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Understanding the functioning of fishing enterprises: an essential tool in fisheries management

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Management of an inshore fishery on the French Atlantic coast is a complex business requiring an understanding of how fishing enterprises work because of the impact they have on fisheries management. An acceptable management decision was reached through parallel changes in the rules concerning fishing licences and in the relative priorities of the objectives of the different parties and interests. An understanding of how fishing enterprises take their decisions is shown to be useful in negotiating towards an adaptive consensus conclusion. It allows management measures to be adjusted towards projected objectives, goals determined, and priority allocated. Following previous system studies in agriculture development, groups of fishing enterprises have to be defined on the basis of their present state and their (often long-term and unstated) objectives. This vision of public fishery management as a process of system regulation underlines the importance of shared information in facilitating desirable collective action.

Key words: adaptive behaviour, fishery, management, system, typology.

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Introduction

For many European fisheries, the problem is more about finding a way of effectively reducing fishing effort than knowing the exact level to which it must be reduced. Total allowable catches, technical measures, and restraints on fishing capacity have been tried, but with little success in terms of controlling fishing mortality. This lack of effectiveness is often said to be caused by a deficiency in implementation controls on the management measures. There is no doubt that such controls have not always been very strict, but the obvious lack of improvement after years of claims about their strengthening leads one to the conclusion that it is more a symptom than a cause of the malaise in European fisheries mismanagement. This suggestion presupposes a much more complex process of fisheries management than commonly assumed when a lack of implementation control is identified. The management of an inshore fishery, in which the La Rochelle laboratory of the French state fishery research agency (IFREMER) has been involved for many years, offered a useful case study to illustrate this complexity.

Fishery management in the Pertuis charentais

The Pertuis charentais are two shallow-water areas between two islands (Ré and Oléron) and the mainland off the west coast of France, roughly in the middle of the French portion of the Bay of Biscay (Fig. 1). They spread over 33 miles off the coast and are up to 17 miles wide. The main commercial species caught in the area are sole (*Solea solea*), cuttlefish (*Sepia officinalis*), and sea bass (*Dicentrarchus labrax*) from April to November and glass eel (*Anguilla anguilla*), variegated scallop (*Chlamys varia*), and common prawn (*Palaemon serratus*) during winter. With the excepton of the variegated scallop, the exploited populations of these resources are not confined to the area; they show seasonal changes in abundance related to migration patterns. The Pertuis charentais are a nursery for some of the species, particularly sole. About 200 small boats (mean length 9.6 m and none longer than 12 m) fish in the area, half of them trawlers the other half mainly fixed-net fishing boats.

At the end of the 1970s, a licensing policy for trawl operations was investigated by a committee including

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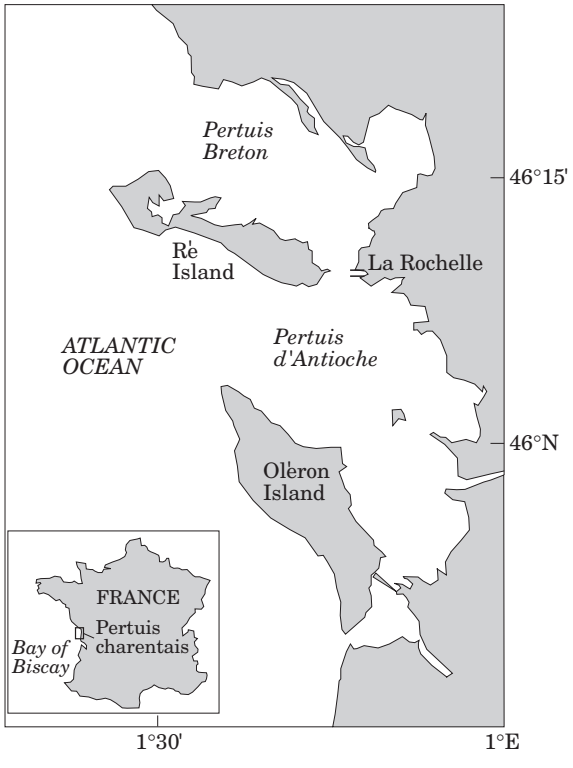

Figure 1. The Pertuis charentais area.

fishermen, fisheries managers, and scientists (Table 1). The wish of the managers was to decrease the number of Pertuis trawlers to zero by issuing non-transferable licences. Each licence would end when the trawler owner retired. Biologists had already pointed out the likely adverse effects of Pertuis trawling on the adult biomass of some of the valuable resources in the Bay of Biscay, particularly sole, because of the large by-catch of juvenile fish. That assessment underscored the threat to the Bay of Biscay offshore trawl fleet, which was going through a crisis at the time. Offshore fishers were concerned at possible future escalation of its difficulties as a direct result of the development of Pertuis trawling, which itself departed from national and European regulations operative at the time. The administrative authorities were therefore obliged to find some way to limit the development for biological, economic, and political reasons.

