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A new proposed experiment on *Macrocystis pyrifera* ont the Brittany coast

by

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The weight of all the Laminariae species harvested on the Franch coast has not exceeded 5 000 tons for 1960.

Until 1970, the harvesting was practised by hand : a hard work for a very small income.

From 1960, mechanisation reduced human effort considerably and increased the efficiency but no the total harvest.

There are social reasons for this phenomenon :

The old fishermen are gradually retiring and the young ones are not interested in the job which lasts 6 months a year only.

So one can foresee, if nothing is done, that this part of our economic activity will slowly disappear.

Conscious of this evolution the Marine Algae interprofessional Board proposes some solutions. The most interesting of these would certainly be the introduction and cultivation of a fast-growing seaweed coming from the western shore of the Pacific Ocean : *Macrocystis pyrifera*.

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DIAGNOSIS OF THIS ALGAE

The giant kelp is a brown algae growing to 30 yards long. Its exceptional meristematic activity allows from 3 to 4 harvests a year.

Floats a the upper part of the fronds allow the algae to reach the surface providing an easy harvest even in a rough sea.

This algae lives for 8 to 10 years. A first frond gests life from a cramp, it will die after the 12th month to be replaced by a new one whose life lasts between 6 to 9 months. Then comes a third frond living as long as the 2 nd one and there comes a 4 th and so on.

So, the fronds live about 8 months where as the cramp which gives life to them lives from 8 to 10 years.

The cultivation of this algae is possible and comes to be quite economical owing to the longevity of the plant and the weight it reaches.

The introduction of this species on the French shore would allow an annual harvesting changing the seasonal seaweed activity into a real annual business. It would lead to a constant and abundant supplying of our factories allowing a low price of the alginic acid and a high competitivity of the French products in the world's markets.

THE EXPERIMENTAL WORK

After these constatations the Marine Algae Interprofessional Board wondered whether this introduction was possible on the coasts of Brittany.

A first experiment was realized in 1972 by the Applied Algology laboratory of the ISTPM. It showed that the kelp could live under the physico-chemical conditions of the French coast. Some adult individuals were obtained from spores coming from Chile. A group of representants of the interprofession has been commissioned to investigate into all the kinds of living near the Californian and Chilian coasts, where large populations of Macrocystis live. They had to state the possible consequences of the introduction of this species on the French coast.

A report was written to draw the conclusions on the advantages and disadvantages caused by the presence of this giant algae.

As previously said, the upper part of the plant comes to float on the surface. One can think that it could disturb the navigation. In fact, it is true for very small boats but, most of the time, the crossing of the Macrocystis beds can be done without any trouble except for the algae, the growing areas of which get crushed by the propellers leading to a damage of the population.

To hold the beds in good conditions, it's better not to sail across them at all.

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The algae develops on the surface a kind of vegetal canopy which forms a screen to the light. This phenomenon leads to an alteration of the ecological conditions of the seaweed living underneath ; the growth of which must be checked. Some species might even disappear. But, these troubles are nothing compared to the advantages brought by the cultivation. It seems to be evident that the lenth of the kelp, its meristematic power, and its longevity constitute the biological properties which allow the kelp to build some real underwater forests. Like earthly forest, Macrocystis beds are characterized by a very rich biomass constituted by a lot of species of fish crayfish and molluscs. A Macrocystis bed multiplies by 5 the rate of proteins.

The algae can be set for periods of 8 to 10 years on concrete blocks in a biologically very poor sandy or slimy bay to make the biomass increase swiftly.

One easily understands why the beds of giant kelp are so well protected and subsidized by angling clubs, as it is the case in California, or by the state itself as in Tasmania. In those countries, it now seems quite natural that the Public Affairs (Universities, Department of fish and game) and the private organisms (Kelco Company and Angling clubs) should be collaborating to maintain and improve the actual beds. Some new ones are even created.

Whould the algae bring these advantages on the French coast ? No one can tellitsolong as an experiment has not been carried out.

This introduction must not be an irreversible one. It must be strictly controlled so that we can spread the beds or root them up it the wished advantages are not obtained.

At the end of the very profitable proceedings that enabled the National as well as the International Authoritees to give their opinion, it appeared that such an experiment couldn't be carried out if a reproduction process started.

So, we now propose a new experiment without spore emission.

The most interesting problem is to know whether, in France, Macrocystis would live with the autochtonal Laminariae or if it would exclude them.

We can't refer to what happened in other countries :

- in California the Laminaria stop the kelp habitat improvement ;
- in Southern Canada Macrocystis superseded them ;
- else-where, it depends on the conditions of the sea, the kelp beds get either a californian structure of a canadian one.

The fundemental element in this competition is constituted by the vegetal canopy we have already talked about. We must know whif the quantity of light got by the seaweeds at the bottom is high enough to allow them to grow normally.

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So first of all, it seems necessary to create this canopy from Macrocystis heads sterilized by suppressing their reproductive system.

Sterilization of the kelp

The reproduction is carried out from fronds situated near the cramp. Those fronds are called sporophylls and bear some dark sports when they are about to get ripe. Those spots are first isolated, then they come to join. They are called sories.

Under a microscope examination, those sories appear to be constituted by many little bags or sporocysts, containing the spores which are 3 u or 4 u large. Those spores are freed in sea-water with two flagellas.

