

## Appendix S2

### *Model limitations and sensitivity analyses*

We have listed five uncertainties intrinsic to model parameter estimation and collected data (see Discussion in the main text). The first three uncertainties are related to the set-up of the physical ocean simulation and are discussed in Somot et al. (2006) and more recently in Planton et al. (2012). We are aware that using only one simulation (one model, one set of forcings, one socio-economic scenario) did not allow us to take into account the uncertainty issue in the current study. However, coordinated multi-model ensemble runs for a given scenario and/or multi-scenario ensemble runs for a given model are on-going efforts for Mediterranean regional oceanography and the outputs of those projects were not ready at the start of our study (Dubois et al. (2012), Planton et al. 2012, Adloff et al., unpublished data; [www.medcordex.eu](http://www.medcordex.eu)), but may be used in forthcoming studies.

The last two uncertainties relate to the strong dependence of connectivity on species life-histories (Tremblé et al., 2012; Baguette et al., 2013) and the consequent need of parameterizing a model of functional connectivity using species-specific data. Such data are scarce for marine species, especially for larvae. However, sensitivity analyses can help overcome data shortage and uncertainties. We have run sensitivity analyses on larval behaviour, by simulating diel vertical movement, and have observed no difference in the rate of change of connectivity metrics with time. This indicates that, while larval behaviour certainly affects the extent of present larval connectivity and is an important parameter to take into account in biophysical modelling (Leis, 2007), it will not affect the rate at which connectivity will change following climate change, at least for the type of larval behaviour simulated here. Further effects of larval behaviour on connectivity are expected when climate-induced ocean acidification and warming will impair the orientation ability of larvae and thus the ability or recruiting to

suitable habitats (Munday et al., 2009; Munday et al., 2010). Uncertainty in larval settlement length did not affect the results either: even if the intercept of the models were affected by larval settlement length, showing that it is an important parameter to estimate current connectivity, the slope of the regression lines was not changed and the temporal change in larval dispersal distances, connectance, seeded area and larval retention is not expected to be affected by the precise values of this parameter. The effects of uncertainties in adult biology seem even less important than those concerning larval biology, because adult reproductive timing affected considerably only connectance and not the other connectivity measures. Moreover, the effect on connectance was due to the increased potential of MPAs for reproduction rather than shifts in reproductive timing. The knowledge of the precise distribution of reproductive events within the year is therefore not as important as the suitability of MPAs for species reproduction.

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