

# Bound Together or Falling Apart? Foraging Association in Red Knots

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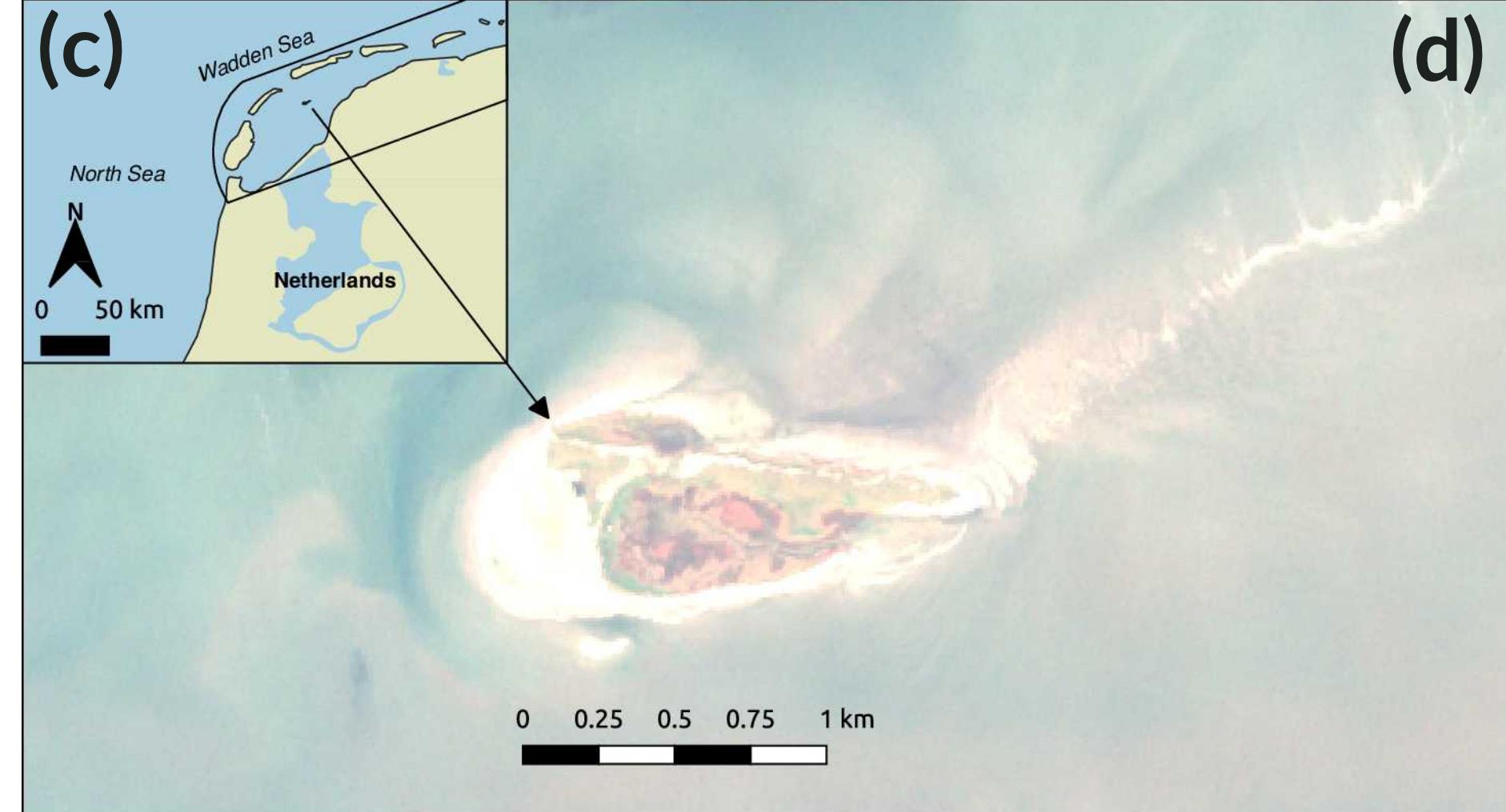
## Background

