

Bound Together or Loose Ends? Foraging Associations in Red Knots

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B A C K G R O U N D

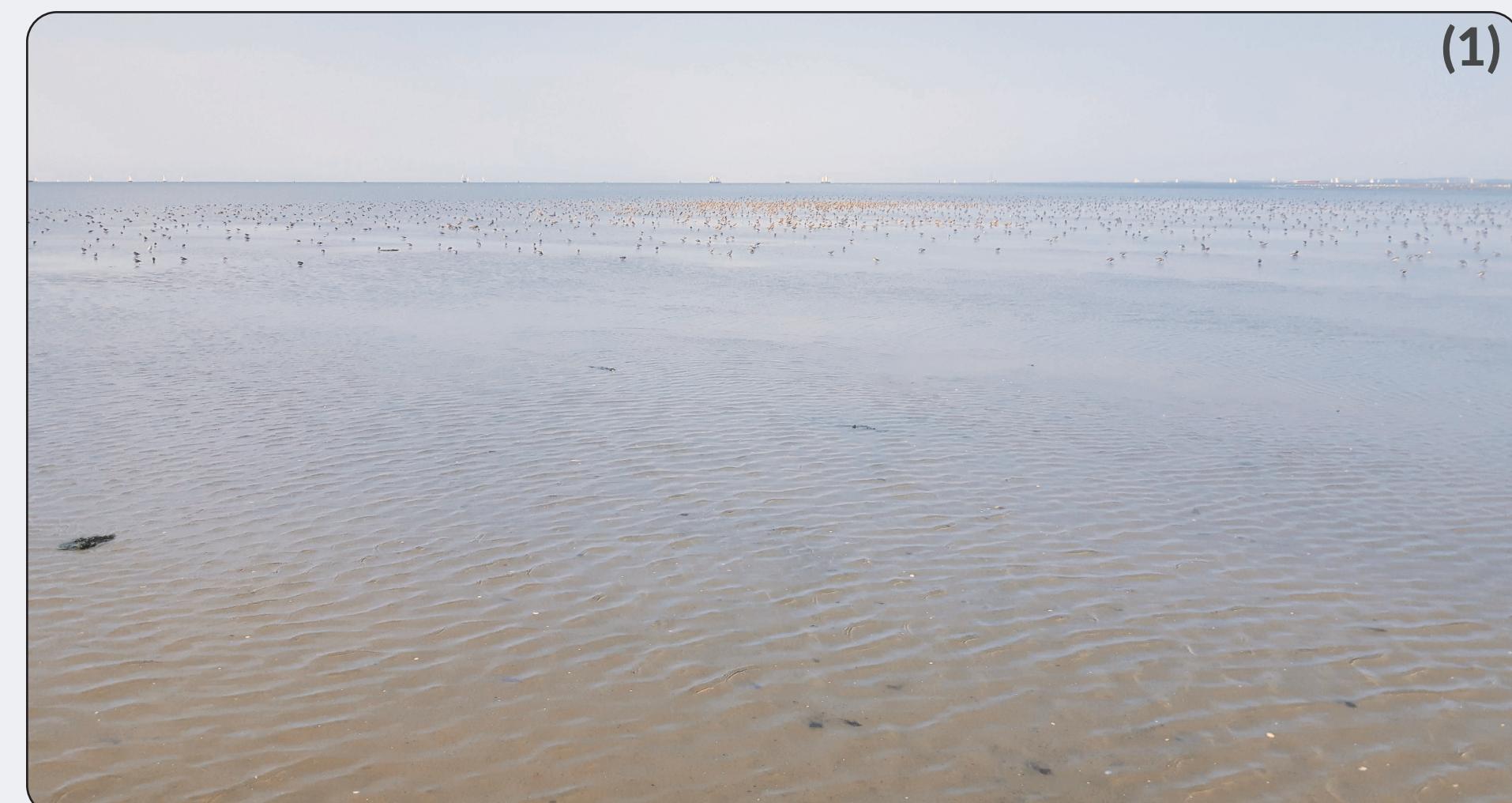


Fig. 1 Wadden Sea mudflats

1 Waders such as red knots *Calidris canutus* gather in large flocks in the Wadden Sea, where they forage on the intertidal mudflats

2 Knots use social information in the lab to find food¹, and learn the location of foraging patches by observing flock-mates²

3 Knots benefit from associations, but do they have 'friends' – persistent, non-random associations – within & between tidal intervals^{3,4?}

