TURKANA ADULT AND CHILD LIVELIHOODS: ACCOMMODATION AND PERSISTENCE IN AN UNPREDICTABLE ENVIRONMENT

by

TAMMY YVONNE WATKINS

(Under the Direction of BRAM TUCKER)

ABSTRACT

Turkana of northwestern Kenya are responding to environmental changes and continued marginalization by government and international development at both the household and individual level. The diverse livelihood strategies used by Turkana suggest that local knowledge and behavior patterns enable continued existence in a harsh and unpredictable environment. Turkana local ecological knowledge is explored through interviews and collection of specimens in order to assess knowledge of wild foods that offer important nutrients to a pastoralist diet. This dissertation uses a livelihoods framework to understand what the strategies are and how the portfolio of strategies has changed in response to external influences. Economic theory informs analysis of how Turkana value the diverse species in their herds and how diverse strategies affect health and nutrition outcomes. At an individual level the contributions of children are evaluated through direct observation and ultimate benefit is ascertained using anthropometrics and nutritional status. Household ecology of complex pastoralist households is incorporated in to research design, methods of data collection and analysis. This research focuses on middle childhood, the period between four and twelve years of age, bridging the gap

between child-focused feeding programs and adolescence. Children with a lower birth order demonstrate better nutritional status than more senior siblings, especially in girls, suggesting that gender roles have an effect on nutritional status during childhood. The biological tradeoffs involved in growth, development and health are evident in Turkana nutritional status through the lifespan. Some of the external influences on Turkana livelihoods include government and non-government organization programs of relief and development, which are addressed in discussion throughout each chapter. Turkana display cultural and biological plasticity that allow them to continue to survive in a harsh and unpredictable environment. By understanding some of the challenges Turkana face in maintaining livelihood portfolios in a changing environment, policies and programs will have more success as well as theory and practice of social science research on risk management through diversification, pastoralist resource management, biological development and nutrition in unpredictable environments and child development.

INDEX WORDS: children, pastoralism, Turkana, Africa, drylands, nutritional anthropology, medical anthropology, economic anthropology, livelihoods

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CHAPTER 1

INTRODUCTION

Purpose of the study

This research explores how Turkana of northwestern Kenya are responding to continued marginalization by Kenyan and international development and environmental changes through introduced species and climate variability at both the household and individual level by asking a series of questions. Given that the environment is highly unpredictable and suffers from cyclical drought, what are the livelihood strategies Turkana use and how has the portfolio of strategies changed in response to external influences? How does local ecological knowledge affect Turkana livelihood strategies? Since Turkana are pastoralists, how do they value the different species that make up their diverse herds? Does Turkana children's labor benefit themselves or their households? Nutritional outcomes across the lifespan are used to measure the success of individual or household livelihood portfolios.

In this study, livelihood literature, informed by economic anthropology and human behavioral ecology's contributions to risk minimization and diversification, guides the questions regarding livelihoods strategies of both adults and children as well as valuation of livestock. Ethnoecology shapes the research and analysis of Turkana local ecological knowledge of wild foods. Life history theory, primarily the biological tradeoffs involved in accessing food, nutrition and health, informs analysis of nutrition and health outcomes. Since children under five years of age are routinely the focus of

nutrition assessments and interventions, this research focuses on middle childhood, from age four to twelve years of age, bridging the gap of childhood and adolescence. Biological and social development of children are considered, primarily using household production of nutrition and health and the developmental niche theory, both of which are well suited to the complex pastoralist households. In addition, foraging theory and evolutionary ecology inform the analysis of children's time allocation.

The household ecology of complex pastoralist households is incorporated in research design, methods of data collection and analysis. Nutritional status of individuals and community health indicators of morbidity and mortality serve as measures of outcome, or success of livelihood strategies. Some of the external influences on Turkana livelihoods include government and non-government organization programs of relief and development. Past and present program impacts on livelihoods are addressed throughout this dissertation.

This introductory chapter will include theoretical background and methods for the dissertation research, important ecological and environmental information on the research sites, political ecology of the study population, ethnography of northern Turkana and framing of the upcoming chapters.

Theory and Methods

Theory and literature important to the research will be reviewed and related to this project. Then data collection methods, derived from the theory and literature review will be described. Finally, methods of analysis and the research sites are also described.

Livelihoods is a term that indicates not only a living but also capabilities and resources that provide a living (Chambers and Conway, 1992). These assets, capabilities and resources can be grouped into various types of capital. Ellis (2000) divides them in to natural, human, financial, physical, and social capital and stresses the importance of diversity in rural livelihoods. This diversity becomes more important in arid environments, like those in East Africa, where risks of failure of individual livelihood strategies are high (Ellis and Galvin 1994). Using a livelihoods framework, including the important element of diversification of strategies at the level of the households as well as individual children, allows for a better understanding of child development in this pastoral society as well as future comparisons across cultures. This understanding can then be applied to livelihoods literature in development studies, theories of child development as well as government and NGO policies and programs. I hypothesize that Turkana households employ a variety of strategies towards more stable livelihoods and that similar diversification of strategies is employed by children.

Pastoralists have an array of mechanisms they use to deal with the unpredictable and patchy environment of East Africa. Herd composition and movements of herds and households address variations in access to forage, water and ultimately food production for the household (Dahl and Hjort 1976; Mace 1993). Turkana livelihood strategies include herding, consuming both plant and animal wild foods and occasionally sorghum or maize cultivation. Labeling an array of subsistence practices as a portfolio draws on economic theory of risk minimization (Markowitz 1952). This theory has been applied to field scattering among agriculturalists and herd diversification among pastoralists (Dahl and Hjort 1976; Goland 1993; McCloskey 1991). Application of risk minimization theory

to both household and individual level strategies, including those of children, is appropriate in the highly unpredictable disequilibrium ecosystem of northern Kenya (McCabe 2004).

Local ecological knowledge is important both as a form of human capital as well as a tool for a livelihood strategy with the ultimate goal of risk minimization (Winterhalder et al, 1999). Ethnoecology utilizes anthropological methods to research local knowledge, ranging from cognitive classification schemes (Berlin et al, 1966) to applied subjects like ecological and environmental knowledge and management practices (Nazarea et al, 1998). Ethnoecology can help to define Turkana knowledge and management practices of wild food resources that are an important element of the portfolio of livelihoods and may contribute to risk minimization.

Evolutionary Anthropology, specifically life history theory, considers the biological trade-offs required during high nutrient dependent times and the potential costs of these trade-offs in the short and long term development (Panter-Brick 1998). Some trade-offs include failure to thrive and wasting in children, leading to stunting and possible social and psychological development issues if not addressed (Bogin et al, 2007; Mace 2000). Concerns later in life are maternal depletion leading to low birth weight infants who are then at high risk of failure to thrive. From an evolutionary perspective there are trade-offs in decisions regarding maintenance of biological functions such as the immune system versus additional growth (Leonard 2000; ShellDuncan 1997). The Turkana experience of some of these tradeoffs is complicated by the unpredictable and harsh environment. Therefore they make an excellent case in which to study the impacts of life history theory across the major life stages.

Human behavioral ecology grew out of evolutionary ecology, using evolutionary theory to analyze human behavior within specific environments (Smith and Winterhalder 1992a). Human behavioral ecological theory considers the adaptiveness of specific behaviors, for example, wild food foraging by the Turkana in the semi-arid environment of northern Kenya. Within human behavioral ecology, foraging theory focuses on foraging behaviors, removed from anthropologically imposed boundaries such as hunting and gathering as a mode of subsistence or production (Kelly 1995). Turkana adults and children have been reported to hunt and gather wild foods but the contribution of these resources has not been clearly defined (Gray et al, 2003; Gulliver 1955). This research quantifies children's foraging for wild foods along with other behaviors that may give them access to food by the amount of time they spend in these behaviors. Nutritional analysis of available wild foods demonstrates the availability of micronutrients, important to health and nutrition, as well as macronutrients for caloric intake (see Appendix B).

Some anthropologists have proposed that the child, as the helper at the nest, does have an evolutionary impact although the exact impact is sometimes difficult to separate from larger issues of kinship, sharing and reciprocity (Bird 2000; Bird and Bird 2002b; Crognier et al, 2001; Hawkes et al, 1995a; Kramer 2002; Kramer and McMillan 1998; Zeller 1987). Limitations of size, knowledge and differences in environments are other issues and topics of theory and research regarding children's foraging and are evident in research among Hadza children (Jones and Marlowe 2002).

Turkana children foraging for wild foods is but one in an array of activities used to gain access to food or food resources. Other studies of children's foraging have begun to include behaviors beyond foraging for wild foods such as food acquisition in urban

areas and behaviors that include begging and working for food (Baker et al, 1997; Lee 2007).

This dissertation research investigates how children use livelihood strategies, and the values and outcomes to themselves, their peers, and their households among Turkana pastoralists in the drylands of East Africa. The success, or outcome of these strategies, is assessed through nutritional status or anthropometrics. By focusing on children's strategies and contributions, much can be learned about risk management, buffering, and coping mechanisms with applications to development and policy across Africa.

Children may use a different set of livelihood strategies or use them more frequently in a household environment of chronic food insecurity. In East Africa, regional and household food insecurity as well as malnutrition are often the result of environmental factors such as drought or flooding and animal predation as well as social factors such as violence or displacement (Nyariki et al, 2002). Using Entitlement Theory, Sen (1984) defines food security as access to assets that produce food as well as access to food itself. Children's livelihood strategies, in a setting of chronic food insecurity, would be modified to gain access to different sources of food or assets of production of food. In an insecure environment, due to raiding activities and prevalence of firearms (Gray et al, 2003), children's mobility, therefore some of their food seeking behaviors, will be restricted.

Children's contributions to household livelihood have been studied among agriculturalists (Kramer and McMillan 1998) and more recently, among hunter-gatherers (Bird 2000; Bock 2002b; Hawkes et al, 1995b; Hewlett and Lamb 2005). Children may begin to contribute to household production through foraging or household labor at early

ages, depending on the subsistence mode of their society and the environment in which they live. This research will address basic anthropological questions such as: what is the function of children's livelihood strategies; who receives the benefits of them; which strategies do they use and when; and what are the biological consequences of children's choices of livelihood strategies? These questions are important to evolutionary questions about childhood as a life stage, household subsistence, livelihoods and biological and psychological development of children. The answers to these questions are important not only to anthropologists, but also to governments and non-government organization (NGOs) working on policies to address food security and development among pastoralists. In addition, this research will provide important insights into children's roles as individuals and within households with important implications toward policy regarding education in these societies.

Most anthropological studies of children's nutrition have focused on the role of parental and household factors, such as parent's feeding strategies (Gray 1998), or malnutrition as the outcome of household food shortages (Sellen 2000). There is a growing realization that children's worldviews and actions may crucially shape their nutritional status (Draper and Hames 2000) and health (Berman et al, 1994; Bronfenbrenner and Ceci 1994). Children have been observed to forage, scavenge, beg, access food aid programs, or work within households in order to increase access to food (Baker and Hinton 2001; Bird 2000; Bock 2002a; Little 2002). These behaviors are a few that are expected among the portfolio of livelihood strategies used by Turkana children and may represent embodied capital in the form of environmental and cultural knowledge (Bock 2002b)

Moving beyond foraging behavior, the idea of a developmental niche is one attempt to address the complexities of children's roles within a household (Bronfenbrenner 1986; Super and Harkness 1986). The idea that children's roles are moderated by the household as well as the cultural environment was later applied to health and well-being (Berman et al, 1994; Harkness and Super 1994; Schumann and Mosley 1994). These ideas were eventually adapted to evolutionary theories of adaptability and heritability (Bronfenbrenner and Ceci 1994). I predict that birth order and household position will predict behavior and impact nutritional status of Turkana.

Children's subsistence strategies vary according to the value of their labor, which is modified by sex, age and birth order. According to the developmental niche framework (Super and Harkness 1986), as children mature they are constantly redefining their roles within their household and society. Older children, especially the oldest girl, often provide care for their younger siblings in many societies (Hewlett and Lamb 2005; Whiting 1963). Among pastoralists, boys are expected to contribute to the care of livestock (Fratkin 1987), but their labor is highly substitutable (Bock 2002a). Thus, strategies among female children may vary according to age or birth order while sex will explain more male behavior.

Within pastoralist societies, men and boys are more likely to use strategies related to livestock care while women and girls are more likely to use strategies surrounding household activities (Fratkin 1987). Strategies conducted outside of the household compound are likely to increase dietary diversity and provide more micronutrients, thus correlate positively with better nutritional and health status (Arimond and Ruel 2004). Strategies conducted closer to the compound, especially those related to food aid

programs (school and supplementary feeding programs), will correlate negatively with dietary diversity, thus poor nutritional and health status.

As suggested before, civil security will affect which livelihood strategies children are able to choose and when. Much of the decision-making of children's strategies in this research originates with the children with either implicit or explicit approval of the caretakers. During periods of violence, pastoralists construct thorn and brush fences around villages and compounds that are closed at certain times, or post armed guards around villages, compounds, or herds of livestock (Pike 2004). These measures to increase community security could present barriers to children's subsistence strategies. In addition, during periods of civil insecurity, usually due to raiding between groups of pastoralists, parents and village leaders will restrict movements and activities outside of the village or compound. This may have a limiting effect on children's subsistence strategies by restricting their movement.

Successful strategies should lead to better nutritional status and subsequent improved health status as evidenced by decreased morbidity and mortality (Eveleth and Tanner 1990). Increasingly, it is understood that children living under subsistence conditions can be knowledgeable about resources in their environment as well as methods of extraction and processing (Blurton Jones et al, 1994; Chipeniuk 1995). This fits with the theory that children are more than simply passive social actors, even in difficult circumstances such as an unpredictable and harsh environment (Panter-Brick 1998). Rather, they exercise their own agency and actively shape their roles and contributions to the household and the greater society (Bird-David 2005; Harkness and Super 1994; Super

and Harkness 1986). This agency is evidenced by children independently using their own portfolio of livelihood strategies to minimize risk and to increase their access to foods.

Methods used in this research rely heavily on practices common to Human Behavioral Ecology (HBE) and Nutritional Anthropology. HBE relies more on observation of behaviors and less on reported behaviors through questionnaires or interviews. Time allocation through instantaneous scans of households and focal follows of individuals demonstrate how index children and their households distribute their labor to various modes of production and subsistence strategies (Borgerhoff Mulder and Caro 1985). Instantaneous scans of participant households across seasons and at different times of the day and week reveal time allocation by individuals within households (Hames 1992; Hawkes et al, 1997). Focal observations come from Ethology where individuals are observed for prescribed periods of time and all behaviors are logged and coded (Lehner 1979). In this research, children from middle childhood, aged four to 12 years, were observed for three five hour windows, spanning daylight hours and into the evening meal period to observe food sharing practices. Any foraging returns during these observation windows were logged and measured and behaviors were coded for self-provisioning, working alone or in groups and who receives the benefits of strategies.