French fishery administrative officials generally try to reach a negotiated consensus for management decisions, particularly in respect of local regulations inshore. An institutional framework supports this management process. Fishers' committees have to be consulted extensively, and the outcome is that it may take a long time to reach a consensus decision if there is strong opposition by one of the parties. For the Pertuis charentais trawler licensing scheme, 5 years of negotiations took place before an acceptable regulation was adopted in 1983. During this long process, inshore trawlermen strengthened their organization, not only because of their opposition to the licensing proposal, but also because of some conflicts between them and other groups of fishers. They formed a pressure group that became well used to negotiating with the administrative officials, and finally managed to force a basic change in the initial proposal for the licence, namely to make it transferable.

Throughout the licensing adoption process, there was a shift away from the original aim of phasing out trawling in the Pertuis charentais, supported by general and agreed management considerations on resource conservation, to a solution that demonstrated that the trawlermen were certainly not prepared to accept being phased out with nothing in return. The mixed-species nature of the trawl catch was said by them to be necessary when selling directly to consumers. As this sale is generally made by the trawler-owner's wife, a total cessation of trawling would have signalled the end of a family organization that allowed some enhancement of family income. More generally, the trawlermen certainly feared difficulty in selling their trawlers locally in the future, as well as not being able to transfer their fishing knowledge to a son. More than simply curtailing the use of a particular form of fishing gear, the initial licensing proposal could have affected a social organization based on family workers and associated strong relationships. The trawler owners obviously had something to lose when transferability of the licence could bring financial gain if they decided to sell their boats. Their interest was obviously to close access to the Pertuis charentais fishery, but not to become doomed through the extinction of their fishing fleet. Their defence of licence transferability was perfectly understandable. Under their pressure, protection of juvenile fish became a secondary aim compared to their will to demand a fair share of a limited resource in a limited area, first between all trawl users and later between all fishers.

Concomitant with the implementation of the trawler licensing policy, the size of the netting fleet increased. Quite naturally, the trawl lobby acted so that a netting boat licensing policy was also implemented in 1988. At first, this licensing policy was only slightly restrictive, because it limited only the number of boats from outside, not the local fleet. In 1997, however, the total number of netting boats was limited as well. In 1998, a licence was also proposed for trap fishing and line fishing. If adopted, the licensing policy extends to the entire commercial fishery in the Pertuis charentais.

Management process change

At the end of the 1970s, the biological information gave a basis for managers to propose management action that

Table 1. Chronology of main events related to the Pertuis charentais fishery management system.

Year	Fishery	Science	Management
1970–74	Oyster and offshore fishing crises. Fleet size increases		Low regulation constraints on trawling
1975	275 trawlers (11 200 kW) 31 netters 107 line, trap or other gear boats	First study	Low regulation constraints on trawling
1977		Study on shrimp trawling. Data on juvenile fish by-catch in trawls	Low regulation constraints on trawling
1978	Dispute between trawlermen and users of other gear		First meeting on trawler licensing policy. Minimum mesh size for Bay of Biscay trawling
1980	Decreasing economic interest in shrimp trawling	Advice on adverse effect of trawling on juvenile fish in Pertuis area	Close relationships between scientists and administrative authorities. Proposal for trawler licensing policy. Non-transferable licence objective: end of trawling in the Pertuis for resource conservation.
1983	Decreasing economic interest in shrimp trawling		Trawler licensing policy adopted. Change to transferable licences objective: social stability
1985	Increase in numbers of netters		
1988	Increase in numbers of netters		Pressure of trawling lobby to limit netting. Netting boat licensing policy adopted
1997			Pressure of trawling lobby to limit netting. Netting boat licensing policy revised. Fishers' proposal for trap- and line-fishing licence policy. Objective: closure of access
1998	85 trawlers (7500 kW) 90 fixed-gear fishing boats 24 boats with main gear unknown		

could clear up the problem. Scientists and managers used to meet frequently in committees or working groups during that period of national fisheries policy reform. They knew each other well and shared the same view on the aim of the licensing policy. As experts and advisers to the managers, the biologists at the local fisheries laboratory had a major place in the launching of the decision-making process. The set up was a classic example of a linear management process (Step 1 in Fig. 2).

