

Bound Together or Falling Apart? Foraging Association in Red Knots

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Background

Waders in the Wadden Sea

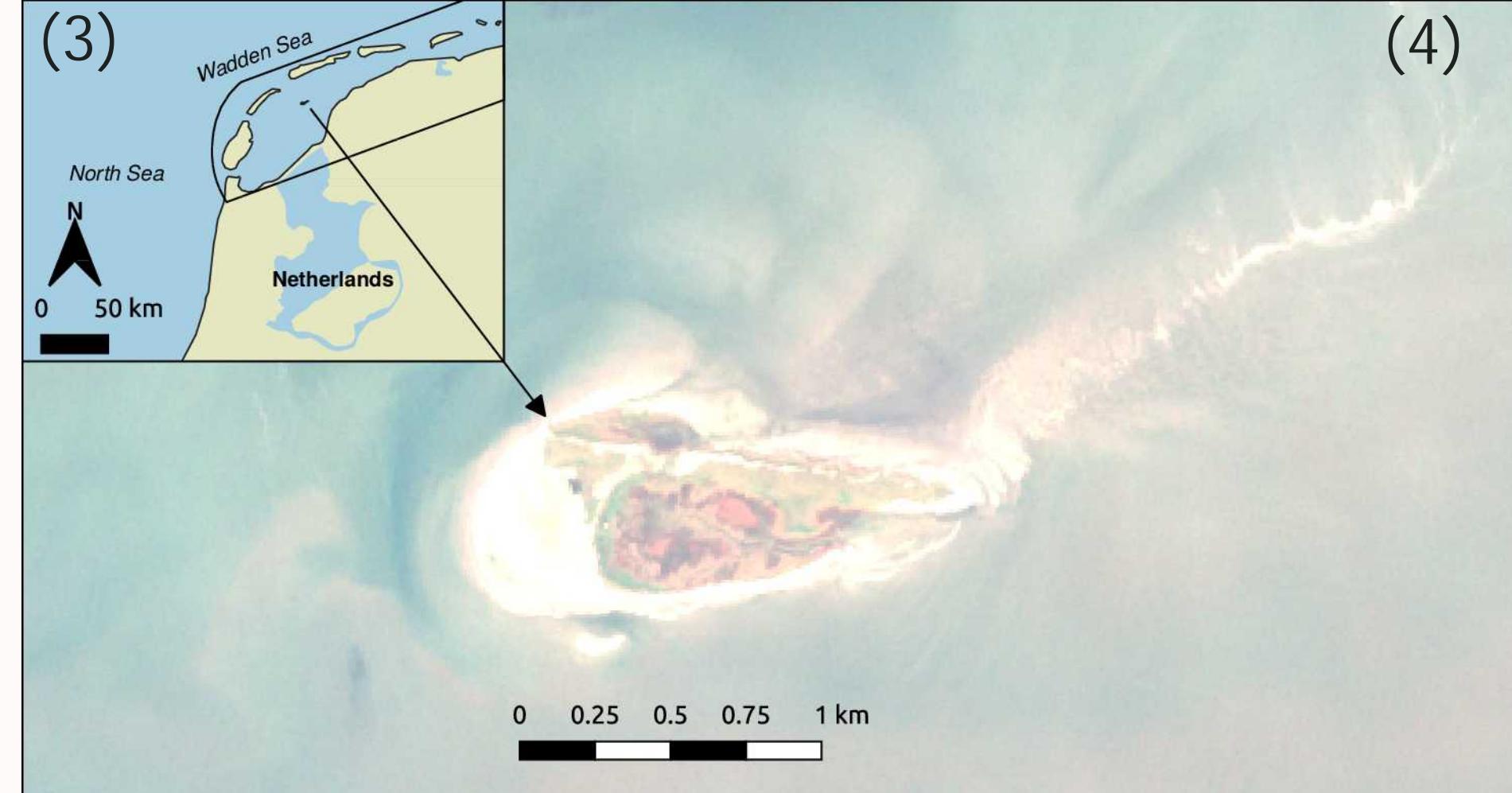
1 Waders such as red knots *Calidris canutus* gather in large non-breeding flocks in the Wadden Sea, where they forage on intertidal mudflats



