Human activities explain the degradation status of a marine ecosystem. Which use for management?

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Abstract

During the last fifty years, there has been a dramatic increase in the development of anthropogenic activities, and this is particularly threatening to marine coastal ecosystems. The management of these multiple and simultaneous anthropogenic pressures requires reliable and precise data on their distribution, as well as information (data, modelling) on their potential effects on sensitive ecosystems. Focusing on *Posidonia oceanica* beds, 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. We used Random Forest modelling to explain the degradation status of *P. oceanica* (defined herein as the shift from seagrass bed to dead matte) as a function of depth and 10 anthropogenic pressures along the French Mediterranean coast (1700 km of coastline including Corsica). Using a 50 x 50 m grid cells dataset, we obtained a particularly accurate model explaining 71.3 % of the variance, with a Pearson correlation of 0.84 between predicted and observed values. Human-made coastline, depth, coastal population, urbanization, and agriculture were the best global predictors of *P. oceanica*'s degradation status. Aquaculture was the least important predictor, although its local individual influence was among the highest. Non-linear relationship between predictors and seagrass beds status was detected with tipping points (i.e. thresholds) for all variables except agriculture and industrial effluents. Using these tipping points, we built a map representing the coastal seagrass beds classified into four categories according to an increasing pressure gradient and its risk of phase shift. Our approach provides important information that can be used to help managers preserve this essential and endangered ecosystem.

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