Disturbance methods:

To quantify extent of disturbance to shorebirds in different habitat types, counts of disturbances by humans and avian predators were conducted from observation points in areas of suitable wader habitat in the study estuaries’ surroundings. Each site was observed for a minimum of 30 minutes and a maximum of one hour at a time, and all sites were visited at least twice between October 2022 and February 2023.

Sites were selected that were known to be wader foraging sites, and that were easily observable from a single observation point without spooking the birds. In total, 10 intertidal sites were surveyed (at low tide), and 12 supratidal sites (at high tide). Intertidal foraging sites were identified from tracking data and were surveyed within two hours of low tide, to minimise changes in the area of mudflat available due to rising or falling tides. Supratidal sites were also identified from tracking data and were surveyed as close as possible to, or at least within an hour and a half of high tide. All observations were undertaken during daylight hours (between 8am and 5pm).

During the observation period, the numbers of walkers, dog walkers (with dogs on and off the lead), cyclists, joggers, vehicles and avian predators passing through the study area were noted, and those that caused waders within the area to react (vigilance behaviour, walk/run away from disturbance, alarm call, take flight) were noted along with the estimated proportion of the birds that reacted. Any disturbed behaviours shown by the birds with no obvious cause were also noted. For disturbances which elicited a response from the birds, the minimum distance of the cause of disturbance from the birds was estimated and recorded.

The habitat type, weather conditions, tidal state, and number of waders present in the observation area were also noted at the start and end of each observation period.

Behaviour methods:

To quantify behaviour, focal birds that could be seen clearly from the observation points detailed above were selected haphazardly and followed for periods up to ten minutes, and their behaviour recorded every 15 seconds. The behaviour types identified during pilots were: resting (head under wing, standing on one leg), stretching/preening, feeding (consuming or handling food items), foraging (head down, walking and pecking), vigilant (head up, alert, looking around), avoidance (walking/running from disturbance), aggression (chasing another bird/being chased, posturing) and flying. At the end of the ten minutes of behaviour recording, provided the focal bird was still within sight, a further ten minutes were spent counting the number of unsuccessful and successful (resulting in a food item being swallowed) pecks. Pecks were defined as times the bird stopped to probe its bill into the ground – briefly holding the bill near to the ground while searching was not counted as a peck. The size of flock with which the focal bird was associated was also recorded (conspecific and other species), as well as the habitat type on which the bird was foraging.

Focal surveys were repeated on up to three birds within the observation area, with each bird followed for a maximum of 20 minutes. If the focal bird left the observation area or moved out of sight during the behaviour recording, a different bird of the same species was selected for the following peck rate count.

Colour-marked birds were selected preferentially for focal observations, to prevent accidental selection of the same focal bird more than once. However, the majority of the time there were no marked birds present, and so birds that looked noticeably different from one another were selected (e.g. white collar vs no white collar, long vs blunt beak, etc).