1 Red knot – 2 Wadden Sea mudflats

Knots Benefit from Sociality

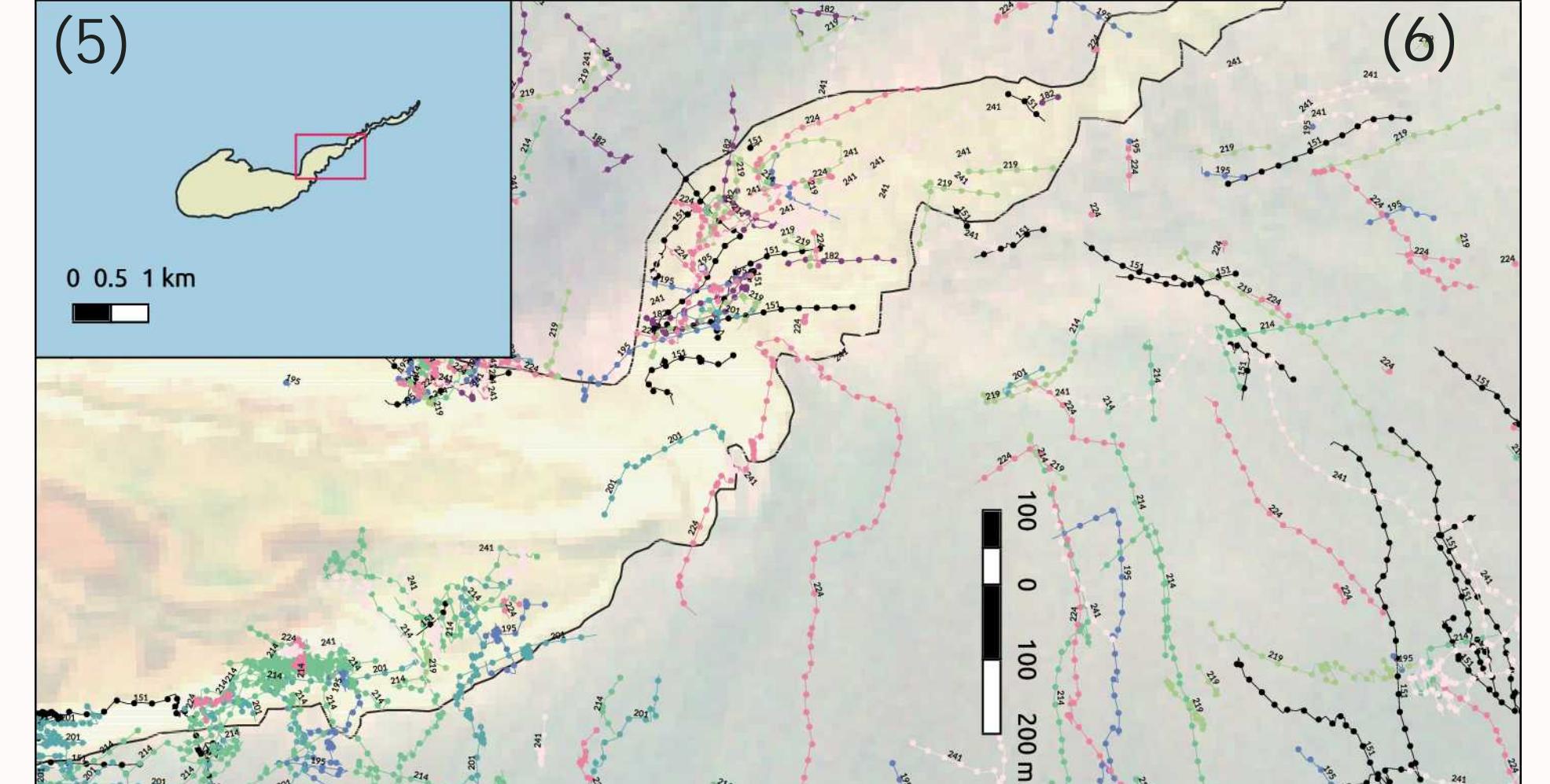
2 Knots can use social information in lab settings to find food, and could determine the location of profitable foraging patches by observing flock-mates



