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< Fisher behaviour and economic interactions between fisheries. Examining seaweed and scallop fisheries of the Brest district - Western Brittany, France - >

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Fisher behaviour and economic interactions between fisheries

Examining seaweed and scallop fisheries of the Brest district
(Western Brittany, France) [2]

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Abstract

This papers aims at understanding the strategies of fishers operating two fisheries which are biologically independent but economically interrelated. The case studied is that of the fishers who dredge scallops, queens and clams in the bay of Brest during winter, and harvest the *Laminaria digitata* field in the open sea, north-west of Brest in summer.

Taking this peculiarity into account, the paper makes a distinction between different strategies, which enable fishers to adapt to a changing environment (abundance variation but also economic and institutional shifts) during recent years. Fishers have to choose among different activities, which bring about various investments. Vice versa, their behaviour has feedback effects on the global institutional environment, and especially on the regulation system of input control. The study is based upon a significant range of individual data, about fishing schedule, productions, and prices.

Keywords

Fisher behaviour, fisheries management, seaweed harvesting, scallop dredging.

[2] This paper was presented at the XIth annual EAFE Conference, Dublin, 7-10 April 1999.

Introduction

According to the principle of subsidiarity, wherever no conflict has to be solved at a higher decision level, fisheries management should be the concern of regional or local authorities. The question of defining adequate management areas is of interest in this context. It is often said that fisheries management should be based upon biologically relevant areas, i.e. stock-based areas. However, besides biological interrelations, some economic interactions have to be considered, and this may result in complicating the problem of determining the relevant area to be managed.

This paper puts seaweed and scallop fisheries forward, as an illustration of some of the problems that might emerge when setting the principle of subsidiarity into practice. We focus on fishers who dredge scallops, queens and clams in the Bay of Brest (Western Brittany, France) in winter, and harvest the *Laminaria digitata* (brown algae) field in the open sea, north-west of Brest during summer.

Because of fisher multi-activity - a consequence of fishing job diversification -, seaweed and scallop fisheries are economically interrelated, even if they are biologically independent. The paper aims at understanding the fisher strategies and choices, taking their adapting to a changing environment into account. First, we describe the main trends concerning the seaweed fishery separately. But some of the dynamics of the seaweed fleet cannot be explained without any consideration to scallop fishery evolution. Economic and institutional interrelations between fisheries are set out in second part.

1. Observing seaweed harvesting activity dynamics

Seaweed harvesting is a traditional summertime activity on the north-west coast of Brittany, which experienced substantial changes related to mechanisation during the seventies. The only controls of the activity are input-based : the number of boats is limited (limited entry licence system), the maximum authorised length of boats is 12 metres, and the harvesting season is limited.

This section first describes the dynamics of the fleet over the past two decades, and then relates it to the evolution of effort and landings and to the characteristics of the market of seaweed.

1.1. Main trends regarding the seaweed fleet

After a fast growth during the seventies (Arzel, 1998), the number of seaweed harvesting boats increased at a slower pace during the eighties, and started decreasing after 1991. The number of boats in activity is now below the mid-80's level, and the gap with the number of available licences is widening (table 1).

Table 1. Number of seaweed harvesting boats

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Number of licences	70	71	74	73	75	76	76	72	70	70	70	70
Number of boats in activity	67	65	67	70	72	74	74	70	64	63	64	61

Source : Arzel, 1998

However, the change in the number of boats should not be regarded as an accurate indicator of the evolution in the total harvesting capacity of the fleet, because the average characteristics of the boats changed significantly during the last two decades (table 2).

