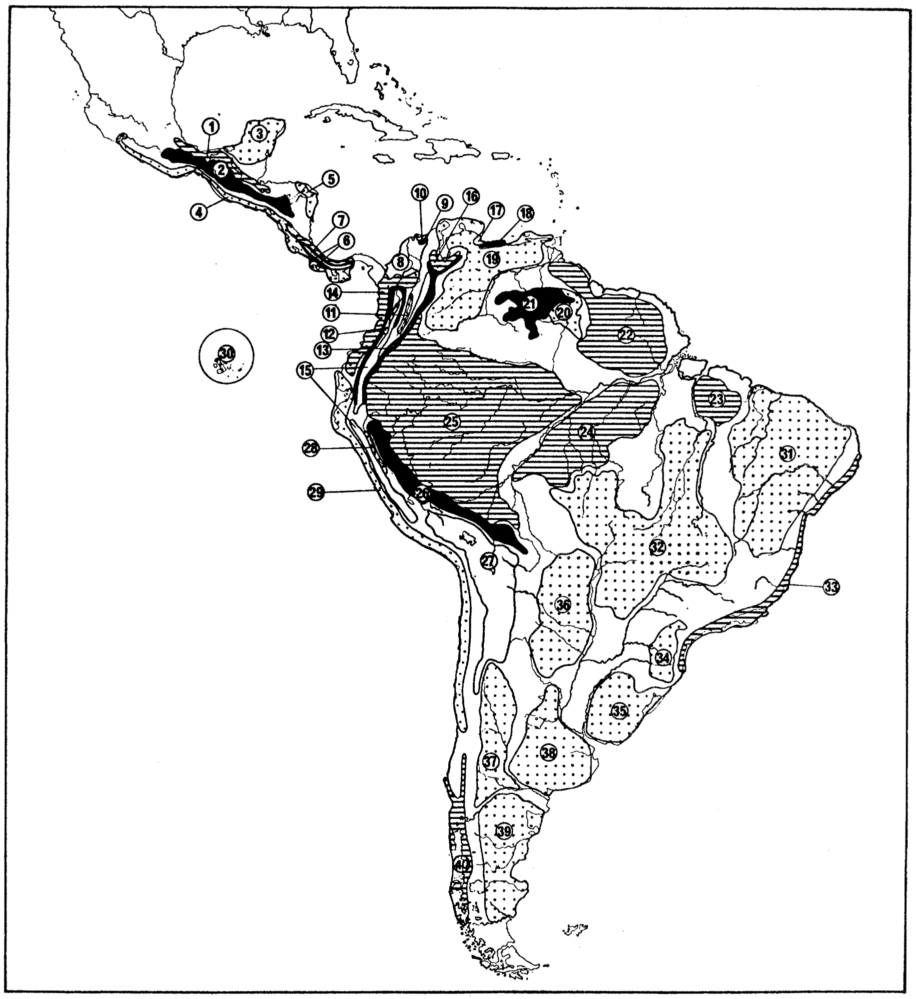

The 40 dispersal centers identified by Müller. "Dispersal centres can be worked out by plotting the breeding ranges of species and subspecies on a map of the region under investigation. . . . The individual ranges overlap in 'areas of congruence' or 'nuclear areas' . . . regions where an unusually large number of ranges overlap . . . are what we call dispersal centres." [From *The Dispersal Centres of Terrestrial Vertebrates in the Neotropical Realm*]

Nothofagus dispersal center is typified by a series of frogs (*Telmatobufo, Batrachyla, Hylorina, Calyptocephalella*, and *Rhinoderma*) that must have occurred in temperate South America from the Paleocene onward (*Calyptocephalella* and other allied genera are known from Oligocene Patagonia). This center seems to include the remnants of the original southern temperate frog fauna of the Cretaceous that invaded and evolved in the tropical area through Cenozoic times into the modern diversity of leptodactyloids and tree frogs (Hylidae). Many other component species of Müller's centers must have had, at the very latest, an origin during other Pleistocene alternations in climates, earlier than the last glacial cycle.

Finally, the evidence for conclusion 5 is not convincing. It may well be that the distinctive fauna of the three mentioned areas consists of relicts of a complex forest community, with only that fragment that could adapt to more open situations surviving to the present.

Müller has opened the way for a fuller and more determined attack on these and other problems. His emphasis on only the most recent aspects of distribution in the region leaves this reader intrigued anew by the emerging outlines of a comprehensive biogeography of the neotropics, but frustrated by the narrow time span employed to explain the now, thanks to Müller, obvious patterns.

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Population Mathematics

The Estimation of Animal Abundance and Related Parameters. G. A. F. SEBER. Hafner, New York, 1973. xii, 506 pp., illus. $29.95.

This is a book that animal ecologists have long needed. Numerous techniques have been devised, over many years, for estimating the sizes of animal populations and, to quote its preface, "this book is an attempt to bring this material together." It is a most successful attempt.

It is a very compact book in spite of its length and provides an enormous amount of information in highly concentrated form. Although the intended audience is not explicitly described in the preface, the book is for users with considerable knowledge of, and familiarity with, mathematical statistics. I say "users" rather than "readers" deliberately. The book is essentially a manual, and will be found useful (it seems safe to say, indispensable) by all research workers who need to estimate animal population sizes, provided they do not flinch before the fairly heavy mathematics. The exposition is admirably clear.

