# Lessons Learned from the South Turkana Ecosystem Project

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## INTRODUCTION

Ecological studies in anthropology cover a wide array of approaches to inquiry. Single investigators have attempted to understand cultures in both their ethnographic and their environmental contexts. In one of the best known studies of human ecology, the late Roy Rappaport (1968) studied the ritual cycle of the Maring people of the Central Highlands of New Guinea. During the 14 months of his investigation, he attempted to gather comprehensive information on climate, soil, plant species and ecology, wild plant resources, garden productivity, human energy expenditure, human dietary intake, and carrying capacity of the land. All of these data were collected at the same time that he compiled detailed ethnographic and social data. It is a tribute to Rappaport's stamina and intelligence that he was able to do as much as he did. However, there are limits to the tasks that one investigator can carry out under difficult field conditions. In the years between this masterful research and the present, other investigators have concentrated their efforts on specific facets of the ecology of a culture such as energy flow (Little and Morren, 1976; Morren, 1977; Thomas et al., 1982) or optimal foraging (Smith, 1991; Winterhalder, 1983). Some of these studies had the advantage of being conducted in the setting of a large research project. Others were carried out by single investigators who have worked alone. When anthropologists conduct studies within an ecological framework, and even outside of this framework in more conventional ethnographic studies, they are limited because of the enormity of the research task. Sociocultural anthropologists, who are not generally known for careful scientific design, are prone to take on difficult and large problems, and then to approach them in non-systematic and non-scientific ways, making the problems even more intractable than they might be.

In this paper, I propose that only through collaborative research efforts and multidisciplinary approaches to ecological studies can progress be made in the understanding of complex entities such as human populations in their ecological setting. Multidisciplinary approaches require that several scientists from different fields work together on a single research problem or that they combine efforts to understand the complex workings of a single human population. With the understanding that a single human population, however small, is extraordinarily complex, one approach to understanding is to apply systems theory and to begin to examine the inner workings and relationships of the population when modeled as a system (Breymeyer and Van Dyne, 1980). How, then, can a society be partitioned into subsystem components that can be studied independently and then reintegrated for a more holistic understanding? Whatever the approach to understanding that is taken, there should be research questions and hypotheses with which to structure the research and partition the responsibility. However, it is often the case that so little is known about the inner workings of a society in relation to its environment that much of the investigation must necessarily be of a descriptive nature. Descriptive studies allow the accumulation of sufficient information to begin to generate hypotheses about the details of the social, economic, human biological, and environmental operations of the population. Unfortunately, granting agencies are seldom willing to fund expensive multidisciplinary projects, particularly when the first few years will be devoted to descriptive studies with little in the way of immediate, exciting results.

In the comments that follow, I shall chronicle the history of a multidisciplinary project in which rangelands and ecosystems ecologists, sociocultural anthropologists, biological anthropologists, and biomedical scientists combined efforts to study the Turkana herders of East Africa. The project, known as the *South Turkana Ecosystem Project*, was devoted to the integrated study of this pastoral nomadic population from northwest Kenya.

## HISTORY OF THE SOUTH TURKANA ECOSYSTEM PROJECT

### *Formative Processes*

In 1974, Neville Dyson-Hudson, a sociocultural anthropologist who had just taken a position at Binghamton University, and I began to discuss prospects of developing an ecological project on Kenyan Turkana. Dyson-Hudson and his wife Rada Dyson-Hudson had extensive experience

working with a related Ugandan pastoral population (Karimojong) and were well-known for their research on pastoral populations. I had no experience with East African pastoralists. N. Dyson-Hudson also had field experience conducting research with Turkana when he worked with ecologists and geographers between 1968 and 1972 during the Royal Geographical Society's South Turkana Expedition. At that time, the principal published sources of information were papers from the South Turkana Expedition (Gwynne, 1969; Baker and Lovenbury, 1971; Hemming, 1972), earlier ethnographic work that had been done by Gulliver (1951, 1955), largely in north Turkana, and a single paper by N. Dyson-Hudson (1973) on the Ngisonyoka Turkana, the ethnic subgroup or *section* with whom we later were to work. The Ngisonyoka Turkana are nomadic pastoralists who move their settlements frequently throughout the year in search of green forage for their five species of livestock — dromedary camels, zebu cattle, fat-tailed sheep, goats, and donkeys. Each of the species is milked and bled, and the small stock are occasionally slaughtered for meat. The availability of green vegetation for the livestock is dependent on seasonality and longer-term rainfall patterns (temporal variation in the environment) and ecosystem diversity (spatial variation). The environment can be characterized as *dry savanna* with limited vegetation. A simple conceptual model of the Turkana pastoralist system is given in figure 1.

This early collaboration between N. Dyson-Hudson and me was possible because we both shared a theoretical perspective that human populations adapted to their environments by contingent responses in their behavior (including their social behavior) and by short-term, developmental, and genetic means in their biology. We also believed that these patterns of behavioral and biological adaptation to the environ-ment were closely tied and interdependent. In addition, both Neville and Rada Dyson-Hudson understood and were committed to evolutionary and ecology theory and explanation of human social behavior and biology, so there was considerable compatibility in basic anthropological perspectives. These perspectives of ecology and evolution as explanatory forces for human behavior were clearly not "main stream anthropology" at that time, nor are they today.

That same year, in order to generate some interest and explore funding possibilities a brief prospectus was prepared and sent with a prominent anthropologist who had been invited to a Unesco Man and the Biosphere (MaB) conference on Arid Lands in Paris. Contacts were made also with Kenyan, British, Dutch, and American scientists and representatives of international agencies (e.g., MaB, United Nations Environmental Program) to seek advice and to generate interest. Although the (MaB) prospectus was well received at the Paris conference and the support from international and American colleagues was encouraging, it gradually became clear to me that the project was too ambitious for a formative study.