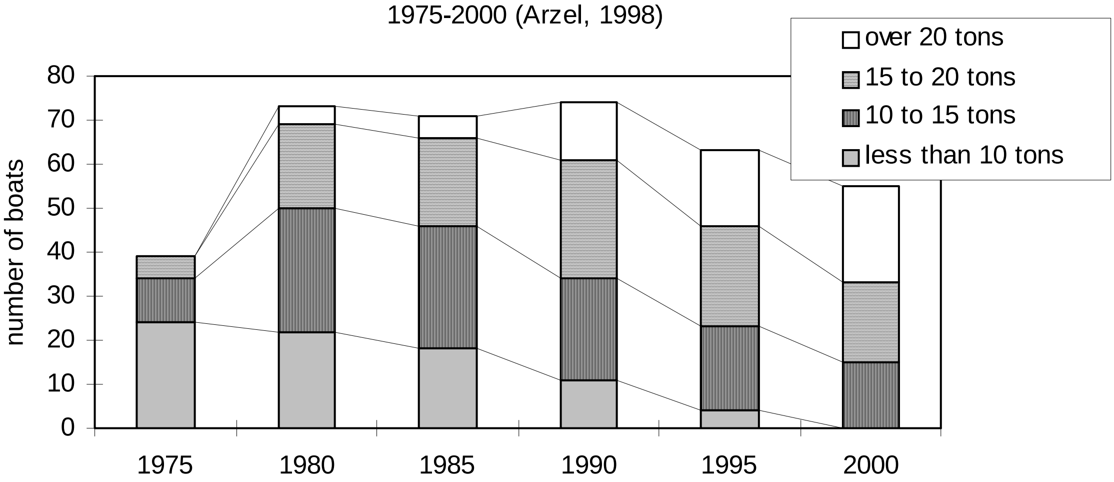
Table 2. Average characteristics of seaweed harvesting boats

	1985	1990	1995	1998	% of change 1985-98
Average length (metres)	8.6	8.9	9.4	9.5	+ 10 %
Average GRT	8.0	9.2	9.6	9.8	+ 23 %
Average HP (kw)	46.8	54.0	60.7	64.9	+ 39 %

Source : Ifremer

Due to this fact, in 1996 the total GRT and HP of the fleet were approximately 10% and 20% (respectively) above their 1985 level. This trend is mainly due to a change in the structure of the fleet, the main feature of which is a shift to boats with a larger carrying capacity :

fig. 1. Distribution of seaweed harvesting boats according to carrying capacity, 1975-2000 (Arzel, 1998)



1.2 Effort and landings

The shift in the structure of the fleet induced a new time-schedule for seaweed harvesters : with the increase in the carrying capacity of their boats, their trips between the seaweed fields and the landing places got fewer and longer (table 3).

Table 3. Average yearly number of trips per boat and average duration of a trip, 1995-96

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Number of trips per boat	78	94	82	76	75	72	65	70	52	69	63	72
Trip duration	8h06	7h08	6h33	7h55	7h26	7h48	8h08	8h00	8h15		9h12	9h10

Source : Arzel, 1998.

As a result, the average yearly number of hours at sea per boat increased by 5% between 1985 and 1996 and, during the same period, the total yearly number of hours at sea decreased only by 4% (table 4).

Table 4. Yearly time of activity, 1996-96

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Average per boat (hours)	630	669	540	604	559	565	531	560	429		580	664
Total (1000 hours)	42.2	43.5	36.2	42.3	40.3	41.8	39.3	39.2	27.5		37.1	40.5

Source : Arzel, 1998.

In the same time, the total yearly harvest fluctuated around a stable mean close to 60 000 tons, within a range of variation of ±10% (except for the year 1993). Notwithstanding the decrease in the number of boats after 1991, the average yearly output per boat did not reach its 1986 level before 1996, and this year the average boat output per hour was less than 10% above the 1986 level (table 5).

