Bound Together or Falling Apart? Foraging Association in Red Knots

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Background

Waders in the Wadden Sea

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

Fig. 1 Red knot — **Fig. 2** Wadden Sea mudlfats

Knots Benefit from Sociality

2 Knots can use social information in lab settings to find food, determine the location of profitable foraging patches by observing flock-mates

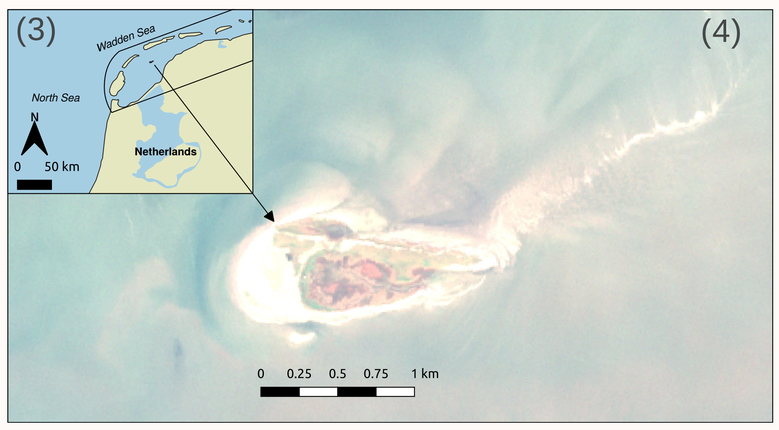


Fig. 3 Study site — **Fig. 4** Island of Griend

Do knots have friends?

3 Knots could benefit from association, but do they have friends — persistent, non-random associations — within & between tidal intervals?

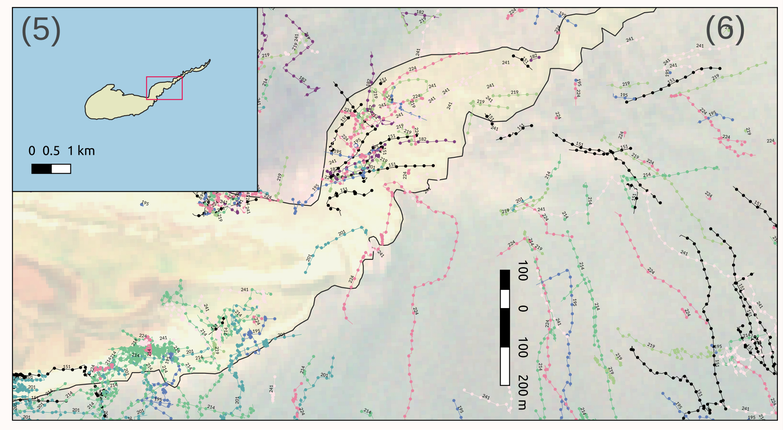


Fig. 5 Tracking towers — **Fig. 6** Knot positions

Methods

ATLAS Tracking

1 Tagged knots (n = 35) 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 at 1 minute intervals over the tracking period (n = 414,797, Fig. 6)

Tidal Intervals

3 We obtained water-level data and determined tidal intervals (cite) — 35 tidal intervals over 19 calendar days

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

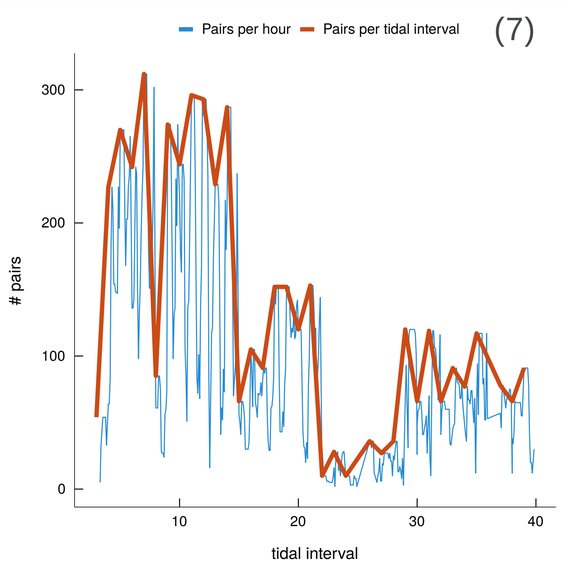


Fig. 7 Number of unique pairs, ie, (a — b), but not (b — a) over the tracking period