Anthropometrics include height, weight, skinfold, mid-upper arm circumference (MUAC) and skinfold measurements, and were obtained on index cases and members of their household initially and seasonally. Height was measured using a Schorr board, a stadiometer with a wooden base and height scale that enables both standing and recumbent measures. Individuals under 85 centimeters in height were measured in a recumbent position. Weight was measured with a Tanita digital scale that was calibrated

prior to each measurement. Infants were measured with a hanging scale that was calibrated daily before use. Mid-upper arm circumference was measured with a MUAC strip provided by UNICEF or Action Against Hunger in Lokichoggio. Subcutaneous skinfold thickness was measured at the same location as the MUAC but in the triceps muscle area and subscapular area using a Holtain skin caliper that was calibrated weekly. These measurements were converted to indices (such as weight-for-age, weight-for-height, and body mass) of nutrition and developmental status (WHO 1995). Analysis of anthropometric data was completed with EpiInfo 3.3.2, a software program from the United States Centers for Disease Control (CDC). Outcomes to determine health status are frequency of illness events as determined by morbidity recall surveys and reports of mortality for the three months prior to the fieldwork through the last site visit.

Wild food samples were collected and transported to the University of Nairobi, Upper Kabete Campus where the Laboratory in the Department of Food Science, Nutrition and Technology ran proximate and Vitamin A and C analyses. Proximate analysis consists of measurements of moisture, protein, fat, carbohydrates, fiber and ash, expressed as percentage of total (see Appendix A).

Semi-structured interviews focused on food security (access to food resources like milking livestock, gardens, food aid programs), health (morbidity and mortality, health seeking behaviors and response to therapies), livestock wealth (local exchange values, preferred and actual herd composition, animal health issues) and household composition. Baseline interviews at enrollment were quite lengthy in order to elicit household composition and demographics of constituent members. This required construction of local event calendars (see Appendix B). Households, as well as individuals, are an

important level of data collection, analysis and interpretation. Turkana households are often polygynous and a head of household may have multiple household compounds. The household unit of data collection is defined not only by the physical compound but primarily by the shared cooking pot, serving as a proxy for the shared resources and multiple livelihoods household members may use. Since nutritional status serves as a measure of outcome, the household, or the shared cooking pot, also serves as a unit of analysis and interpretation.

Participant observation allowed for informal discussions related to nomadic migration, household construction, oral histories, concerns about environmental and health issues, both human and animal. Repeated visits to locations combined with prolonged stays in each location contributed greatly to cooperation and inclusion in community events like NGO targeting meetings, health and nutrition screenings and distributions and celebrations.

Data collection occurred during three periods timed to coincide with important seasonal fluctuations in the environment; enrollment and baseline data collections from September through October of 2006, dry season from January through February of 2007 and wet season from March through June of 2007. The wet season data collection period took longer due to transportation issues and timing visits after the onset of rains in each location.

Observational data was collected with a combination of handwritten notes using an ethogram developed for this research and Observe software (Psychsoft v. 3.2). Observe software allows the ethogram codes to be entered into a handheld computing device, in this case a Palm Pilot Tungsten E2. Due to difficulties in providing electrical

power to charge them and having more field assistants than Palm Pilots, a combination of electronic and hand written coding was used. Observation data was summarized for each index child according to duration of events and behaviors, time spent in coded locations and time spent in coded events and behaviors. These summaries were then used, along with anthropometrics and indices, in SPSS 13 for further statistical analysis. Detailed notes for the entire observation period are available for descriptive analysis or future coding and analysis.

This field work was conducted from August 2006 through July 2007, encompassing baseline data collections near the end of the rainy season of 2006, a transition period between seasons, through the dry season and beyond the onset of rains again in 2007 and was conducted primarily in Lokichoggio Division, the most northwestern division of Kenya. Households were surveyed in three villages, Nadome, Nanam and Lokangae, each the seat of the sub-location chief for three of the five sub-locations in Lokichoggio Division. Each village is successively further from Lokichoggio, the largest trading center of North Turkana District. Previous research with Turkana has focused heavily on southern Turkana clans, most notably the Ngisonyoka clan documented by the South Turkana Ecosystem Project (Little and Leslie 1999). Earlier research, conducted near the end of the colonial experience, was also heavily focused on southern Turkana District, although the most remote village of this research is near an area visited by Gulliver (1955). Selection of these three research sites allows for comparison across slightly different ecological use areas with varying access to markets and integration into markets as well as bridging the better-researched southern region with the northern region of Turkana.

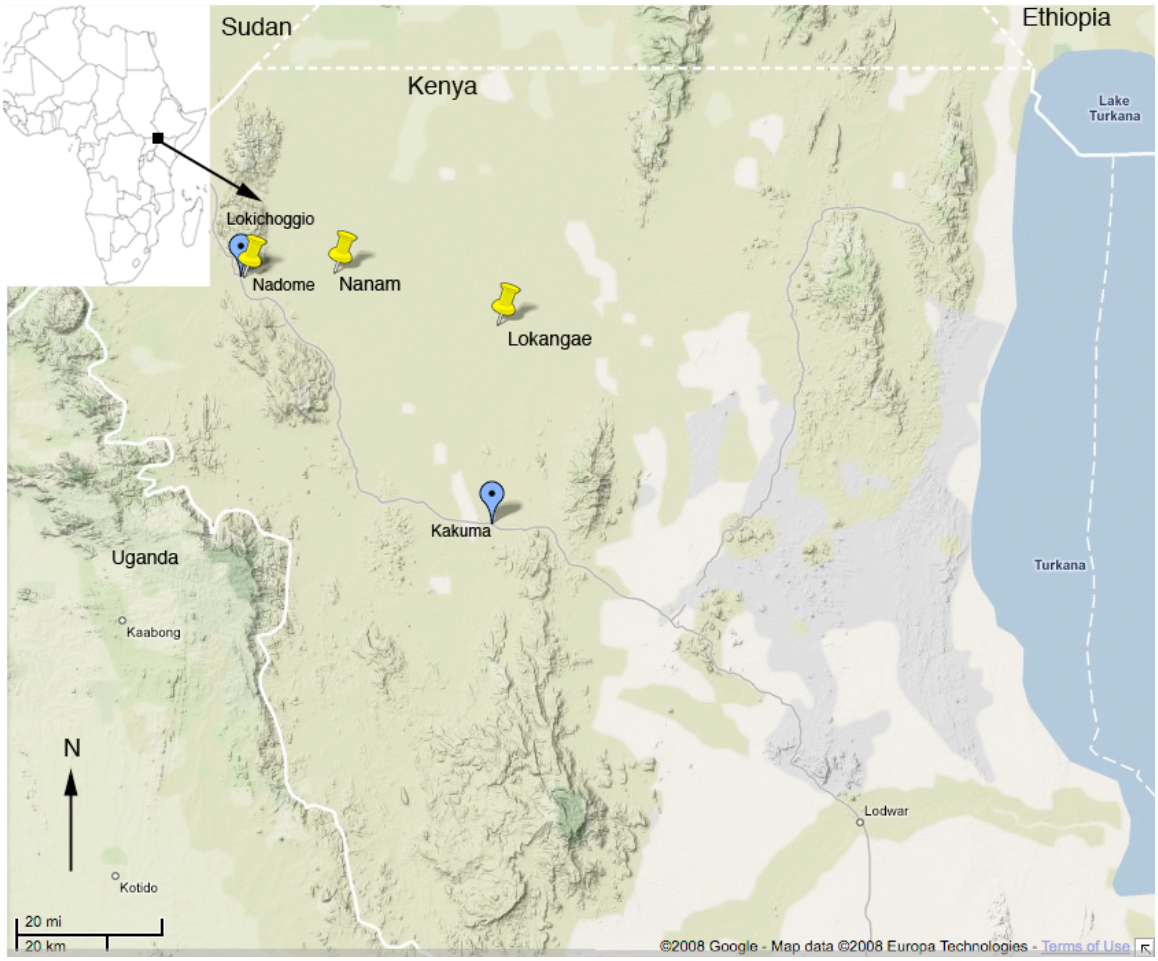

Figure 1.1 Map of research area from Google Maps

Figure 1.1 is a terrain map from Google Maps with global positioning satellite (GPS) points acquired at the center of each research village. GPS points were collected using a Garmin eTrex Venture handheld unit.

Ecology and Environment

Ecology is an integral part of this research project, from the largest multinational scale of the Sahel to the smallest ecological niche of arable soil along Turkana rivers. This section will describe the ecological changes in the region that have affected migration and allowed the pastoralist subsistence mode to persist. Past research on climate variability across time is presented and cultural practices that provide some historical perspective on climate is also presented. Geology of the region affects landscape use and will also be discussed.

The arid and semi-arid lands (ASALs) of Africa are of increasing global interest for reasons of climate change (van der Geest and Dietz 2004) and ongoing issues with livelihoods (Galvin et al, 2001), food security (Dyson-Hudson and McCabe 1985; Mace 1990) and development (Ellis and Galvin 1994). As climate change occurs, a better understanding of the capabilities of ASALs will enable both local and regional development as well as aid in protection of existing livelihoods (Reynolds et al, 2007). In addition, a better understanding of current drylands livelihood strategies could position government and development agencies to cope with desertification and the potential spread of arid ecosystems with global climate change. Food insecurity, often measured through nutritional assessments, has been and remains a key focus of subsistence and livelihood research in East Africa (Fratkin et al, 1999; Galvin 1992; Watkins and Carduner 2002). Available regional nutritional assessments serve for comparisons of the nutritional analyses of this research.

A review of the ecological history of the regions will aid in understanding migration and current Turkana livelihoods. East Africa and the Rift Valley have undergone major climactic shifts in the past and this has affected human evolution, subsistence practices and human migration. The early Holocene, 10,000 to 8,000 bp, was a wet period when rift valley lakes and the Nile River were much higher than today. This is determined from a common subsistence pattern evidenced by bone tools, specifically a particular harpoon style, microliths and faunal assemblages in archeological sites scattered from the shores of Lake Turkana to the confluence of the Blue and White Nile (Smith 1992). By 7,500 to 4,500 bp the environment began to dry and grasslands emerged, a prime environment for agro-pastoralism like that found in Shaheinab sites along the upper Nile (Smith 1992). A comparison of multiple sites suggests a southern movement of pastoralist societies, especially along the Rift Valley, starting around 4,000 bp (Robertshaw and Collett 1983; Smith 1992). This pattern of migration is attributed to further climatic shifts, primarily in rainfall, that provided a tsetse fly free zone, encouraging livestock keepers to follow the grasslands south (Smith 1992).

The contemporary Turkana Districts of Kenya lie in the northern Rift Valley and consist mainly of lowland plains with altitudes between 300 to 800 meters (McCabe 2004). These plains are broken by dramatic mountain ranges that can rise to 2,200 meters and by lower lava hills, lava flows and rocks. This research was conducted in North Turkana District where the Mogilla, Songot and Pelekech mountains provide stark relief to the Lotikipi Plains**.**

The climate of this region is classified as arid, receiving from 100 to 500mm annual rainfall, and semi-arid, receiving from 500 to 1000mm annual rainfall (Ellis and Galvin 1994). These ASAL regions can support very little agriculture, although when there is a coincidence of rainfall in a locality with soil able to retain moisture, Turkana will plant sorghum and maize with limited success. The wall of the Rift Valley, proximity to the equator, topography and continental climate patterns all drive the bi-annual rainy seasons of northern Kenya and the Turkana Districts. The intertropical convergence zone (ITCZ) drives the dry monsoon seasons and leads to an April-May maximum called the long rains and the October-November maximum called the short rains. Variability, not only of the location and amount of rainfall but also in the arrival of the rains, is quite high. Maximum and minimum monthly means of temperature are mostly related to cloudiness and highest temperatures usually occur in association with the onset of rains (Nieuwolt 1977).

The most comprehensive climate observations of northern Kenya were collected by the South Turkana Ecosystem Project (STEP) that was conducted in the southern Turkana District in the Ngisonyoka Turkana clan rangelands from 1980 to 1995. They reported three levels of rainfall cycles in analysis of rainfall data from 1923 to 1995, using data from the Lodwar meteorological station in South Turkana District. The first level of variation is the bimodal rain cycle that, due to highly unpredictable timing of the onset of rainy periods, may cause several months of drought after the long rains. During these seasonal dry periods herbaceous vegetation withers and dries but shrub and woody vegetation tends to survive, providing browse for camels, donkeys and small livestock. At these times Turkana rely on forage for cattle at higher altitudes that experience slightly

more rainfall or low-lying catchment areas like the Lotikipi plain. The second level of variation in rain cycles observed from 1923 to 1995 is a three to five year drought cycle, occurring when there are one or two subsequent years of decreased rainfall. At these times Turkana nomadism is important as entire regions will lose all herbaceous forage and browse is also diminished. McCabe reported increased livestock mortality during a drought in 1980 and 1981 (McCabe 1987). The third level of variation in rainfall is the multi-year trends that have the ability to transform the landscape for decades, depending on whether precipitation is higher or lower than normal. African Medical and Research Foundation (AMREF) officials who have worked in northern Turkana District since the 1970s report a wet period in the Lotikipi plain that resulted in very tall grasses and abundant milk production, named *erupe ngakile* and *ekoromwae* in the oral event calendars. This coincides with a wet period of average annual rainfall over 200mm, recorded between the late 1950s and 1980 by the Lodwar meteorological station.

This level of data or analysis is not available for North Turkana Districts since there is no meteorological monitoring station or long-term research project. However, a shallow analysis of climatic history can be achieved using local knowledge. Local Turkana elders serve as historians by naming each year and sometimes each season with local events. These names can record political events like national elections; *Munyes* who is the District Minister of Parliament, noting the first year he was elected, *Ebom* noting the year the government bombed the region in order to punish raids across national borders; raids, *Narus* who was a Toposa leader who broke a peace agreement and raided the region; disease outbreaks, *Lobolibolio* the Turkana name of a hoof disease; climatic, *Ngakipi* reporting good rains, *Echoto* reporting mud, *Ibore akwaan* reporting excess milk

production processed locally into a dry, white powder; or geological and astronomical events, *Aribokin* records a solar eclipse or *Arikirik* records an earthquake. The political and geological events can then be used to correlate the local event calendar with the Gregorian calendar.

Analysis of the local event calendars of northern Turkana reveals some of the same cycles reported by STEP in southern Turkana. According to the Lotikipi plain area local event calendar (Appendix C), from 1943 to 2006, the following years were named for drought conditions like "camels like sticks", "everything died", "migrated to Kidopo (Uganda)", "dried grass" or "cracked skins"; 1945, 1946, 1948, 1951, 1952, 1955. There was then a period of better rain with year names of wild fruits, mud, "happy rain", or political events. The 1970s had two isolated dry years according to the names *akipor ngorok* or short rains in 1975 and *lopiar* or drought in 1979. This is followed by another period typified by political and other events, including several animal and human diseases. 1998 is named *logaara* or "everything died" but it is unclear if this was disease or climatic related.

A similar consideration of the Lokichoggio region event calendar (Appendix B) shows slightly different results but a similar pattern. A single informant reported 1930 as a "bad year" of drought. Only a few years are recorded until 1960 when the animals "became like sticks" due to drought and 1962 when there was "one rain" for the entire year. Regular year names are recorded from the early 1960s through 2005 (no name had been given to 2006 by the time research was completed in August of 2007). The following years were all recorded as being "dry" or experiencing a "drought"; 1967, 1970, 1972, 1976, 1980 and 1982. 1999 is recorded as *Kidopo*, a year so dry that most

people migrated across the border to the mountains in Uganda and 2004 is also recorded as a year of little rain that required a move, but this time the location is not specified.

