

Supplementary Material

Appendix S1. Glossary

Breeding dispersal – movement between sites of consecutive breeding opportunities (Greenwood 1980; Daniels & Walters 2000). Breeding dispersal is not limited by the success of breeding attempts but may occur following the death of a mate or reproductive failure (Greenwood 1980).

Connectivity – we consider three types of connectivity, based on Lindenmayer & Fischer (2006):

1. *habitat connectivity*: the connectedness of habitat patches for a given taxon
2. *landscape connectivity*: the physical connectedness of patches of native vegetation as perceived by humans
3. *ecological connectivity*: the connectedness of ecological processes at multiple spatial scales.

Corridor – a linear, two-dimensional landscape element that connects two or more patches of wildlife habitat that were connected in historical time, and that functions as a conduit for animals (Soule & Gilpin 1991).

Dispersal – intentional movement of individuals in which they leave their home range, sometimes establishing new home ranges (Lidicker 1975). This movement can be short term in search of resources or mates, or long term to establish a new home range.

Dispersion – the overall pattern of distribution of individuals, home ranges or territories within a population (Clark & Evans 1954). Dispersion is often referred to as the distance between individuals, which can be uniform, random or clumped, and is influenced by the species' social structure.

Forest bird – a species or subspecies whose individuals are found mostly in forest communities throughout their range and life cycle (Innes et al. 2010; Table 1). We exclude species that occasionally or historically used mainland forests but are now primarily associated with wetlands (pāteke *Anas chlorotis*, grey duck *Anas superciliosa*, whio *Hymenolaimus malacorhynchos*, matuku / bittern *Botaurus poiciloptilus*, mātātā / fernbird *Poodytes punctatus*), or alpine areas (takahē *Porphyrio hochstetteri*, rock wren *Xenicus gilviventris*).

Gap crossing – movement across non-preferred habitat that provides little or no short-term refuge for forest birds, such as pasture or ocean.

Habitat – an area with a combination of resources (e.g. food, cover, water) and environmental conditions (e.g. temperature, precipitation, predators and competitors) that promote occupancy by individuals of a given species and allows those individuals to survive and reproduce (Morrison 2009). Note that habitat is a species-based concept (Hall et al. 1997), and that it includes predators, despite New Zealanders frequently equating 'habitat' to 'a kind of vegetation' and being an attribute separate to the presence of mammalian pests.

Home range – area occupied by an individual or group in its normal day-to-day activities, such as foraging, mating and caring for young (Burt 1943). A home range is usually static during a season, but can change between seasons depending on environmental conditions, food availability, and recruitment and dispersal events. Migratory species can have breeding and non-breeding home ranges.

Migration – round-trip seasonal movement, usually between breeding and non-breeding grounds (Jönsson et al. 2016). *Obligate or regular migration* occurs when individuals migrate

consistently from a breeding site, while *facultative or irruptive migration* occurs when individuals move in response to conditions at the time. *Partial migration* is often observed in the latter, where the timing, direction and distance travelled can be highly variable between individuals and, at the population level, between years (Berthold 2001; Newton 2012).

Natal dispersal – the process through which immature individuals permanently depart their natal area (place of birth) to their first breeding site (Greenwood 1980; Studds et al. 2008).

Natal philopatry – the tendency of an individual to return to, or remain in, its birthplace to reproduce (Greenwood 1980; Jones 1984).

Post-release dispersal – immediate dispersal of individuals following translocation of individuals from a source site to a release site (Richardson et al. 2015). Post-release dispersal occurs prior to the establishment of a permanent territory and is not necessarily representative of natural dispersal patterns.

Territory – any area that is actively defended by an individual (Noble 1939). Most territories are located around specific breeding or nesting locations (sexual territories) but can occur in non-breeding areas where refuges or important resources can be found (Greenwood 1980).

References

- Berthold P 2001. Bird migration: a novel theory for the evolution, the control and the adaptability of bird migration. *Journal für Ornithologie* 142: 148–149.
- Burt WH 1943. Territoriality and home range concepts as applied to mammals. *Journal of Mammalogy* 24: 346–352.
- Clark PJ, Evans FC 1954. Distance to nearest neighbor as a measure of spatial relationships in populations. *Ecology* 35: 445–453.
- Daniels SJ, Walters JR 2000. Between-year breeding dispersal in red-cockaded woodpeckers: multiple causes and estimated cost. *Ecology* 81: 2473–2484.
- Greenwood PJ 1980. Mating systems, philopatry and dispersal in birds and mammals. *Animal Behaviour* 28: 1140–1162.
- Hall LS, Krausman PR, Morrison ML 1997. The habitat concept and a plea for standard terminology. *Wildlife Society Bulletin* 25: 173–182.
- Innes J, Kelly D, Overton J, Gillies C 2010. Predation and other factors currently limiting New Zealand forest birds. *New Zealand Journal of Ecology* 34: 86–114.
- Jones WT 1984. Natal philopatry in bannertailed kangaroo rats. *Behavioural Ecology and Sociobiology* 15: 151–155.
- Jönsson KA, Tøttrup AP, Borregaard MK, Keith SA, Rahbek C, Thorup K 2016. Tracking animal dispersal: from individual movement to community assembly and global range dynamics. *Trends in Ecology & Evolution* 31: 204–214.
- Lidicker WZ Jr 1975. The role of dispersal in the demography of small mammals. In: Golley FB, Petruszewicz K, Ryszkowski C eds. *Small mammals: their productivity and population dynamics*. Cambridge, Massachusetts, Cambridge University Press. Pp. 103–128.
- Lindenmayer DB, Fischer J 2006. Tackling the habitat fragmentation pantheon. *Trends in Ecology and Evolution* 22: 127–132.
- Morrison ML 2009. *Restoring wildlife: Ecological concepts and practical applications*. Washington, DC, Island Press. 350 p.
- Newton I 2012. *Obligate and facultative migration in birds:*

- ecological aspects. *Journal of Ornithology* 153: S171–S180.
- Noble GK 1939. The role of dominance in the social life of birds. *The Auk* 56: 263–273.
- Richardson KM, Doerr V, Ebrahimi M, Lovegrove TG, Parker KA 2015. Considering dispersal in reintroduction and restoration planning. In: Armstrong DP, Hayward MW, Moro D, Seddon PJ eds. *Advances in reintroduction biology of Australian and New Zealand fauna*. Melbourne, VIC, CSIRO Publishing. Pp. 59–72.
- Soule ME, Gilpin ME 1991. The theory of wildlife corridor capability. In: Saunders DA, Hobbs RJ eds. *Nature Conservation 2. The Role of Corridors*. Chipping Norton, NSW, Surrey Beatty & Sons. Pp 3–8.
- Studds CE, Kyser TK, Marra PP 2008. Natal dispersal driven by environmental conditions interacting across the annual cycle of a migratory songbird. *Proceedings of the National Academy of Sciences* 105: 2929–2933.