

An asymmetric percent similarity index

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Kunin (1995) proposed an asymmetric index of community similarity related to the Morisita index. The author pointed out that almost all similarity indices are symmetric, i.e., equal for the two parties compared, but that an asymmetric index may be more meaningful, particularly when dispersal and its effects are compared. The only previously proposed asymmetric index, according to Kunin, is that by Simpson (1960), which is based on Jaccard's index using species lists. However, this index does not allow abundances of species to be considered. The index proposed by Kunin can exceed the value of one. Izsák (1999) discussed the history of asymmetric association measures, and in particular, the index family containing the Morisita index, and the conditions for obtaining an index value exceeding one.

In the following, we draw attention to an asymmetric index based on the similarity index for niche overlap (e.g., Renkonen 1938, Pielou 1977: 317, Hurlbert 1978) and originally proposed by Rohde and Hobbs (1986). This index was applied to test whether congeneric fish parasites on the same host differ in their degree of niche overlap from non-congeners, but can be used to compare any quantifiable aspect of species in communities (see below).

The percent similarity index is

$$PS_{A,B} = 100 \sum_{i=1}^n \min(P_{iA}, P_{iB}),$$

where $PS_{A,B}$ = percent similarity of A and B , P_{iA} = proportion of individuals of species A in the i th microhabitat (relating to total number of individuals of species A), P_{iB} = proportion of species B in the i th microhabitat, n = total number of microhabitats.

The modified and asymmetric percent similarity index is

$$O_{A,B} = \frac{100S_A}{N_A} \sum_{i=1}^k \min(Q_{iA}, Q_{iB}),$$

$$O_{B,A} = \frac{100S_B}{N_B} \sum_{i=1}^k \min(Q_{iA}, Q_{iB}),$$

where $O_{A,B}$ = overlap of A with B , S_A = number of individuals of species A in those k microhabitats in which B also occurs; N_A = total number of individuals of species A in all microhabitats; Q_{iA} and Q_{iB} = quotients of the number of individuals of species A and B , respectively, in microhabitat i and the total number of individuals of each species in the k microhabitats in which they co-occur. $O_{B,A}$ = overlap of B with A , etc.

An example of the analysis in Rohde and Hobbs (1986) using both symmetric and asymmetric percent similarity indices is given in Table 1. The authors attempted to clarify whether interspecific competition or reinforcement of reproductive barriers is responsible for niche segregation in parasites inhabiting the gills of marine fishes, by comparing niche overlap of congeners and of non-congeners using the same resources. Overlap between congeneric pairs of fish parasites was compared with overlap between all non-congeners. Wilcoxon's two-sample test performed on the asymmetric indices (of which only one example is given in Table 1) showed that congeners overlap less than non-congeners ($t = 2.87$, $P < 0.01$). The results were not significant when symmetric percent similarity indices were used ($t = 1.79$, ns). The results suggest that the asymmetric index is more sensitive than the symmetric one. It has the advantage of being simple and of considering not only presence/absence data, but abundances of species as well. It can be used to measure similarities or differences of any parameter between species in communities that can be quantified, for example differences in the abundances of species (as in the example given by Kunin 1995), or differences in the sizes of individuals or their mobility. As with other indices, the proposed index allows computation of similarities between sets of

Table 1. Symmetric (top) and asymmetric (bottom) percent similarity indices for comparisons of congeneric and non-congeneric species pairs of ectoparasites of the mackerel *Scomber japonicus*. Indices for congeners are underlined. Numbers 1–9 refer to particular parasite species. Data from Rohde and Hobbs (1986).

	1								
	<u>18.86</u>	2							
	53.89	7.80	3						
	0.00	0.00	0.00	4					
	0.00	0.00	0.00	<u>0.00</u>	5				
	35.01	46.65	18.40	<u>0.00</u>	<u>0.00</u>	6			
	0.00	0.00	0.00	2.50	0.00	0.00	7		
	40.71	29.45	40.89	0.00	0.00	32.42	0.00	8	
	11.25	10.53	5.00	73.33	0.00	9.75	0.00	13.28	9
	1	2	3	4	5	6	7	8	9
1	<u>100.00</u>	<u>18.85</u>	42.39	0.00	0.00	28.88	0.00	40.71	47.49
2	<u>18.85</u>	100.00	3.58	0.00	0.00	45.63	0.00	29.45	35.18
3	63.90	44.95	100.00	0.00	0.00	37.87	0.00	52.99	55.56
4	0.00	0.00	0.00	100.00	<u>0.00</u>	<u>0.00</u>	2.32	0.00	87.14
5	0.00	0.00	0.00	<u>0.00</u>	100.00	<u>0.00</u>	0.00	0.00	0.00
6	38.76	49.78	10.77	<u>0.00</u>	<u>0.00</u>	100.00	0.00	40.35	46.54
7	0.00	0.00	0.00	46.43	0.00	0.00	100.00	0.00	0.00
8	40.71	29.45	34.98	0.00	0.00	30.26	0.00	100.00	66.02
9	6.33	4.69	2.78	73.33	0.00	5.43	0.00	8.80	100.00

species occupying two communities as follows: S_A now is the sum of individuals of each species in community A which also occurs in community B ; N_A is the total number of individuals of all species in community A ; Q_{iA} is the quotient of the number of individuals of species i in community A and the total number of individuals in both communities of the k species which occur in both communities.

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