The obligation to control trawling by acceptable means through participation in the management process induced a change to a process in which the influence of the trawling lobby dominated (Step 2 in Fig. 2). This group diverted the priority in management aims to its advantage and reversed the control relation with the administrative authorities. The number of trawlers actually decreased, but mainly because of the exclusion of part-time fishers, for instance non-members of the trawling lobby and oyster farmers. However, the mean horsepower of the remaining trawlers increased over time, first because the licensing policy did not restrict it, when agreed, and later because of the trawling lobby's pressure for a higher effective limit. Both fishing power and fishing time per boat have consequently increased. As a result, the present total trawler fishing effort is likely close to the value prior to 1983. The main consequence of the Pertuis licensing policy has therefore been a concentration of trawler fishing rights in fewer hands and a closure of access to the fishery by newcomers.

The administrative authorities have tacitly agreed a change in the priority of the aims of the licensing policy. The conservation aim to end trawling has been replaced by the social aim of resource sharing, although resource conservation has been stated throughout as the major management objective. The actual contents of the licensing policy are different, but there is now social acceptance of the decision to share resources in the name of resource conservation. Two reasons may explain the response of the administrative authorities. First, social stability has high priority in the eyes of administrative officials; the advantages given to the trawling lobby may be considered a consequence of the strong negotiating capacity of this lobby in terms of maintaining social