This analysis of local event calendars yields similar patterns to the meteorological data in southern Turkana District. Droughts can occur and be recorded in local memory according to short durations, usually one skipped or short rainy season or in three to five year cycles. The local event calendars do not have the specificity or retrospective longevity to detect longer cycles that meteorological data collection could yield if they were recorded in North Turkana District. If local event names are recorded with attention to larger-scale geological, astronomical and political events across locations, this method could yield important understandings of environmental change over time and shed light on variations in livelihood practices and migrations.

In addition to unpredictable rainfall across large timescales, the variability of rains across the landscape is also remarkable. By the expected time of the onset of the long rains of 2007, weather monitoring stations consisting of a wooden box installed four feet above the ground, ventilated on two sides, holding a thermometer to record minimum and maximum temperatures and a rain gauge fastened to the back, were installed in the market center of Lokichoggio and in each of the three research sites, Nadome, Nanam and Lokangae. The stations were installed at local schools, or in the case of Lokangae where the school had ceased to function, at the church. Schoolteachers or village council members were trained in how to record data and given graph notebooks. There was difficulty in compliance with requests to record temperatures on a regular basis but rainfall was recorded reliably and is reported below in mm.

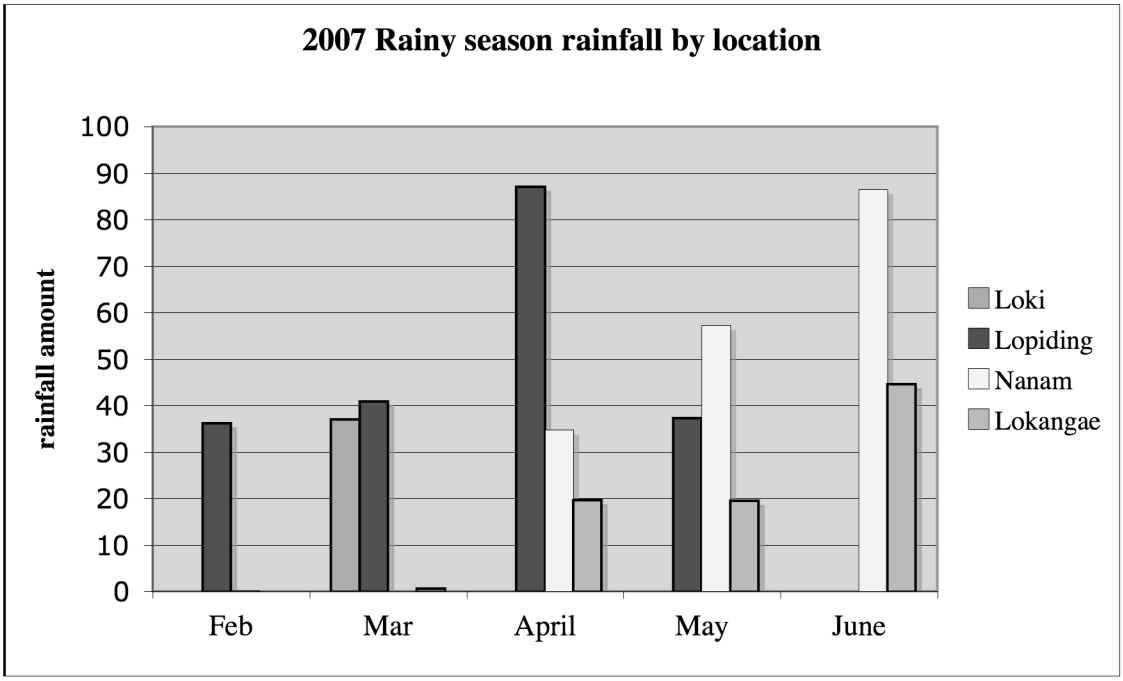

Figure 1.2 Onset of 2007 rains by location

The patchiness of the onset of rains demonstrated in Figure 1.2 contributed to the difficulty in timing rainy season data collection since the rains were late and very small in Lokangae. This also contributed to low observations of wild food use and foraging behaviors in Nanam and Lokangae. There were more wild foods such as greens and vegetables in the environment and in household food baskets after the short rains of November 2006 but field assistants were still being trained in observation techniques and the arrangements with the laboratory for analysis of wild food specimens had not yet been finalized.

The rivers in northwestern Kenya only flow seasonally and even then only for a short time before the water seeps into the sandy riverbeds. Some surface water will remain in riverbeds where there is enough clay in the soil to form natural holding ponds.

These can last a few days to a couple of months after rainfall ends depending on the soil, heat with associated evaporation and use by humans and their livestock.

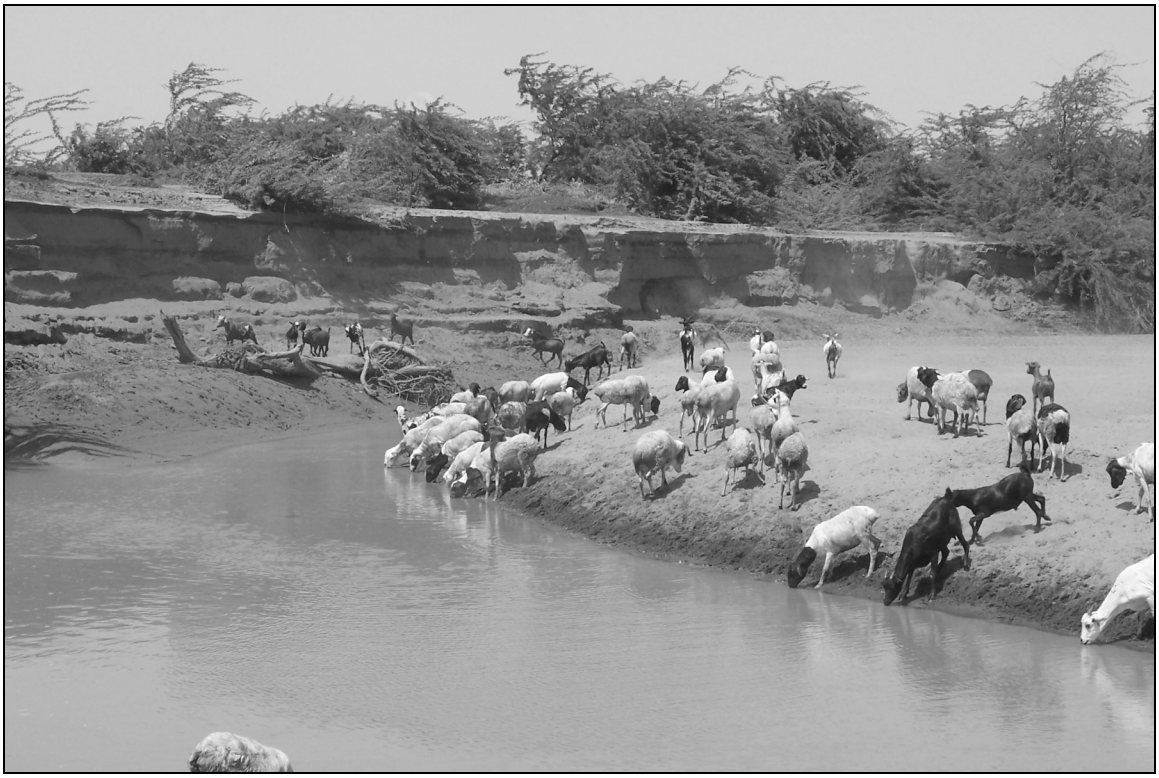

Figure 1.3 Clay lined pool in Tarach riverbed near Lokangae (photo by TYWatkins 2006)

Wildlife has little effect on forage or surface water due to long residence and persistent hunting of large mammals by nomadic pastoralists in northern Kenya. The surface and subterranean water of riverbeds support a narrow gallery forest along their edges. The more expansive gallery forests of the Turkwell River in southern Turkana are unique for the Turkana Districts (Stave et al, 2003). Larger forested areas, especially near natural ponds in the riverbeds, are a favorite settlement area for Turkana. Permanent villages and trading centers are usually found along riverbeds. During migration, nomadic Turkana will often set up temporary camps along riverbeds or near villages.

The Lotikipi plain of northwestern Kenya receives all of the runoff from the rivers of the northern region. After a good rainy season, the heart of the Lotikipi plain can be quite marshy with surface water and tall grasses lasting into the next rainy season. Even during drier years the Lotikipi plain serves as an important dry season reservoir of livestock forage (Gulliver 1955; McCabe 2004). There are other, smaller plains on the perimeter of the Lotikipi plain. These large flat surfaces collect rainwater that then slowly flows into the riverbeds through numerous streams. Depending on the soil structure of the plain, enough grasses may grow to support livestock forage or it may remain quite barren except for more hardy *Acacia* species and low brush suitable for some browsers.

The plains are broken by occasional outcrops or mountain ranges. Since northwestern Kenya is a part of the Rift Valley of East Africa these mountains are usually aligned north-south along the Rift Valley. Most rise to around 2200 meters, not high enough for true montane forests. The Pre-Cambrian basement system rocks are mostly semi-granitized sediments and some limestone. The "Turkana Grits … overlie the Basement System rocks" and consist of quartzites, sandstones, shales and a few older volcanic basalts (Walsh and Dodson 1969:9). The eroded canyons of mountains channel rainwater toward the plains but a few clay deposits and rockpools can hold rainwater in the mountains. Due to the altitude and the monsoonal winds, during low rainfall periods the mountains often get more rainfall than the plains. Turkana often use mountain environments as a refuge due to the presence of both surface water and forage. For this reason, cattle are most often kept in or near mountains for their easy access to both resources (Dyson-Hudson and McCabe 1985).

Political Ecology of Turkana Districts

Northern Kenya, eastern Uganda, southern Sudan and southwestern Ethiopia have similar climates and geography, thus share similar human use and migration before European colonization. As the environment changed, human subsistence practices changed and populations migrated across the landscape. The tsetse fly free zone across the ASAL belt of Africa was an important factor in pastoralist movement and could have contributed to the various branches of Nilotic linguistic groups that will now be described. This evidence regarding migration and interaction between pastoralist groups is further supported by oral histories. Cultural practices of herd migration that govern some of the large-scale movements of people and livestock are shared as well.

Turkana language belongs to the Eastern Nilotic branch of Nilotic, one of the ten sub-branches of the Eastern Sudanic family within Nilo-Saharan (Dimmendaal 1983). Turkana belongs specifically to the Teso-Turkana cluster along with Dodos, Jie, Karimojong, Nyangatom, Toposa and Teso, most of which could be called regional dialects since they are mutually intelligible and all found in the same region (Dimmendaal 1983) of East Africa. Many of these groups also share a common myth of origination in northeastern Uganda (Dimmendaal 1983; Lamphear 1988).

Turkana in the Lotikipi plain repeated a version of this myth during this research. Most would point to the western horizon where the Ugandan escarpment was visible and say “first grandmother lived there and we all came from her”. Turkana refer to themselves as *ngiturkan,* meaning “people of the caves”. The story related by Lamphear (1988) is of a time of drought in Uganda causing young men to migrate to the southwest with a few women and some cattle. They found mountains with caves that could serve as

shelter on the edge of a plain with good grazing grounds and established a new home there. Lamphear (1992) suggests that by 1800 Turkana, due in part to ecologic pressures of drought and disease, had advanced across the plain to the shores of Lake Turkana, south to the Kerio River and north to the Mogilla mountains. By 1850 Turkana occupied the largest region they would ever control, expanding south to the shores of Lake Baringo and to the eastern side of Lake Turkana. During this time they absorbed communities like the Siger and Kor and forced retraction of boundaries with the Samburu east of Lake Turkana and the Pokot to the south. These interactions with neighboring pastoralist groups resulted in oral histories of acquiring pastoral customs like camel herding from Rendille and herding of zebu cattle, which are better adapted to arid environments than long-horned *bos indicus* (Lamphear 1992).

Since early settlement *eturkan,* or land of Turkana, has been culturally divided into northern and southern sections and this was reinforced during colonial occupation. Initially all Turkana lands fell under the Eastern Province of the Uganda Protectorate of 1895. Being so geographically distant, the region was ignored for many years until the southern section switched to rule under British East Africa, now Kenya. Finally in 1915 the current boundaries of Kenya were established and *eturkan* was reunited under British East Africa. It was not until 1926 that a post was occupied and actual administration began, again focusing on the southern region (Little and Leslie 1999).

According to Lamphear, during the colonial experience Turkana were considered to be hostile and were the frequent targets of British punitive military expeditions (Lamphear 1992). At this same time, the region surrounding Lake Turkana was suffering from slave raids from the coast, ivory expeditions and military raids from Ethiopia

(Imperato 1998). North Turkana District became a refuge, geographically distant from British colonial rule in Nairobi and Kampala, Uganda. Here Turkana organized around charismatic war leaders and prophets in order to stave off the colonial rule for a while (Lamphear 1992). It was during this contraction of Turkana influence during colonialization that *eturkan* began to resemble the current boundaries of the Turkana Districts.

The colonial history contributes to the self-defined difference between contemporary North and South Turkana. North Turkana consider themselves to be less dependent on money and less linked with Kenya markets while South Turkana has been the administrative seat of the District since the region officially became a part of British East Africa or Kenya. It has enjoyed more development with electrical service from the Turkwell Dam, schools and a regional museum. In early 2007 the government of Kenya officially divided the previous Turkana District into North and South Turkana Districts.

Although there has been a great deal of fluctuation, the current Turkana population is around 300,000, living mostly in the Turkana Districts of Kenya (McCabe 2004). Turkana livelihoods rely primarily on herding a diverse collection of livestock and nomadism to minimize the risks of patchy and unreliable rainfall supported forage. Agriculture may be practiced, focusing primarily on sorghum and maize when seeds are available, there is suitable soil and rainfall is adequate. Turkana have a long history of trade with neighboring agriculturalists in Uganda and along their southern border in Kenya (Dyson-Hudson 1989; Gulliver 1955; Hakansson 1994). The long-term presence of Operation Lifeline Sudan (OLS), an umbrella organization of the United Nations, multi-national NGOs, and other relief and development organizations working in Sudan

largely drive development in northern Turkana District. This export driven relief offers limited opportunities for local Turkana, and that only after violence forced employment of local Turkana in to day labor positions (Broch-Due 2005). The colonial image of Turkana men as violent and protective warriors persists today and makes them desirable as guards for expatriate compounds.

Besides external administrative and relief influences, Turkana are organized into loose social organizations called *adakars*. These organizations enable coordination of movements to maximize access to available forage and water for themselves and their livestock with minimal conflict and some conservation of resources. (Dyson-Hudson and McCabe 1985). The patchy nature of soil, rainfall and vegetation necessitates frequent movements. *Adakars* are loose organizations in which an individual can choose to follow coordinated movements or may choose to move on their own. Membership in an *adakar* generally follows clan lineages, which are patrilineal. However, close friends or "age-mates" can choose to herd in the same *adakar* regardless of clan associations. In addition, an individual herder who chooses to move independently can rejoin *adakar* movements at any time with no penalties. The African Medical Research Foundation (AMREF), a NGO that has worked in northern Kenya for almost thirty years, constructed a map (Figure1.2) demonstrating these *adakar* movements in northwestern Kenya. This map was completed during my fieldwork of 2006 by a group of researchers from the University of Nairobi in association with AMREF and was provided from a report prepared by AMREF.

