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**Supplementary material S1.** Mathematical arguments demonstrating how connectance and the average of normalised degree give equal values in ecological networks.

Consider the case of the average of normalized input degree of prey where outputs come from predators ( $A_{d \rightarrow p}$ ), the average of normalized input degree for prey is calculated as:

$$\frac{\sum_p (I_p / S_d)}{S_p}$$

where the sum is over all prey in the CN. We can also write this as:

$$\frac{\frac{1}{S_d} \sum_p (I_p)}{S_p} = \frac{\sum_p (I_p)}{S_d \cdot S_p}.$$

Note that for arrows  $A_{d \rightarrow p}$ , the total of inputs  $\sum_p (I_p)$  overall preys is equal to the total of arrows  $L_{d \rightarrow p} = |A_{d \rightarrow p}|$ , that is to say:

$$\frac{\sum_p (I_p)}{S_d \cdot S_p} = \frac{L_{d \rightarrow p}}{S_d \cdot S_p}.$$

Note that the connectance predator-prey is calculated as  $L_{d \rightarrow p} / m_{d \rightarrow p}$ , since

$m_{d \rightarrow p} = m_{p \rightarrow d} = S_p \cdot S_d$  then:

$$\frac{\sum_p (I_p / S_d)}{S_p} = \frac{L_{d \rightarrow p}}{m_{d \rightarrow p}}$$

That is to say, the average of normalized input degree of prey is equal to the connectance of predator-prey.

Similar arguments can be applied to the next cases:

$$\frac{\sum_d(I_d/S_p)}{S_d} = \frac{L_{p \rightarrow d} \sum_p(I_p/(S_p - 1))}{m_{p \rightarrow d} S_p} = \frac{L_{p \rightarrow p}}{m_{p \rightarrow p}}$$

$$\frac{\sum_d(I_d/(S_d - 1))}{S_d} = \frac{L_{d \rightarrow d}}{m_{d \rightarrow d}}$$

We concluded that for arrows  $A_{p \rightarrow d}$ , the average of normalised input degree of predator is equal to connectance prey-predator; for arrows  $A_{p \rightarrow p}$ , the average of normalised input degree of prey is equal to connectance prey-prey; and for arrows  $A_{d \rightarrow d}$ , the average of normalised input degree of predator is equal to connectance predator-predator.

**Supplementary material S2.** Description of the final seven measures, their modifications, or their derivations when it was necessary, and their application in the study of avoidance or tracking behaviours.

### 1. Number of nodes ( $S$ )

The species richness observed within a landscape is an indicator of resources, habitat quality, and structure and can serve to monitor changes in communities (Magurran, 2021). In our CN, the number of nodes ( $S$ ) corresponds to the number of species in the network (Delmas, 2019). In our case  $S = S_p + S_d$  where  $S_p$  is the number of prey species and  $S_d$  is the number of predator species.

### 2. Number of links ( $L$ )

In ecological networks, links correspond to interactions (Delmas, 2019). The Higher the number of links in the network, the higher the number of interactions among species in the community. In our CN, a link is a significant co-occurrence between pairs of species within a specific time interval.

For our CN, we represented the number of links by  $L = |A|$ , where  $L$  is the cardinality of the set of arrows in the CN denoted by  $A$ . These arrows represented four kind of associations: 1) from predator to prey ( $A_{d \rightarrow p}$ ), i.e. the predator occurred after the prey, and can be interpreted as a tracking behaviour by the predator; 2) from prey to predator ( $A_{p \rightarrow d}$ ), i.e. the prey occurred after the predator, and it can be interpreted as no-spatiotemporal segregation of the prey from predator, as the prey coexist in the same locations as the predators, possibly due to limited alternative safe sites; conversely, if prey species do not

