Human Population Biology

A Transdisciplinary Science

Edited by
MICHAEL A. LITTLE
and JERE D. HAAS

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Edited by
Michael A. Little
State University of New York at Binghamton
and
Jere D. Haas
Cornell University

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To Paul T. Baker
with affection and respect
from his students

Foreword

GEOFFREY A. HARRISON

It is one thing to be a great scientist, and quite another to be a great teacher; often, the qualities for one seem inversely correlated with the qualities for the other. Paul Baker has both, and it is fitting that this tribute to Paul's scientific work should be entirely written by the formidable band of his past graduate students.

"Festschrifts" are all too often little more than sets of loosely connected essays. Not this one. Any book attempting to embrace the many themes in human population biology would hope for these authors, and they have created a coherence and unity that a single author might envy: remarkable, considering they now hold posts all over the United States, in many different kinds of departments. They are so much in unison that not only the book as a whole, but individual chapters in it are multiauthored from different establishments! Presumably, the fact that they worked with Paul Baker at a critical stage in their lives, as well as with each other in the Andes or in Samoa is of major significance in achieving such intellectual empathy.

Let it not be supposed that this empathy reflects any Procrustean training. In science, as in person, these authors are as individual as they come. What they gained from Paul Baker was a vision of the ways human populations function and are structured and how the many different components interract with one another through time and space. They also gained a commitment to rigour and a concern with the power and limitations of field methodology from him that was, for so long, almost absent in biological anthropology. One also suspects that they also gained much nurturing of their natural curiosity and stimulus for their natural scepticism! This was sufficient to create a generation of able human population biologists with a common direction and an ability to talk meaningfully to each other over a wide range of issues—which they have done constantly, long after leaving Penn State.

The tribute they have come to offer Paul is one of which, I'm sure, he will be justly proud. We tend to associate Paul Baker with two major pieces of holistic human ecology in the Andes and in Samoa. Here, he and his group teased apart and then put together again the various biological strands—and many social ones as well—that characterized the populations studied. The work is a monumental tribute to multidisciplinary and indeed interdisciplinary research; however, Paul was not just interested in Andean farmers and Pacific islanders as such—he saw opportunities for analyzing fundamental processes in human adaptation in their

situations. He used the natural situation as best as he could to answer questions that could not be approached experimentally in humans, and he chose the field situations with great care in order to maximize information about processes, such as physiological acclimatization, growth plasticity, or acculturation.

These double objectives of the integrative and the reductionist are well represented in this book, but since the former has been dealt with in two previous book publications (with many of the same authors) it is appropriate that this volume tends to deal more with the latter.

By so doing it provides us with a text that is relevant to all field human biologists, wherever they may be working and whatever their particular problem. And I do not doubt it will be a landmark in the development of human biology for many years to come.

Preface

This volume was prepared as a tribute to Paul T. Baker, Evan Pugh Professor Emeritus at The Pennsylvania State University, by his former students. The volume also serves as a reflection of his theoretical and research perspectives, which are biocultural, ecological, and transdisciplinary in nature. Paul Baker has dedicated his professional life to the promotion of these perspectives through research, graduate and undergraduate training, and service. His students, associates, the scientific community, and the general public have all benefited from these contributions, and they should be acknowledged with thanks.

Within the past three decades, Paul has guided about 25 students through the doctorate in biological anthropology. Paul's wife, Thelma Baker, also contributed to this training by providing intellectual stimulation, emotional support, and strong encouragement to Paul's students. During the early 1960s, when he first began training graduate students, his demands for scientific rigor were not the norm for anthropology. It was this dedication to solid scientific training combining with the excitement, inspiration, and romance of anthropological ideas that made him attractive to students both during this period and later. It was only through his active and original research programs, however, that he was able to train students properly.

The two major projects that he organized are the Andean research on high-altitude adaptation of Peruvian Quechua Indians that was completed in 1976, and the Samoan migration and modernization study designed to explore the effects of changing environments on health and human biology that was completed a decade later. Perhaps more than anyone else of his generation, his ideals and ideas have been instrumental in reshaping studies of human population biology among anthropologists in the United States.