The *adakar* movements are delineated by the pink, green and purple arrows indicating circulatory movement. What is not evident on this map is the presence of mountain ranges that help to delineate the movements of livestock and people. Most herders of Lokichoggio Division move in the *adakar* indicated by the green arrow, although a few will opt to move slightly west to the Oropoi area indicated by the pink arrows. Of sixty-one participating households in this research project, only one opted to participate in the Lapur area movements indicated by the blue arrows, and then only temporarily. This decision seemed to be based on matrilineal ties.

The larger movements indicated by the red arrows delineate stock movements in trade and exchange. These routes are important when considering livestock diseases. There are many diseases that are endemic to the region such as rinderpest, caprine pleuropneumonia and foot and mouth disease. There is no successful program to routinely treat these conditions and this remains a goal of development planning in the region. In addition, these trade flows can aid in the spread of other infectious diseases such as *peste de petits ruminants* (PPR), a viral disease that occurred during the fieldwork of late 2006, early 2007.

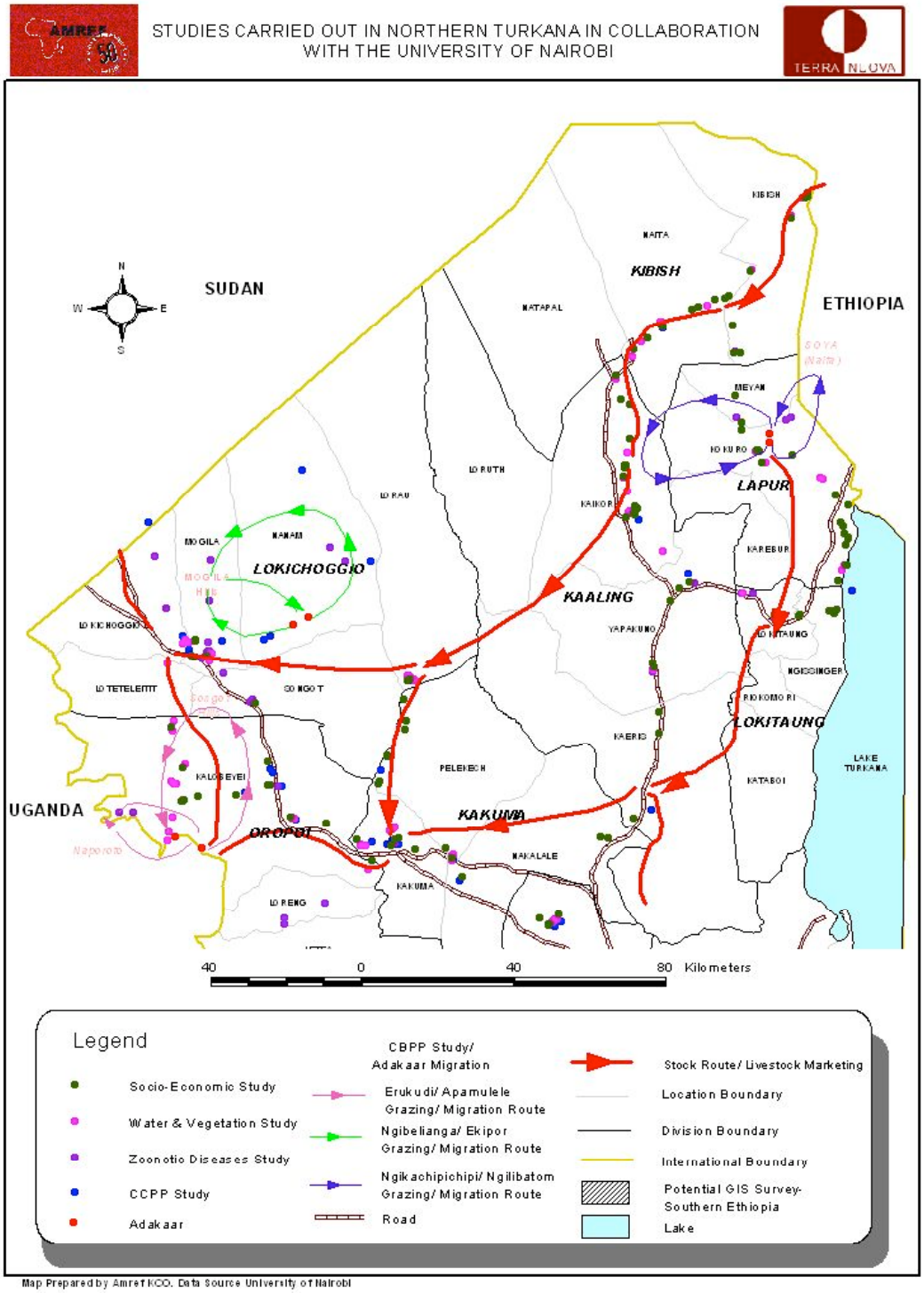

Figure 1.4 Map of *adakar* movements in North Turkana District provided by AMREF

Ethnography

Settlement, household organization, social networks and livelihoods are all influenced by Turkana culture. This section will explore Turkana cultural ethnography and how that has changed over time.

Turkana are pastoralists living in a disequilibrium ecosystem in northern Kenya (McCabe 2004). The majority of their population live in the Turkana Districts in the Rift Valley Province of northern Kenya. Few Turkana have migrated outside of the Turkana Districts for work or education. Historically nomadic, cyclical droughts combined with international relief have led to permanent settlements where there were once trading centers (Little and Leslie 1999). Residents of these permanent villages will often be absent for months at a time, visiting family or friends in "the reserve" or bush area, often people who are taking care of their livestock in their absence. The majority of businesses in trading centers are owned and operated by Somali families or Kenyan's from outside the Turkana Districts. Contemporary Turkana could be grouped into three categories: settled, who work for wage labor and rarely visit "the reserve", semi-nomadic, who still own livestock and have close ties to "the reserve" but live in permanent villages part of the time, and nomadic, who spend most of their time in "the reserve" and move three or more times a year with livestock.

Settlement patterns in permanent villages often mirror the patterns of seasonal or temporary camps in "the reserve". Each household has a compound that consists of at least two huts, a sleeping hut and a kitchen hut. Each hut is a round, domed structure formed by interweaving limbs or brush. Often the dirt floor of the hut is built up by the soil removed to bury the limbs a few inches into the soil to form the wall. A few larger

branches arch over from the wall to begin to form the ceiling and provide structure to the hut. The sleeping hut will be thatched with herbaceous plants or occasionally plastered with mud two or three feet high. Most sleeping huts will have a plastic tarp lashed on to form a waterproof roof during the rainy season and is left loosely thatched the rest of the year. Traditionally waterproof roofs were achieved by lashing animal skins across the roof (Gulliver 1955). Most huts last about three years before termites or weather cause irreparable damage. Dried donkey or goatskins are used as mats for sitting or sleeping. Occasionally a platform will be formed with larger branches and be used as a sitting and sleeping platform. Dried food or bags of flour are stored either in metal trunks shaped by hand from 50 gallon drums in trading centers, or more commonly in plastic or skin bags hung from the branches that form the roof.

Figure 1.5 Nomadic compound near Nanam (photo by TYWatkins, 2007)

Figure 1.5 shows a recently constructed sleeping hut, which is covered with plastic, kitchen hut and corral to the left. The brush pile to the right will probably be used to construct a larger corral or a compound fence. This nomadic compound was located near Nanam as people shifted to the west where the rains had begun earlier and there was more grass.

The kitchen hut is the same basic structure but with no roof and only loose thatch. Cooking is usually over an open fire with a pot resting on two or three hearthstones. Fires use brush, wood and occasionally animal dung if available. In a village there are usually one or more kitchen fires with a few embers from which children will collect and transport home to start other kitchen fires. A few households have *jikos* or small metal

containers for charcoal cooking. Charcoal is made locally, usually from trees felled by flooding along riverbanks. Cooking pots are usually aluminum and once too battered and leaky to use as a pot, are often melted down to make knives or jewelry.

Most compounds will have additional, although usually smaller, sleeping huts for visiting friends or relatives. Occasionally when relatives or friends stay for long periods, they will have their own kitchen hut. Many sleeping huts, especially in more densely populated permanent villages, will have a C-shaped courtyard formed by attaching a wall to the sleeping hut, that affords some privacy and shade for residents sitting outside. Several female-headed households did not have a compound but shared one with a relative or employer. These women often had only one hut that served as a sleeping hut and kitchen for themselves and their children.

Household compounds are often in groups of three or more forming neighborhoods or what Gulliver (1955:11) called “secondary neighborhoods”. Sometimes these neighborhoods have different names and may eventually become a separate village. These neighborhoods often share an animal corral where livestock are kept overnight or where nursing livestock are kept separate from nursing mothers until milking is complete, either in the morning, evening or both. In Nadome and Nanam these neighborhoods also occasionally shared a pit latrine. In one case they shared chickens and in another they shared a garden. Neighborhoods also often share trees that may provide shade as well as food as in the cases of *Cordia sinensis* or *Dobera glabra.* Thorn or brush fences around the perimeter delineate neighborhoods. These fences are constructed of a combination of living and dead plant material and provide a barrier to keep animals inside and other human or animal intruders out.

Figure 1.6 Satellite image of Nadome (Google Earth, May 2006)

In Figure 1.6 the neighborhood fences are distinct. Nadome is located on the western banks of the Nanam river. On the eastern side of the river is the former compound of the International Committee of the Red Cross, now the Lokichoggio Division hospital. During the short rainy season of 2006 severe flooding of the Nanam River caused many households to relocate about 500 meters west of this location. Most male-headed households will have more than one compound, a homestead, often located in more permanent villages, and at least one satellite compound in "the reserve". Semi-nomadic households may still have multiple compounds but instead of moving with

an *adakar* like nomadic households, they will move between two established compounds. This was often the case for many participant households in this research project. If the entire household or individuals were not at the homestead in the village, neighbors could guide me to their satellite compound that is in roughly the same place from year to year.

Figure 1.7 Lokangae and satellite settlements (Google Earth, October 2008)

Figure 1.7 is a satellite image from Google Earth. The entire region is a part of the Lotikipi Plain and the striations visible in the image are mostly differentiations in soil type and shallow washes etched in the flat plain by runoff and pooling. The Tarach River

runs roughly North-South, on the west side of Atiir and Nakalalait villages. The green shadings probably represent new plant material that appears after rains. Each of the green points in Figure 1.7 represent a village in "the reserve" where individuals or households who were enrolled while resident in Lokangae at the end of 2006 had satellite households and were found in subsequent seasons. These villages were named and could be located by most residents of the area but settlement was far more sparse than permanently settled villages like Lokangae. For example, while at one household compound in Namone, only one or two huts or fences of other compounds were visible.

Satellite compounds are not always left vacant but instead co-wives and children are moved between compounds while young men are sent to mountain reserves with cattle. Turkana children cannot expect to reside with biological mothers for most of their childhood. Once they are able to take on significant household responsibilities, children will often be moved from one compound to another to meet the labor needs of all household compounds and livestock. Young girls of 12 years and older were sometimes in charge of a satellite compound that is near (1-5 km) to the homestead. This meant they helped in construction of the hut and any other constructions like a kitchen hut, corrals or fences. They were solely responsible for meal preparation, household cleaning and laundry. Young boys of nine years and older are often in charge of small livestock for the entire day, leaving in the morning and returning in the evening. Young girls often aided in care of small livestock but were rarely solely responsible. As children gain skills they are often sent to help co-wives manage household livestock, help grandparents maintain nomadic or semi-nomadic lifestyles or to help out relatives or friends during special occasions like wedding celebrations or mourning feasts.

Traditional Turkana marriages can be arranged through parents but it is not uncommon for Turkana adolescents to meet and establish relationships at community dances. These dances are held year round but are more common at full moons when walking after dark is safer and after the rainy season has begun and temperatures are cooler. They begin with children singing playful songs and dancing just before or at dusk. By 10pm adolescent boys have begun to sing and dance in the manner of many pastoralist societies (Evans-Pritchard 1940). Songs are usually about rams, oxen or bulls or about the strength and stamina of the young man. Dancing consists mainly of individuals jumping with females joined by the hand and alternately jumping and crouching while a male jumps as high as he can from a standing position and occasionally rushing the line of females. If a woman lets herself be "captured" by a man, this is a signal of courting. This courting sometimes results in a young woman co-habitating with the man and bearing children before the relationship is formalized, either by the man paying rites of filiation or a brideprice to the woman's parents.

Parents arrange the more traditional marriages and brideprice is negotiated upfront. Neither arranged marriages nor spontaneous relationships allow for clan endogamy; intermarriage within bloodlines or with clansmen. Other than *adakars,* clans are the only visible social organizations in North Turkana District. Although Gulliver (1955:224) reports a taboo against Turkana marrying into either the mother's or the father's clan, participants in this research report that the wife joins her husband's clan, making it difficult to trace a woman's clan relations more than a generation. It is during wedding arrangements that clan becomes evident since they prescribe the specific negotiations, the order of events and even the manner of dress for the individuals in

question. After negotiations are settled and at least a preliminary number of livestock have changed hands, the bride will leave her family and move in with her husband. Gulliver (1955) reported that Turkana brides did not usually co-habitate with the husbands until payment of brideprice was made in full but this was not the case during this research. When the bride moves from her parent's house she will be responsible for constructing her own hut or her own compound. If she is lucky she will have access to milking livestock and is free to manage their output in milk and blood. Infants, children and breastfeeding women have priority access to any milk obtained from livestock allocated to that household.

Men usually obtain blood from livestock and give it to the woman to prepare for household consumption. Blood is harvested from slaughtered animals and prepared like a pudding. Fresh blood is obtained at the discretion of the male in charge of the animals, depending on the season, access to forage, water and the health of the animals. It is often prepared with milk or cooked in porridges for general consumption. Men consume fresh blood directly from the animal or combined with milk, tree saps or wild foods when in "the reserve" with livestock.

Although management of livestock is important to Turkana livelihoods it is only addressed in this dissertation from a household food security point of view. The presence or absence of livestock, primarily related to access to them as a food resource, is noted at the household level. Larger management units, usually from senior men who may have delegated sections of herds to individual compounds, are not addressed other than in the valuation exercise in Chapter three. Instead, the extensive work of others who have

described the social networks (Broch-Due and Anderson 1999) herding decisions (McCabe 2004) and pastoral ecology (Little and Leslie 1999) of Turkana are relied upon.

Conclusion

This research considers Turkana subsistence strategies that make up a livelihood portfolio. Chapter two considers how ecological knowledge contributes to these strategies. If wild food knowledge is widely shared it is proposed that they offer a viable option to make a significant contribution to food security, nutrition and health. Since this knowledge is widely shared, even across geographic locations, collecting wild foods remains an important element of livelihood portfolios in ASALs.

Chapter three focuses on how to quantify livestock holdings when attempting to gain a better understanding of pastoralist livelihoods. Wealth is a common and important measure of successful livelihoods. How this has been measured and quantified in the past will be examined, then a participatory method that includes Turkana valuations of price, costs and preference will be described.