share spatial and temporal overlap (low number of links), it could imply that the landscape provides ample resources to support their presence in areas free of predators (Prugh, 2023; Van Scoyoc et al., 2023; Berger-Tal and Saltz, 2019); 3) from predator to predator ( $A_{d \rightarrow d}$ ); and 4) from prey to prey ( $A_{p \rightarrow p}$ ), in these cases links can be interpreted as intraguild competition, serving as a mechanism for coexistence where species share space and time in days. A high number of predator-prey could be interpreted as a high number of predators tracking prey, suggesting predators are performing an active hunting. On the predator-predator and prey-prey cases, a high number of links indicate a low intragremial avoidance, likely due to scarcity of resources, since there is no space for evasion.  $A$  is the disjoint union of these four sets, that is  $A = A_{d \rightarrow p} \cup A_{p \rightarrow d} \cup A_{d \rightarrow d} \cup A_{p \rightarrow p}$ .

### . 3. *Connectance* ( $L/m$ )

Global connectance is considered a measure of specialisation, it is an indicator of the complexity of the community, and it is useful for measuring changes between arrangements in communities (Kay et al., 2018). It was calculated as the number of significant co-occurrences ( $L$ ) divided by the total possible number of co-occurrences  $m$ . The connectance varies between 0 and 1; when it is close to 1, the network is almost entirely connected (Delmas et al., 2018; Wells et al., 2014; Blüthgen et al., 2006). In our approach,  $m_{d \rightarrow p} = m_{p \rightarrow d} = S_p \cdot S_d$  is the total possible number of co-occurrences between predator and prey and vice versa. On the other hand,  $m_{d \rightarrow d} = S_d \cdot (S_d - 1)$  and  $m_{p \rightarrow p} = S_p \cdot (S_p - 1)$  are the total possible number of co-occurrences among predators and prey species, respectively, not interacting with themselves. The global connectance was

obtained dividing  $L$  by the total possible number of co-occurrences, that is  $m = 2(S_p)(S_d) + (S_d)(S_d - 1) + (S_p)(S_p - 1)$ .

Connectance, in this context, is a measure that describes how much behaviour interactions are occurring in the landscape. A low value, close to zero, is indicative of strong spatiotemporal segregation between species, while a high value, close to one, suggests that species are more likely to interact in space and time.

We measured the following types of connectance for every type of co-occurrence: 1) predator-prey,  $L_{d \rightarrow p} / m_{d \rightarrow p}$ ; 2) prey-predator,  $L_{p \rightarrow d} / m_{p \rightarrow d}$ ; 3) among predators,  $L_{d \rightarrow d} / m_{d \rightarrow d}$ ; and among prey,  $L_{p \rightarrow p} / m_{p \rightarrow p}$ .

For each type of co-occurrence, a value of 0 indicates high spatiotemporal segregation, while values close to 1 indicate high spatiotemporal aggregation. In the case of connectance predator-prey, values close to 0 could be interpreted as predators not actively seeking prey, i.e., they are probably engaging in opportunistic hunting behaviour; whereas values close to 1 suggests a tracking behaviour. On the other hand, connectance prey-predator, low values suggest an avoidance. And values close to 1 describe coexistence.

#### 4. Normalised degrees

The degree of a node is basically the sum of the inputs and outputs in the network (Koutrouli et al., 2020; Delmas et al., 2019; Kéfi et al., 2015). The degrees are an indicator of the contribution of species to network robustness and describe the importance of the species in the community (Araújo et al., 2011). Since CN is a directed network, there are two types of degrees: input and output degrees. Due to communities having differences in the number of

species, we normalised the input and output degrees (also known as centrality degree; Delmas et al. 2019) allowed us to compare CN of different landscapes.