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Contributors

Dr. Andrew Abelson
Flat 12, 29 Westbourne Terrace
London W2
England

Dr. Donald Austin
4768 Salem Drive
Mesquite, Texas 75150

Dr. Carol Ballew
Department of Community Health
and Preventive Medicine
Northwestern University Medical School
303 E. Chicago Ave.
Chicago, Illinois 60611

Dr. Cynthia M. Beall
Department of Anthropology
Case Western Reserve University
Cleveland, Ohio 44106

Dr. James R. Bindon
Department of Anthropology
University of Alabama
University, Alabama 35186

Dr. Douglas E. Crews
Department of Community Health
and Preventive Medicine
Northwestern University Medical School
303 E. Chicago Ave.
Chicago, Illinois 60611

Dr. Norris M. Durham
Department of Sociology and
Anthropology
University of Northern Iowa
Cedar Falls, Iowa 50614

Dr. James S. Dutt
Division of Computer and
Information Sciences
University of South Alabama
Mobile, Alabama 36688

Dr. A. Roberto Frisancho
Department of Anthropology
University of Michigan
Ann Arbor, Michigan 48104

Dr. Timothy Gage
Department of Anthropology
University Center at Albany
State University of New York
Albany, New York 12222

Dr. Ralph M. Garruto
Bldg. 36, Rm. 5B-21
National Institutes of Health
Bethesda, Maryland 20892

Dr. Lawrence P. Greksa
Department of Anthropology
Case Western University
Cleveland, Ohio 44106

Dr. Jere D. Haas
Division of Nutritional Sciences
Savage Hall
Cornell University
Ithaca, New York 14853

Dr. Joel M. Hanna
Department of Physiology
School of Medicine
Biomedical Sciences Bldg.
University of Hawaii
Honolulu, Hawaii 96822

Dr. Charles J. Hoff
Statistics Section
Battelle Pacific Northwest
Laboratories
Box 999
Richland, Washington 99352

Dr. Gary D. James
Cardiovascular Center
Cornell Medical Center
New York Hospital
New York, New York 10021

Dr. Paul W. Leslie
Department of Anthropology
University Center at Binghamton
State University of New York
Binghamton, New York 13901

Dr. Michael A. Little
Department of Anthropology
University Center at Binghamton
State University of New York
Binghamton, New York 13901

Dr. John M. McCullough
Department of Anthropology
University of Utah
Salt Lake City, Utah 84112

Dr. Stephen T. McGarvey
Department of Medicine Box 6 - RW
Brown University
Providence, Rhode Island 02912

Dr. Ivan G. Pawson
Department of Epidemiology
University of California
San Francisco, California 94143

Mr. Jay Pearson
Department of Physiology
School of Medicine
Biomedical Sciences Bldg.
University of Hawaii
Honolulu, Hawaii 96822

Dr. David L. Pelletier
Division of Nutritional Sciences
Martha Van Rensselaer Hall
Cornell University
Ithaca, New York 14853

Ms. Diana E. Schendel
Department of Anthropology
Carpenter Bldg.
The Pennsylvania State University
University Park, Pennsylvania 16802

Dr. R. Brooke Thomas
Department of Anthropology
University of Massachusetts
Amherst, Massachusetts 01003

Dr. Anthony B. Way
Department of Preventive Medicine
and Community Health
Texas Tech University
Lubbock, Texas 79430

Dr. Charles A. Weitz
Department of Anthropology
Temple University
Philadelphia, Pennsylvania 19122

Dr. Shelley Zansky
Department of Anthropology
University Center at Albany
State University of New York
Albany, New York 12222

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INTRODUCTION

Human Population Biology and the Concept of Transdisciplinarity

MICHAEL A. LITTLE AND JERE D. HAAS

The contributions to this volume represent a field of human biological sciences that can be identified as transdisciplinary in scope. A transdisciplinary science is one that cross-cuts several traditional sciences, while at the same time providing synthesis, integration, and greater understanding of a body of knowledge. Nearly all sciences borrow ideas, paradigms, methods, and theoretical frameworks from one another. For example, all natural, medical, and behavioral sciences draw on mathematics, particularly statistics, for analysis and interpretation. Correspondingly, integrated fields of investigation based on physics such as biophysics, geophysics, medical physics, and neurophysics are now established academic disciplines. As understanding about the universe grows, the traditional borders that circumscribe realms of exploration (academic sciences) become less well defined, and new fields arise. *Human population biology* is moving toward this transdisciplinary level from a biobehavioral and biocultural base that has its origins in anthropology (Baker 1982, 1988).