3 Study site – 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?



5 Tracking towers – 6 Knot positions

Methods

ATLAS Tracking

1 Tagged knots 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 for 35 knots at each minute over the tracking period

Calculating coherence

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

Where

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

N = number of positions where i and j

Results

Data summary

Knots

34

Data points

346,414

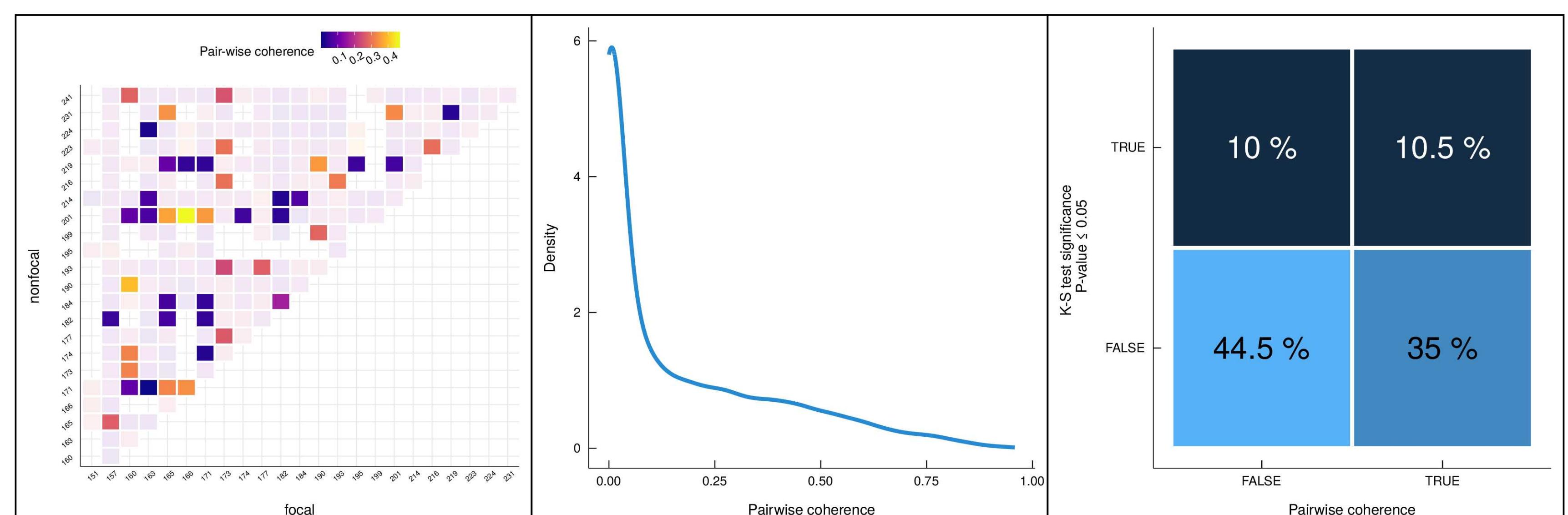
Tracking days

25

Tidal intervals

44

Knot coherence between & within tides

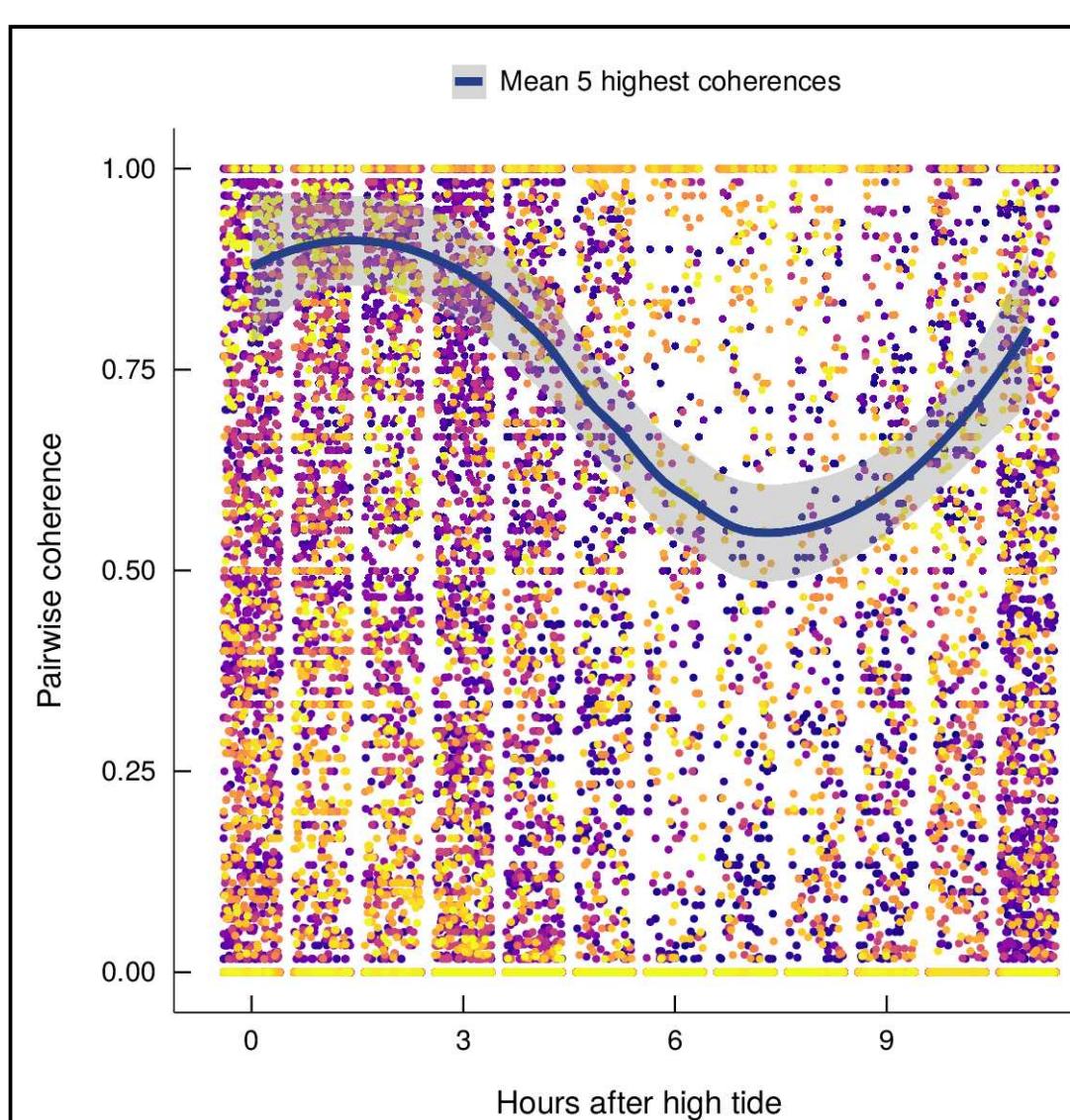


Pairwise coherence over the tracking period – values not significantly different from a random distribution are shaded over grey

