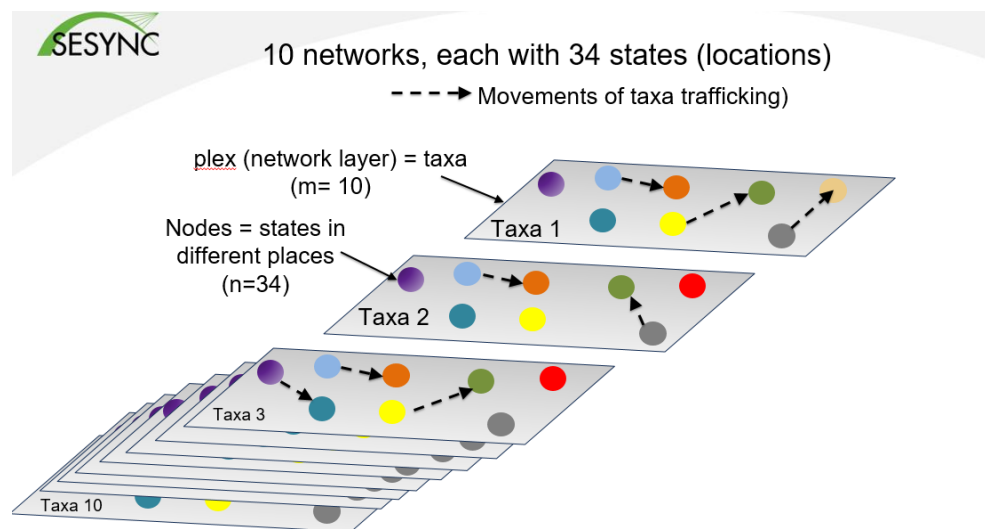


## Background Notes for

Arroyave et al. (2020). Multiplex networks reveal geographic constraints on illicit wildlife trafficking. *Applied Network Science* 5, 20. <https://doi.org/10.1007/s41109-020-00262-6>

When there are insufficient data to identify all the actors/entities in a network, proxies must be used. The Arroyave study addresses the “data-lacking” problem by using spatial proxies to represent actor behavior. Specifically, the researchers study illegal trafficking of wildlife in Colombia using data on confiscation of wildlife products from governmental departments (equivalent to states).

They take a multi-plex network approach with 10 plexes (network layers), each representing a different wildlife taxon ( $m_i$  to  $m_{10}$ ). Departments or states are the nodes (physical location of government regions) in these network layers and the links define the source-destination for illegal shipments for each taxon. This is illustrated in the figure below, but note that only a handful of nodes (states) in each layer are illustrated.



Using empirical confiscation data to analyze each network, they calculated various network properties (e.g., centrality metrics) to compare to null models (i.e., random network configurations). They also compared trafficking patterns among taxa and then looked at the aggregated (i.e., networks across all taxa) results. Note that in the illustration, movements of wildlife from the blue location (state) to the orange occurred in all three taxa networks shown, making it the most common trafficking path. The second most common path is the shipment of wildlife from the yellow location to the green location.

Studies of multiplex networks like this typically ask: Can the properties of the whole system (all networks (layers) together), be detected from the properties of the individual networks, or does some new system-level pattern emerge from the presences of multiple layers? And does that emerging pattern depend on the number of species (layers) included in the whole system? In this case, they want to know the general pattern of trafficking, regardless of the species.