Nevertheless, we continued with planning and training inexperienced graduate students (with whom I was on an equal footing because of my own

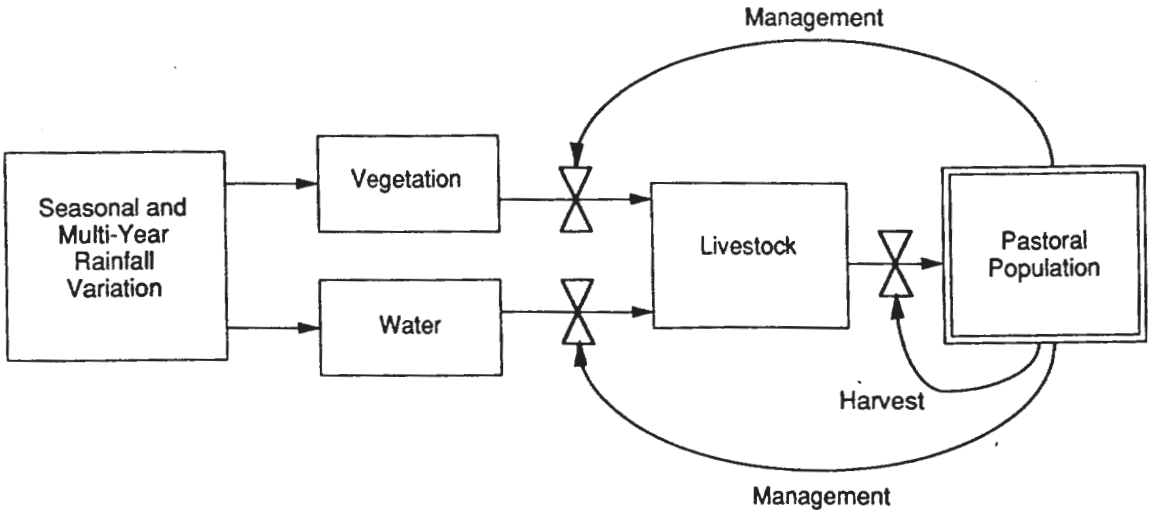


**Fig. 1. A diagram of savanna pastoralist ecology at its simplest conceptual level.**

lack of experience with East African pastoral populations). N. Dyson-Hudson and I also spent considerable time in informal weekly seminars with about a half-dozen graduate students designed to build expertise. Fortunately, a rich source of information was available through the Kenya Archives on microfilm at Syracuse University. Weekly trips of about 140 km to Syracuse gave us access to these British colonial documents which provided the recent historical context for the research that we planned to conduct. These activities consumed most of 1975 and early 1976.

### *Proposal Preparation and Funding*

During the second half of 1976, N. Dyson-Hudson and I began to prepare a proposal for the U.S. National Science Foundation (NSF). We had linked components of the research to current graduate students' interests and our own interests, that included: pastoral decision making, movement of herds and people, livestock management, hierarchical social units, human diet and nutrition, demography, and energy flow through the pastoral system, among others. A very ambitious proposal was submitted to the NSF in December 1976, slightly more than two years after our early discussions were held about the feasibility of such a project. The proposal was rejected in early 1977 on the grounds that it was too ambitious, too expensive, and not well formulated; however, reviews ranged from excellent to fair, and we were encouraged to resubmit a scaled-down version of the proposal. A second proposal was submitted to the NSF in 1977 and was also rejected. I was ready to end the effort but Neville Dyson-Hudson prevailed and we submitted a very limited two-year proposal in the early part of the year that was funded in mid-1978.

Several events in 1977 and 1978 contributed to the successful funding in 1978 and progress in developing the research project. First, earlier in 1976, the Dyson-Hudsons had visited Ft. Collins, Colorado and had met two rangelands ecologists who were affiliated with the Natural Resource Ecology Laboratory (NREL). This ecology research unit of Colorado State University was previously called the Grasslands Laboratory and played an instrumental role in ecosystems research during the years of the International Biological Programme (IBP) in the 1960s and early 1970s. Two rangelands ecologists, James E. Ellis and David M. Swift, expressed an interest in collaborative research on the Turkana work and plans began to develop in 1977 for a joint proposal. The proposal was to include some of the ideas already developed in anthropology and a more sophisticated approach to the ecology of the Turkana than the anthropologists had been able to generate. As with many active scientists, it took some time for the NREL ecologists to complete ongoing projects, such that they could devote considerable time to the Turkana project.

The second event of 1977, was the successful funding of a graduate student, Jean Brainard, who had applied independently to the Rockefeller foundation for predoctoral funds to support studies of fertility of the Turkana. She travelled to Kenya to begin her work in late 1977 at the settlement of Nakwamoru along the Turkwel River (see Fig. 2). After more than three years of planning someone had finally gotten into the field to begin the research. A third important event was that N. Dyson-Hudson had taken a temporary position with the International Livestock Centre for Africa (ILCA) and had moved to Nairobi, Kenya. He was then in a position to work on research clearance, and to supervise graduate students in the field. Also, because the project plans had already become known within the community of ecologically-oriented anthropologists, the Dyson-Hudsons and I were invited to participate in a 1978 Wenner-Gren Foundation Conference in Austria on "Human Ecology in Savanna Environments" (Dyson-Hudson, 1980; Little, 1980). Although I had only visited East Africa briefly during the summer of 1978, I prepared a review of the human biology of East African pas-toral populations that forced me to review exhaustively the current literature. All of these events almost certainly contributed to our credibility when the third proposal was submitted successfully to the NSF in 1978.

In early 1979, a collaborative project proposal, prepared by the Colorado State University ecologists and the Binghamton University anthropologists, was submitted to the Ecosystems and Anthropology Programs at the NSF. This first attempt at joint funding was not successful, but a resubmission in late 1979 was funded. The majority of the funding was provided by the Ecosystems Program (about 80 to 90 percent). Active field research began in 1980, with preliminary ecological reconnaissance and graduate student dissertation work in sociocultural anthropology. The project was named the South Turkana Ecosystem Project and it was headed by James E. Ellis. The prolonged effort to launch the project had led to a number of unanticipated problems during the six protracted years of preparation.