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

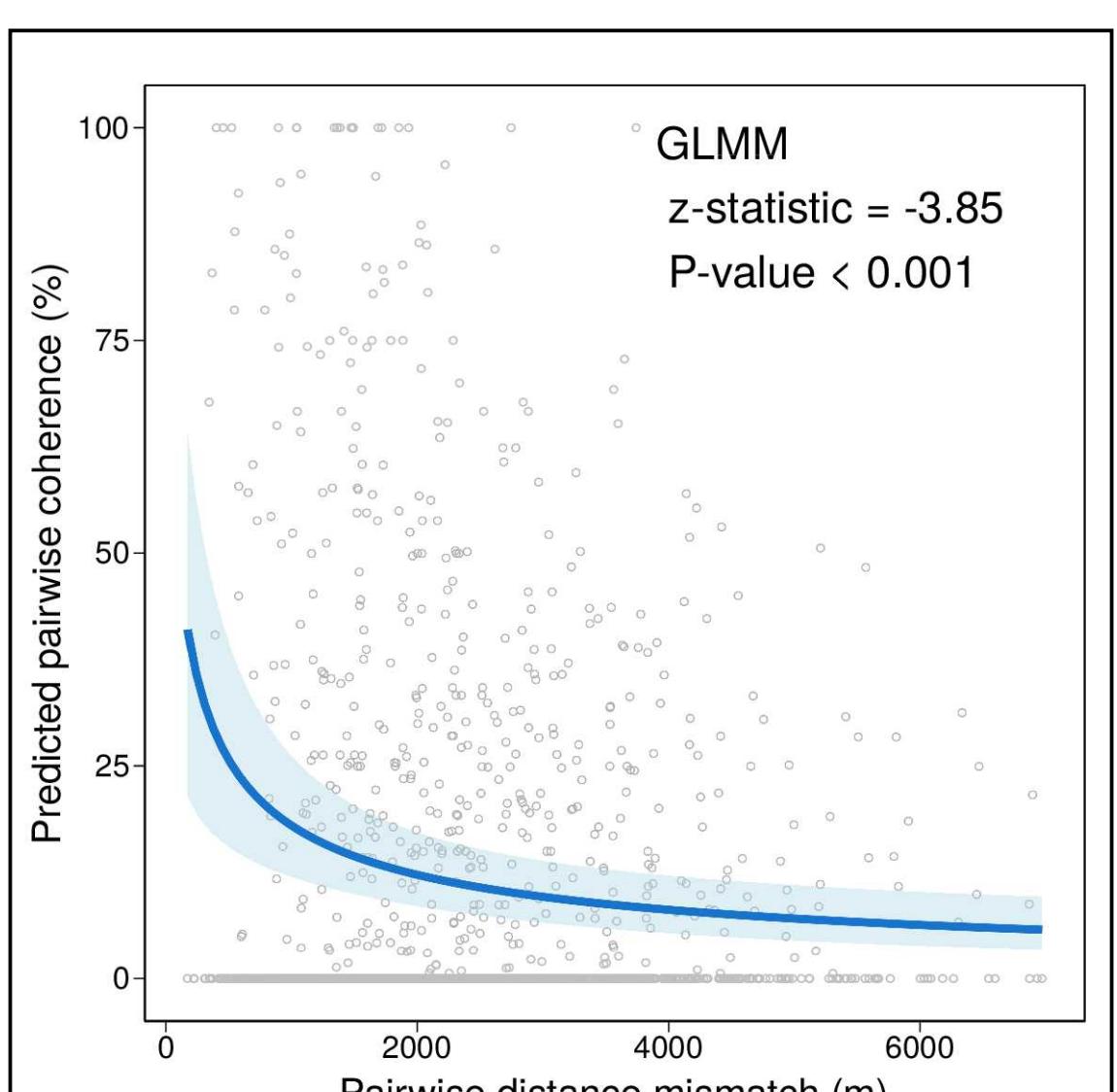
Do knots find their 'friends' after foraging?

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.

Calculating coherence

1 Randomly replace 1 row and 1 column 100x for a mean matrix