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The planned construction of increasingly large marine renewable energy installations around the UK could substantially increase the availability of hard habitat in many coastal locations. Many authors have suggested that once colonised, these structures are likely to act as stepping-stones for the spread of both native and non-native species. Stepping-stone connectivity between structures may be of growing concern as marine renewable energy developments begin to transition from single devices to increasingly large arrays. Current marine renewable energy environmental impact assessment (EIA) regulations state that cumulative effects must be addressed in any EIA; modelling studies of connectivity could be useful when identifying the scales of concern for relevant environmental effects (e.g. spread of non-native species, enhancement or detraction from commercial species stocks).

We aimed to assess the characteristics of dispersing organisms which might enhance their ability to colonise offshore structures and spread via stepping-stones. These characteristics included larval behaviour in the form of vertical distribution routines, spawning habitat depth and location, and pelagic larval duration. We coupled a hydrodynamic model of the Firth of Lorn region, Scotland, to realistic biological models of the larval behaviour of three species of barnacle. These biological models were developed from field surveys of horizontal and vertical zooplankton distributions and available literature data on seabed habitat. Modelled dispersal distances ranged between 17.5 and 74 km, and particles could be effectively dispersed throughout the model domain. Vertical positioning in the modelled flow fields strongly influenced the dispersal paths and transport distances of particles. Where spawning habitat was located several kilometres offshore, horizontal transport and dispersal were enhanced.

We suggest a sound understanding of species biology, including habitat preferences, larval vertical distributions, and pelagic larval duration, is essential when assessing the stepping-stone connectivity of biofouling species on marine renewable energy developments. Furthermore, populations formed at renewable energy structures may experience greater transport and dispersal, as larvae may be more quickly swept into directional flows and away from natal habitat. This could increase downstream connectivity for these populations, and amplify the effects and population impacts of successful settlers on offshore renewable energy devices, despite the small habitat surface area they offer. Where these developments span biogeographic barriers, unprecedented dispersal to further habitat could become a possibility for some organisms including climate migrants and/or non-native species.