### *Project Objectives*

In any multidisciplinary project there are com-

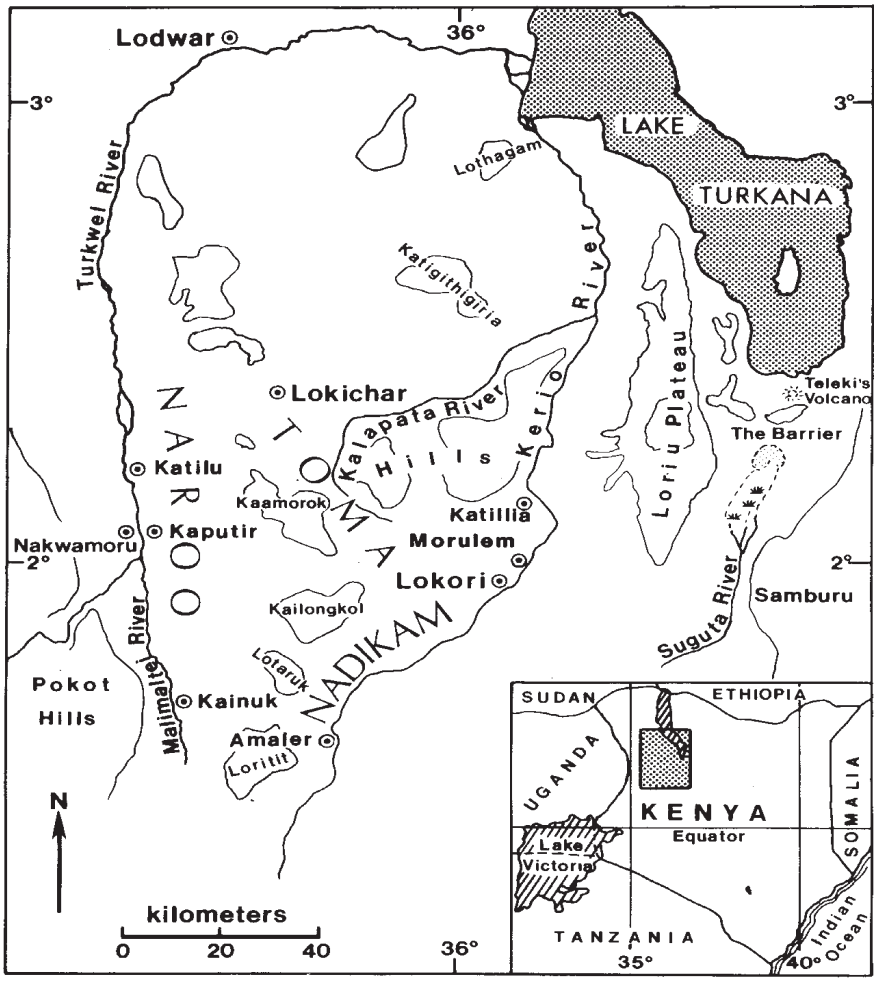


**Fig. 2. A map of the South Turkana region. The *Toma* is a central sandy outwash plain with runoff into the Kerio River; the *Naroo* is another plains area to the east of the Turkwel River with runoff into this river; the *Nadikam* is a southern outwash plain with gravel hills.**

mon goals and interests. There were also more specific goals that were pursued by the ecologists and by the anthropologists. Some of the common goals of the South Turkana Ecosystem Project were to: (1) join anthropological and ecosystems sciences to study pastoral nomads; (2) model and understand the South Turkana ecosystem; (3) conduct long-term studies to assess temporal variation in the ecosystem; (4) develop a general framework to understand African pastoral populations; (5) acquire baseline data to characterize pastoralists before programs of economic development transform their ways of life.

Subprojects for some of the ecological work were to: (1) model the seasonal and longer-term climatic effects on vegetation and ecosystem productivity; (2) characterize soil, vegetation, and community structure; (3) measure primary production and grazing effects on it; (4) study livestock ecology, nutrition, and activity patterns; (5) identify forage and water limitations on livestock production; (6) model ecosystem nutrient and energy dynamics; (7) model ecosystem change and succession under livestock feeding pressure. Figure 3 is an five-component ecological model that helped to structure the early research.

Subprojects for some of the anthropological work were to: (1) define the social organization of resource exploitation; (2) identify livestock management strategies; (3) chart the movement of herds

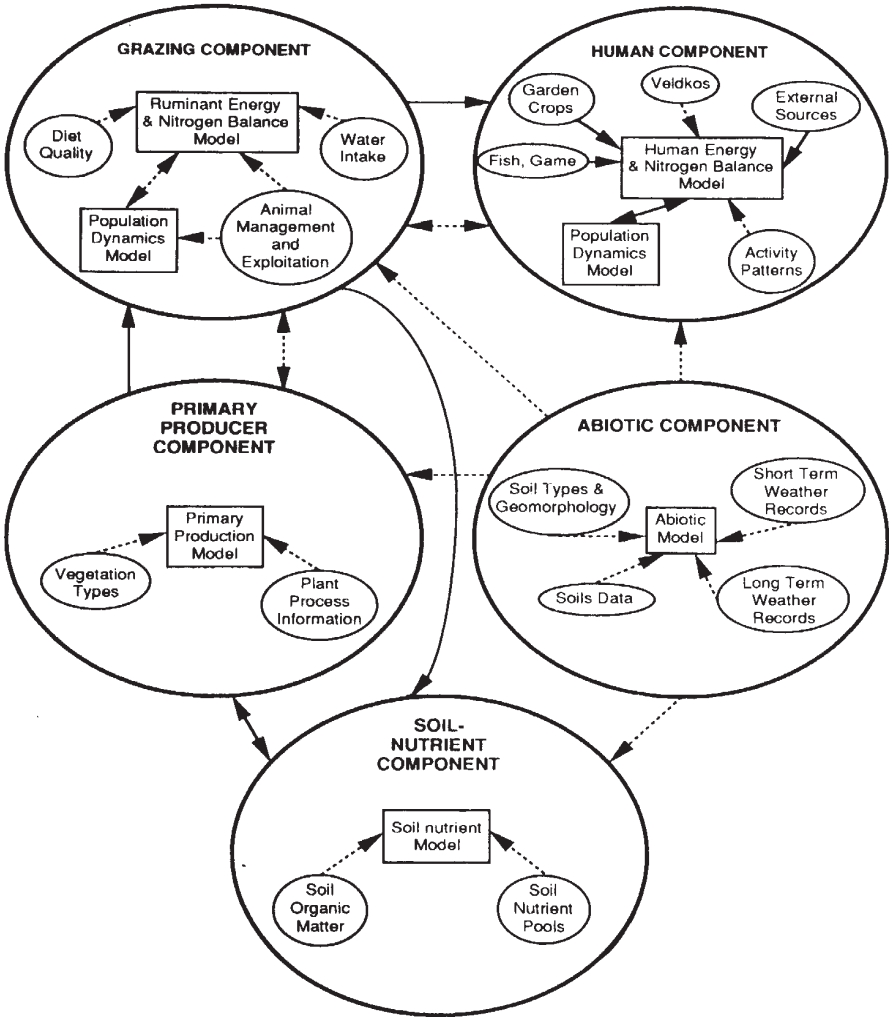


**Fig. 3. A composite model of the South Turkana ecosystem (after Ellis et al., 1979)**

and identify grazing orbits; (4) define how resource information is acquires and transmitted; (5) characterize the adaptability of the people through health status, reproduction, and child growth patterns of the population; (6) define the diet and nutritional status of the people; (7) model the demographic structure of the human and livestock populations. Figure 4 is a conceptual model that helped us to design the research on Turkana health and adaptability.

