

R. LASAGNA, M. MONTEFALCONE, C.N. BIANCHI, C. MORRI, G. ALBERTELLI

Dip.Te.Ris., Dipartimento per lo studio del Territorio e delle sue Risorse
Università di Genova, Corso Europa, 26-16132 Genova, Italy

MORPHOLOGY OF A *POSIDONIA OCEANICA* MEADOW UNDER ALTERED SEDIMENTARY BUDGET

Abstract

The construction of a small jetty in Prelo cove (Ligurian Sea, NW Mediterranean) involved cutting in the *Posidonia oceanica* (L.) Delile (Monocotyledonae, Posidoniaceae) matte terrace, modifying the rip current path and altering the sedimentary budget of the cove. The aim of this study was to investigate how the sedimentary regime influenced the meadow morphology. Distribution, cover and other morphological features of the meadow were described. *P. oceanica* was patchy distributed between 0.5 and 15 m depth, covering a total area of about 4.8 ha. Three classes of living *P. oceanica* cover were distinguished: high cover (> 65%), low cover (65% to 15%) and single shoots (< 15%). Non vegetated areas fell into four types: dead matte, sandy channels, sandy patches and beyond the lower limit of the meadow. Regressive sharp limit was present in the central area of the meadow and regressive shaded limit at the extremities.

Key-words: *Posidonia oceanica*, sediment, meadow morphology, Ligurian Sea.

Introduction

The general decline that *Posidonia oceanica* meadows are undergoing has been attributed to two main causes linked to human impacts: coastal constructions and increased turbidity (Ruiz and Romero, 2003). The former affects the currents (Meinesz *et al.*, 1991) and influences the sedimentary budget (Albertelli *et al.*, 1996; Góngora-González *et al.*, 1996; Cavazza *et al.*, 2000); the latter, decreasing light penetration, may cause regression of the deep limit or, at higher rate, even stifle the plants (Góngora-González *et al.*, 1996). Concomitant causes may be ascribed to the presence of sewage discharges or to trawling activities (Pèrès and Picard, 1975), as well as to climate fluctuations (Peirano and Bianchi, 1997; Peirano *et al.*, 2005). In order to protect the *P. oceanica* meadows, they were listed as a priority habitat on Annex I of the EC Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna (EEC, 1992).

A general regression trend, due to various human activities, has been observed as a common feature of all Ligurian meadows (Peirano *et al.*, 2005). Peirano and Bianchi (1997) focused on the deficiency and discontinuity of quantitative data on the present status of the Ligurian *P. oceanica* meadows.

In the first decades of the XIX century the construction of a small jetty at Prelo cove, in the Eastern Ligurian Riviera, required the cut of the *P. oceanica* fringing reef. This cut, causing modifications in both coastal and meadow morphologies, might have involved the reinforcement of the rip current and have altered the sedimentary budget (Lasagna, 2004). The aim of this work was to describe the present day morphology of the *P. oceanica* meadow after the fringing reef cut and the supposed alteration in sedimentary budget.

Materials and methods

Prelo is a small cove (about 8 ha) of the Ligurian coast sited between Rapallo and Santa Margherita Ligure, in proximity of Portofino Marine Protected Area (Ligurian Sea, NW Mediterranean). The cove is sheltered by winds and by waves (Danovaro *et al.*, 1994) and is characterized by a rocky coast, as typical in Eastern Liguria, and by a small beach. At the beginning of the XIX century, this cove underwent different anthropogenic impacts such as the construction of a jetty, used by pleasure craft, and of a small promenade.