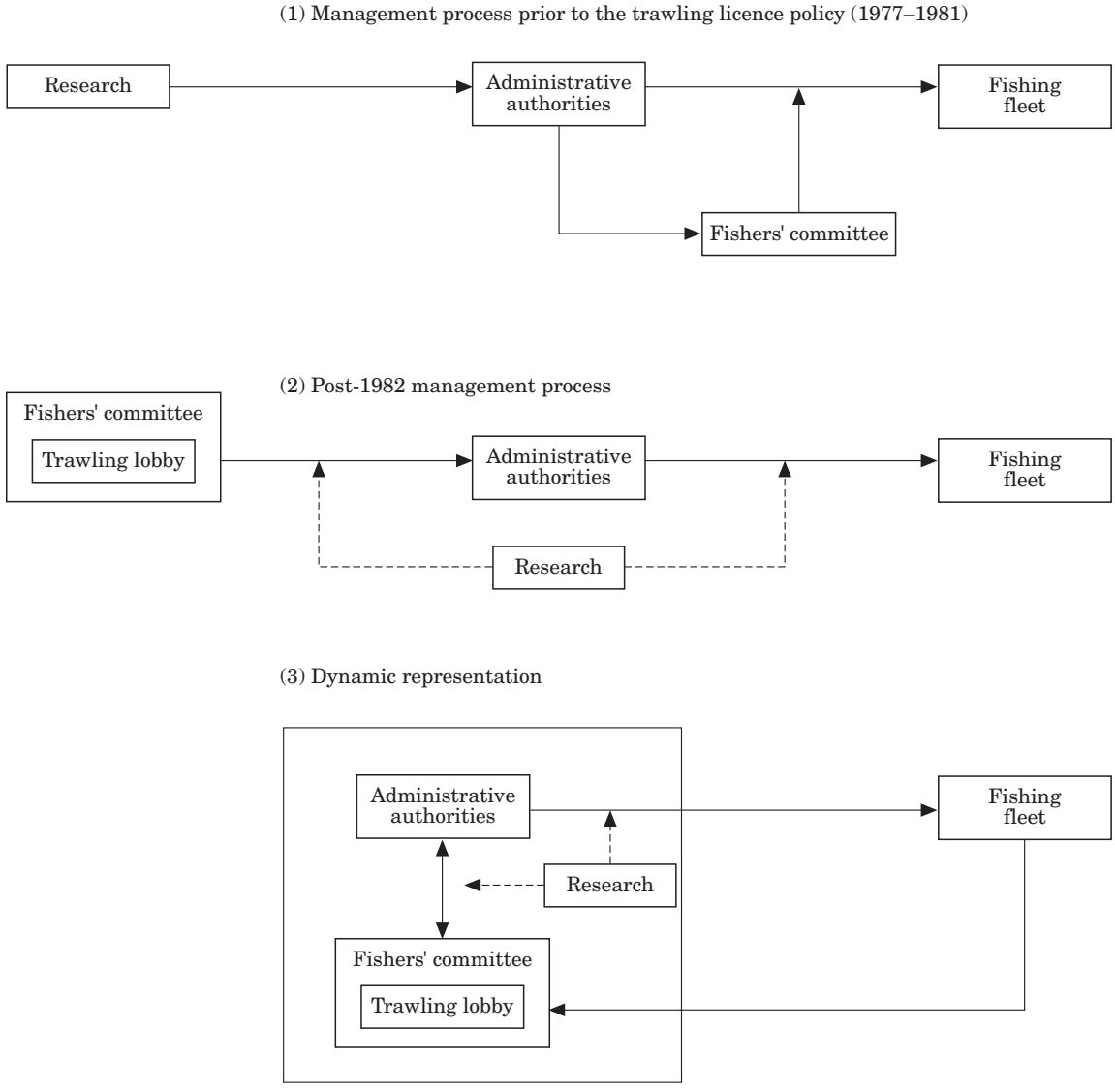

Figure 2. Change in the management process through implementation of the Pertuis licensing policy.

harmony in the area. Second, assessment of the biological risk may have changed. The threat to the future of Pertuis trawling seemed less critical when the shrimp trawling effort also declined because of decreased abundance of that resource. The emphasis on biological risk was also reduced by a change in leadership of both the local fisheries administration and the local fishery laboratory.

Throughout implementation of the licensing policy, the management process was an interaction between a management system (research; administrative authorities; fishers' committee; trawling lobby) and a fishing fleet (dynamic representation in Fig. 2). Management actions induce feedbacks, in the Pertuis example through participation of the trawler lobby in the management process. Elsewhere, feedback may exist through non-compliance with regulations or through political pressure. The management decision-making process leads to a fishery system in which the management system is not driving it from the exterior, but rather is an interacting part. Such a process aims to promote acceptable decisions through parallel evolution of both means and priority objectives, as shown by the Pertuis fishery-management system.

Participative management facilitated this process. It has the obvious advantage of crisis prevention, but it may not guarantee that the management system gives fair attention to all interests, including long-term conservation and overall social interests. The Pertuis licensing policy demonstrates that point well, because it

is far from being satisfactory concerning the resource conservation objective. This example of fishery management then raises the question of how to reach acceptable decisions that do not suppose an unstated shift in priority or some latitude in implementation of management measures. Some help may be provided by investigating how the fishing enterprises function.

Addressing the behaviour of fishing enterprises

Technical, social, and economic information must be collected to understand how fishing enterprises function. Apart from the difficulty in gathering such information, the major problem is that every enterprise functions differently if considered in enough detail. Similar problems have been found when conducting agricultural research on farming systems. For some 20 years, research on farm functioning has been carried out in an attempt to understand failures to adopt innovations. That approach has now found new usefulness in the management of environmental effects of agriculture (Perrot and Landais, 1993; Landais, 1996).

The approach considers that a fishing enterprise is an objective-orientated system (Rey *et al.*, 1997). The enterprise is then a decision unit associated with some productive means. Several persons may make up the decision unit, even if in most cases one dominant person takes the lead. In the classic family fishing enterprise, everyday decisions are made by the head, generally the owner, but long-term objectives are generally formulated within the family group. These objectives are neither well defined in hierarchical order nor necessarily perfectly in coherence, and they may change with time (Brossier *et al.*, 1997). For instance, they may represent the way of life, security of income, or the future of the children. Decision-making depends on this set of objectives and on the perception of the state of the fishing enterprise in its environment. Behaviour is a double adaptation to modify both (Fig. 3). The problem is that the objectives are often not openly expressed because they are not well defined, and they must therefore be inferred from actions.

A framework of three groups of questions has been designed to garner information from the heads of fishing enterprises. The following questions summarize the questionnaire:

(A) Fishing enterprise evolution pattern over time:
  (1) What has been the development path of the enterprise?
  (2) At what point in his career is the head of the enterprise?
  (3) What is the possibility of transfer of the enterprise to another person?

(B) The means:
  (1) What are the productive factors of the enterprise?
  (2) What are the knowledge and sources of information available to the members of the enterprise?

(C) Fishing enterprise management:
  (1) How are the different fishing practices distributed throughout a year?
  (2) What decisions are made by the head of the enterprise?
  (3) What other activities than fishing are carried out by members of the enterprise?
  (4) What are the minimum, mean, and acceptable turnovers?