### *In Retrospect*

The first lesson to be learned from these early experiences was that the project was too ambitious at the outset and should have begun with more modest and inexpensive pilot studies. With a more modest beginning, field work could have been initiated at an earlier time and the experience gained might have been used to build more sophisticated research designs and conceptual models at an earlier phase of the project.

Casualties of the delays in funding were several graduate students who were lost because they were unable to wait for the project to be up and running. Of the six graduate students who participated in the planning during the mid-1970s in preparation for doctoral research only two were able to continue. The others lost patience and pursued other avenues

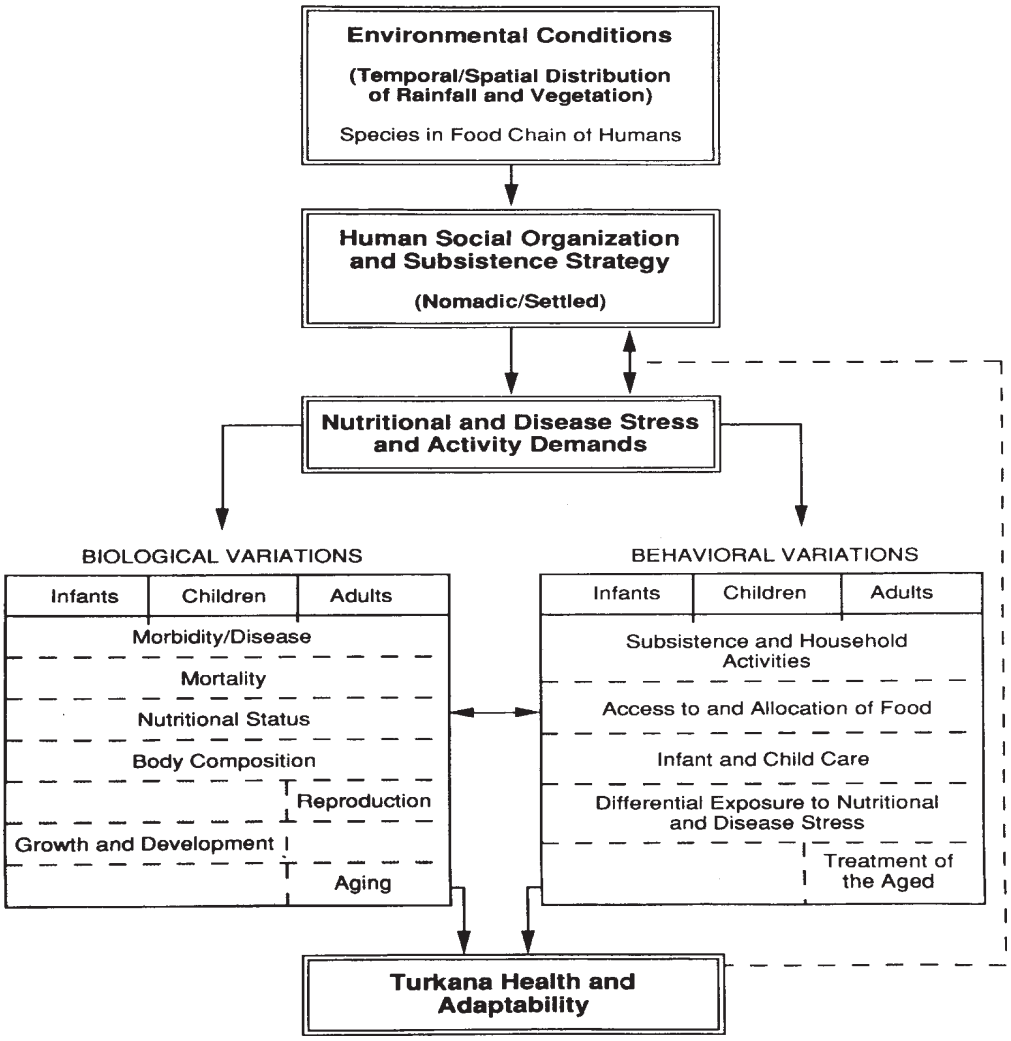


**Fig. 4. A model of some of the variables that were investigated to study the human biology and behavior of the Turkana people.**

of research. One way to avoid this problem during the slow process of launching a major project is to assist students to apply for independent funds, and, as noted above, begin the integrated research with small steps.

Field research was not able to begin for more than a year after funding became available because research clearance had not been secured before funding. This would have been a difficult task in Kenya in the late 1970s because some instability in the Kenyan Government led to changes in the bureaucracy that may have affected clearance regulations (Jomo Kenyatta died in 1978 and Daniel T. Arap Moi succeeded him as President). It is usually the case now that U.S. granting agencies will not approve of grants unless provisions have been made to secure research permission. Throughout the tenure of the project from 1980 to the mid-1990s, renewal of the research clearance document was a troublesome and time-consuming problem. Involving local students in research activities through training or employment is an obligation that researchers must meet to ensure governmental cooperation and permission to carry out the research.

Multidisciplinary projects are different from other, more conventional projects, in that investigators require considerable time to exchange ideas, formulate plans, and understand the fundamental

principles of each other's scientific perspectives. Funding agencies are willing often to cover expenses for the basic research and even the presentation of papers at professional meetings. Agencies are almost always unwilling to provide funds for basic communication, integration, and planning for synthesis and reorganization, which is crucial at certain junctures of the research program. On our project, not nearly enough time was devoted to mutual exchange of ideas and information between the ecologists and anthropologists. An ideal pattern of research might be: (1) formulation of research ideas, (2) conduct of the research, (3) publication and synthesis, and (4) reformulation of research ideas to enter a new cycle of research. This fourth step was usually dealt with inadequately because of limited funds. Most of the effort, when we were able to meet, was devoted to seeking funding. This led, through lack of reinforcement, to a loss of the original enthusiasm for the synthetic ideas and a general gravitation to more specialized ecological or anthropological research topics.

Finally, it was initially difficult to promote joint funding (Ecosystems and Anthropology Programs in the NSF), since anthropology research was considered weak by the reviewers in the ecology program and ecology problems that dealt with humans were considered naive by the anthropologist reviewers. Many reviewers evaluated the research in the context of their own specialization and were unwilling or unable to consider integrated or synthetic perspectives and objectives. That is, reviewers focused on the details rather than the overall picture. There was little history of joint or multidisciplinary funding at the NSF in the late 1970s, and the importance of such research was less recognized than it is today.

