
Preface

In an age when the natural environment is under threat from habitat loss, pollution, and climate change, it is more important than ever that ecologists develop and employ uniform procedures for assessing the condition of all the canaries in the mine, so to speak. Unless results can be compared directly, confusion is likely to result. The lack of a universally accepted (theoretical) species-abundance distribution, along with appropriate methodology for assessment, hampers the field greatly. A widely accepted and well-established distribution would be greatly preferable to the present situation.

The natural focus of the population biology described in the following pages is not the species, but the community of which it forms a part. The behavior of populations may forever defy our efforts to quantify them beyond recognizing their fundamentally stochastic (i.e., random) nature. But a *community* of populations produces a collective behavior, population-wise, that almost always follows the same general pattern, a J-curve. It would seem that unpredictability, far from being a cause for despair, lies at the heart of the exact methods employed here and provides new theoretical horizons for a science that has suffered from a lack of (a) adequate contact with real data and (b) appropriate statistical methods. It would appear that a great deal more data is required for studies of abundance patterns than was formerly thought.

The J distribution described in this monograph appears to capture the ubiquitous shape of the J-curve. Mathematically, it could hardly be simpler, yet it is rather odd statistically, a hyperbola truncated by its axes. This form came as a surprise to me when I found that it was implied mathematically by the central hypothesis of this monograph, the stochastic species hypothesis. Ecologists, field biologists, and other readers of this monograph should have no trouble following the theorems and derivations that appear here, provided they have the minimum expected background of college calculus, probability, and statistics, along with high school algebra. The more involved derivations are left to an appendix, so as to pose minimum interruptions for the reader.

The order in which ideas are presented in this book may call for some patience from the reader. The definitions and applications of the hyperbolic theory are presented in advance of the theoretical arguments and empirical tests that establish the presence of the J distribution in natural communities. For those who wish to reassure themselves by reading ahead, the mathematical derivation of the J distribution from the stochastic species hypothesis will be found in Appendix A, while the empirical meta-study that establishes the presence of the J distribution in field samples of species abundances is the subject of Chapter 8. The stochastic species hypothesis, which leads directly and logically to the (hyperbolic) J distribution, is introduced in Section 1.6 of Chapter 1.

I have been fortunate in my relations with field biologists in assisting with the analysis of many of their datasets, not to mention microbial surveys conducted by me (Dewdney 1996, 2010). My feet, I should hope, are firmly on biological ground.

Crucial to such analyses has been the development of a variety of computer programs, as the reader will discover in the pages to come.

I have also been fortunate to enjoy a profession as mathematician along with some training in microbiology and an abiding interest in nature in a broad sense. It therefore seems natural to me to be managing an ATBI (All Taxa Biological Inventory) project in southern Ontario, even as I work on how populations behave within communities.

Note: In previous publications, I have called the J distribution by another name, the logistic-J distribution. The latter name has been dropped owing to confusion with the "logistic distribution" of Balakrishnan (1991), with which it has no particular relationship. The word "logistic" derived in this case from the limiting effect of finite biomass on the abundances to be found in any given community of organisms.