Use of sodium chloride as a means of eradication of Caulerpa Taxifolia

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ABSTRACT

The effects of sodium chloride on *Caulerpa Taxifolia* have been researched in laboratory. Doses of 120 g/l of sea-water led to 100 % destruction of all the samples after fives minutes' contact time and prevented the seaweed from regrowing after a two month time lapse. Destruction tests in situ on small surfaces (from 1 to 10 m²) have shown :

- hand spreading of doses of 20 kg/m² completely destroys the *Caulerpa Taxifolia* cover in the treated area ;
- the areas treated between August 1995 and July 1996 have not been recolonised by Caulerpa Taxifolia but by a native seaweed population after the sedimentary layer had disappeared ;
- the Posidonia areas which were treated with sodium chloride did not deteriorate

Under the same conditions, the treatment of a 500 m² area did not produce the expected results. For extensive areas, the technique has still to be perfected.

Since the appearance of *Caulerpa Taxifolia* on the French Mediterranean costs (Meinesz & Hesse, 1991) its location has been the target of numerous studies, showing its growing speed (Boudouresque & al., 1992 ; Meinesz & al, 1993) and its spreading capabilities (Meinesz, 1992).

Caulerpa Taxifolia is a monocellular algae whose growth is spectacular. Its leaves can be as long as 80 centimeters. In the Mediterranean sea, *Caulerpa Taxifolia* can grow in dense meadows (14 000 leaves/sq.m).

So far, its expansion on the European costs of the Mediterranean Sea has reached about 5 000 hectares (about 12 500 acres) after 10 years of recognition of the algae (Meinesz & Hesse, 1991). Its exuberant growth and the potential risk generated by the settling of *Caulerpa Taxifolia* in *Posidonia Oceanica* meadows have directed part of the research on eradication techniques or development limitation (Augier & al.,1992 ; Brun, 1994 ; Escoubet & Brun, 1994 ; Uchimura & al., 1994). These methods and techniques have to satisfy some criteria : efficiency, easy and quick interventions without any danger for operators, low cost and, of course, full safety for surrounding flora and fauna as well as marine environment.

Within the framework of these researches, Salins Group have demonstrated the effects of sea salt on the development of *Caulerpa Taxifolia* algae in lab experiments as well as in natural environment.

1. IN LABORATORY

1.1. Tests

The samples of *Caulerpa Taxifolia* come from Roquebrune-Cap Martin. There were collected by diving and kept in natural sea water (22°c ; pH : 7.9 ; salinity 39 g/l) in closed circuit tanks.

Field of salinities : these salinities have been realized from sea salt and natural sea water.

For temporary contacts : salinity of 75, 80, 90, 100, 110, 120, 150, 200, 250 g/l, with a contact on the sample from 1 to 20 minutes according to the dose. The samples have been rinsed in three successive deeping natural sea water baths during 5 minutes.

Conservation of samples and witnesses in 100 and 300 cc transparent tanks, in natural light, at room temperature (18° and 24° c), without filtration, after temporary exposure to sea salt solution, without changing the water.

Each test has been carried out on 1 to 3 series of 10 samples each.

1.2. Results

A 120 g/l dose of sea water reduces to 100 % all samples for a contact period of 5 minutes. No regrowth after 2 months.

The Caulerpa samples show either a sort of adaptation to their new condition of culture after fragmentation and immersion in the different brine solutions or a development of necrosis (110/1 = 110 g of salt per litre for a contact period of 1 minute).

2. ON SITE

2.1. In Cap Martin

The tests (13) were carried out between May 14th and October 17th 1996. The follow-ups of these tests were done between August 3rd 1995 and June 12th 1997.

The purpose of this work was to study more accurately the speed of eradication, the persistance of this action and the search for side effects on other organisms found on the site.

The results of the experiment are the following :

- Dissolution of salt crystals (size 4/8) after spreading is completed within 15 to 20 minutes. The salt content in the area comes back to normal (38/39 g/l) about 15 minutes after the beginning of the test. The maximum salt ratio is of 104 g/l. 5 minutes after spreading on the site itself and 58 to 59 g/l at a depth of 1 m under the current.

- On all the treated areas (20 to 25 kg/m²) one can see, after one month, the absolute disappearance of Caulerpa as well as no re-growth of the algae. The limits of the treated area strictly follow the salt deposit.

- The action and direction of natural currents expand the eradicated area (excepted for diving operation of 06.02.1996).

- The disappearance of Caulerpa also induces that the soft substratum film caught in Caulerpa's stolons either by de-earthing up to rock basis or by digging the treated area.

- From February 6th 1996, one could observe on area n° 1 (treated on August 3rd 1995) a new colonization of the rock as well as the appearance of coloured spots. On April 18th 1996, one could observe an important algae stratum (carpet-live) while no Caulerpa had grown back yet.

On June 11th 1996, stratum is fully covered *by Acetabularia Acetabulum, Padina Pavonica* and *Liagora Viscida*. One can also observe the penetrating of some Caulerpa stolons in the soil of the area.

On June 12th 1997 (one year later) the re-colonization of the area by Caulerpa is important (72 to 75 %).

- The above results can be observed on all the others areas, taking into consideration gaps due to eradication delays.

- Two tests have been carried out on mixed meadow (Posidonia/Caulerpa). Six months later only Posidonia remained on the area. We could note the presence of a *Symphodus Occelatus* nests, constructed without Caulerpa.

- Due to the natural cleaning up of superficial sediment layer, the effects of salt on bentic meïofauna cannot be studied. However, it can be noted that during each salt spreading, the fishes living in the area (mostly labridae and sparidae) were coming to the edge of the oversalted water which was clearly visible because of the difference of specific gravity. We believe that the fishes were trying to feed microfauna moved from the sediment by salt.

2.2. St Cyprien

Following the positive results observed in Roquebrune-Cap Martin on areas between 1 to 10 sq. meters, a test was carried out in the harbour of St Cyprien (angle of wharf K) on a 450 to 500 sq. m area.

Ten (10) tons of salt (dry sea salt, 4/8 size in 20 kg bags) were spread by 3 divers in one hour, after immersion of the bags by a surface team.

Ten weeks later, two areas (89 sq. m and 11 sq. m) were observed without any Caulerpa (Meinesz and al.)

Total dissolution of the salt took longer than in the open sea (1 hour versus 15 to 20 minutes) and

the absence of any current in the port area has not encouraged salt dispersion on the whole area.

It seems that for more efficiency, the spreading of the salt (either in open sea or in confined area) should be done in smaller areas of 40 to 50 sq. m. Such areas could be treated by two people only.

Some more tests are currently being carried out by Gis Posidonia, in the frame of Life program).

3. CONCLUSION

The above experiments have shown that :
Total eradication of *Caulerpa Taxifolia* on a flat or slightly inclined area is possible whatever the period or substratum of the place.

- Caulerpa does not come back on treated areas during the following year.
- Better yield is achieved with short foliage and without a strong current.
- Neighbouring species are not affected by salt treatment.
- Re-starting and blooming of local species of algae are normal.
- The method is quick and easy to implement.

Sodium Chloride has all the required qualities and characteristics to eliminate *Caulerpa Taxifolia* or to stop its development. Moreover, salt, as a natural algae inhibitor, has no toxic effect on the surrounding fauna and flora of the treated area.

To our knowledge today, it seems possible to eradicate *Caulerpa Taxifolia* on large areas with the use of divers spreading 20 to 25 kg/sq. m provided the areas are divided and treated one at a time.

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Salt and the environment

Salt works as eco-systems

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