A large supply of worked examples is given, and these enable the user to test his mastery of each technique. However, the examples cannot be made to serve merely as recipes by a user in a hurry who wishes to discover how to come up with a number (or a confidence interval) while neglecting the underlying theory. The examples cannot be followed without going through the discussions preceding them, and therefore cannot be applied uncomprehendingly. This will come as a disappointment to the lazy but is no doubt a good thing: it ensures that the user of a technique shall not be ignorant of the assumptions that must hold for it to be valid.

Fully two-thirds of the book is devoted to accounts of what may be called "capture-and-count" techniques of population estimation, that is, methods in which the entities sampled are individual animals as opposed to sample plots or quadrats the animals contained in which are counted. Capture-and-count techniques comprise mark-release methods, catch-effort methods, and change-in-ratio methods, and the book covers them comprehensively. No doubt these techniques are emphasized because they are peculiarly ecological and have no counterpart in other sampling contexts; and because Seber himself has made notable contributions to them. They are not, however, suitable for very small and fragile animals such as plankton, soil organisms, and soft-bodied insects, and the book rather neglects animals of these kinds: only 15 of 66 examples deal with invertebrates, and these are durable species (such as snails, beetles, lobsters, and crabs). Quadrat-type sampling (more generally, the counting of individuals in a sample of "sample units") is dealt with only briefly, and I was sorry to find no mention of two-phase (or multi-phase) sampling, otherwise double sampling. This is the appropriate method when the animals of interest occupy a living space the quantity of which must itself be estimated, for example, microcrustaceans in marine algae or ectoparasites on rodents. Ecologists often need to use double sampling, and accounts of the procedure are hard to find.

Seber's book will be useful to a wide spectrum of ecologists, from academic theoreticians at one extreme to project-oriented workers (game managers, fisheries biologists, economic entomologists, and the like) at the other. Its usefulness to the latter group is obvious. Theoreticians, on the other hand, because they are concerned with the general rather than the particular, are apt to be impatient with the minutiae of data gathering and handling. But no theory deserves to survive (or even to be advanced) that cannot be supported by empirical evidence, and the book will provide theoreticians with a much-needed guide to the marshaling and rigorous interpretation of actual field observations.

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Plant Ecology: Gradients and Discontinuities

Handbook of Vegetation Science. Part 5, Ordination and Classification of Communities. ROBERT H. WHITTAKER, Ed. Junk, The Hague, 1973. x, 738 pp., illus. + tables. Dfl. 160.

With but few exceptions pre-1950 plant ecology was dominated by a philosophy according to which communities are made up of groups of species with similar distributions that are clearly separate from other such groups. In the last 25 years this view has changed, in large part because ecologists began sampling and analyzing vegetation using techniques that made no a priori assumptions about community discontinuity. This book describes and evaluates these techniques and relates their use to community classification.

This volume, part 5 of a new series, Handbook of Vegetation Science, is the first of the series to be published. Others will follow as they are ready. Aside from the introduction, ten of the book's chapters are concerned with ordination and nine with classification. Each of the two groups of chapters is introduced by the editor, Robert H. Whittaker, who summarizes the background of and the major ideas in the chapters that follow.

Ordination is a process by which communities or samples of communities are arranged in order (ordinated) along gradients of environmental change, or, alternatively, the samples are ordinated along compositional gradients, with those communities most similiar to each other being placed adjacently on a scale describing the range of similarity values among all such samples. This approach to community studies grew largely out of dissatisfaction with rigid views on the discontinuity of communities and from increasingly better information on the nature of species.

The idea of ordination is not new. Sobolev and Utekhin, two Russian contributors to the book, claim priority in ordination studies for their countryman L. G. Ramensky, who pioneered in this field 60 years ago and whose work they translate and synthesize here. In the United States H. A. Gleason had a similar, though less formally developed, point of view. Modern studies of ordination and gradient analysis did not get under way, however, until the early 1950's when Whittaker, working independently, and a group of ecologists at the University of Wisconsin led by the late J. T. Curtis developed convincing evidence that vegetation is continuously variable. The major contribution of the Wisconsin group has been the design and improvement of techniques used to sample and analyze vegetation.

Whereas in classification the emphasis is on combining samples that are similar to each other, in ordination one capitalizes on the differences among them with the purpose of arranging the samples in a linear or multidimensional framework that will reveal something of the relationships between the samples and their environments. In the last ten years or so a great deal of the work in ordination has been directed toward designing better methods of arranging and summarizing sample data so that they will lead to more easily recognizable community relationships while preserving some similitude to nature.

Several chapters describe the most important of these techniques, of which many have been borrowed from other fields. Apart from the mathematical sophistication required for their understanding, the problem some ecologists have with these methods is that there has been little evaluation of how and when specific techniques are useful or of the problems that may be associated with them. Fortunately, David Goodall does precisely this for methods having to do with species correlation and sample similarity, and Whittaker and Gauch evaluate a variety of ordination methods. The latter reach the conclusion that "there is often inverse relationship between mathematical complexity or elegance, and research effectiveness, of ordination procedures," and they conclude that somewhat simpler techniques combined with ecological understanding may yield the best results.

This conclusion will be greeted with some enthusiasm by those ecologists who tend to be suspicious that the kind of analysis that is most gratifying to the mathematician may be irrelevant or misleading to the ecologist. Both Goodall and Whittaker and Gauch offer advice on which techniques may be the most useful in different circumstances.

Community classification as a formal enterprise originated with students of plant geography in the 19th century, at which time it was based primarily on the growth forms or physiognomy of plants. As knowledge of the structure and function of plants improved, the number of characteristics used in classification systems increased. Since community classification is not natural (in the sense in which a species is a