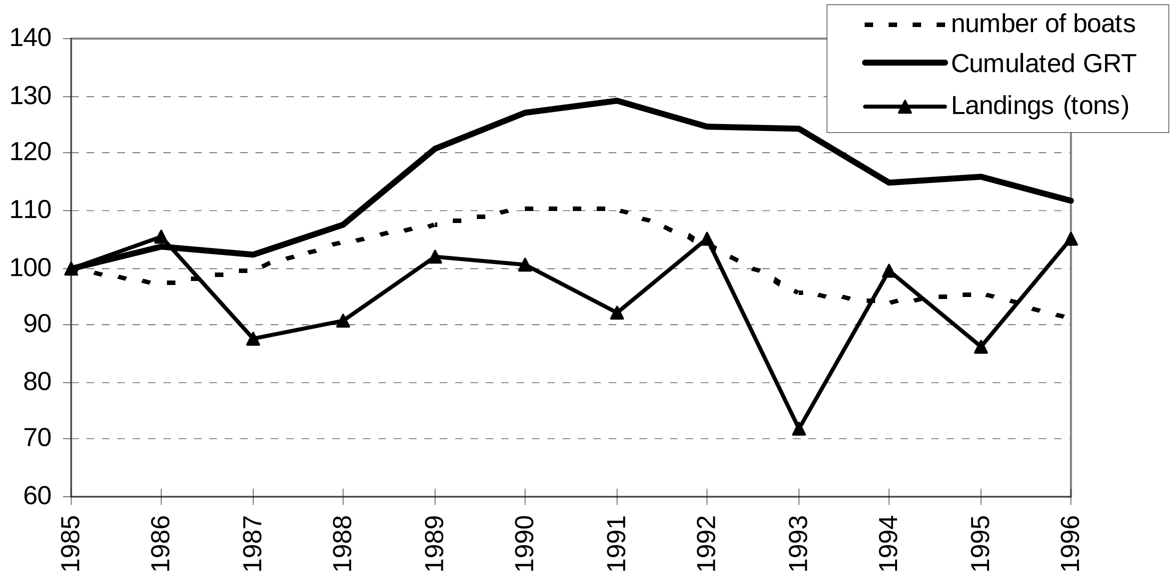
Table 5. Output (tons), 1985-96

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Total (1000 tons)	62.1	65.6	54.3	56.4	63.4	62.4	57.3	65.2	44.5	61.7	53.5	65.3
Average per boat (tons)	927	1008	810	806	881	843	775	931	696	979	836	1070
Average per hour / boat (tons)	1.47	1.51	1.50	1.33	1.57	1.49	1.46	1.66	1.62		1.44	1.61

Source : Arzel, 1998.

According to these figures, the evolution of output could not match the growth in harvesting capacity of the boats during the period 1985-96 (the growth in GRT underestimates the growth in carrying capacity - see Arzel, 1998 -) :

fig.2. Seaweed harvesting : indexes of fleet capacity and output, 1985-96



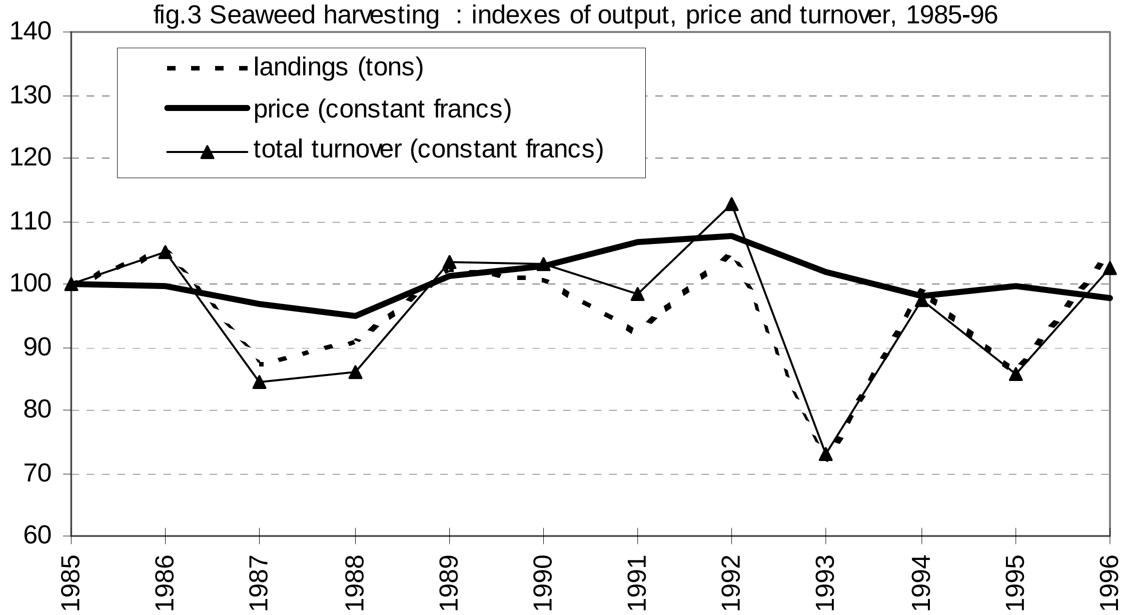
This phenomenon indicates a global decreasing technical efficiency of the activity, and raises the question of the rationality of investing in larger (and costlier) boats, which has been the main feature of the investment behaviour in seaweed harvesting over the last two decades (see fig.1 above).

