explores some of the implications this has for the economic analysis of fisheries management.

Keywords: governance, property rights, fisheries self-regulation

1 ECONOMIC MODELS OF FISHERIES MANAGEMENT

Economic models of fisheries management were developed as extensions of the standard models of private production and exchange of goods and services, using the two *ad hoc* concepts of rivalness in consumption and non-excludability in use (Randall (1993)) to describe the specificity of fish resources. A key objective is to identify, measure and explain observed discrepancies between the results which would obtain in a context of perfectly competitive markets and those modelled and empirically observed in the case of renewable resource use. Hence emphasis is on the mechanisms by which decentralised co-ordination can lead to sub-optimal use of such resources.

Two complementary lines of interpretation of the problems encountered in free and open access fisheries derive from this approach.

First, where a fish stock is only appropriated once captured, there will be a tendency for fishing firms to continue to invest in the fishery until all economic surplus is dissipated. When such *bionomic* equilibrium is achieved, the social marginal revenue derived from fishing will be lower than its social marginal cost, implying that factors currently invested in the fishery could be reallocated with greater profit elsewhere in the economy. This collectively sub-optimal outcome results from free competition between individual firms behaving

rationally, i.e. maximising their profit, hence the reference to a "tragedy of open access" line of interpretation sometimes found in the literature.

Second, while no assumption is made in the above regarding the perception economic agents have of the collective problems generated by open access, it can be shown that they may have little incentives to restrict their levels of investment and catch. If there are many firms, each will anticipate that its individual action will have limited impact on the overall situation, and will rather have others support the costs of regulation (which it can benefit from given the non-excludability of the resource). Thus, even when fully aware of the possibility to improve on the free access situation, firms will face incentives to free ride any collective efforts to do so. This is the collective action line of interpretation.

Debate on fisheries management has largely centred on the means by which an intervention external to the economy as described in these models could change the nature of the situation. A key element in this debate is the possibility that, by changing the property right regime applying to the resources, costs and benefits related to the exploitation of fisheries could be better internalised in private investment and harvesting decisions, thus avoiding the free access tragedy and reducing the incentives to free-ride. Two general lines of conduct for a central authority have particularly been explored: direct intervention to regulate access to and use of fish stocks, or the parcelling out and enforcement of use rights to fishing

¹ The analysis presented in this article is that of the author, and does not necessarily reflect the views of Ifremer.

firms (i.e. bringing the fishery closer to the realm of market allocation of private goods).

1.1 Property rights, authority and the regulation of fisheries.

A central characteristic of these general models is the impossibility to define endogenous solutions to the problems they serve to explain and measure. The logical outcome of a dynamic process of free access is *bionomic* equilibrium. The only way to check this process is to recur to an outside authority with the power to redefine the institutional context in which economic agents operate. Without such an authority, or if the existing authority is deficient, it becomes difficult to conceive any solution to the issues as they are characterised within the models².

This conception of authority is consistent with standard welfare economics, in which outside intervention in market mechanisms (usually by the State) is envisaged with respect to two main functions: to arbitrate between efficient allocations of goods and services according to some collective welfare principle, and to correct the allocative deficiencies of competitive markets³.

In many cases, the theoretical impossibility for regulation to emerge endogenously can be seen to constitute an adequate description of the practical problems encountered in marine fisheries (Arnason (1991)). Numerous independent economic agents operating freely in an institutional context which defines no particular rules of access to harvested stocks will find it difficult, if not impossible, to self-organise in order to avoid the costs of competition. In such contexts, as Clark and Lamberson (1982) stress:

“Our simplistic models (from the institutional point of view) will nevertheless indicate quite clearly the economic losses resulting from unfettered competition, as well as the scope and incentive for mutual agreement to reduce those losses” (p111).

However, with a simple distinction between situations with an agency acting as a “sole owner” and situations characterised by a collection of many independent agents with no over-arching authority, little can be said about the process of management itself.

² This appears as a more general characteristic of the “Tragedy of the commons” literature, as Hardin (1968) stressed in his famous article: « Consider the problem, ‘how to win a game of tick-tack-toe ?’ It is well known that I cannot, if I assume (in keeping with the conventions of game theory) that my opponent understands the game perfectly. Put another way, there is no ‘technical solution’ to the problem » (1243). The need for coercive intervention by an external authority to solve collective action dilemmas is also noted by Olson (1987) in his seminal work on the topic (p31).

³ For a criticism of this view, see for example Williamson (1996).

Economists such as Christy (1996) have stressed to need to go beyond a tendency to see open access as an inevitable characteristic of world fisheries, and to study the socio-economic conditions in which regulation of access to fisheries develops and how this affects the fisheries concerned.

In particular, there is now some experience with the development of right-based management systems in fisheries. Evidence shows that the procedural aspects of these systems warrant further analysis. Rather than being “decided” by a central agency operating with clear and coherent management objectives, rules applying to fisheries and in particular rights-based regulations often seem to develop through an evolutionary process of trial and error (see e.g. Arnason (1993); Hatcher (1997)). For example, according to Hannesson (1991), emergence of individual transferable fishing rights in certain European and Australian fisheries appears to have been neither intended nor anticipated by the governments of these countries.

Another important reason to grant more attention to the process of regulation itself is the on-going debate on the importance of fisherman approval of the regulations, both for their introduction and for their continuance (Hanna (1995)). In analysing obstacles to fisheries self-regulation, Scott (1993) insists on this idea, interpreting the need for approval as a need for agreement *among* fishermen. Understanding how such agreement may arise has been the subject of various empirical and analytical lines of research, some of which are reviewed in the following section.

2 SELF-ORGANISATION IN FISHERIES: EMPIRICAL EVIDENCE AND ANALYSIS.

2.1 Empirical evidence of self-regulatory mechanisms

An important line of enquiry developed from the mid-1970ies, following a debate on the use of the term “common property” in models of natural resource management. Ciriacy-Wantrup and Bishop (1975) considered the possibility for intermediate situations to exist between market co-ordination and totally centralised management of resource use, which standard models of open access did not capture well. This thesis led to the development of a large area of empirical research aiming at identifying and explaining observed forms of collective regulation of *common-pool* resource use⁴. Studies show

⁴ For in depth discussions of the differences between free access, common property, private property and public property, see Berkes, Feeny et al. (1989), Ostrom (1990) and Bromley (1992). See also Hanna (1990), Stevenson (1991), Schlager and Ostrom (1992) and McCay and Acheson (1987).

the existence of a great variety of spontaneous schemes for collectively regulating access to marine ecosystems.