Success of livelihoods can be measured not only through wealth measurements but also by nutrition and health as outcomes. Growth and development of Turkana across the lifespan will be evaluated and discussed in Chapter four. Most government and development organizations in Kenya focus on children under five years of age, using their vulnerable nutrition and health as indicators for the general population. This practice has led to nutrition indicators that now serve to target interventions, as evidenced by supplementary feeding programs that target young children paired with narrowing food distributions for the general population. Morbidity and mortality are final measures of adaptation to the environment. These indicators will be considered along with the

nutritional status of the same population yielding a critique of current programs in Lokichoggio Division.

Since Chapter four critiques focusing on children under the age of five years, Chapter five considers middle childhood, from age four to 12 years. Using focal follows to consider time allocation of 61 index children, location and behavior was observed and coded. Analyses focus not just on where and how children in middle childhood spend their time but also continue to use nutritional status as an outcome. All of these children are provisioned at home but what are the impacts of any extra food seeking behavior? In addition, Turkana pastoralists have complex, polygynous households with multiple wives and often multiple household compounds. Analysis incorporates this household ecology along with gender roles that begin at early ages in an attempt to understand relationships of behavior and nutrition.

Finally, Chapter six provides an overview of research results and analysis focusing on the crosscutting issues of household ecology, nutritional ecology and child development. There is a discussion of interactions between livelihood, food security and the measured outcomes of health and nutrition. Since the data collection methods used yield a large amount of quantitative and qualitative data, future application of these methods is discussed as well as future analysis of longitudinal observation and nutritional data.

CHAPTER 2

THE PREVALENCE OF WILD FOOD KNOWLEDGE AMONG NOMADIC TURKANA OF NORTHERN KENYA [1]

[1] Watkins, T.Y. Submitted to Journal of Ethnobiology 9/2/2008

Abstract

Food insecurity is a chronic problem for much of East Africa and especially among Turkana pastoralists of northern Kenya. Uncertain physical and social environments, high seasonality of rainfall with cyclical droughts, human and animal diseases and civil insecurity cause food insecurity. Researchers often paint the environment as harsh, unforgiving and desolate, yet also acknowledge that Turkana use wild food resources. This research explores the persistence of wild food knowledge using methods drawn from both cognitive and ethnoecological anthropology and the possible implications among Turkana. Wild food resources are found to be a strong domain of knowledge that crosses boundaries of age, sex and location in the region. Using a free list technique, differences in cultural salience were assessed between sexes, based largely on gender roles. Follow up questions suggest that cultural practices in division of labor explain some of these differences. Wild food resources are clearly important to Turkana livelihoods yet are often not addressed in development programs and only marginally addressed in food security research. More research needs to be conducted on the nutritional contributions of these resources, specific management practices of the resources and how they could be incorporated into policy and development programs for the region.

Introduction

Turkana are pastoralists who live in the arid environment of Turkana Districts, Kenya. This research focuses on Turkana of North Turkana District, near the borders of Uganda and Sudan in the Rift Valley Province of Kenya. The climate is seasonal and unpredictable while the landscape is spatially heterogenous (Gray et al, 2003; Little and Leslie 1999). Nomadic pastoralism, moving large numbers of livestock across the drylands, persists in part due to limited opportunities for access to regional and national markets and the subsequent option of market integration and also out of cultural identity and pride in ownership of cattle. Northern Kenya, like much of East Africa, experiences unreliable seasonal rains, frequent droughts and subsequent food insecurity. Malnutrition, especially among children, remains prevalent in Africa, across subsistence modes and cultural groups. Pastoralists have an array of strategies they use to deal with the unpredictable and patchy environments of East Africa. Herd composition and movements of herds and households attempt to minimize the risk inherent in variations in access to forage, water and ultimately food production for the household (Dahl and Hjort 1976; Mace 1993).

In East Africa, regional and household food insecurity as well as malnutrition are often the result of environmental factors such as drought or flooding, animal predation as well as social factors such as violence or displacement (Nyariki et al, 2002). Civil insecurity, due most frequently to raiding between pastoral groups, represents an additional barrier to food security for Turkana (Pike 2004).

In this socially and ecologically challenging environment, it has been unclear how many wild food resources would be available or known to pastoralists who have been resident in this region for hundreds of years. Previous research often mentions but fails to quantify or fully describe foraging by Turkana in northern Kenya (Gray et al, 2004; Gulliver 1955; Little and Leslie 1999). Ethnobotanical studies in southern Kenya with the Loita Maasai (Maundu et al, 2001), Ethiopia, Uganda and coastal Kenya (Guinand et al, 2001) consistently find local knowledge of wild plants for food, medicine and other uses. Both male and female Turkana were able to recall numerous wild resources for food, suggesting that this is a culturally salient resource for maintaining food security in this challenging environment.

This research project uses theory and methods from ethnoecology to explore Turkana knowledge, practices and preferences surrounding wild food resources and cultural ecology to document and analyze preparation, consumption and storage (observed as well as reported) of these wild food resources. Ethnoecology utilizes anthropological methods to research local knowledge, ranging from cognitive classification schemes (Berlin et al, 1966) to applied subjects like ecological and environmental knowledge and management practices (Nazarea et al, 1998). Ethnoecology can help to define Turkana knowledge and uses of wild food resources.

Drawing from cognitive anthropology and cultural domains of knowledge, cultural consensus theory suggests that knowledge of a given domain can be described and measured among a group of people (Borgatti 1994; Romney et al, 1986). This technique was used to analyze the freelists obtained from 31 Turkana, 15 men and 16

women, in three different locations. Cultural salience is used to analyze follow up questions about these resources related to preparation.

Wild foods are important to nutrition and health in that they frequently increase diversity in an otherwise bland diet (Onyango 2003). Pastoralists's diets consist mainly of meat and milk that are high in fat and protein, but offer little diversity (Galvin 1992). The introduction of roots, greens, fruits, seeds, or other wild foods will provide important vitamins, minerals, or complex carbohydrates otherwise absent (see Appendix B). Dietary diversity increases the likelihood of the addition of micro- or macro-nutrients to the diet (Arimond and Ruel 2004). Combining livelihood strategies such as foraging with other pastoralist strategies could have positive nutritional and health effects (Arimond and Ruel 2004).

Environment and livelihoods of Turkana of northern Kenya are described with a focus on food security and foodways. Theory and methods that shaped research design and analysis of data is discussed as well as specific information about the research sties. Consensus analysis and freelist results are presented and discussed, including the context of development projects in the region. The discussion section includes local practices of access and conservation of wild food resources. Concluding remarks include possible contributions of wild foods, not as a dietary staple but as important adjuncts to the pastoralist diet, and future research on wild foods in northern Kenya.

Background

Turkana live in northern Kenya, in the Sahelian zone of eastern Africa where pastoralism is a frequent livelihood strategy. The North Turkana District is the northwestern most District of Kenya, bordering Sudan to the north and Uganda to the

West. Many Turkana practice nomadic pastoralism, a livelihood that maximizes the unreliable resources of the semi-arid environment of northern Kenya (Dyson-Hudson and McCabe 1985; Little and Leslie 1999). Nomadic Turkana have not included significant agriculture or fishing into their subsistence practices, although they may trade with neighbors who have (Dyson-Hudson 1989). Water and fodder for livestock are two important resources around which they manage their movements to minimize risk (Winterhalder et al, 1999) and maximize resource access (Layton et al, 1991). Some Turkana have settled into year-round villages, probably originally established as feeding camps during severe droughts of the 1980s (Little and Leslie 1999). Semi-nomadic pastoralists are probably the most numerous among the Turkana population and are those who move freely between nomadism and sedentarism. Turkana who have been forced into a settled village life and wage labor still desire to purchase livestock and return to a nomadic life (Broch-Due and Anderson 1999). For this reason, settled Turkana will maintain social ties to nomadic family and friends, often through rights to livestock and visits to nomadic camps.

Many resources are used for human subsistence. Meat, milk and blood are the staple of the pastoralist diet. Flour from maize, sorghum or millet are traditionally traded with agricultural neighbors. As national borders began to limit movements trade to the north and west have been limited. Now maize flour must be purchased or accessed via food distribution programs. Before the irregular seasonal rains begin, milk production diminishes and bleeding of livestock for human consumption is limited to reduce stress on animals (Dahl and Hjort 1976). Wild food resources can be extremely important during this time. Wild game are occasionally hunted and consumed (Broch-Due and

Anderson 1999) and wild fruits, nuts, and greens play an important part in the nutrition and food security. In fact, many pastoral groups collect nuts and palm fruits for regular use as well as for famine food during the dry season (Galvin 1992).

Fruits and nuts offer both calories and micronutrients and are dispersed throughout the Sahel and savanna environment. Many greens sought by the Turkana grow in environments that have been disturbed by livestock and human activities. Greens offer flavor and often contain high amounts of micronutrients (Ogoye-Ndegwa and Aagaard-Hansen 2003). The nutritional content of many wild foods makes them important, not only for caloric content and surviving the dry season, but also important for maintaining health status through contributions of micronutrients (Onyango 2003).

There are ongoing attempts in Kenya and Sudan to base micro-development schemes on some fruits and nuts (Belknap and Wagner 2000). It is unclear if any consideration of management of or access to these resources is considered (Fratkin 1997). For example, access rights and privileges to water have been well documented for South Turkana District (Broch-Due and Anderson 1999; McCabe 2004) but there is no information regarding management of other resources such as wild foods. As pressure increases on all resources any existing rights and privileges need to be better understood in order to ensure continued access and avoid conflict. In addition, decades of development projects in East Africa have resulted in foreign and invasive species which may out-compete native flora (Mwangi and Swallow 2005). The fact that indigenous plant resources are important to food security could make understanding and controlling invasive species an even more pressing need. It has been noted that these wild foods are accessed by the Turkana (Little and Leslie 1999), but there is little empirical data

regarding who collects these resources, in what quantities, or if these resources are in any way managed by nomadic pastoralists.

Methods

Cultural consensus modeling has been used in research of environmental knowledge in coastal and fishery management (Miller 2004), business (Caulkins 1998) and medical anthropology (Ryan et al, 2000). In each of these cases data was collected using freelists. Freelists give information on salience, perceptions, classification and ranking of items within a cultural domain (Weller and Romney 1988).

In this study, knowledge of wild foods, specifically from plants, is the domain of interest. Individuals from three locations, each successively further from trading centers, listed all of the wild food plants they could think of. Most began with plants that provide greens. Prompts were given to add any roots, fruit or seeds to the list if these were absent after the initial question. Follow up questions regarding availability and preparation for each item provided successive lists (Ryan et al, 2000). With successive lists to complement assessment of cultural consensus, comparisons could be made based on location, sex of the informant, or preparation methods of wild foods (Weller and Baer 2002).

The three locations were chosen due to their relationship with a trading center and also were accessible via available transportation. Once the chiefs granted permission to proceed individuals were approached for participation. Participant selection began by selecting individuals opportunistically and then balancing sex in an even ratio. There was also a conscious effort to select a variety of ages to determine the scope of the domain by age.

Lokichoggio is the main market town and a point of reference. Nadome is 2.2 kilometers (km) east of Lokichoggio by a seasonal road. Nanam is 22 km east of Lokichoggio by a seasonal road. Lokangae is approximately 70 km southeast of Lokichoggio. This route is usually a footpath and requires crossing two seasonal riverbeds. Lokangae can be accessed by road by going south on a paved road approximately 65 km to the smaller market town of Kakuma, then turning east on a seasonal road for approximately 50 km. The majority of Turkana travel to and from markets by foot, either along roads or on footpaths.

Participant observation of household activities reveals common behaviors of each member of the household, including their various contributions to household production and food security. Informal discussions of food and food preferences, livestock management and nomadic movements of livestock and households provide qualitative insight into free list data and analysis.

During late 2006 and early 2007 some wild food specimens were collected and transported to the University of Nairobi, Upper Kabete Campus where the Laboratory in the Department of Food Science, Nutrition and Technology ran proximate and Vitamin A and C analyses. Proximate analysis consists of measurements of moisture, protein, fat, carbohydrates, fiber and ash, expressed as percentage of total. These results are presented in Appendix A.

Results

Thirty-one informants provided freelist information (Table 1.2). Turkana informants from three locations provided the names of 155 different wild foods. There is some duplication when one plant species provides both fruit and sap or both roots and greens. Fifty of these have been identified to the species level (Appendix A) using available plant keys and where possible, by collecting plant specimens. Plant specimens were keyed with the assistance of the East Africa Herbarium and the Kenya Resource Center for Indigenous Knowledge (KENRIK), both a part of the National Museums of Kenya. In spite of some duplication in species named, the 155 different local names is quite impressive. For comparison, an ethnobotanical study in savanna and bushlands of southern Kenya with Loita Maasai yielded 48 different plant species that are used as food (Maundu et al, 2001). Freelist data are ana4yzed using ANTHROPAC 4.0 for consensus analysis (Borgatti 1995).

Table 2.1. Participants by location

	Nadome	**Lokangae**	**Nanam**	**Totals**
Households	7	7	6	20
Individuals	10	13	8	31
Men	4	7	4	15
Women	6	6	4	16

In order to test for consensus the informants should share a common culture, be interviewed individually and the questions should come from a common domain (Borgatti 1994). The large number of plant names provided still represents a single domain with a ratio of Eigen values between the first and second factor of 41:1. The factor analysis uses a matrix of matches between the lists to calculate an Eigen value ratio. The freelists analyzed here meet the three criteria for consensus analysis since the

ratio is far greater than the 3:1 ratio required to indicate a single factor (Bernard et al, 1986). Consensus analysis was repeated, controlling for age, location and sex of the informants. None of these variables affected the ratio, indicating that they do not represent a subculture or a separate domain.

In addition to the strong cultural consensus, each informant's knowledge score was uniformly high (see Table 2.2).

Table 2.2. Knowledge scores

	N	**Highest**	**Lowest**	**Average**
Male	15	93	81	87.7
Female	16	95	81	89.2

Knowledge scores were not significantly affected by location (ANOVA F = 1.908, p = 0.167) or by age (ANOVA F = .527, p = 0.877). The frequency and salience of wild plant foods provided in the freelists is interesting when compared by sex.

Table 2.3. Frequency by sex

	Top 10 Total	**Top 10 Male**	**Top 10 Female**
1	*Edome*	*Engomoo*	*Edome*
2	*Elamach*	*Edome*	*Elamach*
3	*Edung*	*Elamach*	*Edung*
4	*Ebei*	*Edapal*	*Elero*
5	*Eroronyit*	*Elero*	*Engomoo*
6	*Esekon*	*Ekolese*	*Erut*
7	*Erut*	*Ebei*	*Edapal*
8	*Edapal*	*Engilae*	*Esekon*
9	*Ekalale*	*Edung*	*Engilae*
10	*Esukumaran*	*Erut*	*Ataikol*

Table 2.4. Frequency by sex

	Top 11-20 Total	Top 11-20 Male	Top 11-20 Female
11	*Engilae*	*Ebolo*	*Ebei*
12	*Emeyen*	*Ngakalalio*	*Ngakalalio*
13	*Ngalam*	*Ataikol*	*Lokiliton*
14	*Engomoo*	***Ngapongae***	*Ebolo*
15	*Murere*	***Ngalam***	*Ekolese*
16	*Loyongorok*	***Emeyen***	*Lorakimak*
17	*Lorakimak*	***Esekon***	*Atadita*
18	*Akoporait*	***Ngitit***	*Emeyen*
19	*Ekebose*	***Eminae Ekunoit***	*Ebekut*
20	*Ekaletelete*	***Eminae Ebenyo***	*Ngalam*

The first thirteen wild food sources mentioned by both male and female respondents are similar, with only minor variations in the ranking of frequencies (see Table 2.3). Differences begin to emerge at the 14th name mentioned (see Table 2.4). *Ngapongae, Ngalam, Emeyen, Esekon* and *Ngitit,* numbers 14 to18 for males, are all consumed when collected, requiring no preparation. *Eminae Ekunoit* and *Eminae Ebenyo*, numbers 19 and 20 for males, are both tree saps that are collected and can also be consumed with no preparation.

