Occupancy of wild southern pig-tailed macaques in intact and degraded forests in Peninsular Malaysia

Anna Holzner, D. Mark Rayan, Jonathan Moore, Cedric Kai Wei Tan, Laura Clart, Lars Kulik, Hjalmar Kühl, Nadine Ruppert and Anja Widdig

Supplemental Methods

Occupancy modelling

MacKenzie et al. (2006) described occupancy as the probability with which a species occurs at a specific site. Yet, during wildlife surveys, individuals often remain undetected though being present, which may ultimately cause underestimation of site occupancy or biases in estimates of local colonization and extinction (MacKenzie et al., 2003). Animals' detection may further vary over time, due to environmental factors, or as a result of observational differences. Occupancy models account for imperfect and varying detection probabilities by linking a state model determining occupancy (ψ) with an observation model determining detection (p, MacKenzie et al., 2002).

Statistical Analysis

Occupancy analyses were implemented using the package 'unmarked' (version 1.0.1, Fiske & Chandler, 2011) in R (version 3.4.4, R Core Team, 2018). Dynamic and single-season occupancy models for PFR and BTFC, respectively, were fitted using the functions *colext* and *occu* from this package. Candidate models based on all possible combinations of predictor sets were built using the function *dredge* from the package 'MuMIn' (version 1.43.17, Barton, 2020). Model averaged estimates were obtained using the function *model.avg* from the package 'MuMIn'. The goodness of fit of the global models was tested using the function *mb.gof.test* from the package 'AICcmodavg' (version 2.3.1, Mazerolle, 2020).

Note that the functions *colext* and *occu* produce estimates on the logit scale (Fiske & Chandler, 2011). In order to back-transform them to the original scale, we used the function *predict* of the package 'unmarked'. Further, dynamic occupancy models provide estimates only for first-year occupancy. Predictions for subsequent years were derived from the two parameters governing the dynamics, i.e., extinction and colonization, using the function *smoothed* from the package 'unmarked'. Unlike the projected trajectory that precisely follows the model, the smoothed trajectory is informed by both the model as well as the sample data, thus having been suggested to provide a better representation of the true pattern of occupancy dynamics (Weir, Fiske & Royle, 2009).

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