#### 4.1. Normalised input degree

Normalised input degree is calculated as the number of arrows  $I_q$  with heads in the node  $q$ , which is the input degree, divided by the total number of possible inputs for the node. The values of the normalised input degree vary between 0 and 1. In this study is calculated as:

- For a prey  $p$ , we consider two possible normalised input degrees, one from predators and another from other prey; the first may reflect that the prey is preferred by predator species (predators tracking it). It is calculated as  $I_p/S_d$ . Values close to 1 indicate the prey is tracked by a high number of predators, suggesting prey had a high vulnerability. The second indicates how much prey species are using the same site in the presence of other prey; it is calculated as  $I_p/(S_p - 1)$ ; a low value, close to 0, which indicates prey are avoiding them due to resources being dispersed in the landscape, whereas values close to 1, indicate a high number of prey species are using the same site.
- For a predator  $d$ , we consider two possible normalised input degrees; in the first case, we consider arrows with tails from other predators and heads in  $d$ , it is calculated as  $I_d/(S_d - 1)$ ; in the second case, we consider arrows with tail from prey species and head in  $d$ ; it is calculated as  $I_d/S_p$ . For a predator, a normalised input degree close to 1 could mean prey or competitors are not displaying spatiotemporal avoidance, and values close to 0 indicate prey or competitors are avoiding it.

#### 4.2. Normalised output degree

Normalised output degree is calculated as the number of arrows  $O_q$  coming out of a node divided by the total number of possible outputs for a node, this measure varies between 0 and 1. In this study, it is calculated as:

- For a prey  $p$ , we consider two possible normalised output degrees, one from predators and another from other prey; in the first case, this value could be interpreted as no spatiotemporal avoidance of prey to predators since they are co-occurring in the same sites, although within one or several days of difference; it is calculated as  $O_p/S_d$ ; in the second case, value expresses how prey species are using the same sites, it is calculated as  $O_p/(S_p - 1)$  (it is equal to prey normalised input degrees).
- For a predator  $d$ , we consider two possible normalised output degrees; in the first case, we consider arrows with tail from predator  $d$  and head in another predator and it is calculated as  $O_d/(S_d - 1)$ ; in the second case, we consider arrows with tail from predator  $d$  and head in a prey, it is calculated as  $O_d/S_p$ . For predators, a normalised output degree to prey close to 1 suggests tracking behaviours for several prey (generalist behaviours). The normalised output degree among predators indicates how much these species are avoiding among them, values close to 0 indicate high avoidance, whereas values close to 1 indicate low avoidance.

#### 6. Distribution of the input and output degrees

It is a measure of the relative frequencies of the normalised input and output degrees in the networks. It shows how much predators track prey or how much prey tolerate sites where predators occur. Describe how the number of links are distributed in species in the network.

The normalised input and output degrees are values for each of the species and it shows the individual species behaviour, whereas the distribution of the input and output degrees shows the behaviour of the mammal community. For example, high frequencies in the maximum input degree indicate that the species are co-occurring, unlike high frequencies in the minimum input degree, in this case, we infer that the species are not co-occurring. Therefore, graphically we can know if there is avoidance or co-occurrence in the mammal community.

#### *7. Cumulative frequency of links through time intervals (CFL)*

A landscape accumulating links faster indicates species are co-occurring in nearest time in the sites; likely as a consequence of habitat condition and resources, species are being obligated to frequent sites despite having been previously visited by another species. Since the co-occurrence networks involve time intervals, here we propose a measure describing the accumulation of links in time. Rapid accumulation of links suggests lowest avoidance among species in the community, because time intervals are occurring in the first days; whereas accumulation of links along the days indicate strong avoidance, species are occurring several days after the predator or competitor. For every time interval, there are a certain number of links in the network, this gives a relative frequency for each time interval, which is represented as  $L_t/L$  where  $L_t$  is the number of links for the time interval  $[0, t]$ . The cumulative frequency is calculated by adding each relative frequency until a certain day  $T$  (specific time interval), is represented as

$$CFL_T = \sum_{t=0}^T \frac{L_t}{L} = \frac{1}{L} \sum_{t=0}^T L_t .$$

The greatest value of  $CFL_T$  will always be equal to 1 for the day 20 or before when we cumulated all the links. A high value in the first time intervals ( $T$ ) indicates a high connectivity or interactions among species, i.e. they are co-occurring closely; whereas low values indicate species are displaying avoidance.

