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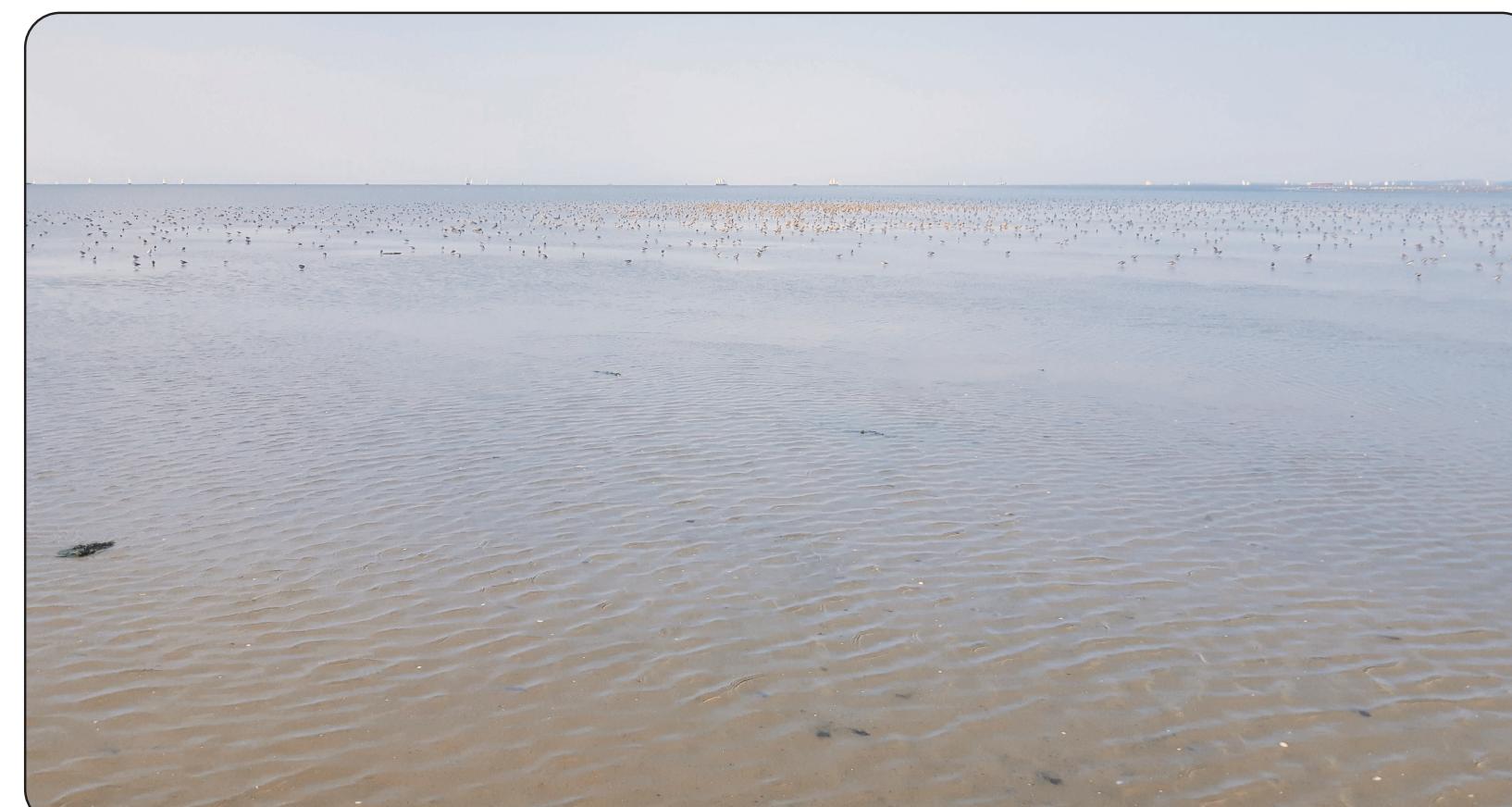
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@pratikunterwegs

- B** 1 Waders such as red knots *Calidris canutus* gather in large flocks in the Wadden Sea, where they forage on the intertidal mudflats
- A** 2 Knots use social information in the lab to find food¹, and learn the location of foraging patches by observing flock-mates²
- C** 3 Knots benefit from associations, but do they have 'friends' – persistent, non-random associations – within & between tidal intervals^{3,4}?