Most of these studies have been carried out outside the main research programs in fisheries economics, by scholars from other social sciences. But the observation of self-regulatory mechanisms in a great variety of contexts also led a number of economists to question the implications of these empirical studies for the general understanding of resource management issues derived from models of free access (Christy (1982), Scott (1993), Baland and Platteau (1996)). Generally speaking, the implications seem to have been considered quite limited on two main grounds.

Scale of the cases reported.

Referring to a study by McGoodwin (1983) which describes a range of local fisheries access restriction schemes, Cunningham and Whitmarsh (1985) acknowledge the existence of self-regulation in fisheries and the need for these to be better studied by economists. The authors however stress the limited scale of the situations considered. Studies usually relate to local level issues, and regulation of access to sedentary resources or to fishing areas which can be easily delimited. Indeed, much of the common property literature has focused on artisanal fisheries, rather than highly industrialised fisheries operating on larger scales.

This is also acknowledged by authors of common property studies (Ostrom, Gardner et al. (1994)), for whom conclusions derived from local scale observations cannot be extended to larger scale problems of resource management. Also, the cases reported often concern groups of relatively small size, with strong social and cultural links affecting resource management⁵.

Nature of the cases reported.

In his detailed analysis of the obstacles to fisheries self-regulation, Scott (1993) stresses that the regulatory systems observed in these studies rarely aim at an explicit sharing of catches among participants. Rather, they remain centred on the control of *ways* of fishing. As Schlager (2000) observes, the spontaneous rules in these artisanal fisheries relate mainly to access to and use of fishing grounds, fishing technologies and their use, as well as sizes of fish caught or seasonal closures. None of these rules say anything about *how much fish* may be caught by each participant in the system.

Scott explains this by the difficulties which independent agents have in agreeing on a distribution of the benefits related to the definition of a control on catches, and of the costs of implementing such control. In particular, the author considers that a lack of adequate information on

the degree of compliance with a catch-sharing scheme will usually prevent such schemes from coming into existence in the first place. The reason why such information will be lacking is that it may be too costly to obtain, but more probably that participants will face distributional conflicts regarding the sharing of costs associated to monitoring and enforcement. Such distributional conflicts are considered by the author as obstacles that cannot be dealt with from within fishing groups: their resolution requires exogenous intervention.

Further empirical evidence: international fisheries management.

Progress in the understanding of the conditions under which participants in a fishery may come to agree on collective rules restraining their activity has also been made through studies of international fisheries management. Because no over-arching authority can be postulated in these fisheries, any collective regulation of fishing must rest on an implicit or explicit agreement between participants.

Various examples can be found in the literature (e.g. Munro (1991), Armstrong (1994) and Munro (1997)). Scott (1988) notes that systems for sharing a total allowable catch between countries were established in most international commissions prior to the second World War (although countries did not replicate this at national level, preferring to use licensing schemes). The extension of national jurisdictions related to the revised Law of the Sea in the 1970ies has also been interpreted as an example of the spontaneous emergence of collective rules distributing international access rights (Pontecorvo (1988)). According to Hannesson (1991), this became feasible due to changes in the relative costs and benefits of designing and enforcing extended jurisdiction.

2.2 Analytical issues.

Two important areas of the economic literature on fisheries (and other natural resources) management can provide some insight concerning self-regulation.

The property rights literature.

The property rights literature emphasises that new institutional designs controlling access to resources will be put into place as a simple cost-benefit calculus of establishing and enforcing them, as compared to the status quo (North (1990)). In other words, the evolution of relative prices, or relative scarcities, will have a key influence on institutional change (Demsetz (1967), Libecap (1989)). The approach introduces the concept of transaction costs as a determinant factor of institutional evolution, in terms of both the potential for and the direction of change.

While these studies have produced considerable insight into the observed development of property right regimes,

⁵ For a recent discussion of the common property literature extending some of the conclusions of previous studies to larger and less homogeneous groups, see Schlager (2000).

two important caveats of the approach have also been recognised.

First, as stressed by Scott (1993), institutional evolution is often considered as a matter of exogenous change in these studies. Second, as Baland (1998) explain, they assume that the main force behind institutional evolution is a search for more efficient utilisation of natural resources. This raises two empirical difficulties according to these authors. First, validation of this thesis can only rest on the observation of systems that have persisted (without being sure why they have persisted). Second, the thesis excludes the possibility for property regimes to degenerate into open-access owing to a lack of adaptability. Among the other factors considered as essential by these authors in understanding institutional change are norms and values and the distributive effects of institutional change.

Game-theoretical analysis of international commons

The conditions for self-regulatory resource regimes to emerge have also been considered in relation to the management of international commons, with the use of analytical tools from game theory⁶. Following this line of analysis, property regimes are considered as “agreements” between the participants – or “players” - in a fishery, and a better understanding of the conditions under which such agreements may be observed is sought. Research in the area provides a better understanding of the nature of transactions costs postulated in the property rights literature, and how they can affect such agreements.

At a general level, two main aspects of fisheries agreements need to be distinguished.

1. Reaching agreement and bargaining on the allocation of benefits.

Agreements are considered from the perspective of players having to decide whether to participate or not. A key hypothesis is that agreements have a chance of coming into existence if they are Pareto-superior to the status quo, usually taken to be the non-co-operative outcome of the fishery game. Another important requirement is that any single player can not be better off free-riding the agreement⁷. Models developed along these lines have shown the importance taken by the possibility for compensation (“side-payments”, monetary or otherwise) to be used in establishing a set of payoffs which satisfies these conditions.

⁶ Game theoretical treatment of the fisheries management problem has been an expanding area of research under the leading work of economists such as Munro (1991) and Kaitala, Hämäläinen et al. (1985). While originally developed for cases where two States harvest a shared fish stock (Munro (1979), Levhari and Mirman (1980)), the approach has since then been extended to many other contexts (see e.g. Munro (1991), McKelvey (1997), Naito and Polasky (1997)).

⁷ In games with more than two players, the agreement must also be “sub-coalition proof”, i.e. no sub-group of players can be made better off by free-riding the agreement.