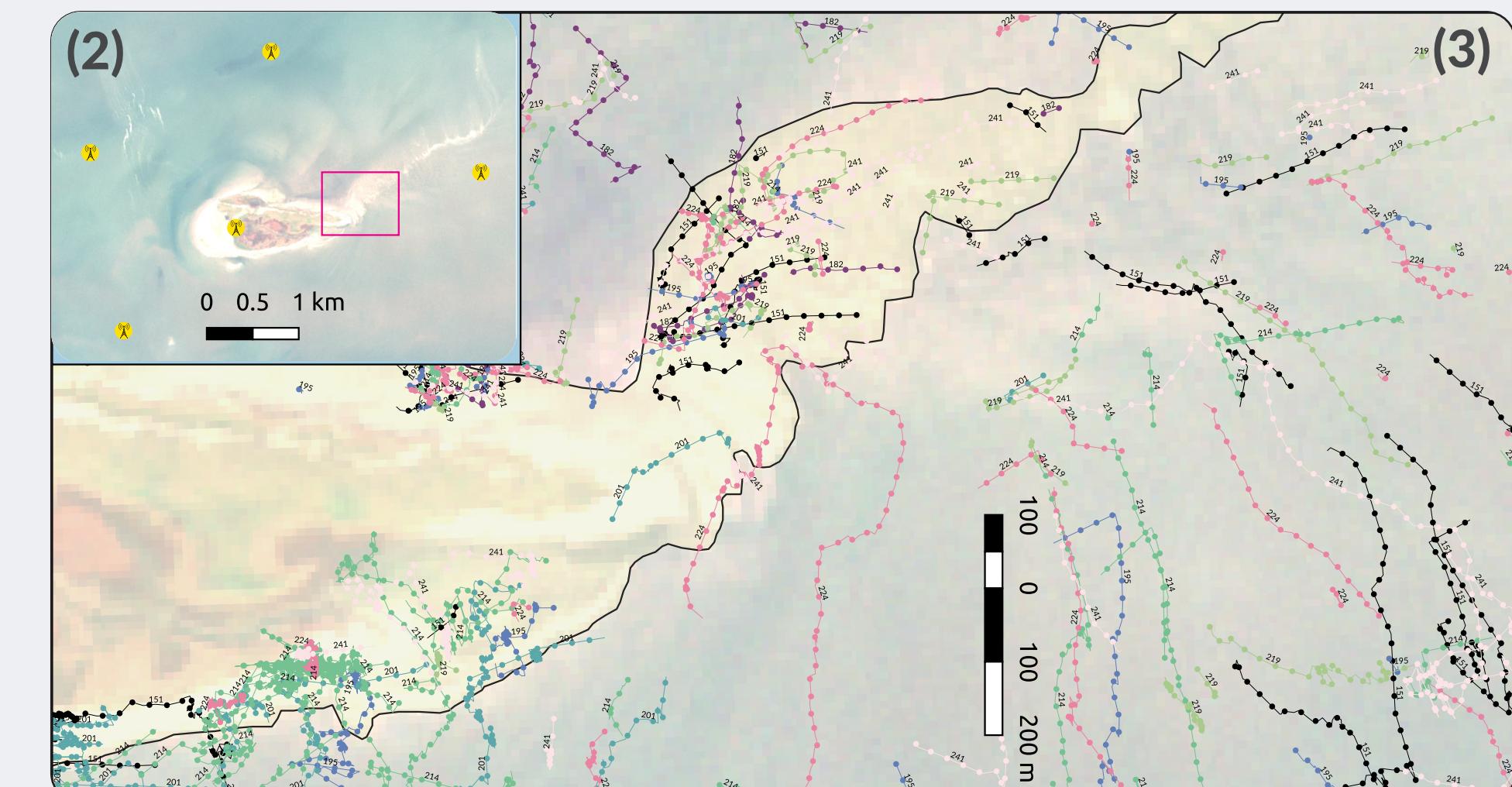


Fig. 2 Study area with ATLAS tower locations

Fig. 3 Knot positions

We ask: Do knots have 'friends'?

METHODS

ATLAS Tracking

1 Tagged knots ($n = 35$, tag mass = 4.2 g) transmit radio signals – tracking tower array ($n = 5$, Fig. 5) finds position using reference beacon and signal Time of Arrival (ToA);

2 We obtained position data ($n = 414,797$, Fig. 6) at 1 minute intervals over the tracking period (Aug. 23 – Sep. 11 2017).

Tidal Intervals

3 We obtained water-level data and determined tidal intervals – 44 tidal intervals over 19 calendar days;

4 We analysed each knot's movement tracks by the tidal interval.

Knot Association

5 We analysed association between two individuals i and j as c_{ij}

$$C_{ij} = n_{250}/N$$

Where

n_{250} = number of positions where i and j are ≤ 250 m apart

N = number of positions where i and j positions are both known;

6 Pairwise association was calculated over the tidal interval, and in each hour within each tidal interval.

7 Association could take values between 0 and 1, where 0 indicates no association between two birds, and 1 indicates association at each point in a time interval.



