Appendix S2

Table S2.1: Metadata of candidate environmental predictors. Variables selected for the Random Forest predictions are highlighted in gray. Abbr. = Abbreviation; Native res. = Native resolution (in decimal degrees).

Layer	Abbr.	Source	Meaning	Native res.	Ecological importance
Depth	Depth	EMODnet	Distance between the surface and the seafloor (in m)	0.001	Depth is commonly described as the main driver of benthic community structure and composition. Often considered a proxy of other shaping environmental drivers, such as temperature, salinity, pressure, and nutrient concentration. (Colloca et al., 2003; Enrichetti et al., 2019; Georges et al., 2024; Lauria et al., 2021)
Slope	Slope	EMODnet	Slope degree of the seafloor (in degree)	0.001	Influences the physical environment (steeper slopes associated with stronger current) and controls food supply (steeper slopes enhance resuspension) + represents the geomorphologic

					al heterogeneity of the habitat (Enrichetti et al., 2019; Morato et al., 2020)
Rugosity	Rough	EMODnet	Difference between the maximum and the minimum value of bathymetry (in µm)	0.001	Captures small-scale geomorphological heterogeneity + influences local hydrodynamics (Zawada et al., 2010)
Average grain size	Substrate	EMODnet broad-scale seabed habitat map	Average size of grain fractions including in the sediment (in mm)	0.001	Driver of benthic community distribution by influencing the ability of organisms to burrow, or move + controls the oxygen penetration + organic matter retention. (Enrichetti et al., 2019; Outrequin et al., 2025; Tecchio et al., 2011)
Mean bottom temperature	Temp mean	Bio-Oracle	Average of monthly bottom temperature for the period 2010-2020 (in T°C)	0.083	Temperature influences the metabolism and growth rate of benthic species (Fanelli et al., 2013; Morato et al., 2020; Outrequin et al., 2025)

Mean bottom salinity	Salinity mean	Bio-Oracle		0.083	Salinity influences the metabolism and growth rate of benthic species (Darr et al., 2014; Fanelli et al., 2013)
Mean bottom dissolved oxygen	o2 mean	Bio-Oracle		0.083	Reflects the input at the air/water interface and controls the metabolism and growth rate of benthic species (Fanelli et al., 2013; Outrequin et al., 2025)
Mean bottom current velocity	Current speed mean	Bio-Oracle	Average of monthly bottom current velocity for the period 2010-2020 (in $m.s^{-1}$)	0.083	Influence the ability of species to inhabit a given area by exerting hydrodynamic pressure and indirectly controls food availability through the resuspension and export of organic matter (Georges et al., 2024; Outrequin et al., 2025; Reiss et al., 2010)
pH	pH mean	Bio-Oracle	Average of monthly bottom pH for the period 2010-2020	0.083	pH variations impact calcareous benthic organisms (Gori et al.,

					2016; Hennige et al., 2014)
Mean bottom chlorophyll A	chl mean	Bio-Oracle	Average of monthly bottom chlA concentration for the period 2010-2020 (in $mg.m^{-3}$)	0.083	Chla concentration reflects the amount of phytoplankton and detrital material exported to the seafloor, available for food supply (Fanelli et al., 2013; Outrequin et al., 2025)
Mean bottom phosphate	po4 mean	Bio-Oracle	Average of monthly bottom phosphate concentration for the period 2010-2020 (in $mg.m^{-3}$)	0.083	Represent the nutrient regime and the remineralization of organic matter at the seafloor. Nutrient-rich areas correspond to areas where large amounts of organic matter are remineralized, with the fraction not remineralized remaining available as food for deep-sea species. Used in biogeochemical partitioning of the Mediterranean seabed (Reygondeau et al., 2017)

Mean bottom nitrate	no3 mean	Bio-Oracle	Average of monthly bottom nitrate concentration for the period 2010-2020 (in $mg.m^{-3}$)	0.083	Represent the nutrient regime and the remineralization of organic matter at the seafloor. Nutrient-rich areas correspond to areas where large amounts of organic matter are remineralized, with the fraction not remineralized remaining available as food for deep-sea species. Used in biogeochemical partitioning of the Mediterranean seabed (Reygondeau et al., 2017)
Mean bottom silicate	si mean	Bio-Oracle	Average of monthly bottom silicate concentration for the period 2010-2020 (in $mg.m^{-3}$)	0.083	Represent the nutrient regime and the remineralization of organic matter at the seafloor. Nutrient-rich areas correspond to areas where large amounts of organic matter are remineralized, with the fraction not remineralized remaining available as food for deep-sea species. Used in

					biogeochemical partitioning of the Mediterranean seabed (Reygondeau et al., 2017)

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