Direct observations by scuba diving were conducted between September 2003 and April 2004. A total of 11 underwater transects were described, each about 300 m long. These transects were stretched perpendicularly to the coast from the upper limit of the meadow to the living *Posidonia oceanica* lower limit and, when present, as far as the end of dead matte areas. During each dive the following data of the *P. oceanica* meadow were recorded on a PVC slate, every 10 m: depth, features of the meadow, percentage cover by living *P. oceanica*, presence of intermatte channels, dead matte areas, and sandy patches. As recommended by Buia *et al.* (2004), the percentage cover by living *P. oceanica* and by dead matte was estimated by eye by two divers independently at about 1 m upon the bottom. Three classes of living *P. oceanica* cover were distinguished: high cover (> 65 %), low cover (65 % to 15 %) and single shoots (< 15 %). Lower limit morphologies were described according to Montefalcone *et al.* (2006a). Shoot density was measured using a quadrat (40 x 40 cm) in three replicated counts at selected sites (in correspondence of upper limit, lower limit and in an intermediate zone) along each transect. Shoot density values were classified according to Giraud (1977) and Pergent *et al.* (1995).

Data recorded during field activities were elaborated in profiles and in a thematic map of meadow morphology.

Results

Posidonia oceanica meadow, ranging from 0.5 m to 15 m depth, extended on a total surface of nearly 4.8 ha, which was about 60 % of the total surface of the sea bottom of Prelo cove. *P. oceanica* developed on rock at the extremities of the cove, while either on sand or on matte within the cove.

A homogeneous and high *P. oceanica* cover (about 80-90 %) characterized the shallow portion of the meadow (1 m to 6 m), with average density value indicating a dense meadow according to Giraud (1977) and a lower sub-normal density according to Pergent *et al.* (1995). At the sides of the jetty a residual fringing reef was observed; on the contrary, in front of the jetty an intermatte erosional channel crossed the meadow to end in a large central sandy patch.

A heterogeneous cover, between 15 % and 80 % (from low to high cover), characterized the intermediate portion of the meadow (6 m to 11 m) and its continuity was also interrupted by dead matte areas, caused by pleasure boats anchoring (Montefalcone *et al.*, 2006b), and by small sandy patches. Moreover, the average density value indicated a dense meadow according to Giraud (1977) and lower sub-normal density according to Pergent *et al.* (1995).

The lower limit of the meadow reached the maximum depth of 15 m. Regressive shaded limits were found in the northern and the southern extremities of the cove (Fig. 1A); these limits showed a living *P. oceanica* cover gradually decreasing

with depth, from 65 % to 0 %, and dead matte areas beyond the lower limit itself. In the northern extremity the dead matte area showed an extension of about 100 m, in the southern extremity of about 20 m. In correspondence of these limits the average density value indicated a sparse meadow (Giraud, 1977) and lower sub-normal density according to Pergent *et al.* (1995). Regressive sharp limit was found in the central area of the cove (Fig. 1B); this limit showed a living *P. oceanica* cover passing abruptly from 80 % to 0 % with depth, and ending with dead matte areas having an extension of about 40 m. In correspondence of this limit the average density value indicated a sparse meadow (Giraud, 1977) and normal density according to Pergent *et al.* (1995). Between the regressive shaded limits and the regressive sharp limit we described regressive sharp limits with patches, which passed abruptly from a *P. oceanica* cover of about 50 % to zero, and showing isolated patches of living *P. oceanica* and dead matte areas beyond the lower limit of the meadow (Fig. 1C). In correspondence of this limit the average density value indicated a very sparse meadow (Giraud, 1977) and lower sub-normal density according to Pergent *et al.* (1995).