A first level of explanation may be found in the looseness of the input-based control of the activity. As the global yearly level of output is limited by the natural productivity of seaweed fields and by the market (see below), the individual output of a boat depends on its *relative* carrying capacity, i.e. its individual capacity compared to the average capacity of the rest of the fleet. This feature induces a « race for seaweed », which each harvester hopes to win by increasing his individual carrying capacity at a faster rate than his competitors (on the other hand, loosing the race means the threat of being forced out of the activity). The resulting incentive to invest in larger boats is not curbed by the boat length limitation, which is easily bypassed by building wider boats.

1.3 The market

Investing in larger and more powerful boats raises costs (operating costs, depreciation costs, capital opportunity costs). The profitability of the firms may be sustained only if this phenomenon is balanced by an equivalent increase in revenue. As the increase in fleet capacity was not followed by any significant improvement in physical output (see fig.2 above), the evolution of revenue mainly relies on prices, which raises the question of the market for algae.

fig.3 Seaweed harvesting : indexes of output, price and turnover, 1985-96

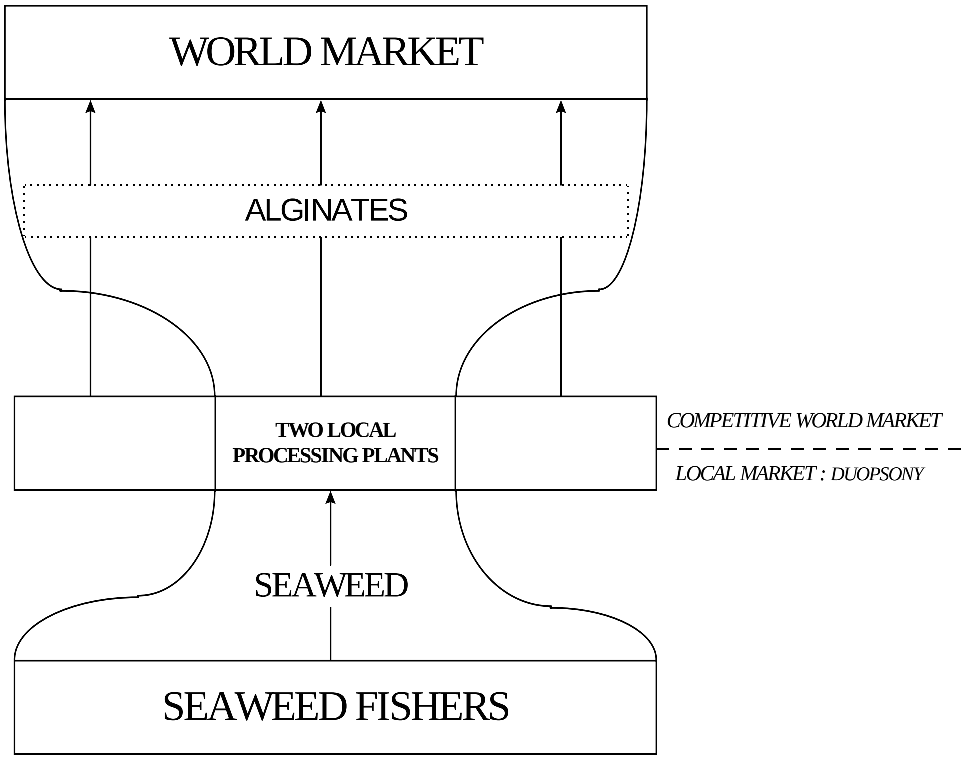


The above figure depicts a fairly stable real price over the period 1985-96 : expressed in constant francs, the price of algae fluctuated within a range of ± 7% around its 1985 level, and in 1996 it was 2% under its 1985 level. It also shows that price does not respond negatively to the variations of supply : on the contrary, between 1987 and 1992, both real price and landings were on an increasing trend. This feature suggests that the local supply, though representing 90% of the national supply, is small compared with the market.

Most of the seaweed *Laminaria Digitata* landed by Western Brittany seaweed harvesters are bought by two plants located in the area (quasi duopsony market). These plants, which belong to foreign companies, operate on the highly competitive international market of alginates, dominated by three main producers (the United States, China and Norway). The output of the two factories located in Western Brittany represents approximately 10% of the world output of alginates.

