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This Week's Citation Classic

Colwell R K & Futuyma D J. On the measurement of niche breadth and overlap. *Ecology* 52:567-76, 1971.
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Measures of range and similarity of resource use should be independent of relative abundance of species and of number of resource states considered, but should depend upon the degree of distinctness of resource states from a biological point of view. Niche overlap cannot be assumed to measure competition. [The *SCI*® indicates that this paper has been cited over 165 times since 1971.]

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"In a field course in tropical biology in 1966, given by the Organization for Tropical Studies, I dreamed up a rather wild-eyed scheme for testing R.H. MacArthur's conjecture that species in richer communities are ecologically more specialized than their counterparts in species-poor communities. My idea was to compare patterns of occurrence of arthropod species on banana lures in a tropical seasonal forest (lower diversity) and a rain forest (higher diversity), computing for each species some measure of its 'niche breadth' in terms of the range of conditions utilized during the progressive decay of the lure. At that time, there were no published measures of niche breadth. Sitting in the pitch-dark forest at 3 a.m. with pistol in hand, waiting in ambush for whatever varmint had been crushing my chicken-wire 'mammal-filters' to steal the rotting bananas, I first systematized the difficulties of standardizing measures of niche breadth for different ranges and varieties of resources.

"With improved lures and exclosures I expanded the project to cover latitudinal, elevational, and forest-successional patterns of species diversity,[1] using variance in time-of-occurrence within the decay period (standardized) as a measure of niche breadth. I was not entirely happy with this measure, since the observations were taken at regular clock intervals, whereas changes in the lures were increasingly gradual with advancing decay—a particular case of the problem of varying distinctness among what I called 'resource states' (the term has since come into general use). My graduate school officemate, Doug Futuyma, made the clever suggestion that the contribution of each resource state to a niche measure could be weighted according to the distinctness of the fauna or flora associated with that state—an 'ecoassay' of resources. With this conceptual foundation, I devised an information-theoretic index of the diversity of resources used by each species.

"Citations to Futuyma's and my paper are quite heterogeneous. Several papers expand on the methodological theme, or criticize our technique. A recurring and important criticism has been that the relative availability (or renewal rate) of resource states is not explicitly taken into account. If the necessary information is obtainable, better methods exist;[2] if not, our method is preferable to unweighted metrics, since it implicitly emphasizes 'populous' resource states.[3] Only a small proportion of the citations are by authors who actually use our technique. (One of these[4] makes a useful mathematical simplification of our niche breadth measures.) Others apologize for *not* using our technique, sometimes for good reasons. A quarter of the citations refer to a brief section in which we warned against the perils of equating niche overlap with competition; several authors then proceed to do so anyway. Apparently this was the first clear statement of the problem, although at the time it seemed to us a piece of conventional wisdom.

"Perhaps the true meaning of *Citation Classic* is the doubtful compliment implied in about five percent of the citations I looked up: 'Colwell and Futuyma 1971' appears in the references cited section, but nowhere in the body of the paper!"

1. **Colwell R K.** Toward a unified approach to the study of species diversity. (Grassle J F, Patil G P, Smith W K & Taillie C, eds.) *Ecological diversity in theory and practice.* Burtonsville, MD: International Co-Operative Publishing House, 1979. p. 75-92.
2. **Feinsinger P, Spears E E & Poole R W.** A simple measure of niche breadth. *Ecology* 62:27-32, 1981.
3. **Inger R F & Colwell R K.** Organization of contiguous communities of amphibians and reptiles in Thailand. *Ecol. Monogr.* 47:229-53, 1977.
4. **Clark R D.** Habitat distribution and species diversity of chaetodontid and pomacentrid fishes near Bimini, Bahamas. *Mar. Biol.* 40:277-89, 1977.