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



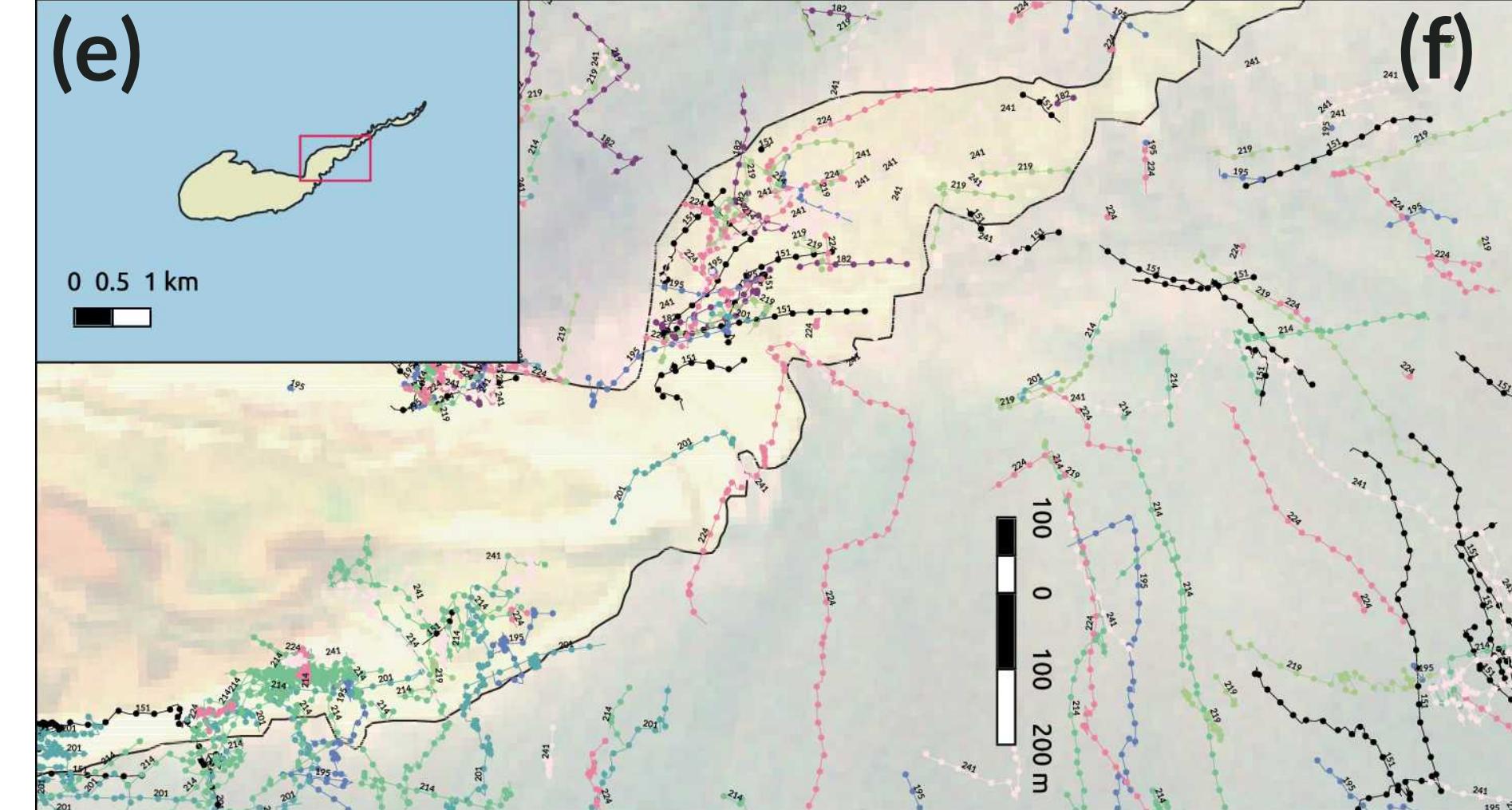
<sup>a</sup>Red knot – <sup>b</sup>Wadden Sea mudflats

2 Waders are highly social, but they have no 'friends' – no persistent non-random association between individuals (cite, cite)