Another crucial dimension is the bargaining which inevitably occurs on division of the potential benefits and costs entailed by an agreement. Myerson (1997.), although not specifically addressing fisheries cases, provides an interesting review of the implications of such bargaining for international agreements on natural resources management. According to this author:

« (...) bargaining is needed to allocate these benefits and costs, before an efficient pattern of use can be agreed on. Thus, the costs of bargaining over the allocation of benefits from common resources must be seen as an essential contributing factor to the waste and mismanagement of the transnational commons » (p17).

The author derives three important lessons from his discussion of the one-stage and sequential Nash demand games as models of international bargaining. First equilibrium outcomes of bargaining in which each player is rationally responding to the expected behaviour of the other player may be very diverse and may prove Pareto-inefficient. In particular, inefficient outcomes may result when each player has wide uncertainty about the other player’s behaviour. Second, the final outcome of bargaining can depend on factors that transcend the economic parameters of the situation. Because of the multiple equilibria in bargaining games, a focal point effect may be observed, with co-ordination of player’s expectations resting on any salient feature of the game or its physical environment. In this context, criteria of equity and efficiency may (but may not) have some impact on the outcome depending on the situation.

2. Enforcing an agreement.

The second important aspect of fisheries agreements is enforcement. Dasgupta, Mäler et al. (1997) consider three broad mechanisms by which agreements can in theory be enforced. First, they can be translated into a contract, which is then enforced by an established authority. Second, they can be enforced through what the authors call “a disposition to abide by agreements”, implying truthful behaviour and trust, akin to the normative determinants of institutional change referred to by Baland and Platteau. Third, they consider the role of self-enforced deterrence: where players meet repeatedly in similar situations, agreements can be kept even without trustworthiness and without a higher authority, if players perceive credible (i.e. individually rational) threats by others that they will impose sanctions on anyone breaking the agreement. This is in practice the main short-term option available where no central authority exists, such as in international situations.

Transaction costs

The two previous points show that an important part of the “transaction costs” entailed by agreements will be in the form of monitoring, bargaining and enforcement costs. As underlined by Scott (1993), information plays a

crucial role in the initial bargaining situation, as it will determine the degree of uncertainty about potential losses and gains and how they are perceived by contracting fishermen. It also plays a crucial role in the process of self-regulation, as it determines (i) the degree of uncertainty about the impact of actions on fish stock; and (ii) the degree of uncertainty about enforcement and compliance.

The costs of information will be affected by various aspects of the situation, particularly the nature of the resource under consideration. The size of the collective of users and whether they know one another, its degree of heterogeneity, as well as the possibilities to monitor individual use so as to prevent free-riding, will also play a central role in determining the costs of reaching agreement.

3 A HISTORICAL CASE STUDY: CATCH AGREEMENTS BETWEEN WHALING FIRMS AND COUNTRIES.

The history of pelagic whaling is often cited as an example of the dynamics predicted by economic models of open access fisheries. The international nature of the Antarctic fishery and its high productivity in physical and economic value terms, added to the special biological features of whales (particularly their low growth rates) set the stage for a classic over-harvesting scenario. Various studies have stressed the (expected) failures of international efforts at regulating the industry, harvests driving whale stocks down to extremely low levels with potential impacts on the entire Antarctic ecosystem (see e.g. Scarff (1977), Elliot (1979), Holt (1985), Peterson (1993)). Observed evolutions of whaling and whale stocks in the Antarctic over almost a century largely confirm this analysis.

Clark and Lamberson (1982) is a classic account of the economic history of pelagic whaling. The authors describe the succession of species in the composition of catches, as stocks of larger whales were successively harvested down to low levels (see figure 1 below). They also explain how factory vessel size and catcher vessel power increased markedly from the early 1920ies, to reach a peak capacity in the early 1960ies. The economic, but also biological over-harvesting of whale stocks are clearly shown in their account.

Despite these results, the authors note that neither unrestricted competition in the exploitation of whales, nor sole jurisdiction over and private ownership of whale stocks, appear as entirely adequate models of pelagic whaling. The industry was highly competitive, but with a limited number of countries and firms, and the International Whaling Commission did provide some institutional control over the whaling competition. Most notably, in the most intensive periods of pelagic whaling,

whaling firms and nations managed to establish agreements to restrict and share catches of whales.

Figure 1 presents catch data for the six main species of commercial interest in Antarctic between 1920 and 1995. A similar graph was used by Clark and Lamberson (1982) to illustrate the rapid growth and collapse of the whaling industry, largely confirming the predictions of the standard bio-economic model. It also shows that this evolution was not continuous. Two distinct periods warrant a more detailed analysis. These are the years 1930-1939 and the years 1950-1965 (see box 1). The first period saw the implementation by whaling firms of a voluntary agreement to limit and share the overall Antarctic catch following a major drop in the price of whale oil on the European market. The second period saw the implementation of a global limit to Antarctic catch by the International Whaling Commission (IWC), which led to a voluntary catch-sharing agreement negotiated by whaling nations outside the IWC⁸.

The agreements ultimately achieved their economically motivated objectives: in the first case, to limit annual production of whale oil in order to sustain prices; in the second case, once a total catch limit was established, to divide this among states and firms in order to reduce the costs of competition. Because they emerged in an institutional context with no central authority, their analysis is of interest to the above discussion of fisheries self-regulation.

3.1 Voluntary agreements between whaling firms in the 1930ies.

The first agreement emerged essentially as the result of a major crisis on the whale oil market. Tonnessen and Johnsen (1982) describe the economic context in which Antarctic whaling developed as one of concentration of oil purchasing on the European market, the main outlet for the whaling industry's production of the time. While in the early 1920ies, the soap and margarine industry was largely concentrated in four main groups, one single trust acted as the largest purchaser of whale oil by 1930.

⁸ The following description of the agreements and the context in which they took place rests on a number of sources, first of which the detailed account of the history of modern whaling by Tonnessen and Johnsen (1982). Among other sources used are the Reports of the International Whaling Commission (IWC) and FAO Fisheries Statistics for primary data, and the works of Mackintosh (1965), McHugh (1974), Schevill (1974), Scarff (1977), Elliot (1979), Allen (1980), Clark and Lamberson (1982), Holt (1985), Le Gall (1989), Gambell (1993) for secondary information.

