Coastal anthropogenic pressures explain the ecological decline of Posidonia oceanica: implications for management and conservation

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Abstract

During the last half of the century, the development of anthropogenic activities has shown a dramatic increase that particularly threatens marine coastal ecosystems. The management of those multiple and simultaneous pressures requires reliable and precise data on their distribution and knowledge concerning their potential effects on the most sensitive ecosystems. Focusing on Posidonia oceanica, a threatened habitat-forming seagrass species endemic to the Mediterranean, we developed a statistical approach to study the complex relationship between human multiple activities and ecosystem status. In particular, we used Random Forest modelling to explain P. oceanica ecological decline (i.e. the shift from seagrass bed to dead matte) as a function of ten anthropogenic pressures and depth along the Mediterranean French coast (1,700 km of coastline including Corsica). Using a 50 x 50 m grid cells dataset, we obtained a particularly accurate model explaining 77.5 % of the variance and showing a 0.86 Pearson correlation between predicted and observed values. Depth, agriculture, man-made coastline, coastal population and urbanization were the best global predictor variables of P. oceanica ecological decline. Aquaculture was the least important variable for the prediction although its local influence was among the highest. Thresholds between predictors and P. oceanica status were detected for all variables except agriculture and coastal population. Using the distance from these thresholds, the coastal seagrass bed was classified into four categories according to an increasing vulnerability gradient. Our approach brings important information to help managers preserving this essential ecosystem.

Keywords: species distribution modelling, Random forest models, human impacts, seagrass distribution, Posidonia oceanica, priority areas, threats, ecological status

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