The characteristics of the market for Western Brittany seaweed, combining a locally concentrated demand for raw product and a competitive world market for processed output, may be represented on the following diagram :

Fig.4 : Seaweed market



Due to their marginal position on the world market of alginates, the processing plants operating in Western Brittany are mainly price takers on this market. In the same time, their duopsony position on the local market provides them with an important bargaining power towards seaweed harvesters, which the latter try to offset by negotiating collectively the price of seaweed with the plants at the beginning of each campaign.

Basically, it appears that the conditions prevailing on the international market of alginates are transmitted to local seaweed harvesters through the channel of the processing plants. In 1993 for instance, a world market glut induced local plants to reduce their purchases of seaweed, which resulted in a fall of output (see fig.3 above). Seaweed harvesters realised the adjustment by shortening the harvesting campaign.

In this situation, seaweed harvesters of Northern Brittany have little control over prices, which mainly depend on world market conditions. From 1985 to 1996, these conditions did not induce a positive trend for the real price of seaweed, and therefore real turnover usually did not behave better than landings (fig. 3 above). The market being of no help for matching the negative impact on profitability of the lowering of overall technical efficiency generated by the « race for seaweed », seaweed harvesters had to look for alternative strategies. The majority adopted a strategy of diversification, using their seaweed harvesting boat for dredging scallops and other shellfish in the winter.

2 - Interactions between seaweed and scallop fisheries

Most of seaweed fishers practise a secondary professional activity, during winter. Whereas the traditional winter job used to be agriculture, fishing has substituted to it for the twenty last years. The main winter activity for seaweed harvesters now consists in dredging scallops, queens and clams in the Bay of Brest, a sheltered area at a short distance from the seaweed fields of Western Brittany.

Table 8. Main winter activities of seaweed harvesters
(Seaweed harvesters registered between 1985 and 1997)

Main winter job	Percent
agriculture	9.40
aquaculture	0.67
Laminaria hyperborea harvesting	0.67
shellfish dredging (skipper)	53.69
shellfish dredging (crew)	8.72
seaman	7.38
working in harbour	0.67
retired	1.34
unspecified	17.45
TOTAL	100.00

Source : IFREMER

The participation of seaweed harvesters in the shellfish fishery of the Bay of Brest tripled during the decade 1985-95 :

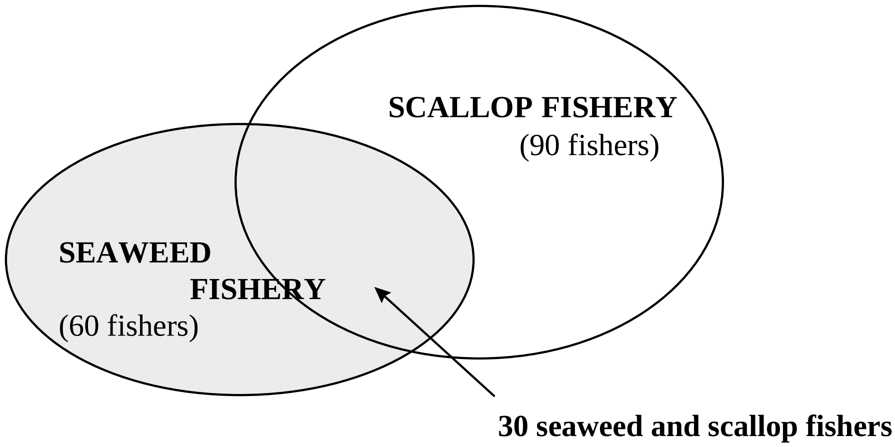
Table 9. Evolution of the number of seaweed fishers
operating the Bay of Brest scallop fishery during the winter season

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Seaweed fishers	11	13	24	25	27	32	33	32	31	36	37	33	33	31

Source : IFREMER

In relative terms, this participation rose from 11% of the total number of boats in the fishery in 1985 to 40% ten years later. The participation of seaweed harvesters in the scallop fishery of the Bay of Brest creates an economic interrelation between these two activities, which are biologically and technically independent :

Figure 5. Participation of seaweed harvesters in the Bay of Brest scallop fishery



After presenting the reasons for the diversification of seaweed harvesters in the dredging activity, we shall examine the type of interaction this diversification creates between the two fisheries.