Box 1 – History of Antarctic whaling

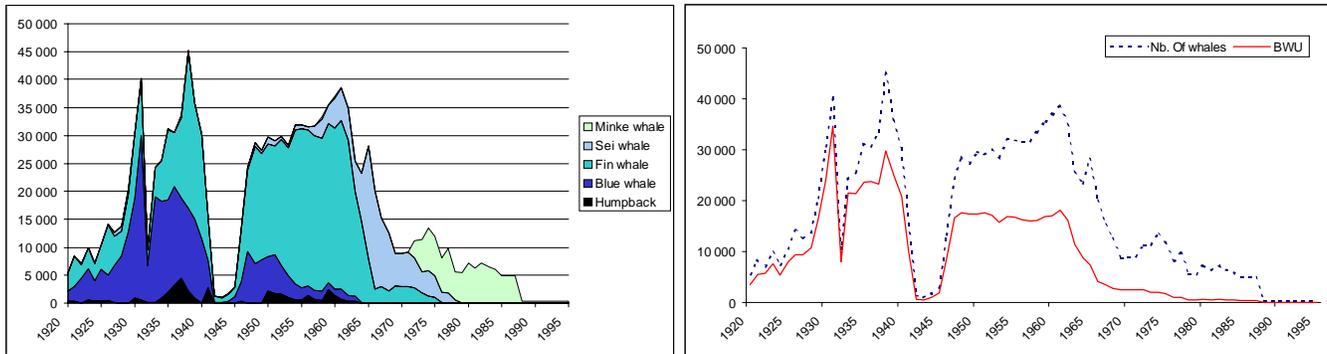


Figure 1 - Evolution of catch per species and total catch in the Antarctic fishery, 1920-1995.

Left: number of whales caught per species of main commercial interest in the Antarctic fishery. Sources: Tonnessen and Johnsen (1982), McHugh (1974); FAO catches and landings (1950-95). The succession of species as the main component of total catch appears clearly – from blue whales to fin whales, to sei whales and finally to minke whales. From the origin pelagic whaling concentrated in the Antarctic, where it took over the shore-based industry from the mid-1920ies. At its peak in the early 1960ies, the typical whaling expedition was composed of a factory ship, 10 or so catching vessels, a cargo to evacuate oil during the season, and in some cases freezer vessels to store whale meat.

Right: both time series represent aggregated catch for the five species. The dotted curve represents total catch in numbers of whales captured. The full curve represents total catch in Blue Whale Units (BWU), with 1 blue whale = 2 fin whales = 2,5 humpback whales = 6 sei whales = 13 minke whales. The BWU system, introduced in 1932, converted the different species into a single measure of their value to the industry at the time, i.e. their oil productivity. Catch agreements in the 1930ies and 1960ies are seen to entail a (transitory) stabilisation of total catch in blue whale units. The dotted curve however, shows that such stabilisation did not lead to a curb in the evolution of the number of whales captured.

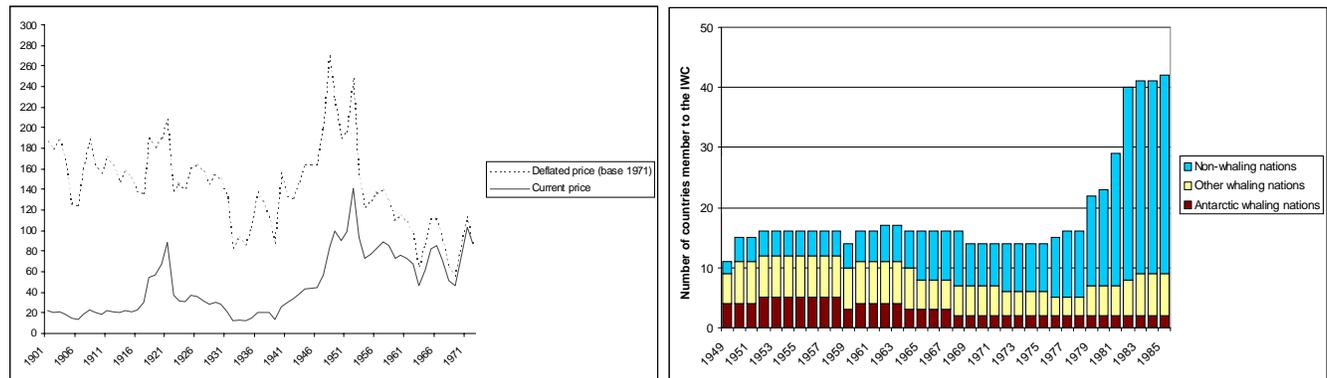


Figure 2 – Market for whale oil, 1900-71 and composition of the International Whaling Commission, 1949-85

Left: current and deflated prices for category 1 whale oil in £/metric ton on the European market. Source: Tonnessen and Johnsen (1982), Liesner (1985). Oil was the main output of the European whaling industry. The Japanese industry that developed in the 1960ies exploited both oil and meat, with the latter attracting higher prices than oil on the Japanese market. This corresponded to the period when catches of Sei whales, which produced a higher proportion of meat, became more specifically targeted in the fishery.

Right: composition of the International Whaling Commission. Source: Holt (1985). Participation in Antarctic fishery was limited to a few countries. Until the 1930ies, pelagic whaling was prosecuted mainly by Norwegian and British firms. German and Japanese ventures developed before the Second World War. The latter, along with USSR, became the main harvesting countries in the 1960ies. A Dutch venture also developed in the 1950ies (see infra.). While Antarctic whaling remained the specialised domain of competence of this limited number of nations, the industry rapidly became the object of international speculations. From the 1970ies, IWC membership extended rapidly to include a growing number of non-whaling nations, signalling an important change in the international perception of whales and whaling.

The quasi-monopsony situation which resulted had two important consequences: it made transactions less costly for the whaling companies, as they could sell their entire

production of the season in a single contract; but it made their bargaining position weaker in the determination of oil prices. Largely as a response to the progressive

concentration of demand for their products, whaling companies had organised themselves into an association capable of defining a collective strategy in price negotiations.

The role of this association became all the more important as the largest quantities of whale oil ever to be produced arrived on the European market at a time of crisis on the international markets for raw materials, the prices of which dropped quickly in a few seasons. For 1929-30 and 1930-31, most of the expected whale oil production had been bought in advance. The high levels of production during these years led oil buyers to accumulate large stocks, which they had purchased at a high price. The flooding of the market which occurred in 1931 with more than 600 000 tons of oil produced, added to a slump in the international markets for food products, led to a pause in pelagic whaling (see figure 1).