The integration of human biological and social sciences dates back at least to the nineteenth century. Early integration resulted as an outgrowth of Darwinian concepts of evolution, selection, and adaptation. Within the framework of evolution, anthropologists incorporated ideas about the biological evolution of humans and the cultural evolution of society. A reaction to the evolutionists appeared around the turn of the century in the writings of Franz Boas, whose lifelong opposition to racism was often incorrectly interpreted as an objection to the evolutionary paradigm for culture (Harris 1968; p. 292). Yet, more than anyone else in the profession during the early part of the century, Boas helped to maintain the tradition of anthropology as a field that embraced both human culture and biology. Boas also advanced biometrical analysis (Tanner 1981:243) and continued the tradition of exploring human biological variation within the context of human cultural behavior (Boas 1940).

The tradition within anthropology of *human biological* and *biocultural* studies was strengthened in its scientific framework after 1950 by a post-World War II movement away from descriptive studies of race and toward problem-

oriented studies of human population (Coon et al. 1950, Washburn 1951, 1953, Warren 1950). Adaptation to the environment within genetic and evolutionary perspectives, and at the level of the population, was the base for inquiry during this period. Further inquiry was directed toward the sources and causes of human variation. Studies of living populations incorporated and applied new methods and perspectives from *ecology* (Baker 1962, Bates 1953, Newman 1953), *demography* (Roberts 1956, Spuhler 1959), *environmental physiology* (Adolph et al. 1947, Baker 1958, Dill et al. 1964), *epidemiology* (Livingstone 1960, Motulsky 1960), *nutritional science* (Garn 1962), and *body composition studies* (Brožek 1956, Baker and Daniels 1956). Many of these early studies were exploratory in nature, but set the stage for increasingly more sophisticated research to follow.

The 1960s ushered in the International Biological Program (IBP), in which the human adaptability component was characterized by *integrated, single-population projects* such as those of the highland Peruvian Quechua (Baker 1969, Baker and Little 1976), Ethiopians (Harrison et al. 1969), Arctic Eskimo (Jamison et al. 1978, Milan 1980), and lowland, tropical Yanomama (Neel et al., 1977), and a *multidisciplinary approach* to research in which investigators from several fields worked together on common research goals (Baker 1968, Baker and Weiner 1966). These were conditions in which human population biologists with training in anthropology interacted with other ecological, biomedical, and social scientists in a multidisciplinary context. At the same time, this tended to encourage a cross-fertilization of ideas and a trend toward transdisciplinary approaches to scientific problem solving. The IBP ended in the mid-1970s after a decade of research and synthesis, and the publication of hundreds of works (Collins and Weiner 1977). Another major contribution of the IBP was in the training of many human population biologists in the United States and abroad. A new generation of scientists, principally biological anthropologists, had been schooled through research projects in which they had worked closely with scientists from a variety of backgrounds. Many of the contributors to this present volume were trained under these often difficult, but intellectually rewarding, multidisciplinary research conditions.

THE SCOPE OF HUMAN POPULATION BIOLOGY

The theoretical perspectives and training experiences that are held in common among human population biologists are based in evolutionary biology, genetics, statistical expression of human variation, adaptation to the environment, an understanding of the human life cycle, and a commitment to learning how the interaction of human behavior and biology contributes to individual and population adaptability (Baker 1982, Little 1982). Within this constellation of perspectives, there is often a strong biomedical component and a concern with health and adaptability (Wienker and Valleroy 1986). This holistic and synthetic training combined with medical interests has equipped the human population biologist with skills for research in a number of realms. A discussion of some of these follows.

Demography and Population

Human population structure and processes have been central to the study of human biology for more than three decades (Spuhler 1959, Baker and Sanders 1972, Weiss 1976, Swedlund 1978). For example, the concept of "human populations" fits well with the anthropological concept of "cultures," the principal demographic variables of fertility and mortality are also the principal means by which natural selection operates, demography and genetics are natural partners within an evolutionary framework (Ward and Weiss 1976), and migration, another central process in demographic exploration, has been used extensively to study human populations undergoing environmental change (Little and Baker 1988). Demographic variables that intersect with other fields in human population biology include mortality, morbidity, and population density with health and epidemiology, and fertility with reproductive biology and health status.

