Alec Robitaille, Quinn M.R. Webber, Julie Turner and Eric Vander Wal

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### Table 1

Multilayer networks are composed of layers, nodes and edges. Layers represent different types of relationships, types of entities, and spatial locations. Nodes represent individual entities in the network, connected by some association or relationship with edges. Interlayer edges connect layers to other layers or individuals across layers. Intralayer edges connect individuals to other individuals within a network layer.

In Table 1, we describe three types of multilayer networks that incorporate spatial variables. The edges are often abstracted because they no longer in the sense that they represent a specific spatial and temporal context, which

(Dale 2017) (Dickison, Magnani, and Rossi 2016) (Pilosof et al. 2017)

Layers represent the different types of relationships, individuals or contexts of the social system.

Relationships between individuals can be differentiated by their physical distance: communication or other high distance, grooming (physical contact), association (threshold distance)

Layers represent a type of edge (e.g.: grooming and association), entity (e.g.: male and female, or different species), or spatial context (e.g.: landcover type, patch).

Depending on the type of network, interlayer edges connect individuals to themselves across different contexts or to different individuals

multilayer networks with layers defined by spatially explicit locations, interspecific interactions, and community or subpopulation structure. Other types of networks, such as intercontexual networks or temporal networks, are likely only to incorporate spatial variables in a hybrid multilayer network and considerations for including those variables will be explored here

An animal’s social network is multifaceted and complex, though this system is often examined

How are layers defined, nodes defined, inter layer edges

We list variables affected by spatial and social scale

We use a definition of spatial scale from LE,

social scale is

|  |  |  |  |
| --- | --- | --- | --- |
| Type of network | Spatial network | Network of networks | Interspecific network |
| Layer | Defined by spatially explicit areas (e.g. discrete patches, landcover classes) | Defined by sub-networks (e.g.: subpopulations, communities, fuzzy patches) | Defined by different species |
| Nodes | 1. Individuals 2. Spatially explicit layers | 1. Individuals 2. Sub-network layers | 1. Individuals 2. Species-specific layers |
| Interlayer edges | 1. Connect individuals to themselves across layers 2. Connect spatially explicit layers to each other (e.g.: defined by euclidean distance) | 1. Connect individuals across sub-networks 2. Connect sub-networks to each other | 1. Connect individuals across species layers |
| Intralayer edges | 1. Connect individuals to other individuals within layers | 1. Connect individuals to other individuals within layers | 1. Connect individuals to other individuals within species layers |
| Social grain – intralayer | Type of interaction between individuals Chain rule (Croft, James, and Krause 2008) Spatiotemporal grouping threshold Temporal window of social interactions | For intra: see left. For inter: similarity, vulnerability |  |
| Spatial grain | Resolution | Number of fuzzy patches, subpopulation or community definition, | Spatial connectivity, |
| Image |  |  |  |

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