<sup>c</sup>Study site – <sup>d</sup>Island of Griend

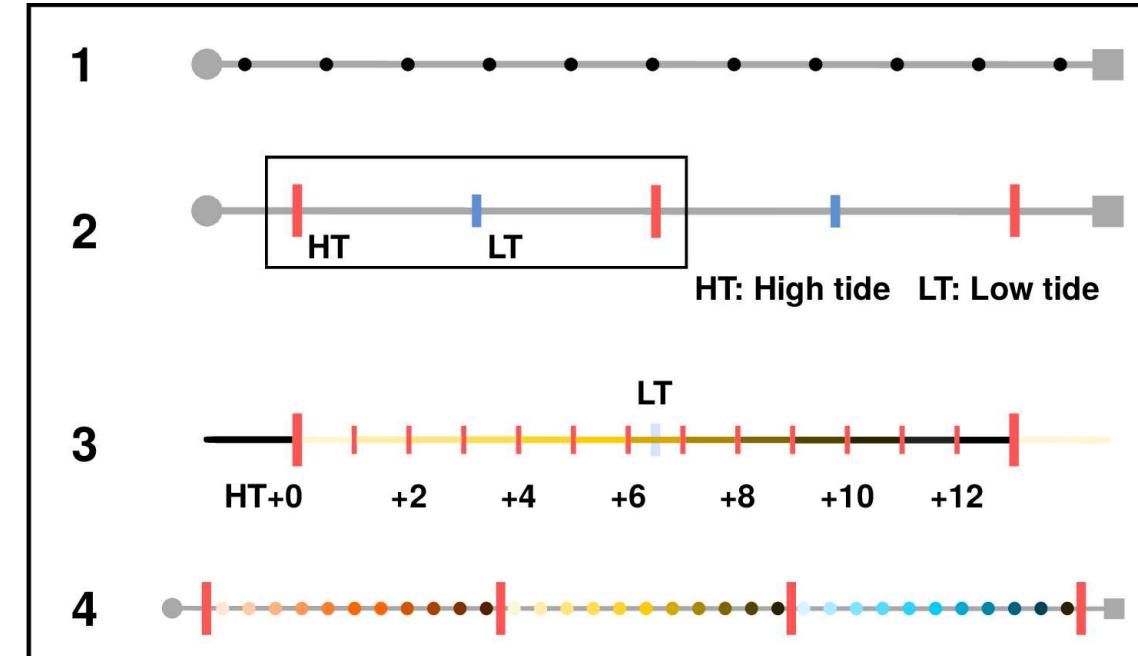
3 ATLAS allows high frequency tracking of multiple knots, and calculation of pair-wise 'coherence' (cite)