Relative frequency can be calculated for prey-predator as  $(L_t)_{p \rightarrow d} / L_{p \rightarrow d}$ , for predator-prey as  $(L_t)_{d \rightarrow p} / L_{d \rightarrow p}$ , for predator-predator as  $(L_t)_{d \rightarrow d} / L_{d \rightarrow d}$ , and for prey-prey as  $(L_t)_{p \rightarrow p} / L_{p \rightarrow p}$ . The  $CFL_T$  for each case, can be calculated by adding the respective relative frequency until a certain day  $T$ .

Table S1. Simulated association scenarios between species A and B, to assess the accuracy of the approach to infer co-occurrence behaviour in mammal communities. Species A passed in the same station before species B.

<b>Species A</b>	<b>Species B</b>	<b>Supposed behaviour association</b>	<b>Interval of time between associations</b>	<b>Interpretation</b>
Predator 13	Prey 1, 2, 3, 4	None	Completely random	An opportunistic predator, which does not perform a tracking behaviour for any prey.
Predator 14	Prey 5	Weak tracking	10 – 12 days	The predator weakly follows the prey.
Predator 14	Prey 8	Tracking	1 day	Co-occurrences are very nearby. Predators actively follow prey. It is the case when the predator prefers or bases their diet on a limited resource.
Predator 15	Prey 9	Tracking	2 – 4 days	Predators follow prey moderately. A prey resource that predator consumes, but it does not strongly

depend on it as a primary source.

Predator 15	Prey 12	Active tracking	1 day	Co-occurrences are very nearby. Predators actively follow prey. It is the case when the predator prefers or based their diet over a limited resource.
Prey 6	Predator 14	Strong avoidance	10 – 12 days	Prey spend a long time to occur in sites visited by predators
Prey 7	Predator 14	Moderate avoidance	3 – 5 days	Prey moderately avoid sites visited by predators
Prey 8	Predator 14	Weak avoidance	1 day	Prey do not avoid predator, occurring in the nearest day after predator
Prey 10	Predator 15	Strong avoidance	10 – 12 days	Prey spend a long time to occur in sites visited by predators
Prey 11	Predator 15	Moderate avoidance	3 – 5 days	Prey moderately avoid sites visited by predators

Prey 12

Predator 15

Weak  
avoidance

1 day

Prey do not avoid  
predator,  
occurring in the  
nearest day after  
predator

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Table S2. Characteristics of the camera-trap stations in four landscapes in southern Mexico, where co-occurrence networks of predators and prey were studied.

<b>Landscape</b>	<b>Relief (%)</b>	<b>Tree cover average (%)</b>	<b>Distance to rivers average (m)</b>	<b>Distance to roads average (m)</b>	<b>Distance to settlements average (m)</b>	<b>Elevation average (m)</b>	<b>Day sampling (day trap)</b>
1	38.2	69.5	1386.4	10158.9	2345.2	173.9	1187
2	47.5	66.5	2276.3	3633.5	1395.5	330.8	1075
3	65.8	72.7	2293.5	13124.9	2297.1	947.2	677
4	61.6	71.2	696.7	11085.8	1724.8	1018.1	1074

Table S3. Measurements obtained from co-occurrence networks describing interval times between simulated predators and prey.

<b>Metric</b>	<b>Simulation one</b>	<b>Simulation two</b>
1. Number of nodes ( $S$ )	15	15
Number of prey ( $Sp$ )	12	12
Number of predators ( $Sd$ )	3	3
2. Number of links ( $L$ )	57	42
Links predator-prey ( $Ld \rightarrow p$ )	9	10
Links prey-predator ( $Lp \rightarrow d$ )	10	11
Links prey-prey ( $Lp \rightarrow p$ )	36	20
Links predator-predator ( $Ld \rightarrow d$ )	2	1
3. Connectance ( $L/m$ ) $m = 2(Sp)(Sd) + (Sd)(Sd-1) + (Sp)(Sp-1)$	0.27	0.20
Connectance predator-prey ( $Ld-p/m d-p$ ) $m = (Sp)(Sd)$	0.25	0.27
Connectance prey-predator $Lp-d/m p-d$ $m = (Sp)(Sd)$	0.27	0.30
Connectance prey-prey $(Lp-p/m p-p)$ $m = (Sp)(Sp-1)$	0.27	0.15
Connectance predator-predator ( $Ld-d/m d-d$ ) $m = (Sd)(Sd-1)$	0.33	0.16
5. Average of normalized degree		
5.1. Average of normalized input (and output) degree of prey ( $d \rightarrow p$ )	0.25	0.27