An assessment of mean productive costs was attempted, but not completed because it was too time-consuming compared with its usefulness. It required a large amount of data that had to be validated, but the result gave little indication about the dynamics of the enterprise. The informative costs when dealing with decision-making are opportunity costs (Brossier *et al.*, 1997), and they cannot be assessed on the basis of a short survey. Moreover, such costs have real significance only if income is the major objective. In any case, it is also useful to assess the changes in working time and organization, in risks, in autonomy, and in the environmental interactions that a decision may cause. Assessment of the effect of such changes must consequently be seen as a second-step deeper analysis within the different ways that fishing enterprises function, once they are determined.

The difficulty in constructing models of fishing enterprises lies in knowing how to handle a large number of variables. To help in the process, an iterative classification was carried out, types being built by alternately examining survey results and reviewing the assumed objectives. Each likely objective was associated with a group of variables for which values were supposed to have been changed significantly in seeking it. Attention was focused on the close resemblance of major features, nevertheless care being taken to investigate possible conflicts between other characteristics. Assignment rules were set progressively by critically scrutinizing the reasons why each fishing enterprise should belong to one group rather than to another. The process continues until an acceptably low number of internally consistent groups is achieved.

"Constructed" types are determined in this manner, in contrast to "extracted"' types, which are derived from multivariate analysis. The latter have the advantage of being more independent of the operator, although their results depend on choice, coding, and weight of variables. Moreover, the complexity of social functioning is difficult to understand from such results (Perrot and Landais, 1993). The manual iterative typology addresses the problem by tackling the functioning of fishing

