

Bound Together or Loose Ends? Foraging Associations in Red Knots



Pratik R Gupte^{1,2}, Selin Ersoy^{1,2} & Allert I Bijleveld²

¹Groningen Institute for Evolutionary Life Sciences, University of Groningen

²Department of Coastal Systems, NIOZ Royal Netherlands Institute for Sea Research

p.r.gupte@rug.nl

@pratikunterwegs

BACKGROUND

- 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}?

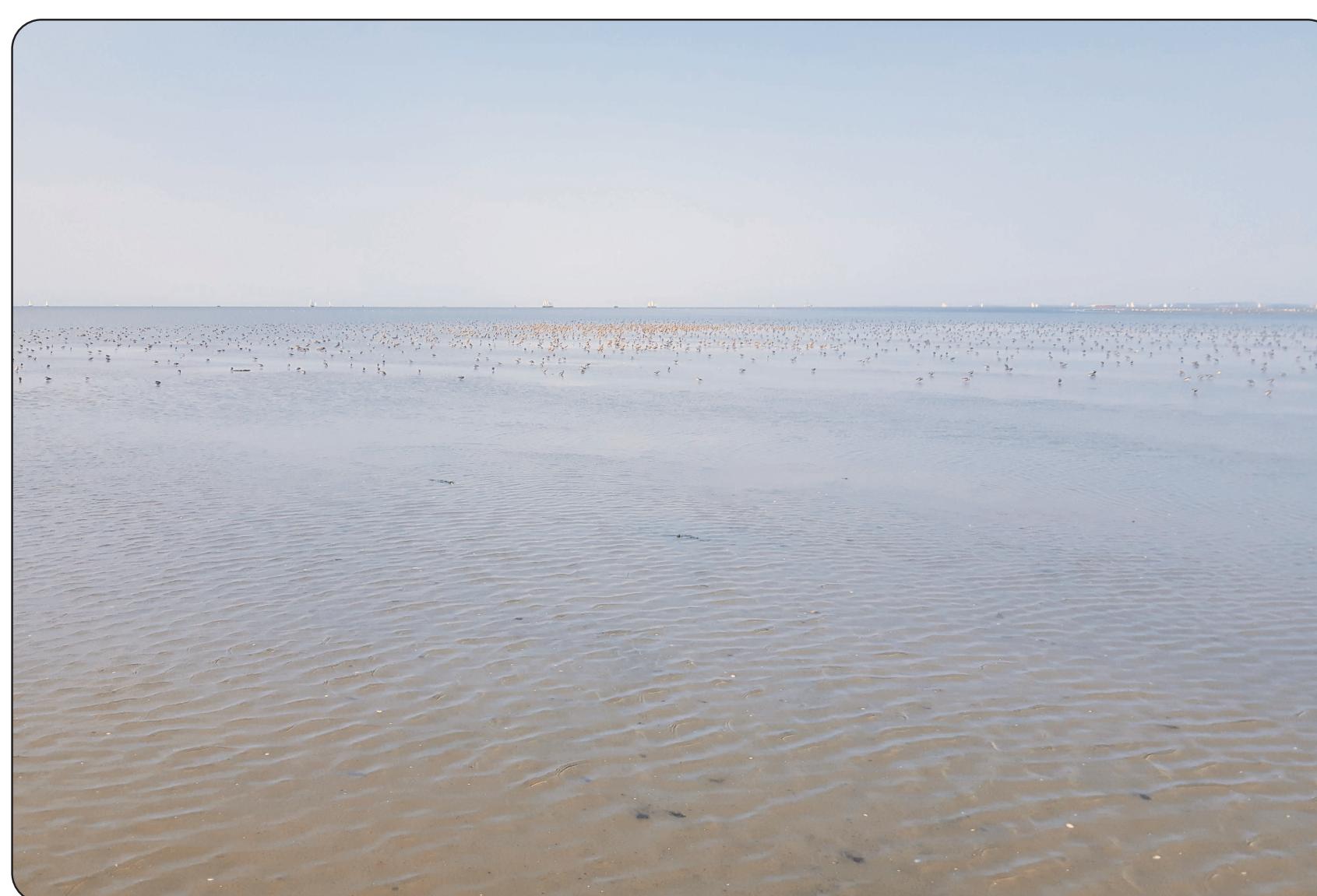


Fig. 1 Wadden Sea mudflats at low tide, with foraging waders

