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Standard Procedure for the study of *Posidonia oceanica* Leaf Litter

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/hile leaf litter is recognized as one of the key compartments in the dynamics of terrestrial ecosystems)LSON, 1963; KARKANIS, 1975), for the Posidonia oceanica bed it has only been studied sporadically /ITTMANN *et al.*, 1981; FRANCOUR, 1990).

.s part of a general survey of the functioning of the Posidonia oceanica ecosystem ("A functional pproach to the *Posidonia oceanica* ecosystem of the Mediterranean"), a standard procedure has been 'orked out for determining the structure, chemical composition and fragmentation and degradation ıechanisms of *Posidonia* leaf litter.

ampling is carried out by scuba diving, using a suction device. A quadrat 35 cm square is set up in a omogeneous area that is representative of the Posidonia bed under investigation. Within this quadrat, the ving leaves are cut off at a height of 3 to 5 cm from the base and removed, and the shoots are counted. he leaf litter is collected in bags (1 mm mesh). Sampling is repeated three times for each station. The mples are transported from the sampling site to the laboratory in damp medium.

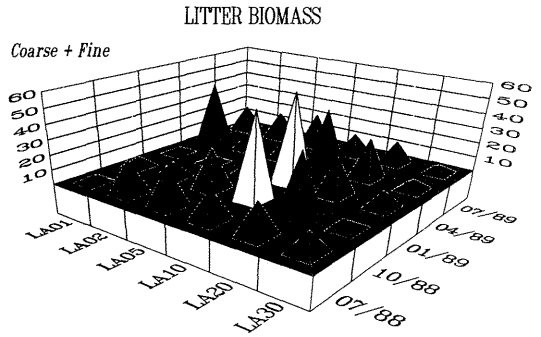
ı each sample, non-litter elements (eg. living leaves, shell debris, algae, animals etc) are removed by nd. Dead rhizomes, with or without scales, and whole scales are separated from the litter, and constitute e RHIZOME FRACTION. Sorting by gravity is carried out to separate the litter from the sediment, which is scarded. Two sieves of different mesh size are used to sort the litter into a COARSE FRACTION (leaves nger than 8 mm) and a FINE FRACTION (leaf debris of between 1 mm and 8 mm).

he three fractions obtained for each sample are placed in the dryer at a temperature of 70°C, until a nstant weight is obtained (usually 48 hours). After drying, the samples are weighed on precision scales mg).

eaf fragmentation experiments are carried out in situ. Aged adult leaves, that are still in place in the oots, are collected and brought back to the laboratory. They are weighed (sub-samples of 30 +/- 0.5 g) d placed in bags (1 mm mesh) sealed with strips of Velcro. The bags are returned to the environment neath the leaf cover in series of three. The series of bags are collected after a predetermined period of ne (1, 2, 3, 4, 8, 12, 16 and 24 weeks). The samples collected are separated into three size classes : aves with a length of > 5 cm (LARGE LEAVES) ; leaves with a length of between 5 cm and 8 mm (BROKEN EAVES), and leaf debris of between 8 mm and 1 mm (DEBRIS). Each fraction is dried in the dryer at 70°C onstant weight), then weighed.

he totality of the samples is powdered (pulveriser) and sieved (0.63 um mesh). The CHN content (Micro HN Determinator, CHN 800), the percentage of ash (Thermolyne Sybron type 2000, 8 hours at 550°C) d the Phosphorus content (Induction Coupling Plasma, after acid digestion according to DELGADO, 986) are measured for each fraction.

ur preliminary results (ROMERO *et al.*, sous-presse) would appear to suggest that the distribution tterns of leaf litter are subject to considerable variation according to the depth, time and site of mpling. At Ischia (Italy), leaf litter maxima (coarse fraction + fine fraction) are found at intermediate pths (Figure 1).



gure I : Mean litter biomass (in mg dry weight per quadrat) at Ischia (Italy), at various depths according to sampling date.

n investigation of degradation in situ, at -5 m and -20 m, has shown that depth does not appear to have y influence on the rate of degradation. On the other hand, the rate of degradation does depend on the ne of year of the investigation (higher degradation rate in July). The curve of decline is of the ponential type :

$y = \exp^{(-0.0066 x + 1.63)}$: - 5 m - October 1988 experiment.
$y = \exp^{(-0.0087 x + 1.78)}$: - 20 m - July 1988 experiment.