Table 2.5. Wild foods by cultural salience

Rank-ings	**Total**	**Smith's S**	**Male**	**Smith's S**	**Female**	**Smith's S**
1	*Edome*	0.719	*Engomoo*	0.675	*Edome*	0.659
2	*Elamach*	0.626	*Edome*	0.784	*Elamach*	0.589
3	*Elero*	0.620	*Elamach*	0.666	*Edung*	0.516
4	*Engomoo*	0.580	*Edapal*	0.611	*Elero*	0.613
5	*Edapal*	0.545	*Elero*	0.629	*Engomoo*	0.491
6	*Edung*	0.532	*Ekolese*	0.557	*Erut*	0.436
7	*Erut*	0.461	*Ebei*	0.542	*Edapal*	0.483
8	*Ekolese*	0.443	*Engilae*	0.276	*Esekon*	0.326
9	*Ebei*	0.412	*Edung*	0.55	*Engilae*	0.218
10	*Ngakalalio*	0.382	*Erut*	0.488	*Ataikol*	0.408
11	*Ataikol*	0.370	*Ebolo*	0.424	*Ebei*	0.292
12	*Ebolo*	0.346	*Ngakalalio*	0.404	*Ngakalalio*	0.363
13	*Esekon*	0.288	*Ataikol*	0.329	*Lokiliton*	0.132
14	*Emeyen*	0.246	*Ngapongae*	0.221	*Ebolo*	0.274
15	*Engilae*	0.245	*Ngalam*	0.205	*Ekolese*	0.338
16	*Lorakimak*	0.184	*Emeyen*	0.3	*Lorakimak*	0.223
17	*Ngalam*	0.179	*Esekon*	0.248	*Atadita*	0.189
18	*Eroronyit*	0.168	*Ngitit*	0.18	*Emeyen*	0.195
19	*Ngapongae*	0.152	*Eminae Ekunoit*	0.111	*Ebekut*	0.106
20	*Ekalale*	0.145	*Eminae Ebenyo*	0.073	*Ngalam*	0.155

When sorted by cultural salience a similar pattern emerges. Cultural salience is measure by Smith's S which is a combination of frequency and ranking. The top 10 or 12 wild foods mentioned by both males and females are similar, with mild variation in ordering, but differences emerge in the second set of 10. Tree saps, or types of *Eminae* emerge as more culturally salient to males than females, not occurring until after the top 20 for females. Males also begin to focus on fruits and seeds, *Ngitit, Ngalam, Ngapongae, Esekon,* that require little or no preparation.

Informants were asked about food preparation methods for each of the wild food names provided in the original freelist. All informants were able to provide at least basic descriptions of these methods. The methods were then sorted by frequency and cultural salience was calculated using Smith's S.

Table 2.6. Method of preparation

Method of Preparation	Frequency	Smith's S
Boil or Cook	35	0.259
Fresh	31	0.17
Fresh or Boil	18	0.139
Dry	8	0.162
Roast	4	0.051
Boil with Milk	3	0.073

All respondents most frequently mention wild foods that can be prepared simply through some kind of boiling or cooking. This suggests that anyone may prepare these foods for themselves or for those who share the cooking pot. Usually this would require sharing with household members, but men are frequently away from the household for long periods and may share cooking pots with other men and boys while tending livestock. This also demonstrates that men and boys have the knowledge and skills of food preparation beyond consuming raw milk and blood, as has been commonly suggested historically (Evans-Pritchard 1950). A close second in frequency for both sexes are those that can be consumed immediately, requiring no preparation.

Table 2.7. Preparation by sex

Male	Frequency	Female	frequency
Boil	19	**Boil**	18
Fresh	17	**Fresh**	16
Fresh/Boil	14	**Fresh/Boil**	10
Unspecified	8	**Dry**	7
Boil w milk	4	**Unspecified**	6
Dry	3	**Roast**	3
Boil/Roast	3	**Boil/Dry**	2
Fresh/Boil w blood	2	**Boil w milk**	1
Ferment	2	**Soak**	1
Fresh,Dry	2	**Ferment**	1
Roast	1	**Fresh/Roast**	1
Roast/Fresh	1		

When considering methods of preparation for each sex independently, wild foods that need some preparation (boiling, repeated boiling with draining, boiling with milk or soaking) are the most common, suggesting that both sexes are capable of collecting and preparing wild foods, for themselves or others. Wild foods that can be taken fresh, with no preparation, are the second most frequently mentioned by both sexes. Males mention various preparations with milk or blood more frequently than females consistent with their frequent access to these food sources while herding alone or in small groups. Females are more likely to mention drying of wild foods, saving them for consumption at a later date. Females are the only ones that reported soaking, also very time consuming, as a method of preparation.

Discussion

Some elements of the domain of knowledge for wild foods among a pastoralist population are surprising. This knowledge seems to be widespread, without strong divisions by location, age or sex. It has long been accepted that pastoralist men and boys forage when they are herding livestock. Exactly what they forage for or what it may

contribute to health or nutrition is just beginning to be explored (Johns et al, 2000). These results seem to suggest that not only men and boys have knowledge and experience in foraging but women and girls also share this knowledge and access these resources on a regular basis when they are available. This is compatible with findings among foraging societies where women and girls do the most foraging (Hawkes et al, 1997). Availability is dependent on rainfall and sometimes by the soil of the region. Given the heterogeneity of the Turkana District environment and the unpredictable rainfall patters, availability of different species may be brief. The wide array of types of wild foods (greens, fruits, seeds and nuts) suggests that each would be available at different points in the plant lifecycle, aiding in general availability across seasons.

Interesting differences in frequency and salience arise in the comparison of lists provided by male and female respondents. There are definitely wild plant foods common in knowledge to all of the respondents, but specialization of subsistence practices and food preferences begin to emerge. More specifically, in follow up questions the salience of certain wild food resources began to emerge, primarily related to food preparation. Males mentioned fruits, seeds, nuts and tree saps, which require little preparation while females mentioned fruits that required more time and some special knowledge to prepare. In addition, the few wild foods more salient to females are more likely to be stored and utilized by households, including the men. A more detailed analysis of observed behavior in a stratified sample will yield useful insight into gender-based knowledge and practices.

It is surprising to many to realize that the harsh, arid, and challenging environment of northern Kenya offers such an array of foods. This region is often portrayed as “marginal” and “desolate” (Dyson-Hudson and McCabe 1985). NGOs and

governments focus on drought and malnutrition in efforts to gain funds for development and relief projects (Nyariki et al, 2002). In spite of this portrayal in much of the literature, when asked, a handful of informants were able to easily recall over 150 edible foods offered by this environment across seasons. By comparison, ethnobotanical surveys of wild plant uses and wild food plants in Ethiopia across several ecological zones provided 100 wild food plants (Guinand et al, 2001). A six month study in agricultural grasslands of Uganda provided 98 species of plants that can provide food but many of these are threatened by habitat destruction and loss of knowledge due to low preference in a society focused on market production and exchange (Guinand et al, 2001).

Nutritional analyses of 22 of the wild food plants collected in Turkana District reveal that they provide important vitamins, minerals and calories (Appendix B). Besides providing calories during seasonal food shortages or droughts, the micronutrient contributions of different wild foods across seasons can have important implications for Turkana health. Care should be taken in development projects to recognize and consider protection, not only of the environment and its resources, but also the knowledge of that environment and the importance of continued access.

Many fruiting trees and shrubs are located near rivers, as are seasonally and continuously occupied settlements, villages and trading centers. Although Turkana are knowledgeable about these resources they were only rarely observed to transplant or nurture any wild foods in their compounds or near settlements.

Some informants suggested that access rights to wild food products can be restricted when plants or trees grow inside a compound but most wild foods which grow in public spaces would be considered an open resource. There did not seem to be consensus on this issue and there was a great deal of variation in the proximity of various wild foods in the different locations. The first location, Nadome, is a small village found on the banks of a seasonal river. There were many *edome* and *ngakalalio* trees as well as other fruit bearing shrubs along the riverbanks. The second location, though also near a seasonal river, is also on the perimeter of a large plain. Availability of greens and wild vegetables is highly seasonal and the plain is often brown and devoid of much vegetation for most of the year. The gallery forest along the seasonal riverbed is limited and few fruit trees or shrubs were noted in any season. The third location, Lokangae, is two or more kilometers from a seasonal river and is devoid of any trees other than some acacia and scrub *ebekut, Prosopis juliflora,* an introduced species that has become quite invasive. Most people here refer to wild fruits and greens that can be found other places. Many people discussed wild greens and tubers that can be found "in the mountains". The nearest mountains are approximately 50 km to the south, the Pelekech range. The fact that the knowledge did not vary by location is a testament to the mobility of even semi-nomadic Turkana.

However, as settlement continues the gallery forests along rivers are threatened. Many trees, shrubs and vines that offer wild foods are found in this riparian environment. In spite of the absence of surface water in these seasonal rivers for most of the year, the water is often just below the surface, which is usually quite sandy, and available to plant species adapted to this particular environment. These gallery forests are threatened by

aggressive erosion due to the heavy monsoonal rains combined with increased human and animal use. As trees fall due to seasonal floods, they are quickly turned to charcoal by women and sold in trading centers. The increased presence of small livestock, especially year round in more settled areas, does not allow natural re-seeding of native flora. Some small trees are cut and used for housing and fencing. All of these activities are having a cumulative effect of deforestation. There is no government forestry nursery in North Turkana District with an active reforestation project.

Turkana are increasingly using the invasive species *P. juliflora* or *ebekut* for thorn fences and house construction, partially in an effort to remove it from the landscape and equally due to the abundance. There are many Turkana beliefs about this species and it is generally viewed as an "enemy of the Turkana". For instance, Turkana believe this tree is poison to both plants and animals since they have observed little vegetation around large trees and how invasive the small, scrub trees are in the environment. Donkeys are observed to suffer and die after consumption of the tree or its seedpods. This is due to the insoluble fiber present in the seedpods that causes intestinal obstruction. Subsequent deaths of other animals, especially sheep and goats, are also attributed to the foliage or seedpods. This assumption is incorrect since the consensus among veterinarians (Zeyle, perscom 2005) is that small livestock intestinal tracts are able to pass the undigestible material. Other Turkana explain the prevalence *P. juliflora* by suggesting that it "steals the water" from other plants and even suggest that it is lowering the ground water levels in the seasonal riverbeds. A better understanding of the spread of this invasive species, its impacts on soil, water and forage as well as ecosystem interactions needs to be better understood.

Some Turkana, especially children, chew *ebekut* seedpods. The insoluble fiber is spat out after the slightly sweet taste has been extracted. Some women report grinding the seedpods, much as they do maize or other seeds like *ngitit,* and using this flour to flavor maize or wheat flour. As the species becomes more of a problem through its invasive nature, the bad reputation follows. After one wife reported grinding and using the flour, her husband became angry and demanded she stop. Local tales of children developing swollen stomachs and becoming sick, like the donkeys that consume the insoluble fiber, became quite common. This is in spite of a government program conducted by the Arid Resources Land Management Program that is trying to encourage utilization of the resource. Again, better information is needed about the species and its interactions in the environment with both people and their animals. Involving Turkana in this process will allow building on present observations and knowledge as well as aid in dispelling myths.

On a larger scale, the arid lands ecosystems are still being explored by researchers and are just beginning to be scientifically understood. The South Turkana Ecosystem Project was a long term, multidisciplinary research project with the Ngisanyoka Turkana in South Turkana District. Clearly this project focused on one particular group of Turkana and the southern part of the region. According to McCabe who focused on livestock and environment interactions, much of the Turkana District could be classified as in a state of persistent disequilibrium (2004). The presence of such a variety of resources important for human consumption, not just livestock and wildlife consumption, underlines the need to continue research in these ecosystems.

Concluding Remarks

Future research will need to include a more in-depth analysis of the micro- and macro-nutrient contributions of these wild food resources. This will aid in better understanding of the nutrition and health impacts they have on individual, household and even regional scales. In addition, a more extensive and fine-grained study of who accesses these resources, how often, and when will need to be conducted. This will aid in a better understanding of current management practices of resources, the potential of these resources to household and regional food security as well as better range management of northern Kenya for continued pastoral production and ecosystem management.

As research continues and data from past research, like STEP, is reviewed and analyzed, arid land ecosystems will become better understood. Currently organizations like the Food and Agriculture Organization (FAO) and World Food Program (WFP), both of the United Nations, look to arid land ecosystems as indicators of how global environments will deal with increasing unpredictability like that forecast with global warming. In addition, the within species variation believed to exist in arid lands could also hold important resources that would contribute to global food security, not just the local food security of Turkana. In addition to climate change, invasive species are a global concern. Species interaction and ecosystem level change need to be better analyzed and understood in order to attempt to meet current and future ecosystem management goals.

CHAPTER 3

QUANTIFYING TURKANA LIVESTOCK USING A LIVELIHOODS APPROACH[2]

[2] Watkins, T.Y. Submitted to Development and Change 9/2/2008

Abstract

Governments and development agencies frequently measure socio-economic status in developing countries. Rural assessments use terms from agriculture, even when assessing pastoralist societies. This research explores terms and methods for assessing pastoralist wealth and socio-economic status and presents a case study using participatory livelihoods assessment with Turkana of northern Kenya. Through participation, the pastoralists themselves communicate ranking, preference and value of various types of livestock that make up a herd and provide a livelihood. This information can then be compared across pastoralist groups. The participatory method demonstrates the importance of local knowledge and herd diversification as successful strategies of risk minimization in an unpredictable environment. The information gained from this type of assessment will be helpful for program implementation and assessment as well as policy for development and government agencies in developing countries. A better understanding of livestock management by pastoralists is relative to ongoing debates among economic anthropologists, human behavioral ecologists interested in risk management and pastoralism.

Introduction

Socio-economic status is routinely measured and quantified by governments to determine the status of the economy and by development agencies, both government and non-government, to target development projects for poverty alleviation, to evaluate outcomes of poverty alleviation projects and to direct current and future policies. In developing countries socio-economic status is frequently quantified through measuring agricultural assets and income producing activities. Agricultural assets may include

livestock, usually divided into small stock such as sheep or goats and large livestock like cows. Traction animals are often considered assets for production, much like a tractor. Some call livestock holdings wealth while others lump them together with income and then rank "well-being" (Lesorogol 2008). The most common methods currently used to describe wealth and socio-economic status of pastoralists will be discussed. The research presented here argues that pastoralists require slightly different classifications of assets since their livestock represent much more than assets for production. Rather, the owning of livestock represents individual and social identity, defines social relations and networks and serves both as a means of production as well as capital for investment and exchange. Livelihood literature offers clearer definitions of terms and allows for better comparisons.