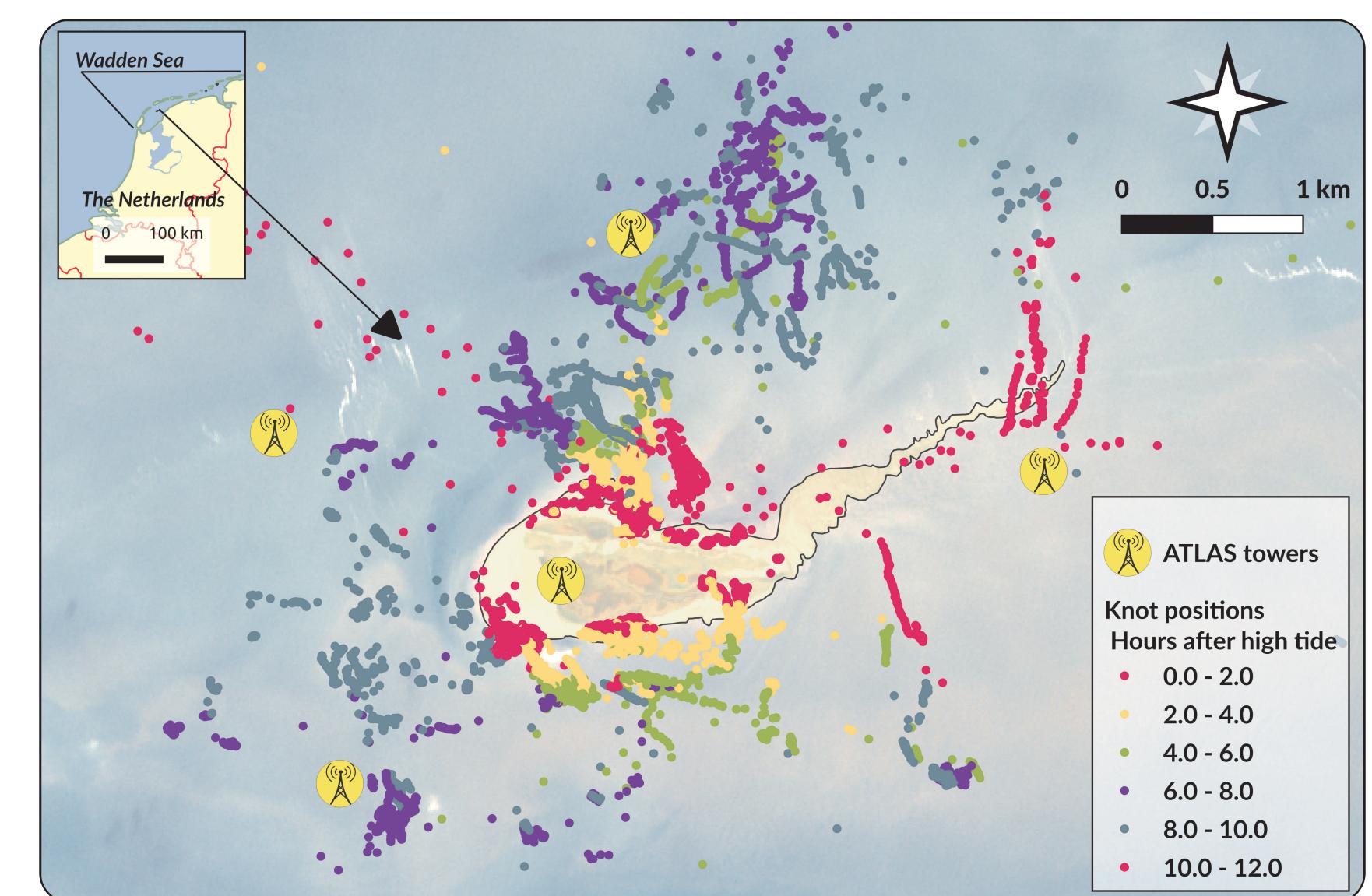


Fig. 2 Study area; ATLAS tower locations; knot positions coloured by hours after high tide.

We ask: Do knots have 'friends'?

METHODS

ATLAS tracking

Over a 19-day tracking period (23 Aug – 11 Sep 2017), we collected position data from 35 tagged knots. Tags (4.2 g, 1 Hz, aggregated over 1 minute) emit radio signals allowing the triangulation of position by an array of five ATLAS towers (Fig. 2).