<sup>e</sup>Tracking towers – <sup>f</sup>Knot positions

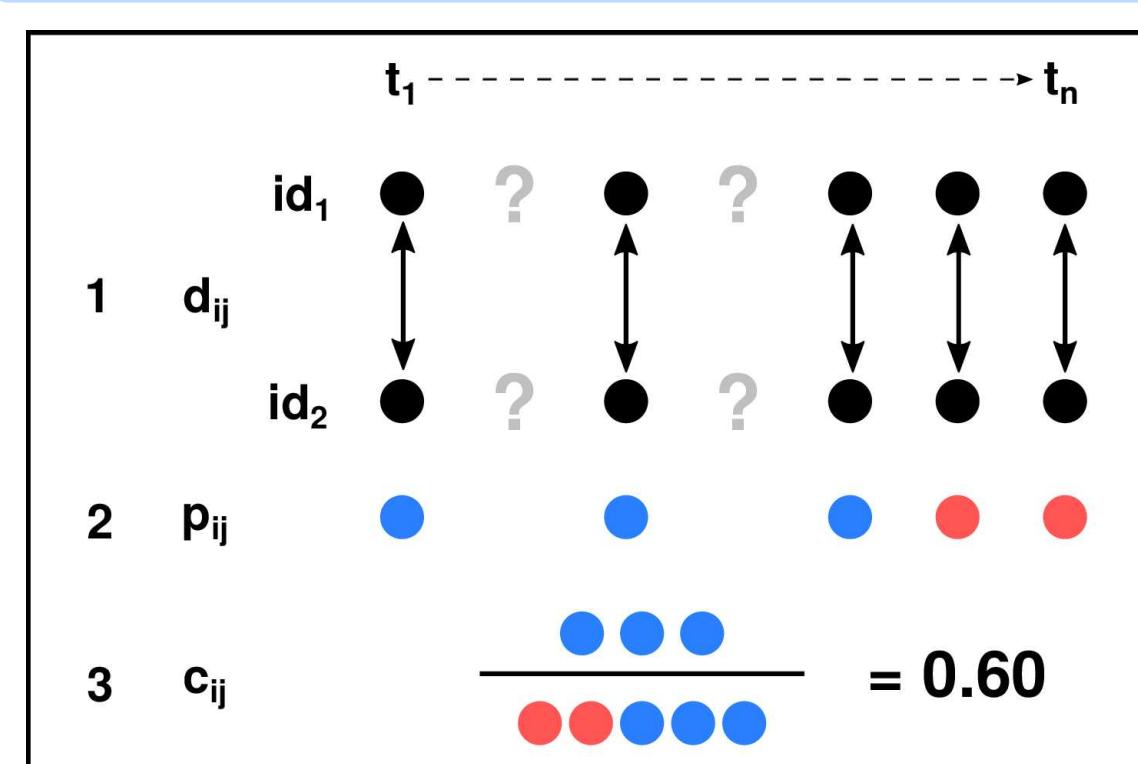
## Data handling

### Identify tidal segments



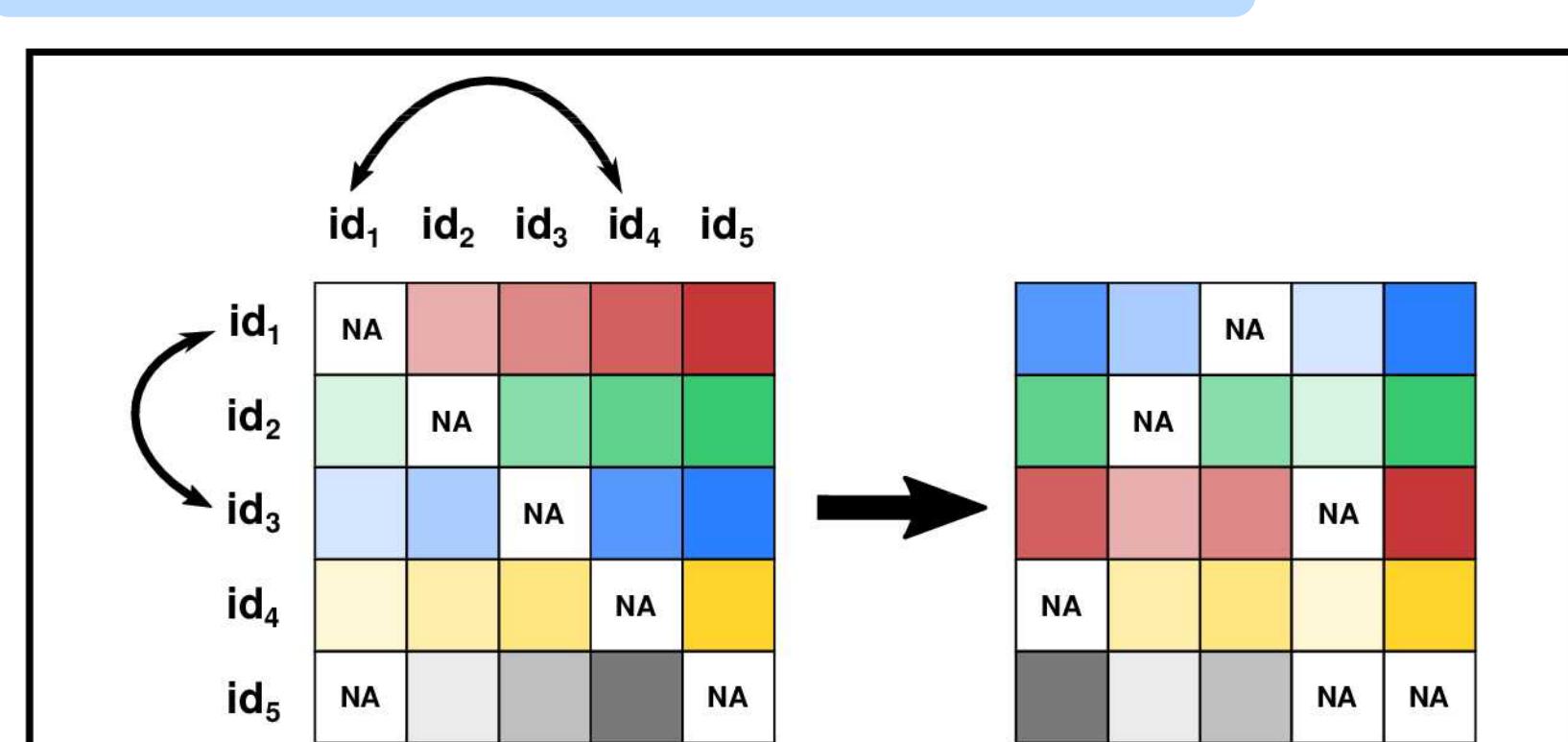
- 1 Obtained the 'lifetime' track
- 2 Identified tidal intervals from water-level data
- 3 Classified data by tidal interval
- 4 Classified data by hours since high tide