Livelihoods is a term that suggests not only wealth but also capabilities and resources that provide a living (Chambers and Conway 1992). These assets, capabilities and resources can be grouped into various types of capital. Ellis (2000) divides them in to natural, human, financial, physical, and social capital and stresses the importance of diversity in rural livelihoods. These types of capital will be discussed from a pastoralist perspective. Using a livelihoods approach, types of capital can be described and quantified, allowing for cross-cultural comparisons.

Participatory methods are well suited for consideration of multiple variables like social preference, local values, ecological interactions or a dynamic environment, all of which are important in the arid and semi-arid lands where pastoralist live. By asking participants to describe an ideal herd it is possible to rank the perceived value of each species, determine herd diversity for achieving security, and thereby determine the

physical capital, or wealth, of individual households by quantifying their actual herds in comparison to ideal herds. By extension, a local exchange value for each species can be determined. These findings can then be used to calculate a livelihood index, a composite measure of each type of capital (Diamantopoulos and Winklhofer 2001).

This research was conducted from July of 2006 to August of 2007 in the northwest corner of North Turkana District. Focus groups were conducted in three different villages, each consecutively further from a major trading center[3].

Pastoralist livelihoods or methods of assessing the success of pastoralist production are discussed, especially in comparison to other modes of subsistence. A livelihoods framework outlined by Ellis (2000) is used to sort and define types of capital from a pastoralist perspective. The shortcomings of these methods are discussed in light of the exigencies of pastoralist livelihoods in ASALs. A participatory method, using Turkana men who currently manage livestock, is presented, including results about herd diversification, factors affecting preference of herd composition and local equivalencies of species. There is discussion of future research to address specific questions from economic anthropology and development and the conclusion presents the usefulness of this participatory method to development and government agencies as well as pastoralist literature, risk minimization, economic anthropology and livelihood theory.

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Pastoralist livelihoods

In sub-Saharan Africa pressures for development have stressed agriculture to the neglect of pastoralism. This practice occurs even in arid lands using technology like boreholes and irrigation. Pastoralists have survived in ASALS of the Sahel zone of Africa but historically had the ability to migrate to follow available forage and to shift between agriculture, pastoralism and hunting (Smith 1992). With a focus on agricultural development in arable lands, pastoralists have been increasingly marginalized to regions where pastoralism is the only remaining livelihood option. Irrigated agriculture in these environments has limited success, often being hampered by salination of soils by high mineral content water from boreholes. Government and development policy makers have a poor understanding of the requirements of a pastoralist mode of livelihood and have often wrongly blamed livestock for desertification and diseases (Fratkin 1997).

Agricultural wealth in the form of asset holdings has been well studied and is common enough in monetized economies that holdings like arable land, harvests and seeds can be quantified in economic terms easily understood across different cultural practices. Pastoralism is not as well understood in these terms. In heavily monetized economies, like those of the United States, Europe and parts of Latin America, where livestock are raised purely for market consumption, a particular species can be quantified according to a consumable product like beef. Meat consumption and the markets it drives are important elements of the global economy. The Food and Agriculture Organization (FAO) tracks these markets around the world and produces annual statistics on production, prices and consumption (FAOSTAT).

The goal of individual, household, regional and international comparisons requires some sort of standardization. As mentioned above, the FAO calculates livestock units (LU). They consider one head of cattle or buffalo to equal one LU and any other livestock is then calculated according to carcass weight (Sere et al, 1995). The primary unit is calculated relative to average carcass weights of the index animal in Organization for Economic Cooperation and Development (OECD) countries. Different regions then calculate their LUs according to average carcass weights reported by cooperating countries within each region (Sere et al, 1995). This does not consider possible limiting factors of raising livestock or any other variations within regions. Using one index animal to evaluate the value of all possible species holds the obvious flaw of assuming all species offer the same products and share the same value to the pastoralist. It is also important to note that LU is based on carcass weight, presumably at slaughter, suggesting that the meat is the only valuable resource and completely ignoring other production assets of living livestock to pastoralist livelihoods, such as milk, blood or traction.

A slightly different attempt at comparisons of livestock is standard stock units (SSU), sometimes called standard livestock units (Fratkin and Roth 1990). This metric focuses on assets required for production of livestock like available forage and water and can address regional variations in stock size within species if it is attributable to variations in these assets. Basically, these calculations attempt to incorporate available forage in a region to determine possible carrying capacity for livestock. Unfortunately there does not seem to be a way of differentiating between browsers and grazers or any combination of the two. Since herd diversity and nomadism are two keys to pastoralism

in arid lands, this method seems inadequate for use in these regions. In addition, SSU is geared more to modeling herd capacity rather than quantifying actual herd value.

Though LU has been in use the longest, the Tropical Livestock Unit (TLU) seems to be the most commonly used in comparative literature, possibly because much of this research is conducted in tropical environments of developing countries. The TLU specifically refers to 250 kg live weight and can refer to any species. An equivalency is then made using the live weight of other species. TLU is the most frequently used to address livestock food production in anthropological literature of Turkana pastoralists (Dyson-Hudson and McCabe 1985; Little and Leslie 1999:128; McCabe 2004:185). Dyson-Hudson specifically suggests that the standardized stock unit used does not adequately reflect production, yet it is a standard used in East Africa to compare livestock resources (1985:360). TLU and SSU are sometimes used interchangeably, which further complicates understanding exactly what is being compared (Chilonda and Otte 2006).

The various forms of capital will now be explored. In developed countries individuals and households strive to gain wealth in the form of financial or physical capital. These forms of capital are easily quantified in terms of monetary value. Even in less developed countries where societies are involved in the market economy, or monetized, these types of capital are easily understood as wealth. Currency is interchangeable in markets for necessary items like food, shelter or clothing. When large enough amounts are accessible, cash currency is also interchangeable for luxury items that may in turn provide social status to individuals or households. A livelihoods approach changes terms like wealth and assets into types of capital, making it more comparable across regions and cultures. The five types of capital described by Ellis

(2000), natural, human, physical, financial, and social, can aid in comparing pastoralist livelihoods with each other and with other types of livelihoods.

In the pastoralist setting of northwestern Kenya, natural capital largely consists of forage and water for livestock, wild foods and water for humans as well as building material for homes and fences. To an outsider the environment may appear harsh but with local knowledge it is possible to access useful resources. Movement around the landscape is a necessity for continuous access to natural capital.

Human capital is generally considered to be investments in human experience and knowledge that enhance the value of labor (Becker 1975). In a pastoralist setting, human capital begins with large and complex households and the subsequent contribution to labor in an extensive agricultural system. Herding knowledge is gained through age and experience in the form of traditional knowledge passed down from generation to generation. As more primary and secondary schools are developed, formal education also contributes to human capital. It is not uncommon for Turkana families to select one child and attempt to give that child access to education, while using other children for required household labor, including herding. Often the selected child will go to live with relatives or friends in a location that has public schools. Secondary schools are not numerous in northern Turkana District, Kenya, thus secondary school education is still uncommon.

With regards to physical capital, Turkana often own their herds and no more than they can carry on their heads and a few donkeys. Often even the clothes on their back are derived from the skins of their livestock. In opposition to Ellis (2000) who classifies livestock as financial capital, I suggest that pastoralist livestock holdings be described as physical capital, much like arable land is

physical capital of a farmer. In each case physical capital is a resource that provides the means for a livelihood and produces food for consumption and any excess production can be exchanged for money.

Financial capital is commonly understood to be cash. A village council member and elder explained to me that northern Turkana do not routinely have money.

> "This part, the people are not really basing on money. Like I sell this bull and go and put it into Posta or the bank. No, you sell that bull for the purpose which is for your family."

Although northern Turkana clearly understand that livestock can be exchanged for money they view livestock as a resource that benefits from the multiple inputs of labor, time and knowledge in accessing forage and water as well as maintaining health. Whereas other pastoralists, including southern Turkana, sell livestock and then hold cash, these Turkana manage the resource for the household and only sell for cash when necessary. There are a few Turkana who regularly exchange livestock for cash, acting as a middleman for other Turkana, usually for a percentage of the sale. In addition, men, women and children work for food or money when opportunities arise. They are not unfamiliar with money, financial capital, but rarely have regular access to it as income and virtually no reserve in the form of monetary savings.

Social capital is the most ephemeral but possibly the most important to Turkana (Bourdieu 1987; Coleman 1988). In a pastoralist society, a social network will support individuals and households in times of trouble and disaster. This network begins with family, and extends to clans, age-mates and fictive kin (Spencer 1998). Many of these social relationships are defined through shared responsibility for and exchange of

livestock (Bebbington 1999). The exchange of livestock in the form of a negotiated brideprice defines a wife. Rites of filiation for offspring are performed through exchange of livestock. Age mates mature and gain local knowledge by increasing responsibility in the care of family herds. Fictive kin relationships usually evolve with associates in the same *adakar* or social groups who migrate with livestock together. All of these fit the Bourdieu definition of social capital in that they derive from relations or group membership (Bourdieu 1987) .

Thus, livestock can contribute to either physical capital, as a means of production, financial capital, as an investment that can be cashed in when needed, or social capital, as a means of exchange to define social relationships or as a representation of success within a pastoralist society. Livestock are so embedded in pastoralist societies that they function as a nexus for many types of capital.

Complexities of pastoralist livelihoods

None of the present methods of quantifying livestock holdings address the complex social, economic and ecological relationships of many pastoralists and their livestock. Livestock have social value not only through the prestige of holdings but also by defining relationships of family and friends (Broch-Due and Anderson 1999). Economic value can be recognized through formal exchange with markets or more informal trade and holdings. Ecological relationships between pastoralists and their livestock are most obvious in the diversification of herds and the nomadic movements of households or smaller subsets of herds. Each of these relationships will be explained.

Social relationships among pastoralists can often be defined through their herds. Most pastoralist societies still exchange livestock for wives through brideprice. This can aid in wealth distribution among mostly egalitarian societies (Gulliver 1955) as well as maintain or establish important social networks that are key to household survival in an unpredictable environment (Dyson-Hudson and McCabe 1985; Little and Leslie 1999; McCabe 2004). Age-mates and clansmen who herd together often have complex social relationships defined through exchange of livestock. These exchanges can take the form of sales, loans, promises or simply shared responsibility for maintenance (Spencer 1998). All of these forms of exchange can improve the viability and survival of each household involved. Of course, having particularly healthy livestock or large numbers of livestock can add to social prestige. Among pastoralists, the presence of a large, healthy herd suggests significant knowledge, skills, and available labor to manage and maintain such a herd. All of this combined grants social prestige (Bates 1998; Evans-Pritchard 1940).

To an outsider, economic relationships can sometimes become confused with social relationships. Upon closer contact many pastoralists refer to their livestock holdings as banks, or important mechanisms for saving in case of droughts, animal disease outbreaks, or human illness (Evans-Pritchard 1940; Gulliver 1955). At times of hardship livestock can be exchanged for money or for foodstuffs, usually grains that otherwise would not be available to non-agricultural pastoralists. Most literature suggests that small livestock, especially males, are the most common off take of herds for this purpose (Dahl and Hjort 1976; Pratt and Gwynne 1977).

Since many pastoralist societies are found in ASALS, it is tempting to suggest that they are shaped by their environment. It follows then that relationships with herds are largely intertwined with ecology (Hakansson 1989). Herd diversification has proven to be key in food security and livelihoods in unpredictable environments (Dahl and Hjort 1976; Mace and Houston 1989). Different species provide milk, blood or meat during different seasons and under different ecological circumstances. Household composition influences livestock holdings while livestock holdings determine household movements and often the makeup of households as they divide in order to meet the needs of the various livestock species. In addition, different species have varying susceptibilities to drought or disease, both of which remain as challenges in sub-Saharan Africa.

Since a more diverse herd, especially one that requires nomadic movements, will have different labor needs, labor can be linked with ecological factors. Labor supply of pastoralist households changes over the life course of the household. A limited labor supply may be a limiting factor on the composition and size of herds in pastoralist societies (Fratkin 1989).

The nomadic option is equally important when considering wealth and livelihoods of Turkana. The highly unpredictable environment requires a full portfolio of livelihood options, not just herd diversification. Most Turkana men mentioned the need to herd different species in different locations but also mentioned the need to sub-divide those herds. Moving herds and sub-divisions of herds can prolong the availability of forage and minimize risks of loss of animals due to drought, disease or raiding.

With increased mobility and sub-division of the already diversified herds, labor becomes increasingly important. In addition to meat, milk is important to food security and dietary diversity of Turkana (Sellen 2000). Dahl and Hjort suggest a correlation between labor input and milk production, stressing that although quantity of milk production may be low in nomadic animals, the nutritional quality can be higher than average (1976:136-7). Absolute herd size, diversity of species in a herd and herd management options may all be limited by the number of laborers available (Dahl and Hjort 1976). The intensity of labor will also be affected by herd size and diversity (Fratkin and Roth 1990; Mace and Houston 1989). When considering household wealth it is important to consider the consumer to worker ratio in order to consider actual production (Sahlins 1972). This can become very complex, especially when attempting to include the labor of children. The point at which children become net contributors of labor versus net consumers is unclear and will vary greatly from household to household. Turkana, as most pastoralists, rely heavily on children of varying ages for particular types of labor in herd management. Some researchers have attempted to address household size but have not successfully addressed actual production versus consumption, taking in to consideration age and type of labor (Little and Leslie 1999).

Much of herd management is geared towards minimizing the risk of food insecurity, or having insufficient food to maintain the household. Having a diverse set of species in the herd, moving herds across the landscape, dividing households to manage the herd(s), are all geared towards minimizing the risks of drought and disease effects on livestock holdings. Civil security also plays an important part in managing herd and household movements. Turkana have traditional raiding activities with Pokot herders to

the South and Toposa herders to the North. Lake Turkana to the East limits contact with Samburu herders. The Uganda border acts as a somewhat effective barrier with Jie and Karimojong to the West. There are also *ngorok* or "bandits" who steal livestock. With the omnipresence of guns in the region due to the proximity of national borders, especially nations with ongoing civil insecurity, traditional raiding has become more deadly (Gray et al, 2003; Pike 2004).

A participatory method of measuring pastoralist livelihoods

Here I will quantify livestock holdings of pastoralists using a participatory method that considers most of these variables from pastoralists' own perspective. During a year of research in northern Kenya, from July of 2006 to August of 2007, focus groups were held with Turkana men in Nadome, Nanam and Lokangae, three villages in North Turkana District, Kenya. Focus groups were limited to men because they are primarily responsible for herd composition decisions and herd movement (Hakansson 1989). Each village is successively further from a market center. Nadome is 2.2 kilometers by road from a major highway intersection and busy market centre. Nanam is 22.7 km by road from the same market centre. Lokangae is approximately 70 km by foot and 150 km by road from the same market centre and approximately 50 km by road or foot from a second market centre. Lokangae is located at the periphery of the Lotikipi plain, the heart of which is an important forage reserve for grazing livestock. Due to this geographic position between important forage reserves and two market centers, this village has been known for trading for at least two decades.