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The Regression of *Posidonia oceanica* Meadows in El Campello (Spain)

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ABSTRACT

The regression of *Posidonia oceanica* meadows has been studied along a 7 km coastal sector on the El Campello littoral. Changes of shallow *Posidonia* beds in the last 30 years are described. Deep *Posidonia* meadow is badly damaged due to illegal trawling. The first symptoms of trawling are detected at 13 m depth. But the deeper we go, the more degraded the meadow gets, reaching densities under 1 sh/m^2. Dead *Posidonia* is seen even suggest at 29 m depth. In order to protect the deep meadow, we suggest as a feasible solution the installation of artificial reefs.

INTRODUCTION

Posidonia oceanica meadow regression has been studied by a great number of scientists (see PERES, 1984). Studies on the effects of illegal trawling in *Posidonia* beds have been carried out in the Tyrrhenian Sea (ARDIZZONE & MIGLIUOLO, 1982; ARDIZZONE & PELUSI, 1983, 1984).

If we concentrate on Spain's situation, we can state that trawling has been forbidden since 1962 at less than 50 m for the whole year (*Orden de 7 de julio de 1962, Reglamento de la pesca de arrastre a remolque. B.O.E. N° 16*). In summer trawling is even forbidden at less than 130m depth (*Orden de 30 de julio de 1975 sobre pesca de arrastre en el Mediterraneo. B.O.E. N° 193*). However, trawling ships often work on *P. oceanica* meadow at less depth.

MATERIAL AND WORKING METHODOLOGY

This piece of research was conducted on a 7 km coastal sector at El Campello (Alicante, SE of Spain). In order to complete this study we carried out nine perpendicular transects to the coastline from the upper level of the *P. oceanica* meadows to a depth of 29m and, in addition, several precise dives. The obtained points were positioned by means of a sextant and enfilades to the coast (RAMOS, 1984). The reconstruction of the *Posidonia*'s upper level was made with the aid of aerial photographs taken in the years 1956, 1978 and 1987.

RESULTS

Two little breakwaters have been built in the area of research, between 1956 and 1987. If we compare the aerial photographs, we can clearly see that shallow *Posidonia* meadows have moved back. The greatest regression appears in the north of Cala Baeza and La Coveta, between 1978 and 1987. At the same period the little port of Cala Baeza was filled up, and now boats cannot tie up in this port.

Deep *Posidonia oceanica* meadow is destroyed due to illegal otter trawling. The depth at which the first trawling symptoms appear increases gradually from north to south. In the northern part of the studied area, which is off Carritxal beach, the first degradation symptoms were observed at 13 m depth; in the intermediate sector, at Cala Baeza, they appear at either 15 or 16 m; finally, in the southern part, Barranc d'Aigues-Morro Blanc, at 17 m depth. At this depth 0.5 m wide channels parallel to the coast line are detected as well as pulled up rhizomes on account of the mechanical effect of trawl boards.

As we go deeper, channels become more frequent and wider; there seem to be more pulled up rhizomes and the proportion of dead matte increases. *Posidonia* meadow density decreases quickly until it reaches values under 1 sh/m^2. From 22 m depth, the sea bottom presents a desolating sight; there are very few *Posidonia* spots and a great mass of dead matte frequently covered with light layers of sediments. *Posidonia oceanica* remains have been detected at 25 m depth at Carritxal and even at 29 m depth between Barranc d'Aigues and Morro Blanc.

CONCLUSIONS

Regression in a shallow *Posidonia oceanica* meadow due to coastal line modifications is seen. More serious seems to be the regression due to illegal trawling.

It is believed that along 7 km of coast, 290 Has of *Posidonia* meadow have been destroyed due to otter trawling. Unfortunately all the province of Alicante seems to be threatened by the same devastating problem.

Moreover several unpublished issues point out that the *Posidonia* meadow at Tabarca's island, La Vila Joiosa and El Campello is largely altered or destroyed at a depth which may fluctuate between 13 and 24 m. Likewise, according to some fishermen, the same thing is happening at other ports in the province of Alicante.

Vigilance committees have clearly proved to be inadequate and insufficient in the battle against illegal trawling and its ravaging effect on *Posidonia oceanica*. In our view, the only feasible solution to this problem is to install artificial antitrawling reefs, like those installed in Tabarca's Marine Reserve (Ramos *et al.*, in press).

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