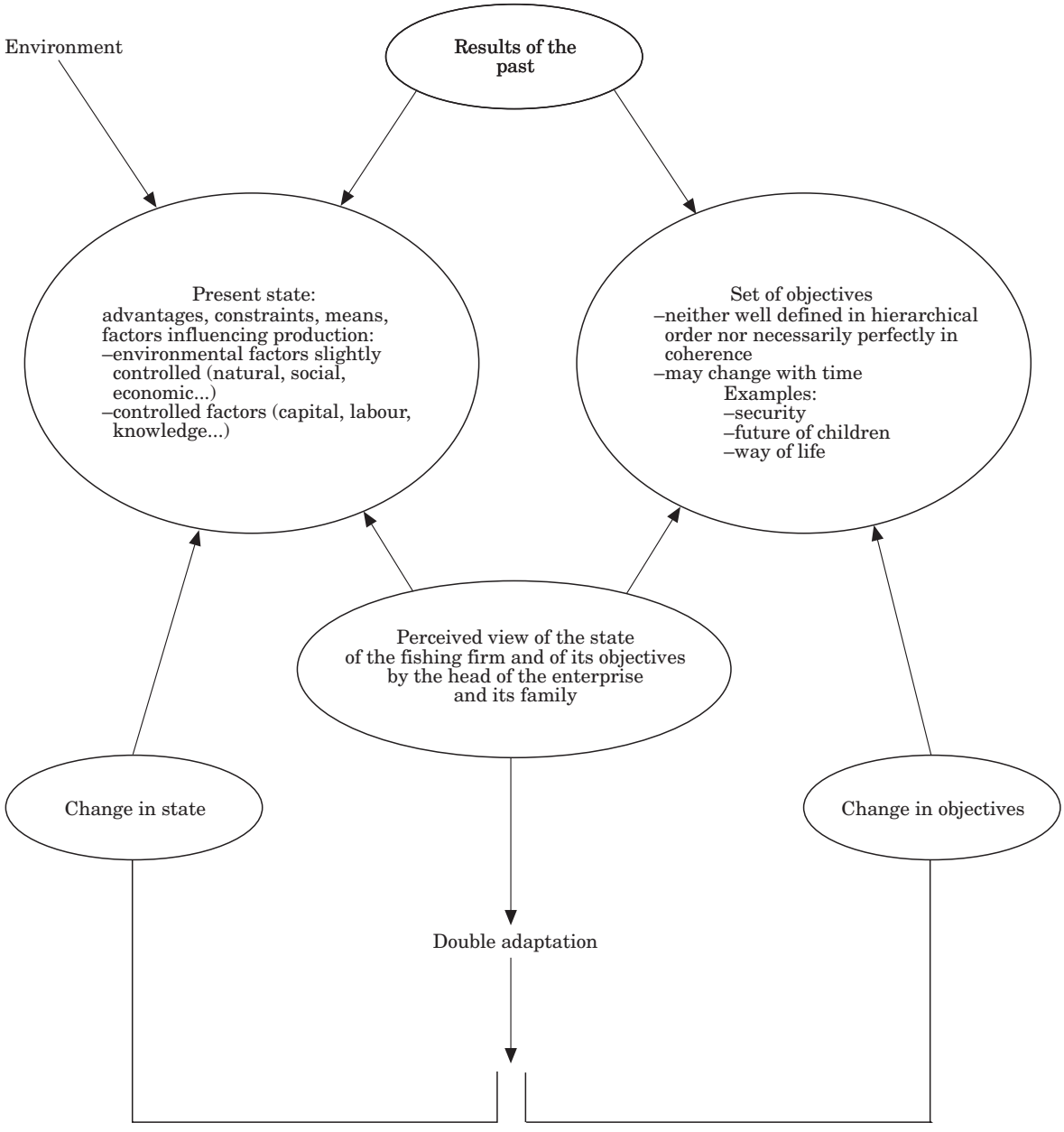

Figure 3. Adaptive behaviour within the family fishing enterprise system (after Brossier *et al.*, 1997).

enterprises directly and by grouping them on the basis of analysis rather than by trying to deduce their main functioning from a typology based on some variables. The method is then supported by its explanatory capacity, justifying its retention over a method that assumes independence from an observer. This approach refers to the constructivist paradigm stating that the knowledge of any complex reality is a creation that depends on the human observer and its social environment (Le Moigne, 1990; Jiggins and Röling, 1997).

The case study of the Pertuis charentais fishery shows that the survey may be carried out at a limited cost (1–3 hours per fishing enterprise). About 60 harvesters were questioned in the survey. Five types of fishing enterprise behaviour were defined, described by:

- self-learning and low financial risk
- reduction of the dependence on fishing by having several income sources
- employment of family in the workforce

- maximization of fishing income
- stability and investment returns.

Two main results must be stressed. First, gear is not a criterion in type definition. Trawlers, as well as other fishing boats, are present in every type. This observation presupposes some flexibility in gear use. A second interesting finding is that there are two dominating factors governing changes in productive inputs and consequently fishing effort trend: the age of the head of the fishing enterprise and the family relations within the crew.

Towards development of a knowledge system

Collective action requires shared objectives and broad agreement on means. The Pertuis fishery-management system shows that the support for the resource conservation objective was rather superficial and dependent on possible means of attaining it. The use of an objective (resource conservation) to gain acceptance of another (resource share) and the change in objective priority attributable to the power relationship in the management system show that decision-making in fishery management is a complex and adaptive process. As in the fishing firm decision-making process, action results from a double adaptation of objectives and means to gain an acceptable result.

The typology of Pertuis fishing enterprises offers some means of increasing control on these dynamics by encouraging acceptance of possible changes in gear and by bringing some knowledge to the negotiation table on the dynamics of the fishing fleet. The resource conservation objective can be reconsidered, but only by further investigating the differential effects of change of gear. The fishing effort dynamics raise the need to tackle the problem of resource sharing that changes in fisher populations may induce.

A fishing enterprise typology does not represent a means to access direct control of fishery dynamics, but provides a picture which, even if never completely definitive nor fully comprehensive, allows relevant questions to be posed. It reveals the susceptibility of fishing enterprises to accepting management decisions, but, as sociologists stress, human behaviour is never definitively determined and there is no social system completely regulated or controlled (Crozier and Friedberg, 1977). The fishery system is no exception to that rule.

The consequences of fishery management decisions are not easy to predict and it is better to be prepared to make successive trials in order to progress towards the ultimate aims. A learning path must be established to reach an acceptable solution, a real one that can be implemented at reasonable costs of control. Such a process may be facilitated if the participation of all actors is organized, but also depends on the accuracy and availability of information. Adaptive behaviour in fishery management is driven by the possibility of each actor assessing rightly what is acceptable to him or her as well as to others. The Pertuis charentais fishery-management system shows this clearly.

The fishing enterprise functioning typology outlined above may be considered as a basic contribution to the development of shared knowledge or a knowledge system, which may allow for collective action to emerge. The need of such a system is underlined in the analyses made on introduction of innovations in agriculture (Jiggins and Röling, 1997) as well as on industrial management (Berry, 1991). This development needs to provide information, but also to act in its acceptance and dissemination. Finally, it should result in a network within which fisheries research moves from its traditional place close to the management authorities, as its technical support, to a more peripheral position with a wide range of links needing multidisciplinary skills.

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