## FIELD OPERATIONS

### *Early Fieldwork*

Field research, between 1980 and 1982, began in Nairobi where supplies and basic foodstuffs were purchased before the two-day drive north to Turkana District. Activities in Nairobi were largely devoted to planning, shopping, and vehicle maintenance. In order to conserve limited research funds, previously used vehicles were purchased, and these vehicles would frequently break down, slowing field operations substantially. Upon arrival in the southern part of Turkana District, we would camp in the town of Lokori (see Figure 2), where several storage structures had been rented to house supplies including fuel for the vehicles. Most of our field research was conducted out of tents, and although we employed several local workers to assist in field maintenance, living conditions were primitive.

Since the Turkana pastoralists are nomadic and move up to 12 times during the year, considerable effort was devoted to locating Turkana settlements, moving to these settlements, and setting up our own camp in proximity to the Turkana settlement. We had established good relations with several Turkana families dating back to contacts that Neville Dyson-Hudson had made a decade earlier and that had been reinforced when the early fieldwork began in 1980. In exchange for the cooperation of the herdowners and their wives, we would provide maizemeal, sugar, tea, and chewing tobacco when we arrived at the settlement. It was usually the case that several families would have their settlements (*awi*) in close proximity, which made data collection sampling feasible. Since one of the objectives of the research was to characterize the effects of seasonality on behavior, subsistence, health, and the like, attempts would be made to visit the same families at different times during the year.

Visits to Turkana settlements were time consuming activities, since water, food, and camping supplies and equipment had to be packed and transported to the Turkana settlements. It was usually the case that loading the vehicles, locating the settlement (often after several hours drive through bushland and rough country), and setting up our camp would require a full day, with an equal amount of time devoted to breaking camp and returning to our base camp in Lokori or Lokichar (see Figure 2). These forays would span a period of seven to ten days, and were limited by the amounts of food and water that we could transport. Hence, each visit to a Turkana settlement would give us between five and eight days for productive work and data collection, and two or three days preparation and clean up. During these trips, data were collected by the ecologists on livestock condition and feeding patterns, palatable plant species, available water sources: anthropologists would interview informants on social structure, herd and settlement movements, and marriage arrangements, and gather data on growth of children, dietary intake, and other aspects of health and human biology. It was estimated that the investigators who participated in this research devoted about 90 percent of their time to preparation and only 10 percent of the effort was spent in active work and data collection with the Turkana.

Field conditions in 1980 and 1981 were particularly difficult because the whole region was suffering from one of the worst droughts in thirty years. *Lochuu*, as it was later called, had begun in 1979 and very little rain had fallen until late February

1981. The impact of this drought on the Turkana nomads was disastrous. Toward the end of the drought in early 1981, animals were dying and people were eating abundant amounts of meat. This, however, constituted unusual dietary practices and, in addition, the Turkana were consuming their economic "capital" and were well aware of the impact that this would have on their subsistence when the drought ended. The drought did end in late February with a monsoon deluge that caused flooding and further livestock losses. The heavy rains, which lasted a full day, precipitated epidemics of pleuropneumonia in many of the livestock (particularly sheep and cattle), because of their weakened condition, which led to further livestock deaths. The effects of this drought and the livestock losses experienced by the Turkana, were felt for several years after. One immediate effect was that because the livestock were in such poor condition in 1980, few conceived and livestock milk production was very low. Following the drought, when animals began to return to normal body weight, conceive, and produce young, milk production was unusually high.

There were additional problems associated with the *Lochuu* drought in that inter-ethnic raiding between neighboring Pokot tribesmen (to the west of the Turkwel River) and Turkana tribesmen intensified. Certain areas of the southern and western part of the Ngisonyoka Turkana territory was subject to Pokot raiding with guns, including automatic weapons. Local Turkana bandits, called *Ngingoroko*, also were raiding family settlements, largely for livestock, but also for other material items that they could carry easily. People were often beaten and terrorized by the bandits. These conditions contributed to substantial tension among the Turkana families with whom we worked, but also among the researchers, none of whom carried firearms. We, as outsiders were never sure whether we would be attacked or whether we enjoyed some degree of immunity. During my first night in Lokori in February 1981, we were awakened abruptly by automatic weapons fire, when the police barracks, about a kilometer and a half distant from our camp, was under attack.

Our basecamp conditions were improved somewhat in 1982, when a small cement building was rented in the town of Lokichar and storage facilities were rented at the nearby mission. This permanent location allowed better planning for the field operations and a place to recover after the strenuous trips to Turkana settlements.

### *Later Fieldwork*

From 1982 onward, field operations had been moved to Lokichar to the north of Lokori. Shortly after, a house was constructed at the edge of the town to serve as a base for all of the field operations. Equipment, supplies, food, and vehicles could be stored with some degree of security and this was a pleasant place to spend a few days recovering from the rigors of living in the bush with the Turkana at their settlements. This "Lokichar House," although not much more than a cabin, allowed researchers to arrive from Nairobi and to begin their work much more rapidly than in the past. Two years later, a house was rented in Nairobi and a field manager was hired to speed up the process of moving from Nairobi to Turkana. The field manager was in charge of equipment and vehicles, including vehicle repairs and servicing. By this time, we were learning how a large-scale research operation had to be managed, and there was markedly improved efficiency to the extent that data collection probably increased to about 20 percent of our overall overseas effort.

### *In Retrospect*

We learned a number of lessons about the difficulties of working with a number of research scientists from both a practical standpoint and in terms of field management. One important point is that living conditions in a basecamp must be relatively comfortable in order to facilitate the data collection that is conducted at the Turkana settlements where living conditions were austere. A portable shower, a comfortable chair, and a decent meal once each day was an unbeatable combination to reduce tensions and enable research workers to engage in sustained hard work. We also learned that adequate clean water and improved sanitary conditions reduced the prevalence of infection among the researchers, thereby allowing more efficiency in field operations.

As we learned more about the South Turkana environment, its people, and their livestock, our idealistic models about "average" conditions were seen as less appropriate in characterizing this dry savanna system. We began to be increasingly sensitive to the variation in the environment, and the sense that a "typical" Turkana year was impossible to identify. Or course, ecologists were able to sense variations in the ecosystem that the anthropologists could not perceive, and the anthropologists were able to identify variations in Turkana behavior much more easily than the ecologists. This is a very positive practical outcome of multidisciplinary collaboration. Sensitivity to variation in specialized areas of expertise is a function of training and learning. Some information on the extent of variation in

child growth, reproduction, and health was not apparent until some time later after data had been analyzed and interpreted.

Photographs of some of the Turkana people with whom we worked are presented in figures 5.