The 1932 agreement

It is in this context that a production agreement was reached by companies of the two countries involved in Antarctic whaling at the time (Norway and Great Britain). This marked an important stage in the international regulation of whaling, introducing the idea of limiting both catch and the length of the Antarctic whaling season. The agreement was based on a two-tiered catch limit: (i) a global limit on the quantity of oil produced L_{oil} ⁹; and (ii) a global limit on the number of whales killed L_{bwu} ¹⁰.

A conversion coefficient - the *Blue Whale Unit*¹¹ - was agreed upon to account for varying levels of oil productivity per whale according to the species targeted. The relation between the two limits was fixed as follows:

$$L_{bwu} = \frac{L_{oil}}{110}$$

⁹ In terms of barrels, with 1 barrel = 169.3 kgs.

¹⁰ The addition of this second limit promoted maximal utilisation of caught whales. From the account by Tonnessen and Johnsen (1982), it appears that the main motivation for this was to avoid the possibility that some expeditions could benefit from transforming only the "best parts" of captured whales into oil, thus gaining a competitive advantage by saving on processing costs. The rule was certainly also influenced by ongoing international efforts to limit wastage in the Antarctic fishery, and to develop an international regime of stock protection (the agreement for example, made for the protection of smaller sized animals). But it seems that its adoption by companies was linked before all to the fact that it placed them on an equal footing with regards to processing constraints.

¹¹ The BWU remained at the centre of international whaling regulation for the following four decades. An equivalent system has been used in the context of the European Common Fisheries Policy with the notion of "cod-equivalents" comparing fish species with respect to their average market price.

All catch beyond the BWU limit being proscribed, this rule implied that at least 110 barrels of oil be produced per BWU caught¹².

Total production was then shared between existing companies according to their respective fleet capacities (in terms of number of vessels). According to Tonnessen and Johnsen (1982) the agreement, in which all but one company operating in the Antarctic took part, concerned 38 factory ships and 4 coastal stations. The possibility of transferring quotas between companies, against freely negotiated compensation, allowed those wanting to take part in the catching season to buy back the catch quotas of companies keeping their fleets in port. For the 1932-1933 season, only 15 factory vessels and one coastal station took part in the fishery. The global catch limit was fixed at more than 18 000 BWU, or less than two thirds of the 1930-1931 production. The agreement also planned for collective negotiation of oil prices with the buying trust.

The objectives of the agreement were achieved to a large extent. With an average rate of extraction of oil of 116 barrels per BWU, the production limit was reached before the catch limit. The average productivity of factory vessels nearly doubled compared to the 1930-31 season, and that of catcher vessels increased by 40%. The reduction in the number of expeditions engaged in the fishery allowed companies to use only the best equipment, and the most qualified crews. From this season until the war, with the renewal of the agreement, only the most modern components of the pelagic whaling fleet operated in the Antarctic, older vessels being either destroyed or reconverted to other maritime activities.

The main objective of the agreement - to restore favourable selling conditions for whale oil by controlling supply - was also achieved to some extent¹³. The impact on harvested stocks was less obvious. On the one hand, fewer whales were captured due to the global limit accepted by whaling companies and to the better use made of catches. But on the other hand, vessels were incited to catch larger animals, from which larger quantities of whale oil could be produced. This led to an increase in the catches of blue whales, which had already been subjected to intense pressure in previous years.

The negotiating context between 1933 and 1938 and the instability of the agreement.

The agreement was renewed in 1933, following difficult negotiations between companies. The main cause for

¹² A 10% over-shooting of the oil production limit was however tolerated, to allow for higher levels of productivity.

¹³ During the first negotiations between whaling companies and the buying trust in 1932 the latter had announced its intention to pay £10/T for oil at most. But faced with the threat to have no oil supplied it was forced to accept a price of £13/T. This however remained much lower than what it had been in the late 1920ies, due to the continuing drop in prices of raw materials on the world markets.

disagreement related to the inclusion of many old vessels in the negotiations, while considered obsolete by companies holding more recent equipment. Including these vessels in the negotiations implied giving them economic value by the catch quotas attached to them - quotas which active companies needed to buy back in order to increase their catching capacity and/or to limit the competition with other operators. According to Tonnessen and Johnsen (1982), in 1933/4, the agreement concerned a total of 40 factory ships, 8 coastal stations, 228 catcher vessels. Only 16 factory ships, 2 coastal stations and 106 catcher vessels were effectively involved in the fishery.

In the following years firms faced growing difficulties in maintaining the agreement, due to changes in the context of negotiations. From the detailed account provided by Tonnessen and Johnsen (1982), two main factors seem to have played a central role.

1. *The diversification of outlets for oil production.* The buying trust sought to ensure itself a supply of oil independent from the Association of Whaling Companies – either by developing its own catching activity, or by passing contracts with companies not part to the agreement. In addition to the development of an independent demand for oil by Germany, this led to the disruption of the quasi-monopsony situation of the whale oil market in Europe, with immediate consequences for price negotiations. The main constraint that had led whaling companies to form an agreement was thus relaxed. The political context of the time, dominated by pre-war considerations, also changed the nature of bargaining stakes regarding production and sales.
2. *The growing difficulty to limit entry in the fishery.* Companies found it increasingly difficult to agree on the catching and processing equipment, which should be taken into account in sharing the catch limit. In addition to the conflict opposing older companies to the more recent ones regarding acceptable sharing criteria, purchasing of old equipment simply to gain access to a share of total catch led to increased capacity in the fishery. Also, new competitors entered the pelagic whaling industry. A Japanese company made the first purchase of a complete Norwegian expedition in 1934, and the building of factory and catcher vessels started in Japan in 1935, initiating a rapid development of Japanese whaling in the Antarctic. Germany organised its first expedition to the Antarctic whaling grounds in 1936.

Bargaining also shifted from the private to the political and diplomatic scenes. This led to the intergovernmental conferences of London in 1937 and 1938, the objective of which was to establish an agreement between all concerned states on a global regulation of whaling. Debates at these conferences centred on the question of stock protection. As Tonnessen and Johnsen (1982) stress,

this was secondary in the private arrangement between companies:

« In five of the seasons during the 1930s, 1932/7, catches were successfully limited to two-thirds of the scope they had had in 1930/1, the utilisation of raw material was considerably increased, and taxing of whale stocks was kept at a level which at that time a great many people believed would be sufficient to preserve them. Private agreements, however, would not have been concluded if their intention had not also been to improve the price of whale oil by limiting production to the quantity the market was capable of absorbing. That stocks of whales in this way were spared was not so much a motive as a consequence of the original intention. » (p406).