Wadden Sea mudflats

Study area with ATLAS tower locations & knot positions coloured by tidal stage

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 finds position using signal Time of Arrival (ToA);

2 We obtained position data at 1 minute intervals for Aug. 23 – Sep. 11 2017.

Tidal Intervals

3 We 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 hourly within each tidal interval.

7 Association was between 0 and 1, where 0 = no association, and 1 = complete association per tide.

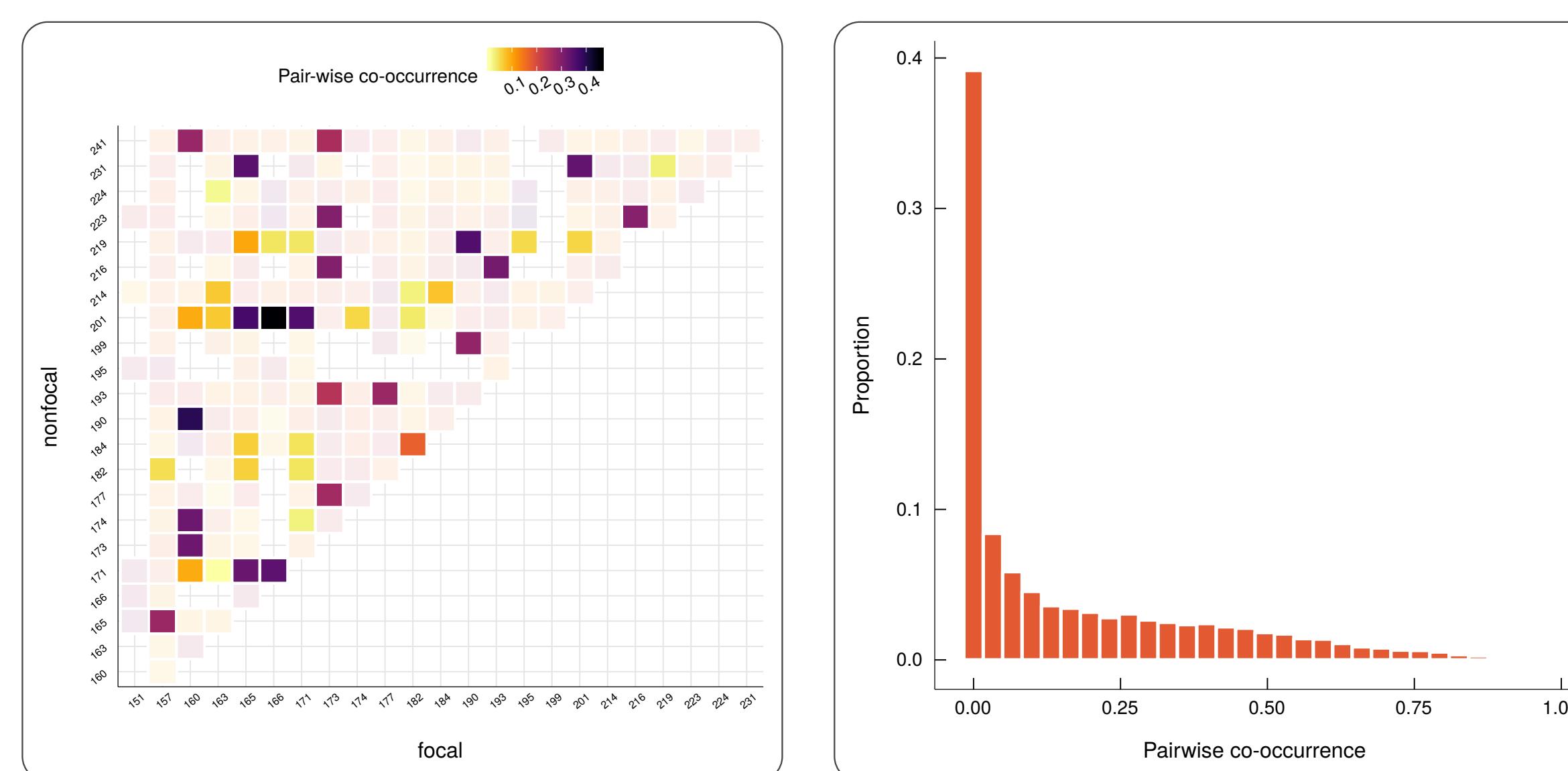


Fig. 3 Red knot pair-wise association

Fig. 4 Red knot pair-wise association distribution



Courtesy Benjamin Gnepp COS-NIOZ

RESULTS

Association is low but 10% pairs are 'friends'

1 Association is mostly low (mean \pm SD = 0.14 ± 0.3)

2 ~80% pairwise co-occurrence distributions are not different from the overall distribution of co-occurrences

3 10.5% of pairwise associations are higher than expected by chance; 10% are 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)

DISCUSSION

1 Most knots, like other waders^{3,4}, have no 'friends'

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

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

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References 1. Bijleveld et al. 2015. Benefits of foraging in small groups: An experimental study on public information use in red knots *Calidris canutus*. *Behav. Processes*. 2. Bijleveld et al. 2010. Beyond the information centre hypothesis: communal roosting for information on food, predators, travel companions and mates? *Oikos*. 3. Myers 1983. Space, time, and the pattern of individual associations in a group-living species: sanderlings have no friends. *Behav. Ecol. Sociobiol.* 4. Conklin & Colwell 2008. Individual associations in a wintering shorebird population: do dunlin have friends? *J. Field. Ornith.* 5. Harrington and Leddy 1982. Are wader flocks random grouping? A knotty problem. *Wader Study Group Bull.*