Although anticipated by N. Dyson-Hudson (1972) several years earlier, it became clear to everyone that extended (longitudinal) field studies provide incredible resolution of patterns of events, environmental variation, and the lives of the people under study. We were successful in avoiding the problem where anthropological studies of one year by one investigator must certainly be inadequate to describe even the simplest population.

## THEORETICAL PERSPECTIVES

### *Ecosystems Ecology and Anthropology*

Ecosystems ecology focuses on the understanding of complex ecological systems of biotic communities and abiotic factors. Much of this work is based on conceptual (illustrative) and analytical (mathematical/computer) models that serve as

**Fig. 5. Photographs of the Turkana people: upper left — young woman nursing an infant (photo by S.J. Gray); upper right — children and adolescents (photo by M.A. Little); lower left — young, unmarried women dancing (photo by P.W. Leslie); lower right — men drinking tea (photo by B.R. Johnson).**

frameworks to test hypotheses within the ecosystem domain. Modeling is a most effective technique for analyzing a system with many variable components. A model may be based on some data and many assumptions, or it may be largely data-driven. Modeling, was important as a methodological approach for the ecological research, and its utility for anthropological studies soon became apparent as the project evolved. Ecosystems ecology, and its development of modeling procedures, rose in importance as a component of biological sciences during the years of the International Biological Programme in the 1960s and early 1970s (Breymeyer and Van Dyne, 1980; Worthington, 1975).

In contrast to much of anthropology and other social sciences today, the approach that we took to understand the Turkana ecosystem and its human and livestock components was a scientific one. That is, we formulated hypotheses and attempted to test them by logically designed data collection and analysis. We viewed the southern Turkana region as a highly diverse ecosystem with human populations as an integral part of the system. It is a *natural* system to the extent that humans are a *natural* component species within the ecosystem, despite the dominant impacts that human populations often have on the environment. With this fundamental perspective in mind, we were able to conceptualize many parallel patterns between human biology and other components of the ecosystem, including seasonality effects in both humans and livestock.

The concept of *adaptation* figured prominently among ecologists and anthropologists, alike. A fundamental assumption was that the Turkana people had adapted to the dry savanna ecosystem in their social organization, livestock management practices, demography, and human biology. *Adaptation*, as we conceptualized it, is an evolutionary concept that implies adjustment to the environment (within the ecosystem) resulting from selection and preservation of biobehavioral responses. Since the Turkana had been resident in this region of northwest Kenya for less than 250 years, we were less concerned with genetic adaptations. Rather, we were interested in biobehavioral diversity that contributed to the survival and persistence of the Turkana people in an ecosystem with a high degree of seasonal and year-to-year variation in resources (rainfall and vegetation), and where resources are markedly limited much of the time.

### *Paradigm Shifts and Problems of Scale*

At the very beginning of project formulation and design, the conceptual models of the South Turkana ecosystem were quite simple because the project investigators had limited information. As knowledge about the system began to accumulate, the models became more sophisticated. But because the anthropologists and ecologists had little time to communicate and exchange ideas outside of their field contacts, the gap between the ecological and the anthropological research began to widen. Although funding was quite good during most of the decade following 1979, new joint proposals had to be submitted regularly (two- to three-year intervals). Since the majority of funds were provided by the NSF Ecosystems program, the ecologists took the lead in proposal preparation and in research planning.

Under conditions where there were limited opportunities for lengthy discussion, new directions in research designs were not well coordinated. An example of this was the proposal that was submitted in 1985. At that time, theoretical perspectives in ecosystems studies were undergoing changes and *landscape ecology* was becoming a popular approach. Landscape ecology applied principles of geomorphology to an understanding of ecosystems. The draft proposal that was sent to the anthropologists for their contribution had a landscape ecology framework within which it was difficult to integrate the human biological and sociocultural research plans. Such problems arose from a lack of coordinated efforts, partly due to the distance separating the ecologists (Colorado) and the anthropologists (New York) and the lack of funds needed for travel between the two sites (about 3,000 km). Another problem that separated the ecologists from the anthropologists was an issue of the incomes of each of the groups of scientists. Whereas the anthropologists had academic jobs with guaranteed salaries (but teaching responsibilities), the ecologists' salaries were covered only by the research funds that were raised by external grants and contracts, and they were, therefore, under considerable pressure to seek funding by submitting numerous proposals.

Throughout the project, scientific interests differed somewhat in levels of scale between the anthropologists and the ecologists. A major interest among the ecologists was in *ecosystem-level processes*, while the anthropologists tended to focus on humans (and their livestock) at the *population-level*. This is not to say that both groups of scientists were interested only in these respective levels of understanding. Rather, this tendency contributed to a further separation in research approaches that limited a full integration of ecology and anthropology on this project. These differences in approaches were unavoidable because of the original theoretical perspectives of the two groups of scientists, and are mentioned here simply to em-

phasize the ongoing need for communication and refocusing of objectives as a project evolves.

## PERSONNEL AND INTERPERSONAL RELATIONS

In the early 1980s, the budgetary allocation of the U.S. National Science Foundation Ecosystems Program was about five- or six-times the size of the Anthropology Program funding allocation. And as noted above, the contribution to overall project funding was predominantly from the Ecosystems Program. The advantages of joint funding from these two programs for the anthropologists was substantial, in that the fundamental infrastructure of the field research was well supported. This included field vehicles and their maintenance, field housing and support, and travel within Kenya. Had the research depended on the Anthropology Program funding for basic support, considerably less funds would have been available and only a fraction of the anthropological research would have been feasible. The only disadvantage of this funding pattern was that it placed the anthropologists in the position of slightly unequal partners. It should be emphasized, however, that disagreements over grant expenditures were almost non-existent and relations were generally good.

Inevitable conflicts did arise over who and who were not contributing fully to the objectives of the project. As the project evolved, some accommodation was reached with the realization that some of the researchers contributed effectively to planning and proposal preparation, while others generated ideas or were good field workers, and others published frequently and communicated the results of the project in other ways. Hence, individual project scientists tended to specialize according to their best skills and functions.

Under stressful field conditions where a number of people live and work together, conflicts often ensue over trivial matters. Tension was greatest between anthropologists and ecologists when several graduate students from each group were in the field together. The inexperienced graduate students brought their traditional biases against other than their own sciences (the *natural* versus the *social* sciences). Another explanation for this behavior is that the graduate students were narrowly focused on their own research, and they were less concerned with or committed to the overall integrated project objectives. More attention might have been spent on socializing graduate students on the values of multidisciplinary research and tolerance of different scientific approaches.