Indeed, while catch in BWU did stabilise during the period, the number of animals killed continued to increase. After a season in which only a partial agreement was reached, covering less than three quarters of total Antarctic production of oil, continued private negotiations between companies between 1937 and 1939 failed to maintain an agreement.

3.2 The agreement on national catch shares in the 1960ies.

From 1946, and until 1959, pelagic whaling was carried out under the International Convention for the Regulation of Whaling, with as a main control over harvesting the institution of a season and a total allowable catch limit in BWU. The text of the Convention explicitly denied the Whaling Commission any possibility to impose restrictions on the number or nationality of factory vessels or coastal stations, or to establish catch limits per expedition. While it appears that the idea of sharing the total allowable catch (TAC) – set at 16 000 BWU in 1946 - between nations or expeditions had been considered in the preparatory meetings of the conference, it was rejected in the final text of the Convention.

While initially prosecuted by firms of the older whaling nations (Norway and the Great Britain), the fishery soon expanded with the development of Japanese, Soviet and Dutch whaling ventures in the Antarctic. The absence of an explicit allocation of total catch between expeditions resulted in the famous “whaling olympics” described by Clark and Lamberson (1982), and the ensuing overcapitalisation of the fishery. None of the catching seasons fixed during the 1950ies was fully used by whalers, the catch limit being reached before the date planned for closing the fishery.

It is mainly this competition which led to agreements between the countries involved in the fishery¹⁴. Again,

¹⁴ Agreements were negotiated principally at the governmental level. In several seasons of the 1950ies, companies also established agreements to limit the number of catching vessels per expedition, to reduce the costs

Box 2 – Catch sharing negotiations, 1959-71

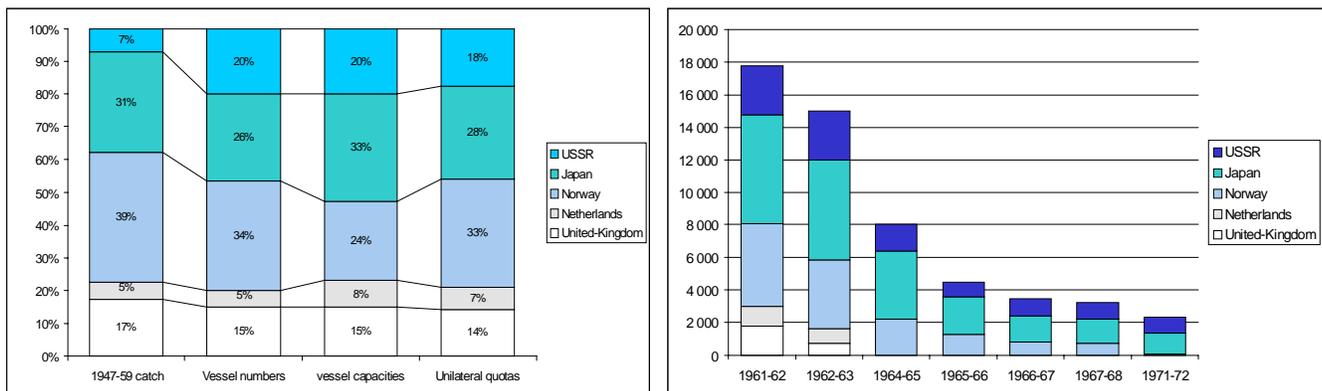


Figure 3 – Debate on catch sharing principles, 1959; and evolution of the catch sharing scheme (BWU), 1961-71.

Left: illustration of some of the sharing criteria discussed in the negotiations between countries. From left to right: (i) according to 1947-59 catch history, (ii) according to vessel numbers, (iii) according to total vessel capacity, and (iv) quotas set unilaterally in 1959. While negotiations were based on a 15 000 BWU catch limit, unilateral quotas increased this to 17 500. Sources: Tonnessen and Johnsen (1982, chap. 32), McHugh (1974).

USSR required that its projects of developing new expeditions be taken into account, thus asking for at least 20% of total catch. The Netherlands demanded the equivalent of 1 200 BWU which they thought necessary to the profitability of their single company. New whaling countries rejected a Norwegian proposal to base allocation on a 10-year track record of catches. These favoured a proposal that quotas should be based on total capacity of factory vessels. This however was considered unfavourably by older whaling nations, with an older fleet of vessels of relatively smaller size and power. To these countries, quotas based on the number of vessels appeared more favourable. But this solution would have disadvantaged new whaling countries with smaller fleets.

Right: Evolution of the catch-sharing scheme between 1961-62 and 1970-71. Sources: Tonnessen and Johnsen (1982, chap. 32), McHugh (1974). The U.K stopped pelagic whaling in 1962; the Netherlands in 1964; and Norway in 1968.

these agreements were unable to prevent the over-harvesting of whale stocks.

The 1962 agreement.

From the early 1950ies, the global catch limit of 16 000 BWU per season appeared too high to allow sustainable harvesting of whale stocks. Under the recommendations of the Scientific Committee of the IWC, a progressive reduction of the limit was initiated in 1953, with the objective to bring catch down to a sustainable level (estimated at 11 000 BWU at the time) as quickly as possible. The process was however stopped at the end of the 1950ies by a conflict on two parallel scenes: (i) within the IWC, due to disagreement on the necessity to reduce global catch¹⁵; (ii) outside the IWC, in

of competition. But although they participated in the negotiations over catch quotas of the 1960ies, they never had the same control over negotiations as they had had in the 1930ies. On several occasions, conflicts even opposed European companies to their governments as to the positions to adopt in international negotiations.

¹⁵ According to the IWC procedure, any member protesting against a resolution of the Commission is not subjected to its practical implications. This made it possible for a country to opt out of a regulation it deemed unacceptable, and usually led other countries to

relation to the negotiations between whaling countries on the sharing of total catch.

In 1958, a meeting of the five harvesting countries was organised in Great Britain, with the aim to negotiate between them a sharing of the annual total catch set by the Commission (15 000 BWU at the time). The countries reached an agreement on the principle that such sharing should be achieved, in order to avoid wasteful competition. The first step in this direction was an agreement on the limitation of the total number of expeditions sent to the Antarctic each year, *de facto* “closing” access to the fishery:

« All delegations declared that they would not expand their fleets with new floating factories; the Soviet Union would not do so after acquiring four.