5.2. Average of normalized input (and output) degree of prey (p->d)	0.27	0.30
5.3. Average of normalized input degree among preys (p->p)	0.27	0.15
5.3. Average of normalized input degree among predators (d->d)	0.33	0.16

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Table S4. Normalised input degree for prey species in four landscapes in southern Mexico.

Species	Landscape	Landscape	Landscape	Landscape
	one	two	three	four
<i>Cuniculus paca</i>	0	0	0	0.33
<i>Dasyprocta mexicana</i>	0	0.33	0.33	0
<i>Dasypus novemcinctus</i>	0	0	0	0
<i>Didelphis spp.</i>	0	0	---	0
<i>Eira barbara</i>	0	0	---	0.33
<i>Mazama temama</i>	---	0	0	0
<i>Nasua narica</i>	0	0	0.33	0
<i>Dicotyles spp.</i>	0	0.33	---	0
<i>Philander opossum</i>	0	0	---	0
<i>Procyon lotor</i>	0	0	---	---
<i>Sylvilagus spp.</i>	0	0	0	---
Average	0	0.06	0.11	0.07

Table S5. Normalised output degree for prey species in four landscapes in southern Mexico.

<b>Species</b>	<b>Landscape one</b>	<b>Landscape two</b>	<b>Landscape three</b>	<b>Landscape four</b>
<i>Cuniculus paca</i>	0	0.33	0.33	0
<i>Dasyprocta mexicana</i>	0	0	0.33	0
<i>Dasypus novemcinctus</i>	0	0	0	0
<i>Didelphis spp.</i>	0.33	0	---	0
<i>Eira barbara</i>	0	0	---	0
<i>Mazama temama</i>	---	0	0	0
<i>Nasua narica</i>	0.33	0	0	0.33
<i>Dicotyles spp.</i>	0.33	0	---	0.33
<i>Philander opossum</i>	0	0	---	0
<i>Procyon lotor</i>	0	0	---	---
<i>Sylvilagus spp.</i>	0	0	0.33	---
<b>Average</b>	<b>0.1</b>	<b>0.03</b>	<b>0.16</b>	<b>0.07</b>

Table S6. Normalised input degree for predator species in four landscapes in southern Mexico.

Species	Landsca pe one	Landsca pe two	Landsca pe three	Landsca pe four	Landsca pe one	Landsca pe two	Landsca pe three	Landsca pe four
	<b>Prey-Predator (<math>p \rightarrow d</math>)</b>				<b>Predator-Predator (<math>d \rightarrow d</math>)</b>			
<i>Leopard</i>								
<i>us</i>	0.1	0	0.5	0	0	0.5	0	0
<i>pardalis,</i>								
<i>Panthera</i>								
<i>onca</i>	0.2	0.09	0	0	0.5	0.5	0	0.5
<i>Puma</i>								
<i>concolor</i>	0	0	0	0.22	0	0	0	0
Average	0.1	0.03	0.16	0.07	0.16	0.33	0	0.16

Table S7. Normalised output degree for predators in four landscapes in southern Mexico.

Species	Landsca	Landsca	Landsca	Landsca	Landsca	Landsca	Landsca	Landsca
	pe one	pe two	pe three	pe four	pe one	pe two	pe three	pe four
Predator->prey					Predator->Predator			
<i>Leopardus pardalis</i>	0	0.09	0.16	0	0	0.5	0	0.5
<i>Panthera onca</i>	0	0	0	0.22	0	0.5	0	0
<i>Puma concolor</i>	0	0.09	0.16	0	0.5	0	0	0
Average	0	0.060	0.11	0.07	0.16	0.33	0	0.16