## SUBPROJECTS, ANALYSES, AND PUBLICATIONS

Each scientist and graduate student worked on specified problems that were subcomponents of the overall project. This was most clearly defined for the students who required control over given research topics for their professional development and identification. With a few notable exceptions, graduate students were slow to analyze and publish the results of their research, and in several cases, students who completed the PhD degree published little or nothing about their research. Out of the 11 anthropology students who completed PhD degrees as members of the project, only 6 individuals published significantly on the results of their work. Some of the project scientists were also slow to publish. Since the synoptic and synthetic work depended on the basic descriptive and analytical publications, this work was often delayed, as well. In some ways, it is fortunate that granting agencies pay less attention to publication records than to new ideas when projects are considered for renewal.

Problems of publication sequence, control over data, collaborative reporting, and authorship are issues for which there should be policy at the outset of a multidisciplinary project. When it was apparent that former PhD students were not publishing their results in a timely fashion, we speculated on setting a rule requiring all junior scientists to have a paper submitted or "in press" 12 months after completing the PhD degree. Otherwise, control over the data would be forfeited so that others might complete the analysis and get the results into the literature. Despite these problems with reporting research results, more than 175 papers* and other contributions from theproject and a synthesis volume summarizing the anthropology research (Little and Leslie, 1999) were published.

Whereas most of the collaborative field research of the South Turkana Ecosystem Project ended a decade ago, related work continued in several directions throughout the 1990s. Work on the Turkana shifted toward more specialized studies of reproductive ecology (Leslie et al., 1993, 1994, 1996; Pike, 1999, 2000 a, b), breastfeeding (Gray; 1995, 1996, 1998), health (Shell-Duncan, 1995, 1997), and violence (Dyson-Hudson and Dyson-Hudson, 1999). Comparative reports (Little, 1989, 1997) and other research was conducted on health of Ugandan Karimojong pastoralists (Gray in press), body composition and diet in the Ethiopian Borana (Galvin,

*A copy of this bibliography can be acquired by sending an e-mail requests to: mlittle@binghamton.edu

1994); and a variety of studies of Tanzanian Maasai (Galvin et al., in press a, in press b; McCabe et al., 1992).

## DISCUSSION AND CONCLUSIONS

There are complex research problems linking the ecosystem, human sociocultural behavior, and human health and biology. It is obvious that no single scientist can untangle and solve problems of such an exquisite nature. Rather teams of investigators must work together within a multidisciplinary framework if there is to be any hope of success. The disadvantages of multidisciplinary research are manifold: management of large groups of scientists is difficult and expensive; overall project costs are high and funds are difficult to raise; publication is often delayed; communication among project members must be facilitated; interpersonal conflicts sometimes arise; field data collection schedules and allocation of resources must be managed; and the project must be administered. However, the rewards far outweigh the disadvantages: intellectual experiences are rich through exchanges of ideas in different scientific specialties; social and natural scientists have an opportunity to work together to break down interdisciplinary biases and to learn together; research results are validated through different perspectives; students benefit by being exposed to cooperative ventures early in their research training to learn outside of their own narrow discipline.

The South Turkana Ecosystem Project was a groundbreaking research experience to both anthropology and ecology. It established a pattern for joint funding through the U.S. National Science Foundation over a period of ten years. The research reflects what is probably the most comprehensive study of a pastoral population that has ever been done, and what is one of the most comprehensive multidisciplinary studies of a single population. In addition to the detailed studies that describe the Turkana people and their environment, the integrated findings have cast doubt on some "conventional wisdom" beliefs; for example, that pastoralism and maximization of herd numbers does not always contribute to environmental degradation. Finally, it is hoped that both anthropologists and ecologists are becoming convinced of the importance of humans in all ecosystems, and of the importance of biosocial/ecological science as an important form of integrated research.

Human ecology can only be pursued as a research effort through multidisciplinary science. There are not only good scientific reasons to promote collaborative, multidisciplinary research, but there are also practical reasons that are important to the survival of humans as integral components of the varied ecosystems on our planet.

**KEY WORDS** Turkana. Pastoralists. Savanna Ecology. Multidisciplinary Research.

**ABSTRACT** The liabilities and rewards of multidisciplinary research in ecology and anthropology are reviewed with examples drawn from the *South Turkana Ecosystem Project.* This project spanned more than a decade from the late 1970s to the late 1980s. Scientists from ecosystems ecology and anthropology combined their skills to study a population of Ngisonyoka Turkana who are pastoral nomads from the dry savanna lands of northwest Kenya. The South Turkana Ecosystem Project has been identified as one of the most comprehensive projects in human ecology ever conducted. It is certainly the most thorough study of a human pastoral population ever done within the framework of human ecology. On balance, the rewards of multidisciplinary research far outweigh the liabilities, not only in the power of the scientific work and information generated, but in the richness of the intellectual experiences from scientific collaboration. It is suggested here that human ecology can only be pursued as a research effort through multidisciplinary science.

## REFERENCES

Baker, M.J. and Lovenbury, H.T.: The South Turkana Expedition Scientific Papers VII. The 1969 season survey. *The Geographical Journal,* **137:** 349-360 (1971).

Breymeyer, A.I. and Van Dyne, G.M.: *Grasslands, Systems Analysis and Man*. International Biological Programme 19, Cambridge University Press, Cambridge (1980).

Dyson-Hudson, N.: The study of nomads. In: W. Irons and N. Dyson-Hudson (Eds.), *Perspectives on Nomadism*, pp. 2-29. E.J. Brill, Leiden (1972).

Dyson-Hudson, N.: Turkana. In: *Primitive Worlds*, pp. 84-111. National Geographic Society, Washington, D.C. (1973).

Dyson-Hudson, N.: Strategies of resource exploitation among East African savanna pastoralists. In: D.R. Harris (Ed.), *Human Ecology in Savanna Environments*, pp.171-84. Academic Press, London (1980).

Dyson-Hudson, N. and Dyson-Hudson, R.: The social organization of resource exploitation. In: M.A. Little and P.W. Leslie (Eds.), *Turkana Herders of the Dry Savanna: Ecology and Biobehavioral Response of Nomads to an Uncertain Environment*, pp. 69-86. Oxford University Press, Oxford (1999).

Ellis, J.E., Dyson-Hudson, N. Swift, D.M. and Little, M.A.: The ecology of subsistence pastoralism. Proposal submitted to the National Science Foundation, Colorado State University, Ft. Collins (1979).

Galvin, K.A., Coppock, D.L. and Leslie, P.W. : Diet, nutrition and the pastoral strategy. In: E. Fratkin, K.A. Galvin, and E. A. Roth (Eds.): *African Pastoralist Systems: An Integrated Approach*, pp. 113-131. Lynne Rienner, Boulder (1994).