The Japanese emphasised that the agreement should recognise the right to buy expeditions, together with their quotas, from other parties to the agreement » (Tonnessen and Johnsen (1982): 590).

also protest in order to avoid accepting restrictions that other countries could ignore.

The agreement stated that no increase in the national fleets would be possible except by purchasing other expeditions effectively engaged in pelagic whaling. Transfer of ownership of expeditions would be conditional on also transferring the catch allocation attached to the expedition or on a commitment by the purchaser not to use the vessels in the Antarctic for the duration of the agreement (7 years). What more, entry of vessels flying the flag of a country not member to the agreement would make the latter invalid. The allocation of national quotas thus rested on existing expeditions, with a total capacity – already considerable – which could only be reduced.

The key question – how catch should be shared between nations – was left to be solved at a later meeting. Despite long negotiations in the following year, the motives for disagreement were too strong for a solution to be found (see box 2). The conflict between countries affected the IWC during its 1959 meeting, and even threatened the existence of the Convention with several whaling countries retiring from the Commission. Between 1959 and 1961, no TAC was set. This was compensated to some extent by voluntary agreement between countries on a global limit, following another set of difficult negotiations. This however led to an increase in TAC to 17 500 BWU in 1959, and 17 780 in 1960-61.

An agreement between whaling countries was reached in 1962 (see box 2)¹⁶. Between 1962 and the middle of the 1970ies, the global catch limit was progressively reduced by the IWC, based on the recommendations of biologists. During the entire period, the sharing scheme was maintained, with occasional adjustments due to a number of participants leaving the fishery (see figure 3).

3.3 Elements of analysis.

The historical analysis of these two periods of intense pelagic whaling thus shows that firms and countries did manage, on several occasions, to agree on collective rules of access to whale resources. An important explanatory factor, already noted, was the limited number of participants in the fishery. As Clark and Lamberson (1982) underline, both technological and sociological barriers to entry in the fishery existed in the most intense periods of Antarctic whaling. The need for specialised equipment and the importance of qualified crews in successfully prosecuting the fishery thus played an important role in limiting access. This was reinforced by the fact that, despite international capital ownership, the harvesting process remained the monopoly of nationals of the two older whaling nations until fairly late in the history of the fishery.

¹⁶ According to Tonnessen and Johnsen (1982) this was partly due to the bad results of the preceding season for European whalers, with some nations only capturing part of the quota they had fixed for themselves.

Analytical elements reviewed in the previous section provide further insight into the processes, which led to these agreements, and influenced their evolution.

3.3.1 Bargaining, and the development of a spontaneous trade in catch quotas.

The development of trade in catch quotas between companies was probably the best proof of the reality of the agreements for whaling firms, despite their short period of existence. In the two periods, the negotiation process led to the emergence of trade in the quotas attached to catching and processing equipment. On several occasions in the 1930ies companies taking part in the Antarctic season bought back the catch allocation of expeditions remaining in port, the 1932 agreement making explicitly for such transfers.

Tonnessen and Johnsen (1982) describe the emergence of a similar system of quota trade during the 1960ies. As early as 1961 – before any catch allocation was officially agreed upon by whaling nations – a Japanese company bought an entire Norwegian expedition to which the emerging sharing scheme explicitly attached a catch quota (in % of TAC). While this expedition was effectively used in the Antarctic by its purchasers, transactions between Japanese and European companies in the following years aimed exclusively at the quotas attached to vessels. Of the three factory vessels bought by Japanese firms between 1962 and 1964, the first were immediately disarmed, and the two others effectively remained the property of the European sellers, and were reconverted¹⁷.

If Japan thus increased its catch quota during the 1960ies, it was essentially by buying back quotas from European countries, as the authors explain:

“From 1961 to 1964, by her four purchases of floating factories together with their quotas, Japan increased her percentage of the global quota from 33 to 52 and, as far as could be calculated, the right to an extra catch of 7 500 units in 1961/2-1968/9. If we make the necessary deduction for the seasons when

¹⁷ The case of the Dutch ship *Willem Barendsz* is cited by Tonnessen and Johnsen (1982) as an example. The sales contract stated that the factory vessel would be re-sold to the Dutch company, but no price was agreed and no transaction occurred: “*The sum of £425 000 was paid for the right to catch, or £800 per BWU if the right had been limited to only this one season, but the right was ‘for all time’*” (p607, emphasis added). The price paid was tied to IWC negotiations on the total catch limit. The ship was only bought after the 1964 meeting of the Commission, which was expected to instore a sharp reduction in TAC. The lack of agreement on the reduction at the meeting, and a voluntary agreement between countries to fix total catch at 8 000 units, allowed the transaction to take place. This can be traced in the international fishing press. N°9 of *Fishing News International* (1966) states “(...) in 1964, the Dutch company sold its whaling rights to Japan. A few of the latest catchers went with the sale, but the rest of the fleet was left idle in Cape Town and the factory ship was laid up in Holland” (p12, emphasis added). The ship was later sold to a South-African company to be reconverted to fishmeal activity.

the entire quota was not accomplished, the figure comes to about 7 000. At an average value of £5 500 a unit, in terms of oil, meat, and other by-products, the result is a gross amount for 7 000 units of £38,5 million. £3.3 million, or about 8.5 per cent was paid for the right to produce this (...). Today we may say that without the Quota Agreement the Japanese would have acquired this ‘quota right’ for nothing, and could probably have bought the floating factories at the price of scrap iron” (p607-8, emphasis added).

In fact, during both periods, the possibility to transfer quotas seems to have been indissociable from the agreements on catch shares themselves. Two factors may explain this.

First, it is possible that no satisfactory bargaining set could have been established without what can be considered as “side-payments” to certain players of the whaling game. For example in the early 1960ies, the Norwegian and British industry produced oil for which prices were low; on the other hand, the Japanese industry faced a strong national demand for whale products, particularly meat which attracted high prices (see e.g. Peterson (1993)). This justified the pursuit of whaling by Japanese firms beyond a level which at least some of the European firms would have considered unprofitable. The former were thus able to compensate the latter for limiting their implication in (and later exiting from) the fishery, an option which might otherwise not have proven acceptable.