### Randomising coherence



- 1 Distances between time-matched positions
- 2 Count distances < proximity threshold
- 3 Calculate pairwise coherence in tidal

### Calculating coherence



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

## Results

### Data summary

#### Knots

34

Data points

346,414

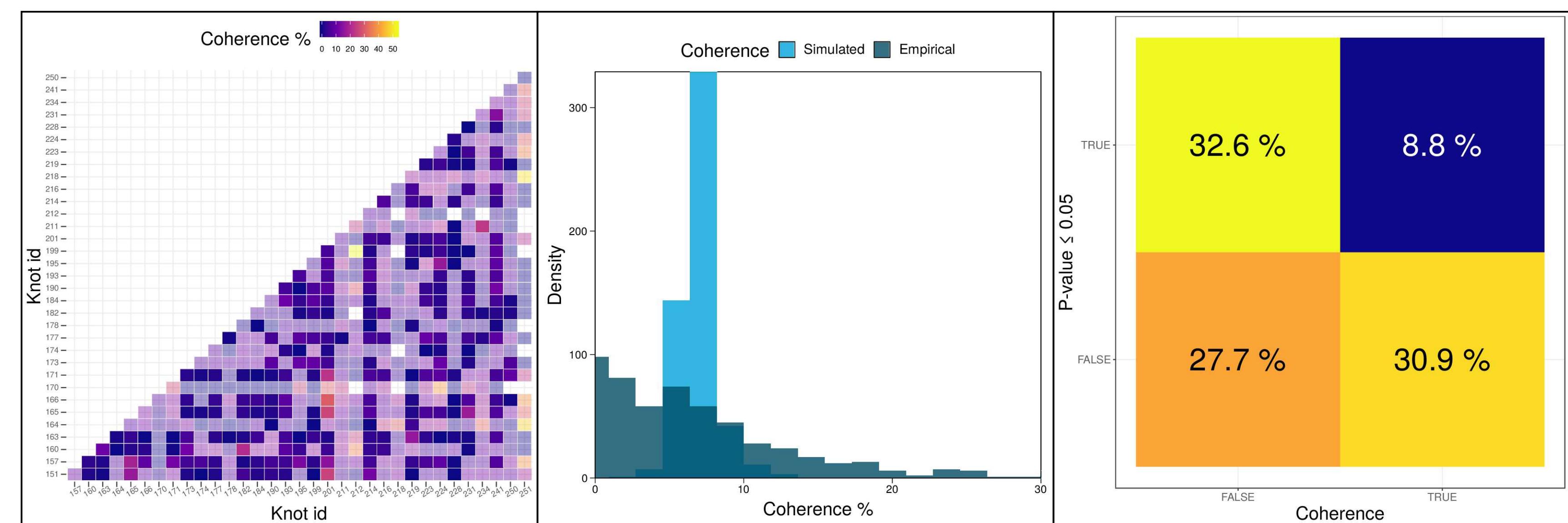
