The 'species alias' problem

SIR — May and Nee[1] correctly raise the issue of synonymy — multiple names for single biological entities — as an important one for biodiversity studies. As Solow *et al.*[2] showed, roughly 20% of names for thrips proposed during this century are now regarded as synonyms. Using the time needed to detect the synonymy to model asymptotic levels, true synonymy rates may actually be closer to 40%. In discussing the general implications of this argument for biodiversity, May and Nee stated that rates of synonymy are lower among the more charismatic vertebrate groups, and that global estimates of diversity need to be correspondingly reduced to correct for these lacunae of misunderstanding.

Both of these important conclusions are debateable. Using an ongoing database for Neotropical mammals[3], it is possible to consider these points for roughly 25% of the world's mammal species. Across 12 terrestrial mammal orders, 1,173 species and 1,439 subspecies are currently recognized as valid, with another 2,143 names treated as synonyms. So defined, synonyms comprise 45% of all mammalian names, about twice the fraction demonstrated for thrips (this number actually climbs to 75% if subspecies are discounted). Synonymy rates for mammalian orders are not correlated with ordinal diversity (r_s=0.06), but are positively (not negatively) correlated with body size and presumed conspicuousness. The rank correlation between synonymy rate and mass (using order-of-magnitude values for each order) is r_s=0.755 (P<0.05). Rate estimates range from a low of 17% for the inconspicuous and poorly known shrew opossums (Paucituberculata) to 78% for tapirs (Perissodactyla; other groups, edentates 64%, opossums 64%, primates 59%, carnivorans 56%, ungulates 56%, monitos 50%, shrews 43%, bats 39%, rodents 36%, rabbits, 26%).

NOMENCLATUREL CHANGES FOR SPECIES OF NEOTROPICAL MAMMALS SINCE 1980[7]

Mammalian orders	(a)* Species both in 1982 and currently	(b) Synonyms newly sunk	(c) Synonyms newly elevated	(d) Names newly proposed
Didelphimorphia	52	21	9	3
Paucituberculata	5	2	0	1
Microbiotheria	1	0	0	0
Xenarthra	29	0	0	1
Lipotyphla	13	0	1	2
Chiroptera	236	6	23	11
Primates	46	1	29	7
Carnivora	54	0	4	0
Perissodactyla	3	0	0	0
Artiodactyla	17	0	2	0
Rodentia	479	32	105	35
Lagomorpha	2	0	0	0
Faunal totals	**937**	**62**	**173**	**60**

*Current species diversity estimate is the sum of columns (a) + (c) + (d)

Species concepts play central and underappreciated roles in all biodiversity matters[4], especially those involving species diversity and synonymy. Widespread acceptance of the biological species concept[5] led many taxonomists in the mid-twentieth century to treat earlier names as synonyms of large polytypic species. Modern workers, perhaps increasingly motivated by phylogenetic interests, place more emphasis on diagnosis of taxa and less on establishing their reproductive limits[6]. A result of this trend has been the resurrection of names that were earlier treated as synonyms. This tendency is documented for Neotropical mammals in the table : three-quarters of the names for all species recognized since 1980 had earlier been regarded as synonyms. Over this same time period, three times as many names were resurrected from synonymy as were newly sunk or newly proposed. Nearly 15% of the names for all valid species today were considered synonyms as recently as 1982[7]. (See also last week's issue[8])

Granted, lower resurrection rates might be expected among the invertebrate groups highlighted by May and Nee. Synonymies among less intensively studied groups are more likely to be a consequence of unwitting duplication of effort than of conceptual disagreement or revision. Nevertheless, synonyms are not purely errors in applying systematic classifications, but are also by products of the systematic concepts used. Although future investigations will assuredly reveal many current names to be synonyms of others now in circulation, changing systematic concepts and improved technologies for detecting and defining species will continue to breathe new life into yesterday's entombed synonyms.

B. D. Patterson
Department of Zoology
The Field Museum
Chicago, Illinois 60605-2496, USA

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In the red zone

SIR — The problem of whether temporal fluctuations in natural populations are composed mainly of low- or high-frequency variation is of theoretical as well as practical interest for ecological and evolutionary questions. Cohen[1] examined eight population models given by difference equations of the form $P_{t+1} = P_t \cdot f(P_t)$, where P_t is the population density at time t, and $f(P_t)$ is a density-dependent fitness function. He argued that high frequencies dominate in the power spectra of chaotic time series obtained from these models. This casts doubt on the usefulness of one-dimensional difference equations for modelling fluctuating population dynamics, because low frequencies are expected to dominate the spectra of natural time series[2,3].

It may, however, be too early for general conclusions. Cohen[1] reports results for a limited choice of parameters in each model, yet these models exhibit chaos for a broad

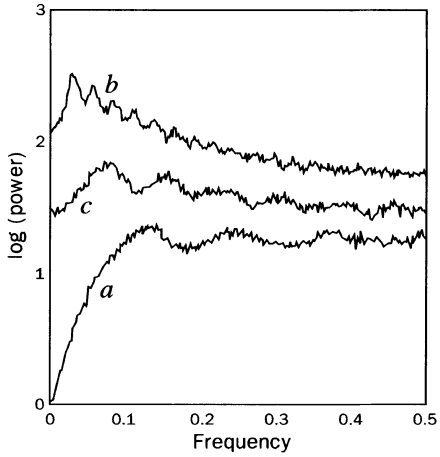

FIG. 1 Averaged power spectra for three one-dimensional models obtained using exactly the same method as Cohen[1]. Curve *a* results from the Ricker equation, with r = 4.7. With increasing r, the initial slope and the similarity with white noise increase, although the fluctuations in the corresponding time series become very large. Curve *b* results from the Maynard Smith model, with a = 0.02, r = 1.5 and b = 50.0, and curve *c* from Bellows' equation with a = 0.1, r = 3.0 and b = 4.8. Both spectra are reddened.