2.1 Scallop dredging as a winter job for seaweed harvesters

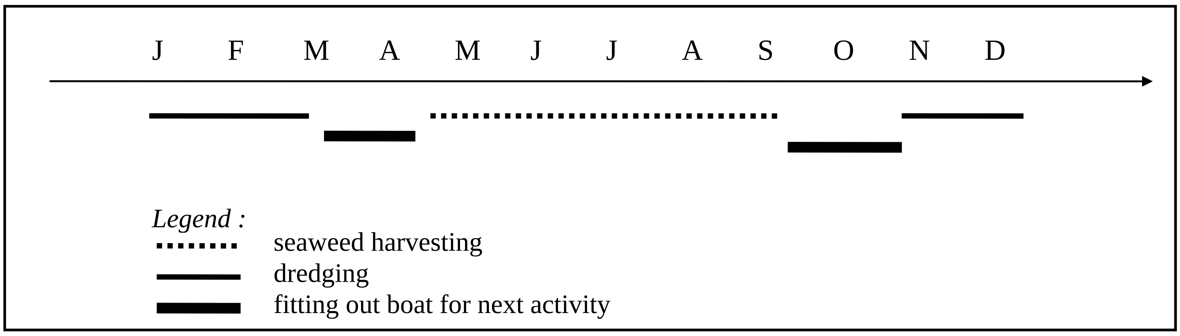
The first job of the 30 fishers practising both activities consists in harvesting the *Laminaria digitata*, while bivalve dredging is for them a secondary activity. This statement is supported by two facts : 1) seaweed harvesters started dredging shellfish in the Bay of Brest and became part of the scallop fleet during the 80', but no symmetric evolution was observed. 2) average turnover provided by seaweed sales is usually significantly higher than turnover from scallop fishing (the average ratio is said to be approximately 3 to 1 - Arzel, 1998 -).

The main reason for this type of diversification of seaweed harvesters may be summarised as follows :

1. It is technically possible to use the same vessel for both activities : since the 70', seaweed boats have been designed so as to offer the possibility of using them for dredging as well.

2. The time schedules of the two activities are complementary : while seaweed harvesting is a summer activity, scallop dredging takes place in the winter time (November to March). Fishers can take advantage of the months of April and October to fit out their boats for the next ongoing activity :

fig.6 Combining seaweed harvesting and scallop dredging time schedules



3. In the winter time, the Bay of Brest is a more secure place for small boat fishing than the rest of the coast of Western Brittany.

4. The markets for scallops and seaweed's are very different and uncorrelated, which may be regarded as a source of financial security. A large part of the scallops from the Bay of Brest are sold directly by fishers to the final consumers at a relatively high price (Boncoeur, Divard and Guyader, 1997).

5. After a collapse of the stock in the 60', the scallop fishery of the Bay of Brest almost disappeared at the end of the 70'. In the 80' it experienced a restocking program, combined with the setting up of a limited entry licence system (Boncoeur and Guyader, 1995). Entering the fishery was then regarded as a good opportunity for seaweed harvesters who operated not far from the bay, and who were seeking for new complementary activities in order to make their investment in seaweed boats profitable (see part 1 above).

It appears that the seaweed fleet dynamics, especially regarding investments trend, is the prime mover of interactions between algae and scallop fisheries.

2.2 Fleet and institutional interactions between seaweed and scallop fisheries

The entry of seaweed boats into the Bay of Brest scallop fishery is associated with changes in the characteristics of the fleet operating this fishery, as well as in its management system.

The cumulated HP of the fleet operating the shellfish fishery of the Bay of Brest rose by almost 80% between 1995 and 1986, and this evolution is parallel to the increase in the absolute and relative involvement of seaweed harvesting boats in the fishery (table 10).

Table 10. Bay of Brest dredging fleet : composition of the fleet and cumulated HP

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Number of seaweed boats / total fleet	11%	12%	14%	23%	24%	25%	29%	35%	37%	37%	40%	42%
Cumulated power (Kw)	3508	3715	3793	4545	4947	5568	5595	5776	5679	5648	6195	6260

Source : IFREMER

However, if during the 80', the average power of seaweed boats was higher than that of the rest of the fleet, the situation was opposite during the 90'. This change is due to the fact that, over the whole period, the increase in average HP was lower among seaweed harvesting boats operating the Bay fishery than among other boats operating the same fishery (table 11)[3].