Knot Co-occurrence

5 We calculated co-occurrence over unit time between two individuals c_{ij}

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

Where

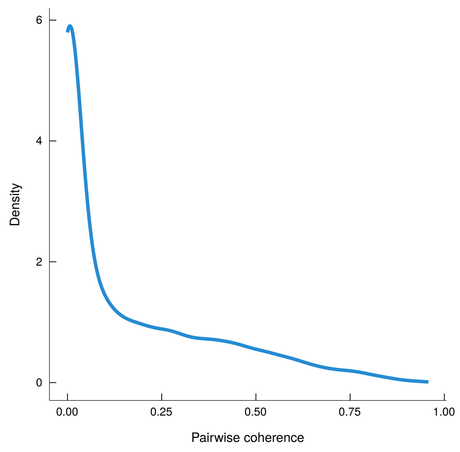
n_{250} = number of positions where *i* and *j* are ≤ 250 m apart

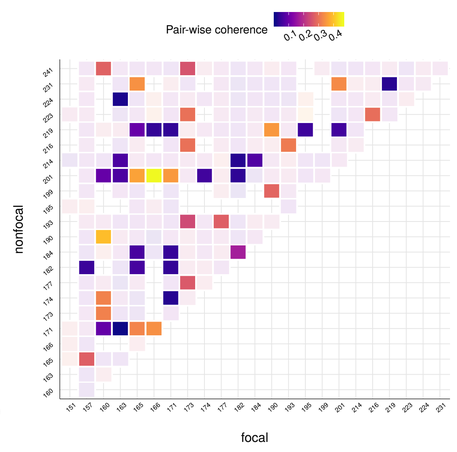
N = number of positions where *i* and *j* positions are both known

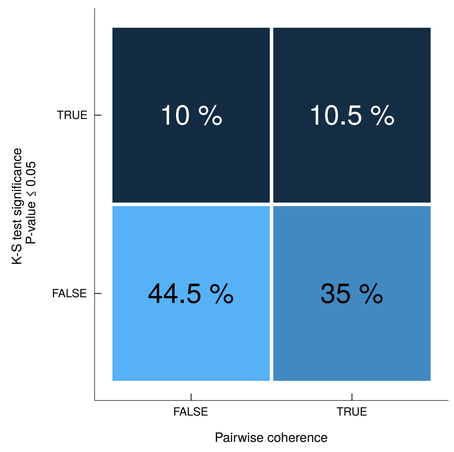
6 Coherence was calculated over the tidal interval, and in each hour pooled across tidal intervals

Results

Knot co-occurrence is low overall







Describe figures here

Pairwise coherence over the tracking period — values not significantly different from a random distribution are shaded over grey

Empirical coherence and simulated coherence distributions over the tracking period

59% of pairwise coherences are not different from those expected by chance — 33% of pairs are less cohesive than expected — 9% of pairs are more cohesive than expected

Coherence over the tidal interval

Observation

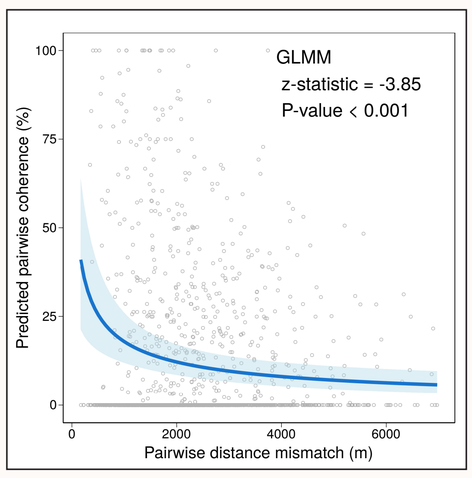
Knots' coherence is highest around high tide, and lowest around low tide

Question

Do knots find their 'friends' after foraging?

Model - GLMM

$$\text{Coherence}_{\text{advancing tide}} \sim \text{Coherence}_{\text{receding tide}} + \text{distance mismatch} + \text{random effects (pair, tidal interval)}$$



Result

Knots do not maintain pairwise bonds through a tidal interval.

Pairwise coherence post-foraging is determined by mismatches in distance covered during the tidal interval.

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References xyz