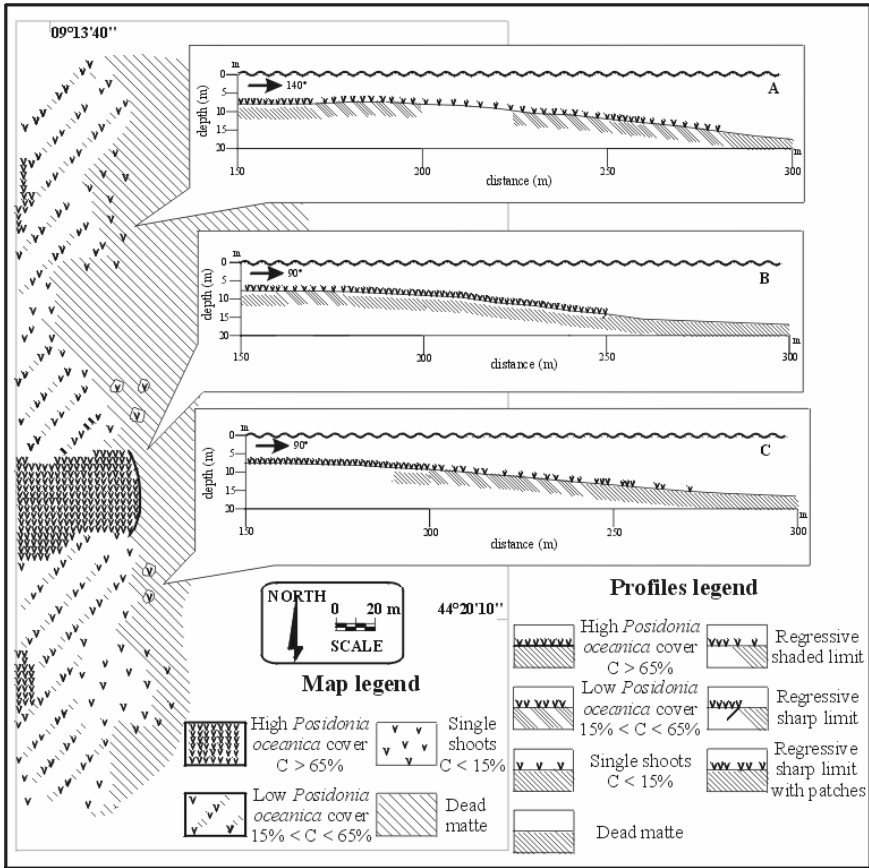


Fig. 1 - A detail of the *Posidonia oceanica* meadow map with the profiles showing different morphologies of lower limits: A = regressive shaded limit, B = regressive sharp limit, C = regressive sharp limit with patches.

Conclusions

A general resemblance between the present distribution of *Posidonia oceanica* and that reported 10 years ago by Bianchi and Peirano (1995) was observed. Some differences can be easily explained by differences in scale and mapping method. Lack of older data prevents any definite conclusion about the importance and magnitude of the presumed alteration in the sedimentary budget. Sediment data by Lasagna (2004) and the present observations on morphology, however, provide suggestive evidence that such an alteration has been dramatic. The occurrence of erosional patterns at shallow depths (i.e. sandy patches and intermatte channel) was spatially related to the presence of the small jetty. The enlarged path of the rip current moved and settled fine sediment in correspondence of the lower limits, causing their extensive regression (as showed by the occurrence of buried dead matte areas and low density values). Lower limit regression was more evident in the northern area because of greater erosion of the matte along the path of the rip current.

On the whole, the present-day *P. oceanica* meadow showed a mediocre state of health with alternation of high and low cover. The meadow resulted sparse according to Giraud (1977) and disturbed (with lower sub-normal densities) according to Pergent *et al.* (1995).

