Preface to the Third Edition

This book attempts to present to ecologists in a coherent form the statistical methodology that is general to ecological field measurements. Scientific progress depends on good methods, and there are two components to progress in ecological methodology. The first component is biological and technical - you must have a good sampling device that catches the animals you wish to study or marks them with tags or bands that will not fall off. There has been very great progress in designing better and better sampling devices in all areas of ecology, from mouse trapping to sampling the deep benthos of the oceans. The techniques and equipment used for sampling vary greatly for different groups of animals and plants and are the subject of many handbooks specific to a given area of ecology or specific group of plants or animals.

The second component of scientific progress is good statistical design. This component is general to all disciplines, and ecology is no exception. Over the past 60 years there has been superb development of statistical methods for increasing precision and avoiding bias in the estimation of ecological parameters like population size. Much of this has now penetrated ecological journals, but there have been few attempts to put these methods together in a textbook. Williams et al. (2002) and Sutherland (2006) are exceptions as is Magurran (2004). Some books cover some methods extremely well but are not comprehensive (e.g. Amstrup et al. (2006) for mark-recapture data). But more general ecological methods books are still very few in number in the library. It has been 13 years since the second edition of *Ecological Methodology* was published and there has been considerable advance in data recording and data analysis since then. Analysis has become more complex, yet there is still a need for guidance to get into the more advanced literature.

This book will not tell you what plankton sampler is best for oligotrophic lakes, but it will tell you how to design your plankton sampling in the most efficient way so that you need to do minimal work for maximal precision. All the methods presented here are well known to statisticians. That they are not always known to ecologists is one of the weaknesses of modern ecology. I hope that this book will

assist field ecologists in the statistical design and analysis of ecological measurements.

Students using this book should have a basic knowledge of statistics of the type that is obtained in a one- or two-semester course in statistics. If your statistics are rusty, you will want to have an introductory statistics text at hand to remind you of the basic ideas of standard errors, variances, and confidence limits. Since I am not a statistician and this is not a book for statisticians, I do not prove any theorems or present rigorous arguments about statistical expectations. I do attempt to translate the recommendations of statisticians into ecological English so that they can be used in the real world. I use approximations when they are needed, because in an ecological study an approximation is better than nothing.

To assist students I work our numerous examples in boxes in each chapter, as well as in the text. For most of the statistical calculations I discuss I have written FORTRAN programs to do the tedious arithmetic, and Alice Kenney has put these programs into *Delphi* to make input and output easy. Computer-literate students can do many of these calculations in other general programs like *R*.

There are mistakes in the book, no doubt, and I will be grateful to be told about them. I maintain a website on the World Wide Web at *www.zoology.ubc.ca* to keep a list of the mistakes that come to my attention. Feedback can be delivered via e-mail to *krebs@zoology.ubc.ca*. One of the things I learned as I wrote this book was the frequency of errors of computation in the ecological literature. The computer should help us avoid mistakes of arithmetic, but of course we must be careful not to institutionalize mistakes in computer programs. Computers do not yet design experiments. If they did, you would not need this book.

I am grateful to my students at the University of British Columbia for helping me develop these thoughts on methodology. I am grateful to all those who have suggested improvements for this edition. I thank the Institute for Applied Ecology at the University of Canberra and the Biodiversity Center at the University of British Columbia for offering facilities during this revision, and I thank Alice Kenney for assistance in getting all this together efficiently.

There has been a tremendous explosion of interest in the statistical problems of ecological methods during the last 30 years, and hope that this book brings these to the attention of field ecologists trying to make the measurements that will help us understand the natural world better. I cannot cover all the detailed advances in methodology, but I am trying to introduce you to this literature to provide the basic background for you to look at the recent advances in ecological analysis.

Until the third edition of *Ecological Methodology* will be available in print, I will put these revised chapters on my web site to allow interested students to download them in order to make an evaluation of their contents and to suggest revisions. In this way I hope to present these methods in the best possible way to students. And I thank you in advance for your help.

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