Table 11. Bay of Brest dredging fleet : average power of boats (Kw)

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Whole fleet	35	40	40	43	47	52	51	62	66	66	69	71

[3] The reduction in the average power of seaweed boats operating the Bay fishery between 1986 and 1987 is the consequence of a shift in the regulation system of the fishery, which resulted in a withdrawal of the largest seaweed boats (see below).

Seaweed boats only	63	67	55	55	54	53	54	57	57	60	61	64

Source : IFREMER

The evolution depicted in the two above tables suggests that the strategy of diversification adopted by seaweed harvesters resulted in transferring to the Bay of Brest fishery the dynamics of investment they were involved in, both directly and through the reaction of the other fishermen operating the fishery : while the number of seaweed boats operating the Bay of Brest shellfish fishery did more than triple between 1985 and 1986, the number of non-seaweed boats dropped by 43% during the same period. As the least powerful ones were the first to be forced out, the consequence was a sharp rise in the average HP of the non-seaweed boats remaining in the fishery. This evolution was strengthened by the investment behaviour of fishers : the increasing flow of seaweed boats into the fishery induced other fishers to invest in more powerful boats, in order to be able to cope with these new competitors. Here again, as regards the overall efficiency of the fishery, the consequences of the whole process are questionable : the growth in output (total landings of shellfish, in tons) was only 30% between 1984-85 and 1995-96, and therefore could not match the growth of cumulated HP of the whole fleet, reaching 78% over the same period.

The regulation system of the Bay of Brest fishery was also affected by the arrival of seaweed boats.

Both seaweed and scallop fisheries of Western Brittany are located in French territorial waters (12 NM zone). Even if EU and national regulations apply, most of the management of these fisheries is realised at a local level by the so-called « inter-professional organisation of fisheries ». This organisation is based on local and regional committees of fisheries (topped by a national committee), usually composed of elected representatives of the fishing industry and fish trade. Fisheries committees are empowered to adopt regulations concerning fisheries management, which become compulsory through a decision of French Government administration[4].

Both fisheries investigated in this paper are within the geographical scope of the Northern Finistère Local Committee of Fisheries[5]. This committee, where seaweed harvesters and scallop dredgers are represented, has directly contributed to the evolution of the rules concerning the Bay of Brest fishery over the two last decades. The main features of this evolution are summed up in the table below.

Table 12. Major institutional shifts regarding the scallop fishery of the Bay of Brest

Fishing seasons	70'	80-84	84/85	85/86	86/87	87/88	88-90	90-93	93/94	94/95	98/99
Boat regulations											
– Licences (number)				110	110	110	110	90	90	90	90
– max. length (metres)										11	11
– max. GRT				10	10	10	10	10	10		
– max. HP (cv)				100	100	100				204	204
Dredge regulations											
– max. weight (kg)	65	125	125	125	125	125	125	125	125	125	170
– spread (meter)			1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8
– mesh size (mm)			60	60	60	72	72	72	85	85	92
– teeth number			18	18	18	18	18	18	18	18	18

[4] As a consequence of the 1992 reform of the inter-professional organisation of fisheries, the regulation power formerly held by local committees was transferred to regional committees (Guyader, 1996). In the case of purely local fisheries such as the ones studied in this paper, this institutional change was of little practical consequence.

[5] Since the 1992 reform, management decisions regarding the Western Brittany seaweed fishery and the Bay of Brest scallop fishery are formally taken by the Fisheries Committee of the Brittany Region, which has created special commissions dedicated to seaweed and shellfish fisheries management.

– teeth length			7	7	7	7	7	7	10	10	10
Catches regulations											
– min. commercial size					10,2	10,2	10,2	10,2	10,2	10,2	10,2

Source : CLPM Nord-Finistère

The introduction of a limited entry licence system in 1985 ended the open access regime in the Bay of Brest fishery. Together with the restocking program, it aimed at preparing the conditions for a recovery of the scallop fishery, in a context of very low stock. At first, the system was not a hard constraint, since the number of licences was fixed at a level slightly higher than the number of boats previously operating the fishery. It became tighter at the beginning of the 90', when the Local Fisheries Committee decided to take advantage of the decommissioning of some boats participating in the fishery to reduce the number of licences (a queuing up phenomenon for entering the fishery developed at this time).

