Behavioural responses to the loss of key social relationships in a wild bird system

Keywords: natural populations, animal networks, applied network analysis, ecology, dynamic systems

Extended Abstract

The social structure of many natural populations can be quantified and analysed as social networks. Using this framework, the social lives of many animal species have now been measured and described, providing a general model for understanding real-world societies (Wey et al. 2008). Network approaches have allowed insights into disease spread (Sah, Mann, and Bansal 2018), social learning (Kurvers et al. 2014), and group structure (Sueur and Maire 2014). However, many practical applications of social network science treat natural animal social networks as static (Farine 2018). In reality, natural populations are dynamic and ever-changing, with individuals joining and leaving the network through the processes of birth, death, and migration (Shizuka and Johnson 2020). Individual animals are likely to respond to these network changes, adjusting their own behaviour in response to changes in their social environment (Firth et al. 2017).

Understanding individuals embedded within natural populations as connected actors in their networks, who respond to changes in their social relationships, is an important step in quantifying the complex dynamics of real-world social networks. Animals hold various social relationships that are particularly important to their survival and reproduction, such as relationships between breeding pairs of individuals (Firth et al. 2015). An individual who experiences the loss of a breeding partner may exhibit behavioural changes to respond to or compensate for this loss; this may create a knock-on effect across the network structure.

Studying social responses to key relationship loss in a real-world social network requires a high volume of individual level social network data. For this research, we used a long-term study of wild great tits (*Parus major*) in Oxford, UK, as a model system with high-resolution of both breeding and individual social network data. We aimed to identify dyadic responses of pairs to ‘divorce’ (the separation of a breeding pair) and individual responses to ‘widowing’ (the death of a mate). We used these measures to assess how individuals adjusted their network position in response to changes in important associations. Understanding how individuals in real systems adjust their own network traits is crucial for building a realistic picture of the dynamism and complexity inherent to animal networks.

We show that pairs which were ‘divorcing’ (breeding together one year and not in the next) had significantly lower association strength in the period between breeding attempts, when compared to pairs which remained breeding together across both years (Figure 1). As such, this model system shows how the association strength of network dyads in wild animal social networks can reflect social changes in wider contexts, such as breeding and reproduction. The significantly higher association strength between ‘faithful’ pairs suggested that individuals invest into this important relationship. We hypothesised that this would lead to changes in individual network position after widowing, as individuals would aim to build an association with a new partner. However, we found no active behavioural response.

These findings show the diversity of real individual social responses to changes in network structure and social relationships. They emphasise animal social network complexity, the dynamic and responsive nature of animal actors, and provide a foundation for further work and approaches considering how real social networks dynamically respond to loss.

Ethical considerations: All work was subject to review by the Department of Zoology (University of Oxford) ethical committee and adhered to UK standard requirements. Animal handling was conducted under the appropriate BTO licenses, as part of ongoing work.

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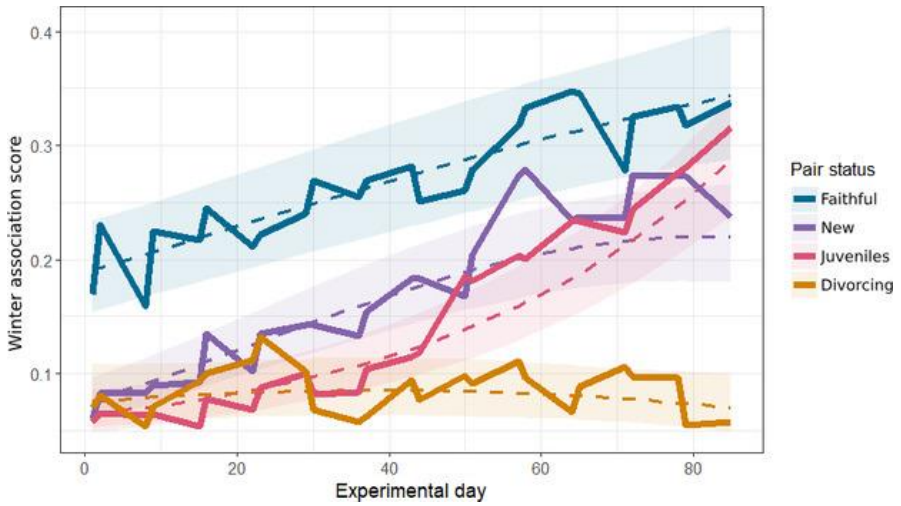

Figure 1: The predicted and observed association between experimental day and winter association score. Dashed lines represent the predicted value from a binomial GLMM, and ribbons a 95% CI around that prediction. Solid lines are the average values from raw data.