Detection and degradation of environmental DNA (eDNA) in the marine environment: a lab and field approach using plaice

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Rapid advances in molecular technologies allow the study of biodiversity based on environmental samples (e.g. water) and can significantly improve biodiversity and ecosystem studies. Yet, the development and validation of these methods in the marine environment is limited. In this study, we evaluated the use of environmental DNA (eDNA) for the detection of plaice (*Pleuronectes platessa*), a common marine flatfish, in the laboratory and the field. We conducted a series of 24h experiments to investigate the eDNA degradation and production rate and detection limit for plaice under controlled laboratory conditions and validated our approach in the field. We observed that plaice is almost instantaneously detected immediately after introduction in the experimental aquaria. During the first 8 hours after introduction, eDNA concentrations increased (k_{prod} = 2.794E-8) after which its concentrations reach a plateau or lag phase. After the removal of plaice, we observed an exponential decline in eDNA concentrations (k_{deg} = 0.124) reaching almost non-detectable concentrations after 24 hours. In addition, field samples of eDNA were collected in winter and summer in the Belgian part of the North Sea showed a clear seasonal pattern that corresponds with the known spatio-temporal distribution of this species. Indeed, in summer, when juvenile plaice is migrating from the Scheldt estuary towards the coastal areas, higher eDNA concentrations were detected close to the coast. In contrast, during autumn adult plaice migrate deeper North Sea waters, which is reflected in the lower eDNA concentrations measured near the coast. Our results show that the eDNA technique can be used to identify current presence of common flatfish in marine coastal waters, resulting in an instant snapshot of the environment. Environmental DNA therefore has the potential to significantly improve environmental studies as a high-throughput non-invasive method.

Keywords: environmental DNA (eDNA); degradation; detection; technical and biological detection limits; monitoring