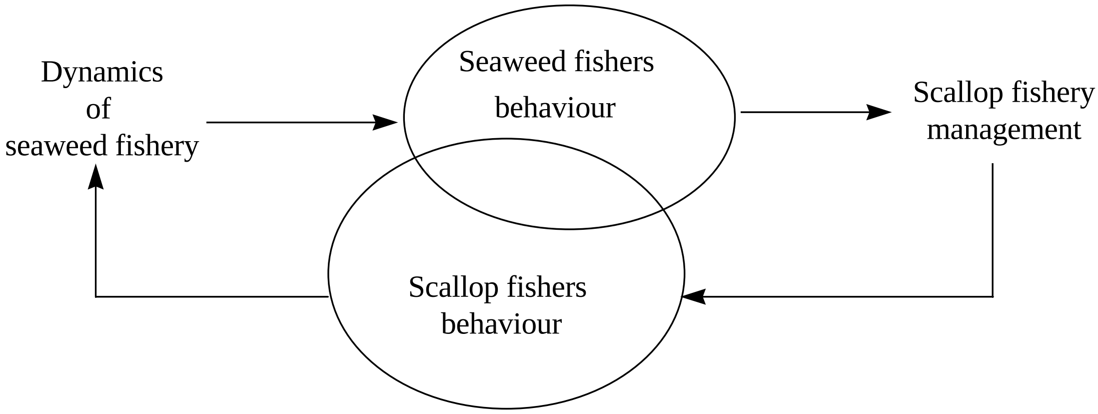
Together with the limitation of the number of boats operating the fishery, other measures were taken in order to control the fishing effort : limitation of the GRT and HP of boats, limitation of the number and technical characteristics of dredges (fishing effort is also controlled through a tight limitation of fishing time). Technical measures were also adopted in order to improve the selectivity of dredging (mesh size, commercial size of catches).

However, some peculiarities concerning the evolution of effort control regulations may be noticed :

- In 1994 the control of boat size, formerly based on GRT, shifted to boat length.
- The limitation of horsepower, initially set at a maximum of 100 CV per boat, was totally removed in 1988, and a new limitation was introduced in 1994, but at a much higher level than the initial one (204 CV).
- The maximum weight of dredges, set at 125 kg in the early 80', was increased up to 170 kg in 1998.

These peculiarities suggest that the regulation system is at least a partly endogenous component in the above depicted dynamics of the fishery : removal of GRT limitation, considerable loosening of HP limitation (and, subsequently, of dredge weight limitation) clearly are a consequence of the pressure exerted by fishers in search of opportunities for making profitable their new, larger and more powerful boats. As a consequence, the dynamics of the seaweed harvesting activity described in the first section of this paper should be regarded as a key to the understanding of the evolution of the management system of the Bay of Brest scallop fishery. In turn, this evolution creates a feedback effect, by helping seaweed harvesters to maintain their activity despite the adverse effect of overcapitalisation (this help might be but a temporary relief if the negative effects of overcapitalisation spreading to the scallop fishery become too important).

fig.7. Interaction between seaweed and scallop fisheries



Conclusion

Seaweed harvesting in Western Brittany and scallop dredging in the Bay of Brest are a case of economic interaction between two fisheries without any biological link. Examining separately the seaweed harvesting activity led to a classical diagnosis of over-investment dynamics, but, in order to understand the strategies of fishers confronted to the negative consequences of this dynamics, it was necessary to take into account the characteristics of a wholly different, but complementary fishery, the Bay of Brest scallop fishery. Conversely, the dynamics of this fishery, as regards the fleet operating it as well as its management system, cannot be wholly understood without reference to the problems met by seaweed harvesters and the diversification strategy they adopted to overcome them.

One may conclude that, even if stocks are wholly independent, a simple version of the subsidiarity principle leading to stock-based management does not necessarily apply. It is true that, in the case under survey, the economic interaction between the two fisheries does not raise any major institutional problem, because both fisheries happen to be under the scope of the same local institution. However, there is no reason to believe this case corresponds to a general rule, and this might be an additional complication in attempts to enforce the subsidiarity principle.

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