DISCUSSION

1 Red knot pairs rarely associate more than expected by chance, suggesting that most knots, like other waders^{3,4}, have no 'friends'

2 However, 20% of pair associations are different from chance --- consistent behavioural differences may play a role

3 Over a tidal interval, association tracks tidal water level, suggesting that wader density and association is largely a result of environmental, and not social, drivers.

RESULTS

Association is low but 10% of pairs are friends

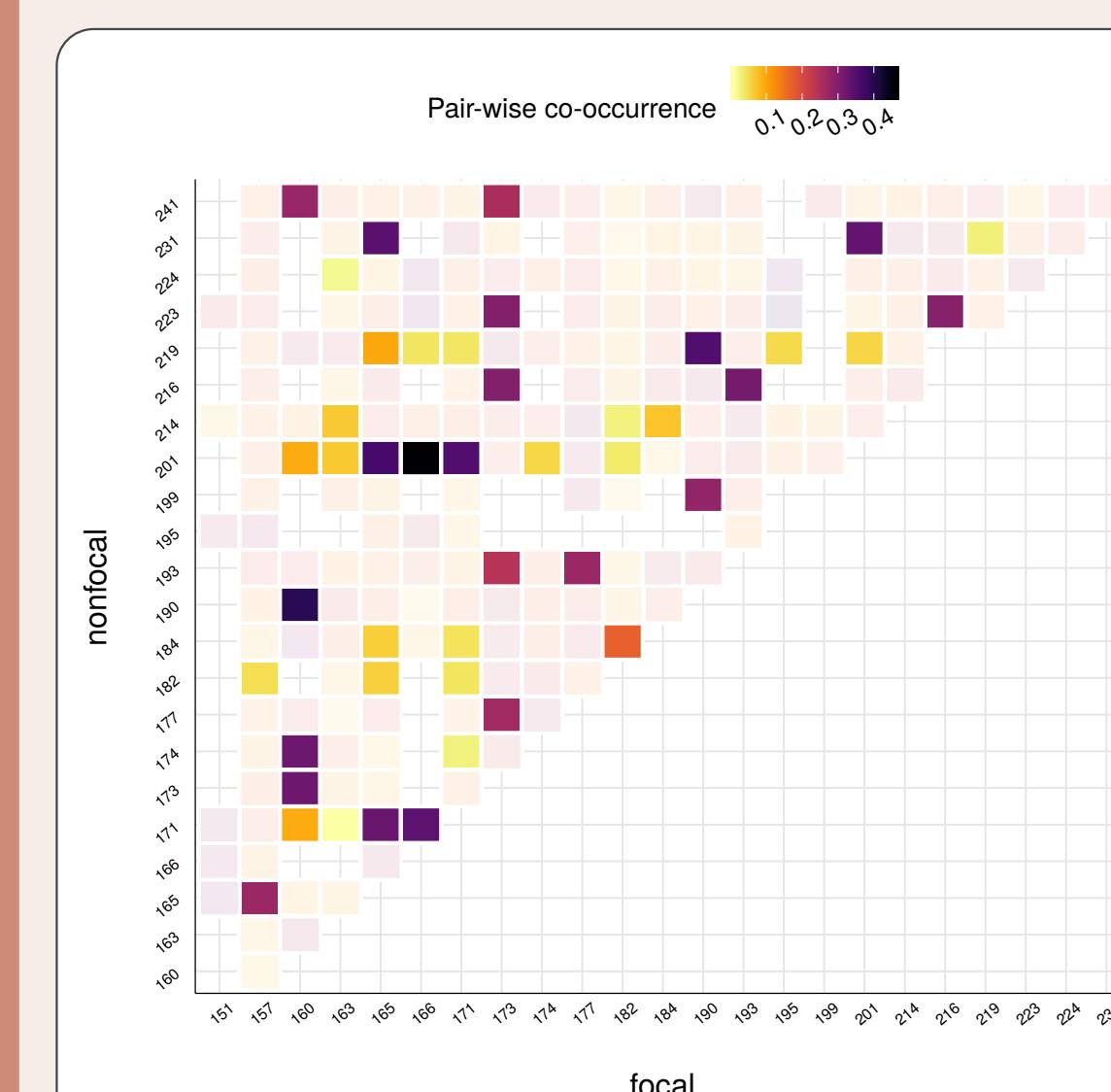


Fig. 4 Knot pair-wise association

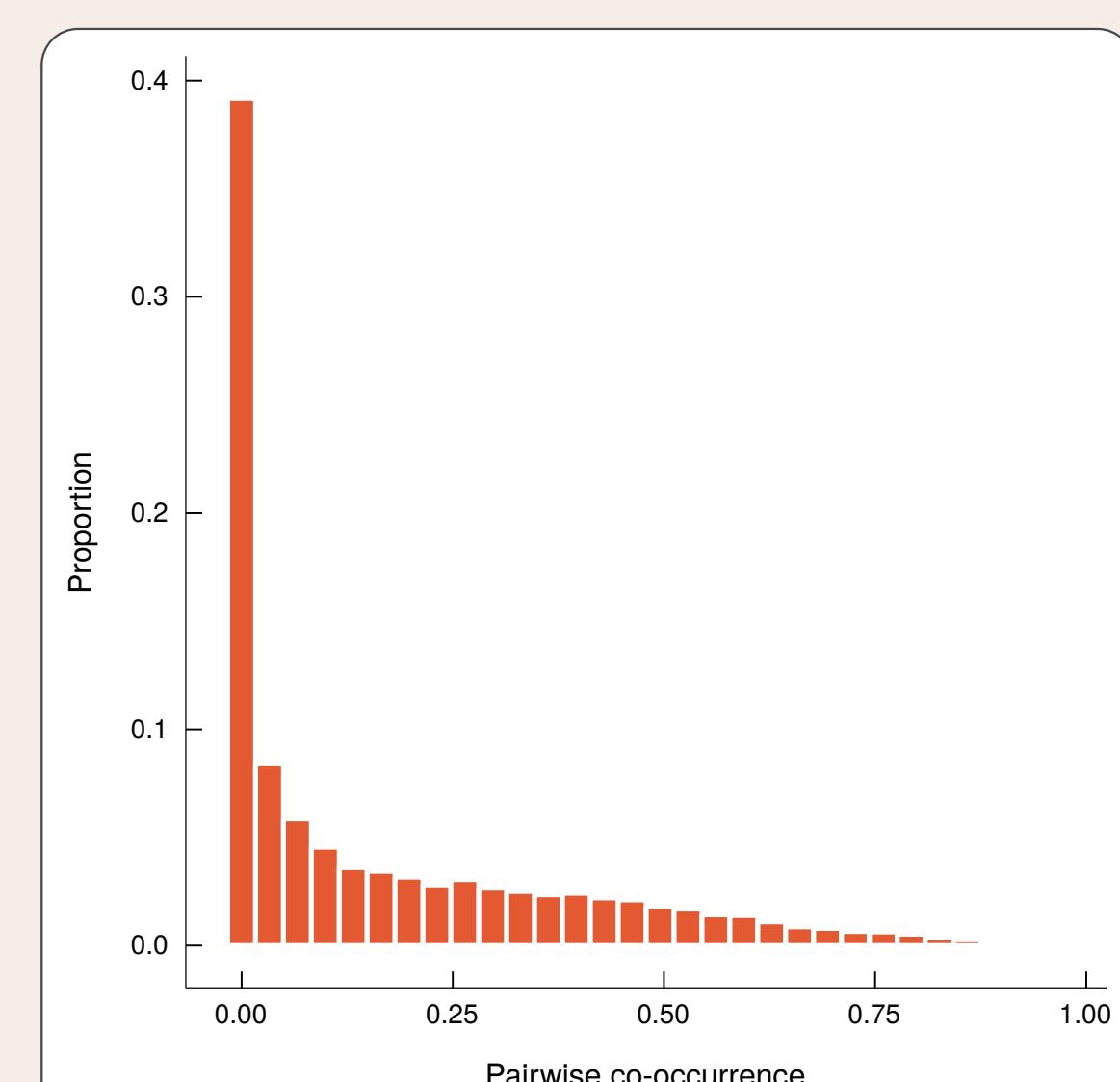


Fig. 5 Red knot pair-wise co-occurrence distribution

1 Pairwise knot co-occurrence is mostly low, with a mean of 0.14 ± 0.3 SD (Fig. 4, Fig. 5)

2 ~80% pairwise co-occurrence distributions are not different from the overall distribution of co-occurrences (Fig. 5)

3 10.5% of pairwise co-occurrences were significantly higher than expected by chance; the same number were significantly lower than expected by chance

Knot association is tidally forced and fleeting

4 Mean population co-occurrence is highest during the receding tide (0 – 3 hours post high tide, mean $\pm 95\%$ CI = 0.22 ± 0.008) and the advancing tide (10 – 12 hours post high tide, mean $\pm 95\%$ CI = 0.12 ± 0.007) and lowest around low tide (4 – 9 hours post high tide, mean $\pm 95\%$ CI = 0.11 ± 0.005)

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