These sporophylls are noticeable :

- by their position just above the cramp at the 2 nd or 3 rd lever (the former is characterized by the presence of the secondary frond) ;

- by their arrangement like a bunch of flowers ;

- by the absence of float at their basis.

So, it is easy to notice them and cut them off a long time before their maturity. If the cutting is done low enough near the basis, their is no possibility of regeneration ; the frond becomes sterile but the plant goes on growing.

The fronds which follow after will not produce new sporophylls before 4 to 6 months ; the same work will then be necessary.

In practice, it is enough to examine each head every month to be sure to stop the spread of any sporophylls.

Fixing of the heads

The experiment can be undertaken in the middle of a bed of laminariae with 60 to 70 heads of Macrocystis, each head being disposed on a 40 kg concrete stone (50 cm x 35 cm x 15 cm) disposed 3 m away from on another. This is the normal disposition of a natural bed of the giant kelp.

It is necessary :

- that the seaweed should stay on a heavy stone so that it can't be washed away in case of rough sea ;

- that the basic part of the head could be drawn up to the surface where the sporophylls will easily be cut off.

To have these two conditions realized, the following process can be used:

- a concrete block A (50 x 35 x 15 cm) ;
- a second concrete block B (20 x 12 x 3 cm). This stone will be supplied with a 10 mm polypropylène rope handle.

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Between the two blocks, a plastic net (0,5 cm mash) measuring 38 x 28 cm will be fixed. It will be held under the smallest block by pegs and copper screws. Under this net, a rhodoïd sheet (same size) will be set.

A small rope (0,3 cm) holding a single young head of 8 cm long will be set against the B block by fastening it to the net's mesh. It will grow and hook itself on the little block to be able, then, to hook itself on the net. It will not succeed in cramping on the A block on account of the rhodoïd sheet set between the A block and the net.

The B block will be tied up to the A one with a 12 mm rope passing through a groove managed on each side of the A block.

To eliminate the sporophylls, we shall juste have to untie the last rope and draw up the B block bearing the kelp to the surface.

How to obtain the heads

The experimental transplantation must not introduce any other species at all. So, the kelp heads will be obtained from axenic cultivation in the laboratory at Nantes.

The spores will be freed from fertile leaves coming from California. They will spring up in a 15 cm large glass box filled with a nutritive media (ASP 8).

The bottom of each box will be fitted with a little 3 mm nylon rope. This rope will be wound on a spiral. The cultivation will continue until we get sure that nothing else but Macrocystis is growing ; fungicides and antibiotics will be used.

When the heads clearly appears (1 mm long), the Petri box will be set down in a running sea-water aquarium and laid there until they are 8 cm long, when they come to be strongly fastened to the rope.

This rope will be unwound and cut into pieces (30 cm bng). Only one head will be kept on each piece that will be set in the open sea against the B block.

The drift problem

When drifting, the kelp goes on with its growing. It can produce secundary leaves liable to give birth to sporophylls that will free spores.

To put a check on this, each head must be fastened to the bottom with a 8 mm rope and a small meshed net set around it.

Moreover, the experiment will be conducted in a bay that will be barred against floatsam with a 30 cm meshed net capable of preventing the large kelp heads from passing through, while the floatsams from the other seaweeds will pass freely.

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Experiment chronology

The experiment must be conducted in the following order.

1 - Choice of the bay

The creek that will be chosen must be characterized by the following conditions :

- protected even at low tide or high tide
- from 5 to 8 meters deep
- planted with a good population of laminariae species
- easy to close in with the net.

2 - Initial conditions of the bay

A very accurate study on the autochtonal seaweeds will have to be done, to determine the ecology of the creek before the transplantation. Efforts will have to be done especially on the study of the density of the laminariae population and of their growth. 4 months will be necessary for this.

3 - Blocks

When the place of experiment will be chosen and studied, the blocks of concrete will be dropped every 3 meters in a 30 m-sided square.

4 - cultivation in the laboratory

The cultivation will be done as previously said and the heads will be set one by one on each stone.

5 - The heads of kelp will be inspected every month to maintain them sterile.

6°) Observation of the effect of the kelp population periodically.

The density and growth of the laminariae and kelp population will be checked. The behaviour of the predators and competitive species will be observed too.

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The first step will last 4 months and the growth of the kelp 2 years. The last step of the experiment must last from 16 to 18 months.

This experiment is then proposed to last from 44 to 48 months. 4 scientists will work on it ; all of them must be able to skin-dive.

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Conclusion

Realized as explained here, the experiment offers no risk at all but if the necessary means are no granted.

There is not any possibility that the population of kelp should spread out of its limits as the heads will be sterilized by cutting off the fertile leaves a long time before they come to be able to produce spores.

The experiment would permit :

- to check if Macrocystis pyrifera behaves in France in the same way as it does in California (growth, number of sporophylls, number of secundary leaves...),
- to conclude if it would be possible to grow a permanent population,
- to check if the canopy eliminates the laminariae species or not,
- to observe the behaviour of the other vegetal and animal species,
- to make the waterside populations know this algae,
- to make the necessary analysis to determine the quality of the alginic acid contained in the heads of Macrocystis.