Tracking days

25

Tidal intervals

44

### Knot coherence between & within tides

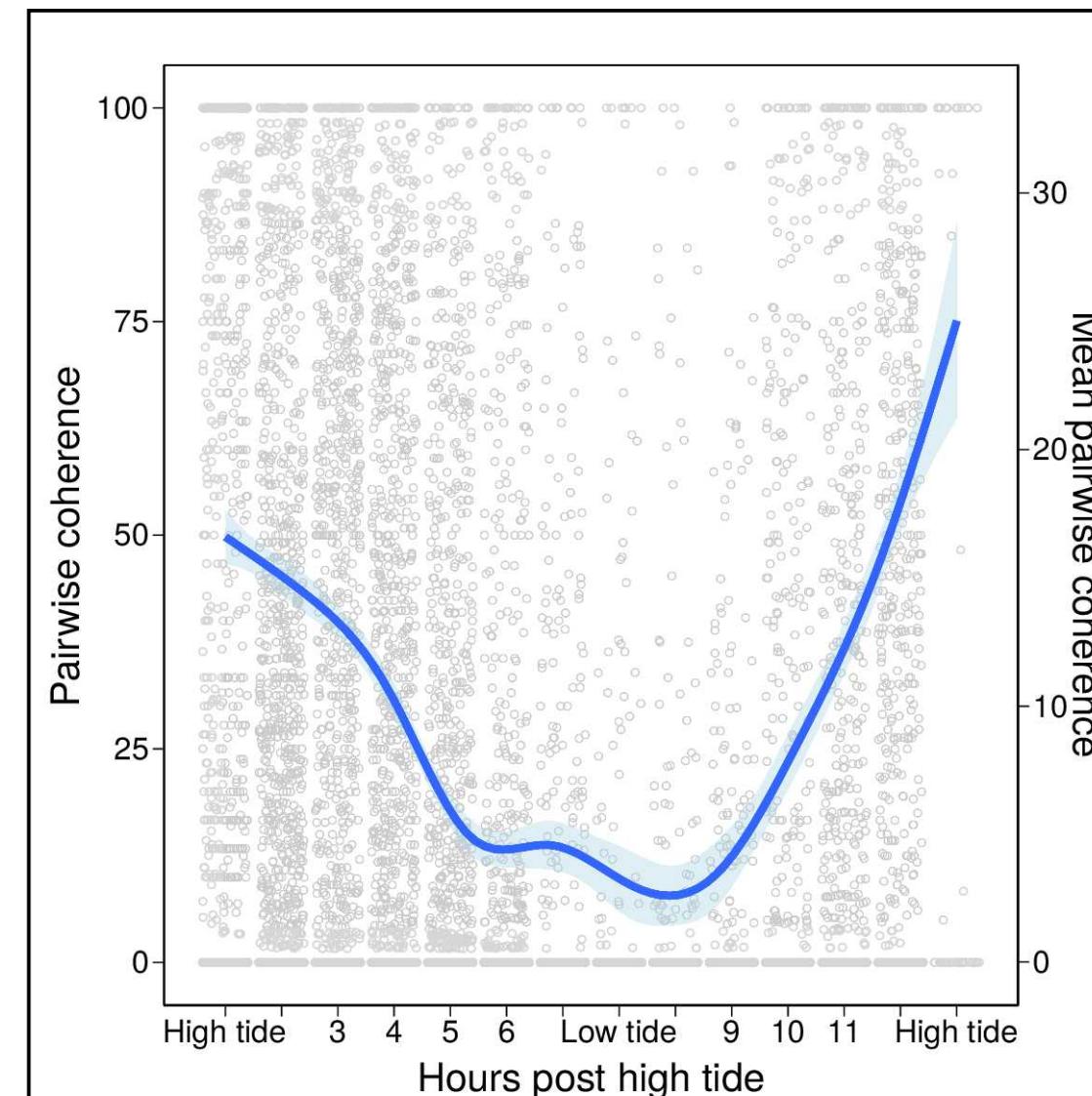


Pairwise coherence over the tracking period – values not significantly different from a random distribution are shaded over grey

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.

### Summary/discussion?