Galvin, K.A., Ellis, J., Boone, R.B., Magennis, A.L., Smith, N.M., Lynn, S.J. and Thornton, P.: Compatibility of pastoralism and conservation? A test case using integrated assessment in the Ngorongoro conservation area, Tanzania. In: D. Chatty (Ed.): *Displacement, Forced Settlement, and Conservation*, Berghahn, Oxford (In Press a 2001a).

Galvin, K.A., Boone, R.B., Smith, N.M. and Lynn, S.J.: Impacts of climate variability on East African Pastoralists: linking social science and remote sensing. *Climate Research.* In press (2001b).

Gray, S.J.: Correlates of breastfeeding frequency among nomadic pastoralists of Turkana, Kenya: A retrospective study. *Amer. J. Phys. Anthrop.,* **98:** 239-255 (1995).

Gray, S.J.: The ecology of weaning among nomadic Turkana pastoralists of Kenya: maternal thinking, maternal behavior, and human adaptive strategies. *Human Biology,* **68:** 437-465 (1996).

Gray, S.J.: Butterfat feeding in early infancy in African populations: New hypotheses. *Amer. J. Hum. Biol.,* **10:** 163-178 (1998).

Gray, S.J., Leslie, P.W. and Akol, H.A.: Uncertain disaster: Environmental instability, colonial policy, and the resilience of East African pastoralist systems. In: W.R. Leonard and M.H. Crawford (Eds.): *Last of the Nomadic Herders: The Human Biology of Pastoral Populations*, Cambridge University Press, Cambridge (2001) In Press.

Gulliver, P.H.: A preliminary survey of the Turkana: A report compiled for the Government of Kenya. University of Cape Town, Communication from the School of African Studies, ns no. 26, Cape Town (1951).

Gulliver, P.H.: *The Family Herds: A Study of Two Pastoral Tribes in East Africa, the Jie and the Turkana*. Routledge and Kegan Paul, London (1955).

Gwynne, M.D.: The South Turkana Expedition Scientific Papers I. Preliminary report on the 1968 season. *Geographical Journal,* **135:** 331-342 (1969).

Hemming, C.F.: The South Turkana Expedition Scientific Papers VIII. The ecology of South Turkana: a reconnaissance classification. *Geographical Journal,* **138:** 15-40 (1972).

Leslie, P.W., Campbell, K.L. and Little, M.A.: Pregnancy loss in nomadic and settled women in Turkana, Kenya: a prospective study. *Human Biology,* **65:** 237-254 (1993).

Leslie, P.W., Campbell, K.L. and Little, M.A.: Reproductive function in nomadic and settled women of Turkana, Kenya. In: K.L. Campbell and J.W. Wood (Eds.): *Human Reproductive Ecology: Interactions of Environment, Fertility, and Behavior*, *Annals of the New York Academy of Sciences,* **709:** 218-220 (1994).

Leslie, P.W., Campbell, K.L., Little, M.A. and Kigondu, C.S.: Evaluation of reproductive function in Turkana women with enzyme immunoassays of urinary hormones in the field. *Human Biology,* **68:** 95-117 (1996).

Little, M.A.: Designs for human-biological research among savanna pastoralists. In: D.R. Harris (Ed.): *Human ecology in savanna environments*, pp.479-503. Academic Press, London (1980).

Little, M.A.: Human biology of African pastoralists. *Yearbook of Physical Anthropology,* **32**: 215-247 (1989).

Little, M.A.: Adaptability of African pastoralists. In: S.J. Ulijaszek and R.A. Huss-Ashmore (Eds.): *Human Adaptability: Past, Present and Future*, pp. 29-60. Oxford University Press, Oxford (1997).

Little, M.A. and Leslie, P.W. (Eds.): *Turkana Herders of the Dry Savanna: Ecology and Biobehavioral Response of Nomads to an Uncertain Environment*. Oxford University Press, Oxford (1999).

Little, M.A. and Morren, Jr. G.E.B.: *Ecology, Energetics and Human Variability*. Wm. C. Brown Co., Dubuque, Iowa (1976).

McCabe, J.T., Perkin, S. and Schofield, C.: Can conservation and development be coupled among pastoral people: the Maasai of the Ngorongoro Conservation Area, Tanzania. *Human Organization,* **51:** 353-66 (1992).

Morren, G.E.B., Jr.: From hunting to herding: pigs and the control of energy in Montane New Guinea. In: T. Bayliss-Smith and R.G. Feachem (Eds.): *Subsistence and Survival: Rural Ecology in the Pacific*. pp. 273-315. Academic Press, London (1977).

Pike, I.L.: Age, reproductive history, seasonality, and maternal body composition during pregnancy for nomadic Turkana of Kenya. *Amer. J. Hum. Biol.,* **11:** 658-672 (1999).

Pike, I.L.: Pregnancy outcome for nomadic Turkana pastoralists of Kenya. *Amer. J. Phys. Anthrop.* **113:** 31-45 (2000a).

Pike, I.L.: The nutritional consequences of pregnancy sickness: critiquing and adaptationist hypothesis. *Human Nature,* **11:** 207-232 (2000b).

Rappaport, R.A. *Pigs for the Ancestors: Ritual Ecology of a New Guinea People*. Yale University Press, New Haven, Connecticut (1968).

Shell-Duncan, B.: Impact of seasonal variation in food availability and disease stress on the health status on nomadic Turkana children: a longitudinal analysis of morbidity, immunity, and nutritional status. *Amer. J. Hum. Biol.,* **7:** 339-355 (1995).

Shell-Duncan, B.: The evaluation of infection and nutritional status as determinants of cellular immunosupression. *Amer. J. Hum. Biol.,* **9:** 381-390 (1997).

Smith, E.A.: *Inujjuamuit Foraging Strategies: Evolutionary Ecology of an Arctic Hunting Economy*. Aldine de Gruyter, New York (1991).

Winterhalder, B.: Boreal foraging strategies. In: A.T. Steegmann, Jr. (Ed.): *Boreal Forest Adaptations: The Northern Algonkians*, pp. 201-241 (1983).

Thomas, R.B., McRae, S.D. and Baker, P.T.: The use of models in anticipating effects of change on human populations. In: G.A. Harrison (Ed.): *Energy and Effort*, pp. 243-281. Taylor and Francis, London (1982).

Worthington, E.B.: *The Evolution of the IBP*. Cambridge University Press, Cambridge (1975).

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