Genetics, Epidemiology, and Clinical Medicine

As Baker (in 1988) noted, in the field of human population biology there has been a movement away from attempts to demonstrate genetic selection in contemporary populations because of the difficulty in illustrating evolutionary processes. Rather, research efforts have shifted toward medical and health areas in what are known as *medical genetics* and *genetic epidemiology*. Weiss and Chakraborty (1982) traced the development of these newly defined areas of exploration in some detail. They emphasized the need in research to maintain "the thread of evolutionary inquiry" within the medical viewpoint, since many disease states can be understood only from biocultural, population, and evolutionary perspectives. Examples of research that required such an integrated approach are Allison's (1954) and Livingstone's (1958) work on sickle-cell disease, the discoveries of Gajdusek (1977) on slow viruses in New Guinea and Blumberg (1977) on hepatitis B and Australia antigen, the complex patterns of Tay Sachs disease (Myrianthopoulos and Aronson 1966, Neel 1979), Mazess and Mather's (1974, 1975) work on osteoporosis in traditional Inuit (Eskimos), and current investigations on cardiovascular disease and diabetes in South Pacific populations (Baker et al. 1986, Prior et al. 1977). Each of these major research achievements, two of which were honored by Nobel Prize awards, was possible only by application of human population biology perspectives.

Physiology and the Environment

Traditionally, research in human physiology has been concerned with environmental stress as a way of defining physiological mechanisms and processes (Dill et al. 1964, Slonim 1974). The connections between this science and human population biology are through the interests of biological anthropologists in (1) adaptation to the environment via environmental stress and selective pressures (Baker 1966, 1974, 1975), and (2) the environment as an ecological system that includes the natural environment as well as the human sociocultural environment (Weiner

1977, Thomas 1975). Much of the early work in anthropology that incorporated physiological methods and theory focused on climate and thermal stress (Baker 1960, Roberts 1953, Steegmann 1975). Later studies dealt with a spectrum of problems including thermal work responses to high-altitude hypoxia (Baker 1969, 1978), work physiology among non-Western populations (Shepard 1978, 1985), and nutrition as a source of environmental stress (Johnson 1987). It has been argued that work capacity is one of the best overall indicators of general health (Weiner 1980), and recent research has explored the capacity of Third World laborers to perform sustained physical work under conditions of poor health and nutritional status (Spurr 1983). Another promising area of investigation is that of measuring human stress–response behavior directly through catecholamine excretion rates (Reynolds et al. 1981).

The Human Life Cycle

Human growth interests in anthropology date back nearly a century to Boas (1892) and have continued as a vigorous branch of human population biology up to the present. Sex and age are two primary sources of variation in human populations, and it is this variation that serves as the groundwork for other studies of health assessment or responses to environmental stress and change. Sorting out the variables that influence growth processes in children and adolescents and biological aging processes in adults is a formidable task, since these processes are remarkably plastic in their expression (Malina 1986). Some of the variables that are known to affect postnatal growth are, minimally, heredity, nutrition, disease status, activity, emotional status and well-being, climate, altitude, and a host of lesser variables (Martorell 1980, Beall 1982). Studies of child growth and adult aging are logically interrelated with several other research areas of human population biology that include epidemiology, maternal health and reproduction, breast-feeding effects on fertility and child health, and effects of obesity in children and adults on biological aging processes. Studies of aging, within a human population biology framework, are of greater interest today as the populations of Western nations become increasingly older. The field of body composition is often tied to studies of growth and aging, and also is closely linked to nutrition, physical activity, epidemiology, and health.

THE FUTURE OF HUMAN POPULATION BIOLOGY

The chapters that follow in this volume reflect the ongoing research activities of a number of human population biologists. All contributors to this volume were trained in biological anthropology, but they have a variety of interests that fit well within the framework described above.

In *Part I, Demography and Population*, Leslie and Gage's chapter reviews the role of demography in the investigation of problems in human ecology, evolution, and adaptation. They outline some of the methods used in the past and then describe newer methods that currently are being developed and applied. These approaches are particularly important because most theory and methods gener-