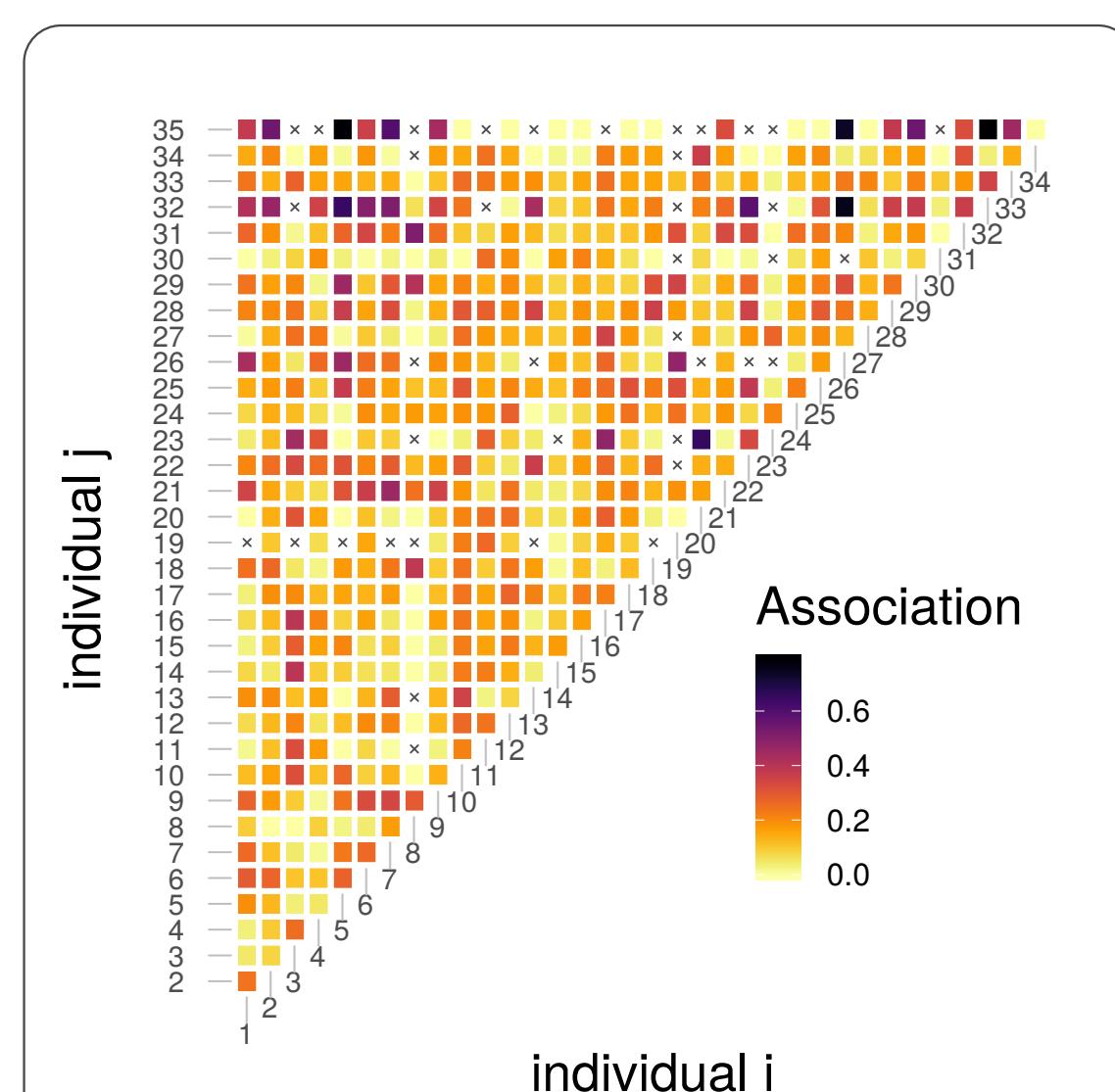


Fig. 3 Red knot pairwise association over all tides

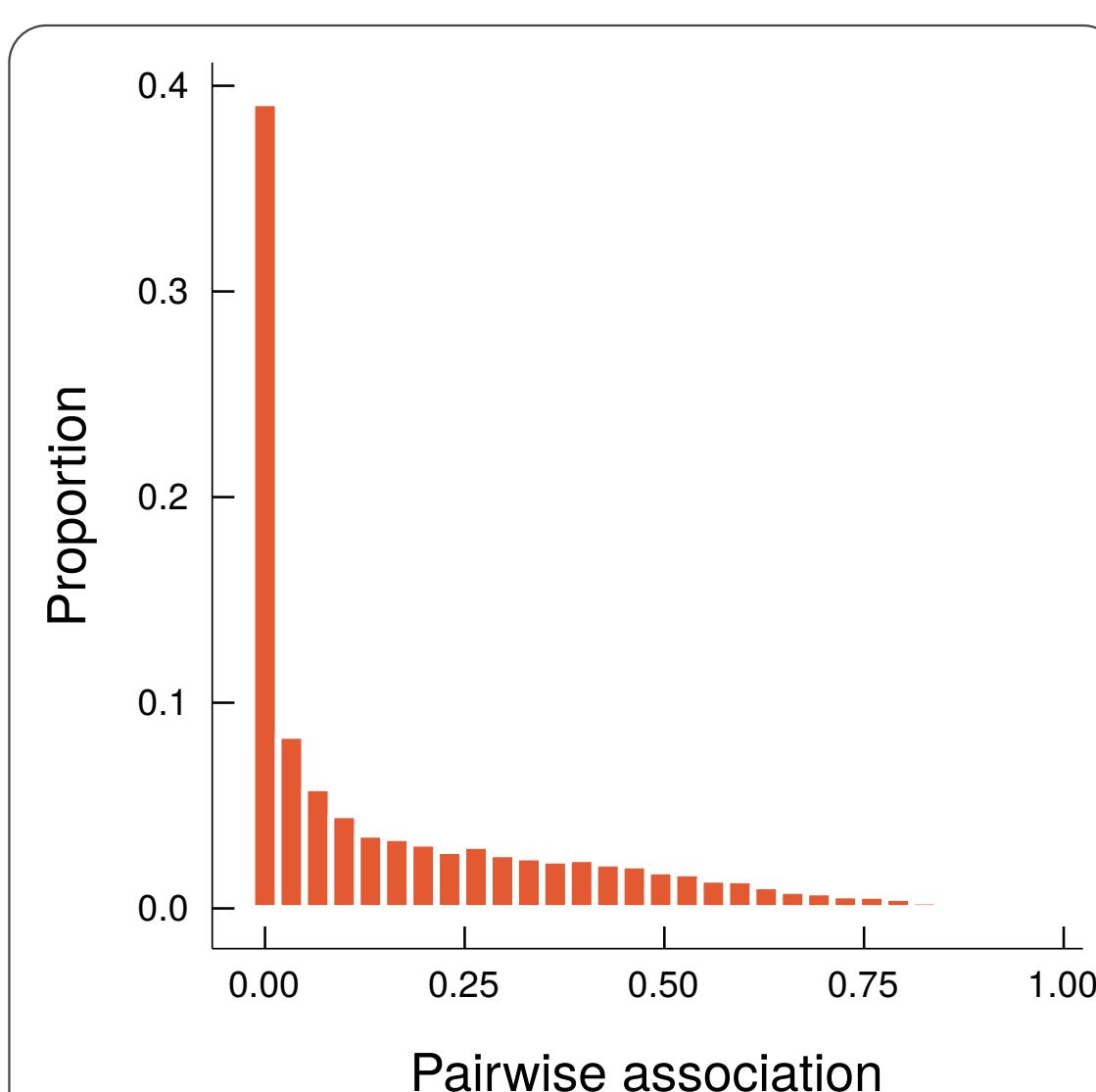


Fig. 4 Overall association distribution over all tides



Courtesy Benjamin Gnepp

Tidal intervals

We determined tidal intervals (high tide to high tide) – 44 tidal intervals over 19 calendar days, and analysed each knot's positions and association with other knots between and within tidal intervals (eg. Fig. 2).

Knot association c_{ij}

We calculated the number of times that the positions of two individuals i and j were both known as n_{ij} and association between them as c_{ij} , the proportion of n_{ij} when the distance between i and j was ≤ 250 m;

c_{ij} varies from 0 (= the distance between the birds was always > 250 m) to 1 (= the distance was always ≤ 250 m);

We obtained one c_{ij} value per pair per tidal interval, for a maximum of 44 values per pair.

RESULTS

Association is skewed, 10% pairs are 'friends'

- 1 c_{ij} was strongly skewed (mean \pm SD = 0.14 ± 0.3 ; Fig. 3, 4);
- 2 ~80% pairwise c_{ij} distributions were not different from the overall c_{ij} distribution (Kolmogorov-Smirnov test);
- 3 10.5% of pairwise c_{ij} were higher than expected by chance; 10% were lower than expected by chance.

Knot associations are tidally forced

c_{ij} was highest during the receding tide (0 – 3 hours post high tide, 95% CI = 0.22 ± 0.008) and substantially lower in the advancing tide (10 – 12 hours post high tide, 95% CI = 0.12 ± 0.007) and around low tide (4 – 9 hours post high tide, 95% CI = 0.11 ± 0.005).

CONCLUSIONS

- 1 Most knots, like other waders^{3,4}, have no 'friends';
- 2 However, 20% of pairwise associations are different from random expectation – 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.

Acknowledgements We thank Emma Penning, Eva Kok, Benjamin Gnepp & Anne Dekkinga for help in the field, & Frank van Marseveen for technical support with the ATLAS system; the RV Navicula crew for logistical support, & many volunteers & NIOZ staff for technical assistance; Ingeborg Jansen of RUG for administrative support; Rijkswaterstaat for Harlingen harbour water level data; Yotam Orchan, Ran Nathan & Sivan Toledo for help setting up the ATLAS system in the Dutch Wadden Sea.

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.*