Reading notes for intro and/or main

Notion of matrix : land use, cover and or environmental conditions tha tidffer from either species habitat or reference natural conditions

The nature of the matrix separating remaining habitat matters greatly for biodiversity in the Anthropocene (Stouffer et al, 2006)

Human land use has transformed 75-95% of the Earth’s ice free land area (Ellis, 2021)

“these changes in land use are creating a spatially pervasive and temporally dunamic matrix in which fragments of remaining natural areas are embedded”

There is increasing empirical evidence from global syntheses that the matrix can have effects as strong or stronger than the spatial attributes of habitat patches. […] More recently, an analysis of 4,426 terrestrial mammals indicated that matrix characteristics may be more influential than habitat loss in extinction risk (Ramirez Delgado et al, 202). There is also increasing evidence that the matrix can alter evolutionary processes, restricting gene flow and altering population differentiation across both short and long timescales (Balkenhol et al. 2016, Brusquetti et al. 2023, Jacob et al. 2020).

May be cool to steal Figure 1 : showing the influence of different land use patterns and matrix on different ecological processes

* Concept stems from island biogeography and the application of an island model to landscapes : only discrete patches of a focal cover type, ignoring all other variation in land cover. Definition with respect to a structural perspective (e.g natural condition)
* Population ecology view : Matrix often associated with species cannot successfully reproduce, or at least, reproduction occurs at a lowered rate (Cronin, 2007; Wiegand et al, 2005). Problematic definition as it is in relation to what it is not, e.g. it is not habitat and refers to a single species. Definition with respect to a functional perspective (species requirements)
* Landscape ecology view : matrix is any land use or land cover that does not belong to the focal land cover; matrix is the most dominant land-cover type other than the focal land-cover type (Turner & Gardner, 2015)

Notion of matrix heterogeneity, whether structural or functional (Fahrig et al, 2011). Heterogeneity can be **due to spatial or temporal variation in landscape composition or configuration.** *Very interesting point : we characterize landscape composition and configuration from a structural perspective, as we remain agnostic about what species are there, and the specific impact of landscape and matrix properties on functional traits.   
Spatial autocorrelation is important to characterize composition and configuration.*

Matrix effects can describe changes that occur in habitat or across land uses that arise from matrix heterogeneity, such as changes in species occurrence in fragments surrounded by different matrix types (Prugh et al. 2008) or changes in movement paths within the matrix due to variation in matrix permeability (Eycott et al. 2012).

Mechanisms for potential matrix effects have been elucidated at the patch and landscape scales (Figure 3). Patch-scale processes largely reflect effects driven by local variation in the matrix surrounding patches, often referred to as edge-type or edge-contrast effects (Ries et al. 2017, Sisk et al. 1997). Landscape-scale mechanisms tend to focus on movement processes and how variation in the matrix, such as matrix configuration, may alter expectations regarding movement between patches (Kennedy&Marra 2010, Ricketts 2001). Landscape-scale mechanisms also focus on the emergent properties that may arise from changes at both patch and landscape scales (e.g., as expectations for metapopulation viability driven by overall variation in between-patch dispersal) (Vandermeer & Carvajal 2001).

**Second, the matrix may alter movement (e.g., emigration, immigration), acting as either a barrier or facilitator of movement** (Eycott et al. 2012). In a related way, properties of the matrix can also alter the cues available about recipient patches, thereby altering the information landscape for dispersing individuals (Sweaney et al. 2022)

Five way the matrix matters :

* Local scale :
  + Spillover hypothesis : movement of materials, energy or individuals spill over across the patch-matrix boundary, and matrix contrast may alter the magnitude, energy and direction of spillover. Spillover may create cross boundary subsidies or spillover predation (e.g. predators from the djacent matrix consuming prey in patches), depending on which species or individuals move locally across patch matric boundary. **The matrix can sometimes impede spillover, generating a fence effect on movement out of patches, typically driven by matrix constrats (Kueffler et al, 2010)**
  + Ecosystem decay : harsh matrix conditions surrounding habitat patches can alter the local environment within patches (Driscoll et al, 2013), lowering fitness and/or demography of organisms within patches (driven by changes in abiotic conditions from the matrix)
* Landscape scale hypothesis:
  + Movement trajectory : resistance or permeability determines movement paths and speed for dispersers, such that matrix configurationlargely determines movement routes (Cushman et al, 2012)
  + Dispersal filter : matrix can alter the rate and identity of individuals that successfully dispers between patches because the matric alters dispersal mobility (Vandermeer & Carvajal, 2001). Slighlty different from previous because it includes a demographic component that focuses on variation in dispersal failure rather than simply how the matrix alters the routes that dispersers take
  + Resource availability : the type or quality of the matrix can increase population sizes in landscapes due to the additional resources provided by high quality matrix. Related to concepts of landscape supplementation and complementation (breed in habitat but forage in the matrix).

Matrix can alter evolution and selective regimes (Cheptou et al, 2017). For mobile species, selection may favor reduced use of patch edges and therefore lead to lower rates of emigration, patch-boundary crossing, and gene flow (Martin & Fahrig 2015). For less mobile species, tolerance and avoidance adaptations might be more likely to be selected. Adaptation to conditions at patch edges that are more similar to matrix conditions because of spillover may facilitate evolution toward using the matrix as habitat, an idea conceptually similar to issues in niche evolution and the evolution of range limits (Holt 2009), although at decidedly smaller spatial scales