Second, private firms, and later States, seemed to have limited incentives to commit to a sharing scheme which could only have been revised by re-negotiating the agreement itself – an unlikely event given the costs of bargaining. Transferability allowed for participants to adjust the allocation of catch to unpredictable changes in harvesting conditions, via trade of catch rights.

The impact of bargaining costs is apparent in both periods. The whaling agreements illustrate the multiplicity of possible solutions to bargaining that can be considered in a process of sharing the benefits and costs of fisheries self-regulation. Debates on a catch allocation scheme in the 1930ies and 1960ies brought up various sharing criteria which often appear in other fisheries (number of vessels, vessel capacity, catch history), and relate to various principles for justifying a particular allocation (e.g. historical involvement in the fishery, importance of past activity, level of investment in the fishery, capacity to fully use resources caught). Each of these criteria can prove more or less favourable to the different parties, hence the conflicts and risks of failed negotiations.

The 1930ies agreement existed as long as it involved firms with roughly the same background, whose operations were motivated by the same objective of selling oil on the European market. It failed to be renewed when new competitors entered the fishery with different

objectives, making it more difficult for firms to anticipate other’s strategies.

In the 1960ies, a large part of the problems encountered in negotiations on allocating catch shares between countries related to the fact that they opposed industries operating in sensibly different contexts. According to Tonnessen and Johnsen (1982), the Dutch industry was largely subsidised; the Soviet industry operated within a centrally planned economy. The other European and the Japanese industries were market driven, with the differences outlined above. In practice, these differences between countries greatly complicated the negotiations on catch allocation, again making it more difficult for each of them to anticipate the motivations and actions of the others.

3.3.2 Monitoring and enforcement

The issues of monitoring and enforcement played a major role in the establishment and evolution of agreements. In both periods, enforcement appears to have mainly rested on the threat by participants to revert to competitive behaviour, in case of observed non-compliance by other parties.

In the 1930ies, it appears that the particular structure of the European oil market – a quasi-monopsony with an annual supply largely reaching the market at the same time in the year – made for easier monitoring of total production and oil price by firms. This allowed them to assess both the degree of compliance with the agreement, and its global impact on the market and the situation of firms. The situation changed with the diversification of demand and the entry of competitors not part to the agreement, leading to difficulties to monitor compliance.

In the 1960ies, information was mainly provided through a centralised system of catch statistics set up to implement the TAC and closed season regulations. Because of the limitations of this system, the overcapitalisation and stock over-harvesting problems were not perceived equally by all countries. Differences in the productivity of expeditions, for example, led some to question the extent of these problems: drops in catches could be explained by the low productivity achieved by the older segments of whaling fleets. Also, until the middle of the 1960ies, the industry and governments had enough doubt regarding the validity of scientific recommendations that these were never used as a commonly accepted basis for negotiations (Elliot (1979)).

In this second period, negotiations were also made more difficult by the absence of an international system for controlling whaling activities. The 1946 Convention did not plan for such a system, the responsibility for enforcing IWC regulations resting with national authorities. In the 1950ies, negotiations began between member states concerning the institution of an international observer scheme. An initial project developed in parallel to the negotiations on catch allocations but was never adopted

because of the strategic value of catch information in the negotiations (Scarff (1977)). A second project was developed in the late sixties and entered into force only in 1971, its adoption also being slowed down by the strategic value of information in the debates on global catch restrictions. The absence of such an observer scheme over most of the post-war pelagic whaling period certainly contributed to the delays in reaching agreements, despite exchanges of observers between whalers on several occasions during the period (Holt (1985)).

3.3.3 Impacts on whale stocks: the irreversibility of a global catch limit set too high.

In both cases, the agreements were motivated by short-term economic considerations. While this may have in some limited ways restricted pressures on whale stocks, it was only as a consequence of these objectives. Investing in stock protection, on the other hand, would have meant bargaining on much longer-term returns, with higher levels of uncertainty as to the evolution of context and strategies of other participants (and to the payoffs of collective regulation).

Scott (1993) stresses the importance played by the initial conditions of a fishery in the evolution of access restrictions. In the 1950-60 period, the 16 000 BWU catch limit, on the basis of which all efforts to reduce catch by the Commission and to share catch by whaling countries developed, was in fact too high. It seemed at the time that stocks (on which knowledge remained limited) could sustain this catch. It was thought important to agree first on the principle of a global limit, which could later be reduced as required.

The experience showed that once established, such a limit was extremely difficult to revise downwards. The first true reduction in TAC took place 15 years after the establishment of the 16 000 BWU limit, and this was only because it proved impossible to catch the existing TAC. According to Tonnessen and Johnsen (1982), with an industry which was entirely to rebuild in the 1940ies, a lower limit could certainly have been accepted by the signatories to the Convention (see also Elliot (1979)). But once it was adopted, all investment plans and anticipations of production possibilities, and all negotiations on the sharing of total catch organised around the 16 000 BWU annual limit. Any downward revision of this limit – since it also implied a revision of this economic, social and political organisation – met with strong difficulties. The initial setting thus strongly influenced the trajectory followed by the pelagic whaling industry and its regulation in the 1950-60ies.

4 CONCLUSION.

Conflicts regarding the limitation of global catch and its allocation between firms and countries had a devastating impact on Antarctic whale stocks, both by their duration

and by the low correlation between quotas being discussed and the true biological potential of these stocks. Despite this, the spontaneous emergence of a collective system allowing the definition and exchange of use rights with some of the characteristics of market trade was observed. On two occasions in the (extremely competitive) process of interaction between the actors involved in Antarctic whaling, enough credence was granted by private firms to the stability of collective harvesting rules for them to accept a trade in catch rights, the enforcement of which was only guaranteed by the parties to the transactions themselves.

This example illustrates the possibility for elements of self-regulation, including distribution of catch among participants, to emerge in large-scale fisheries. However, it does not confirm Scott's observation that these elements do not usually address the issue of stock preservation. It also shows that self-regulatory measures may have a significant influence on the pattern of development and evolution of a fishery.

Understanding how such forms of self-organisation come about seems to require more in depth analysis of the actual processes by which a fishery is being regulated, including the economic, technological, sociological and institutional conditions under which participants operate. This could lead to conceive of more fisheries as cases intermediate between free access competitive and fully regulated situations of renewable resource use. Economics, among other disciplines, provides useful analytical tools to better understand the conditions which may lead such fisheries to self-regulate, and the consequences this has for fisheries management policies.

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