References

- ALBERTELLI G., COVAZZI-HARRIAGUE A., DOIDGE-HARRISON S. (1996) - A preliminary study of a soft-bottom community in Prelo cove (Ligurian Sea, Italy): a comparison with a sandy-bottom community. *In: Albertelli G., De Maio A., Piccazzo M. (eds), Atti AIOL*, **11**: 353-362.
- BIANCHI C.N., PEIRANO A. (1995) - *Atlante delle fanerogame marine della Liguria: Posidonia oceanica e Cymodocea nodosa*. ENEA, Centro Ricerche Ambiente Marino, La Spezia: 146 pp.
- BUIA M.C., GAMBI M.C., DAPPIANO M. (2004) - Seagrass systems. *In: Gambi M.C., Dappiano M. (eds), Mediterranean marine benthos: a manual of methods for its sampling and study. Biol. Mar. Medit.*, **11** (suppl.1): 133-183.
- CAVAZZA W., IMMORDINO F., MORETTI L., PEIRANO A., PIRONI A., RUGGIERO F. (2000) - Sedimentological parameters and seagrasses distributions as indicators of anthropogenic coastal degradation at Monterosso Bay (Ligurian Sea, NW Italy). *J. Coastal Res.*, **16** (2): 295-305.
- DANOVARO R., FABIANO M., BOYER M. (1994) - Seasonal changes of benthic bacteria in a seagrass bed (*Posidonia oceanica*) of the Ligurian Sea in relation to origin, composition and fate of the sediment organic matter. *Mar. Biol.*, **119**: 489-500.
- EEC (1992) - Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora. *Official Journal of the European Communities*, No L 206, 22 July 1992.
- GIRAUD G. (1977) - Essai de classement des herbiers de *Posidonia oceanica* (Linné) Delile. *Bot. Mar.*, **20** (8): 487-491.
- GÓNGORA-GONZÁLEZ E., IMMORDINO F., PEIRANO A., STOPPELLI N. (1996) - Granulometric and geomorphologic features of the Bay of Monterosso al Mare (Ligurian Sea) and their relationship with the evolution of *Posidonia oceanica* meadow. *In: Albertelli G., De Maio A., Piccazzo M. (eds), Atti AIOL*, **11**: 395-404.
- LASAGNA R. (2004) - *Cartografia mediante tecniche di rilevamento subacqueo della prateria di Posidonia oceanica (L.) Delile 1813 della baia di Prelo (Rapallo, GE): morfologia, stato di salute e granulometria dei sedimenti superficiali*. Tesi di laurea in Scienze Ambientali, Università di Genova: 172 pp.

- MEINESZ A., LEFEVRE J.R., ASTIER J.M. (1991) - Impact of coastal development on the infralittoral zone along the southeastern Mediterranean shore of continental France. *Mar. Poll. Bull.*, **23**: 343-347.
- MONTEFALCONE M., ALBERTELLI G., BIANCHI C.N., MARIANI M., MORRI C. (2006a) - A new synthetic index and a protocol for monitoring the status of *Posidonia oceanica* meadows: a case of study at Sanremo (Ligurian Sea, NW Mediterranean). *Aquat. Conserv. Mar. Fresh. Ecosyst.*, **16**: 29-42.
- MONTEFALCONE M., LASAGNA R., BIANCHI C.N., MORRI C., ALBERTELLI G. (2006b) - Anchoring damage on *Posidonia oceanica* meadow cover: a case study in Prelo cove (Ligurian Sea, NW Mediterranean). *Chem. Ecol.*, **22** (1) (in press).
- PEIRANO A., BIANCHI C.N. (1997) - Decline of the seagrass *Posidonia oceanica* in response to environmental disturbance: a simulation-like approach off Liguria (NW Mediterranean Sea) In: Hawkins L.E., Hutchinson S., Jensen S., Williams A.C., Shearer M. (eds), *Responses of marine organisms to their environment*, University of Southampton, UK: 87-95.
- PEIRANO A., DAMASSO V., MONTEFALCONE M., MORRI C., BIANCHI C.N. (2005) - Effects of climate, invasive species and anthropogenic impacts on the growth of the *Posidonia oceanica* (L.) Delile in Liguria (NW Mediterranean Sea). *Mar. Poll. Bull.*, **50**: 817-822.
- PÉRÈS J.M., PICARD J. (1975) - Causes de la raréfaction et de la disparition des herbiers de *Posidonia oceanica* sur les côtes françaises de la Méditerranée. *Aquat. Bot.*, **1**: 133-139.
- PERGENT G., PERGENT-MARTINI C., BOUDOURESQUE C.F. (1995) - Utilisation de l'herbier à *Posidonia oceanica* comme indicateur biologique de la qualité du milieu littoral en Méditerranée: état des connaissances. *Mésogée*, **54**: 3-27.
- RUIZ J.M., ROMERO J. (2003) - Effects of disturbances caused by coastal constructions on spatial structure, growth dynamics and photosynthesis of the seagrass *Posidonia oceanica*. *Mar. Poll. Bull.*, **46**: 1523-1533.