A focus group was held in each village with independent male heads of households who have livestock holdings. A total of 19 willing participants provided basic demographics such as age, sex and livestock holdings. Then colored marbles were introduced to represent each of the five species normally herded by Turkana; sheep, goats, donkeys, cows and camels. Turkana, as well as many other people in East Africa and around the world, spend many hours playing a game with stones, seeds, or clay marbles in small hollows, usually formed in the clay soils. Turkana call this game *pei-arrei* or "one-two", indicating that it is a counting game. In a similar setting, it is not infrequent for these same men to spend hours together discussing rainfall and herd movements, often using sticks to draw on the ground. Thus, using representations of animals and playing counting games with marbles is very familiar to these men[4].

First, each informant counted out a representation of his actual herd using the colored marbles, which was recorded. There was minimal discussion and comments from the group as to the verity of each individual's representation of livestock holdings. Next, we went around the group again with each individual assembling their ideal herd using the colored marbles. This time I elicited more conversation from the individual and the group members regarding choices in absolute numbers of species as well as herd diversity and relative numbers of species. Finally, an equivalency of each species was demonstrated with the colored marbles. For example, one tiger marble equals one cow

[4] I made no effort to hide my counting of marbles to represent counting of their livestock. Often researchers report difficulties getting pastoralists to count livestock, stating that they fear bad luck (Gulliver 1955, Spencer 1998). I did occasionally run in to this problem when actually among livestock, as well as when taking photos of livestock.

equals one green marble equals one camel. There was little discussion and group consensus was consistently reached very quickly. The group was open and eventually both men and women joined in as it progressed. The additional people were included in discussions but only the original men who had given demographic information are included in analysis. The addition of more members rarely added to the length or complexity of group discussion and did not noticeably affect the time it took to reach consensus.

The participatory method allowed Turkana men to factor environmental, labor and social constraints in to their decisions in how to value each species as well as the total herd. Therefore it is not necessary to incorporate these variables that may affect personal preferences in livestock, reflected in price or herd composition in larger comparisons. Any additional discussion can focus on outliers, individuals who seem to vary from the norm, with follow up questions and discussions to elucidate which variables contribute to any deviation. No specific question or representation of labor was included in the focus group process. However, as individual men described their ideal herds they were questioned about their ability to provide the necessary labor for that size herd. The group again acted to provide a check against exaggerations. In addition, I often questioned the capability of a specific region to support large numbers of animals. This usually led to discussions regarding the need to move households, establish satellite households or to send young men on extended treks with animals. It is interesting to note that Turkana men are quite free to make their own herding decisions. They may choose to adhere to communal nomadic groups called *adakars,* but are also free to make independent moves. Breaking from *adakar* movements in no way prevents them from

rejoining the *adakar* at any time in the future. Inclusion in an *adakar* seems to be related to familial and clan associations but age-mates from other clans may also be included.

Results

The individual results for Nadome are not shown here since the transcription has been lost, however the discussions and equivalencies of this group were recorded in field notes and thus are included in the group results. The most striking finding of the group discussions was the persistent desirability of herd diversity. Those who had small holdings of few species almost always wanted a more diverse herd. In the case of two older men in Lokangae, there was a preference for small livestock. When questioned further both men stated age and lack of labor as limiting factors for herd diversity. It is likely that age, associated with the unlikelihood of seeking future brides, was a factor rather than debility. Both of the men in question were still agile and actively taking care of livestock. They reported not wanting to move and not having labor to move with other animal species as limiting factors. There was no Turkana participant who would only want one species in his ideal herd.

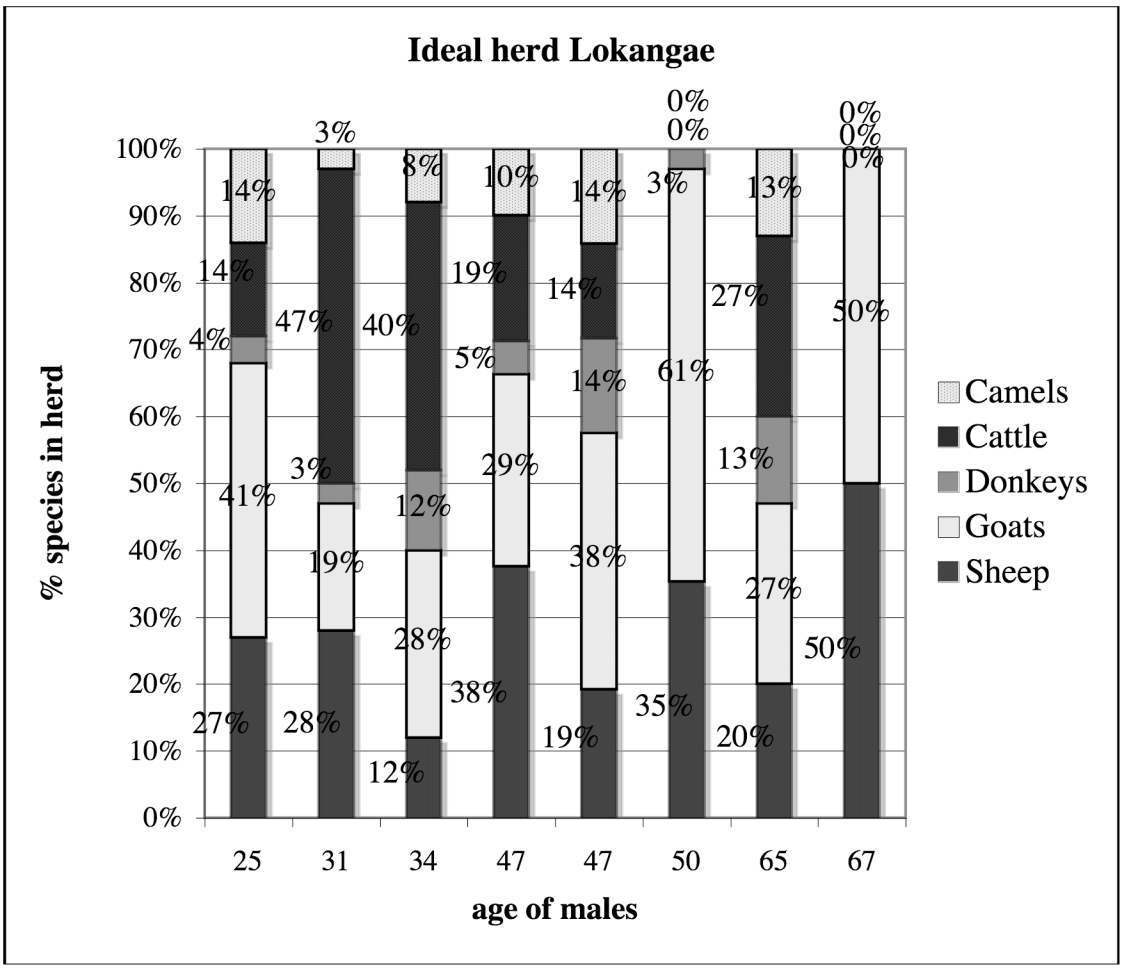


Figure 3.1. Ideal herd diversity, Lokangae

It is also interesting to note that all but these same two informants wanted cattle to make up a portion of their herds. Cattle require the most forage and the most water of any of the five preferred animals. They often require a separate camp and frequent movement to maintain access to both forage and water. If many cattle are in the herd, it may be necessary to divide the cattle into two different herds, especially during calving season. Milking animals and their nursing offspring will be kept closer to a household compound while the remaining number may be moved to another location. This is to prolong forage for the milking animals and also minimize the risk of disease outbreak, loss to drought

conditions or to raiding, resulting in loss of the whole herd of cattle. In comparing actual to ideal herds, all but two of the informants wanted to increase their holdings of cattle, in spite of the difficulties just described.

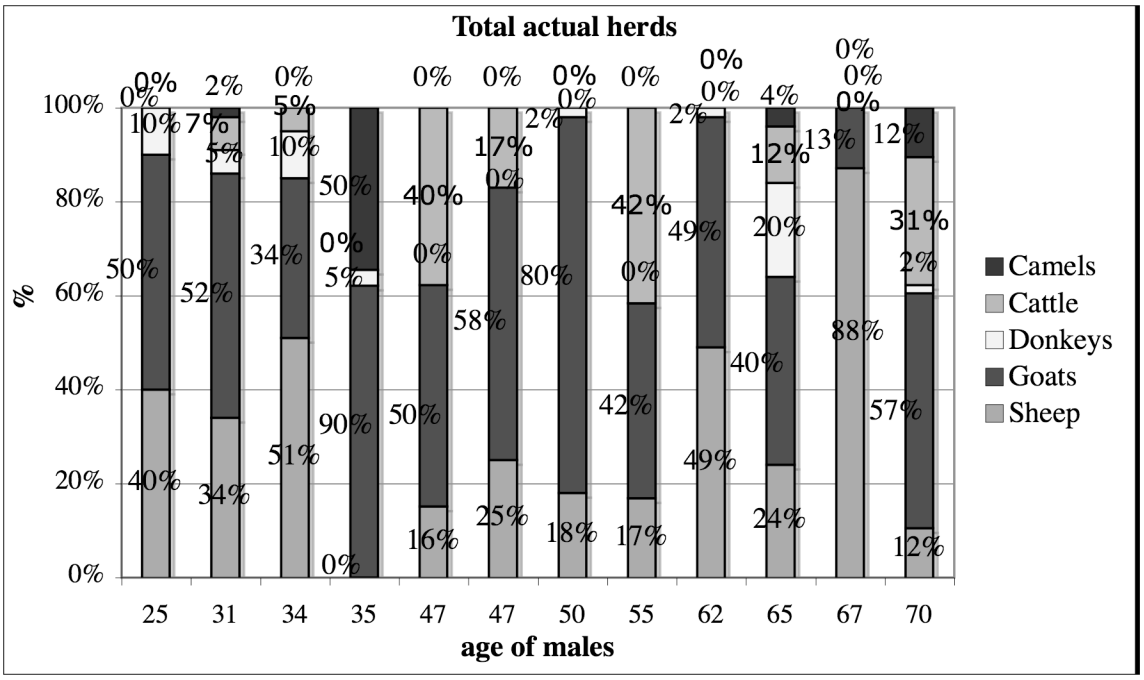


Figure 3.2. Actual livestock holdings for Nanam and Lokangae informants

It is likely that social importance accounts for the continued popularity of cattle. In discussions of brideprice, as well as observed instances of brideprice negotiations, cattle will often serve as the capstone of negotiations. While a number of small livestock will equal one head of cattle, a highly desirable woman will require at least a few cattle in the brideprice negotiation. There was often talk of "a white bull" being marched in with the final few head of livestock to make a brideprice offer impossible to refuse. Likewise, to show respect at the death of an important individual, nothing short of slaughtering a bull will suffice.

A young male head of household (HoH) with few social or familial relations will have less available labor, thereby limiting the size and diversity of his herd, either actual or ideal. However, many young men will maintain relationships with extended family in order to have access to that labor. The group discussions revealed that Turkana are very cognizant of these limitations and kept even their idealized herds within available labor restrictions.

Table 3.1 Comparisons of labor and ideal herd diversity, Lokangae

Age of HoH	Sheep	Goats	Donkeys	Cows	Camels	Total	Laborers
25	200	300	30	100	100	730	10
31	300	200	30	500	30	1060	10
34	30	70	30	100	20	250	4
47	40	30	5	20	10	105	3
47	40	80	30	30	30	210	5
50	60	100	5	0	0	165	2
65	15	20	10	20	10	75	2
67	100	100	0	0	0	200	2

The group meeting in Lokangae had the most detailed discussions of labor requirements for their ideal herds. As previously mentioned, the group was consulted regarding reasonableness of the idealized herds, the suggested labor needs, and the availability of labor. In general, the group agreed that sheep and goats could be herded together under normal circumstances. In times of drought, a large herd will be divided and rotated around the best forage sites, but this does not always require dividing the household. In addition, it is not uncommon for small children aged four to 12 to manage large numbers of small livestock if close to a homestead. Likewise, donkeys and camels

may be herded together and can be left unsupervised for short periods of time. However, camels, if left unsupervised for too long are very prone to "running away", requiring at least one adult male to go in search of them. These searches may take days. Due to the very real risk of raids from neighboring groups, in this case the Toposa of southern Sudan, or from Turkana bandits called *ngorok*, it is unusual to travel for more than a day alone, thus possibly requiring multiple men to search for lost camels. Cattle will usually require at least one person to manage them and this is often at a satellite camp that is free to move in order to follow water and forage. In addition, the herd of cows will often be divided in to milking and non-milking during calving season, keeping the milking animals near both water and a house compound.

Individual herders are always free to make their own decisions regarding the segment of the herd they are responsible for but will eventually answer to the head of household who is the owner of the animals. Most of the men in Lokangae have chosen that location as a homestead and then maintain at least one satellite compound that moves depending on available resources. The head of household then moves between his compounds and the market centers, often walking 50 to 70 kilometers in a day. These men have chosen this semi-nomadic livelihood rather than a sedentary one or a nomadic one where the homestead is not in a fixed place. It is possible that the unique location of Lokangae makes this a more viable option.

The most ambitious men, and also the men who reported the most labor, are two of the youngest in the group (Figure 3.2). Both of these men have several small children and both live with a woman who is not recognized as their wife (no brideprice has been paid). Their large numbers of an ideal herd may represent a desire to take over their own

father's herd and to pay a brideprice. The labor they are reporting is composed of extended family rather than relying on their own, very young children. The 47-year-old man who would like 210 total head of livestock has paid brideprice for two wives and reported that he would like a third, stating that he would need more donkeys in order to entice his "next wife".

The three oldest men represent three different strategies for old age. The 50-year-old man seems to have already achieved social status since he is already considered a village elder, even though he never paid a brideprice for his wife, but instead paid only rites of filiation for his children. He is not looking forward to any more wives and stated clearly that he would not consider nomadic movements required for larger stock species. The 67-year-old man who opted to have only small livestock is a Somali man who married a Turkana woman. The family is Muslim and has close connections with a nearby market center where a select few of the children live for months at a time to go to school. The younger children and one older girl are available to herd the small stock nearby but there is no one to move with larger livestock. Another wife and the associated brideprice are not variables in his decision-making. Finally, the 65-year-old man maintains a homestead and a satellite compound around Lokangae. He has not paid brideprice for either of his "wives" but has paid rites of filiation for most of his children. He is not planning on paying a brideprice and reported being "too old" to manage large numbers of livestock. The group responded that his ideal herd was appropriate for him. He is not on the village council but is accepted at community discussions regarding livestock movements, rainfall, available forage, etc., although he was observed to sit quietly for most of the discussions. It seemed to me that he was focusing on subsistence

for his family and not on promoting his own social status or producing any surplus for exchange.

1 male cow = 12 (male or female) goats = 12 (male or female) sheep = 1 (male or female) camel = 1 (male or female) donkey

1 female cow = 20 (male or female) goats = 20 (male or female) sheep = 1 (male or female) camel

Figure 3.3 Livestock equivalencies for Nadome and Nanam

Nadome and Nanam, the closest of the three villages to market centers, agreed on exchange values for livestock. Female cows are more highly valued than males, due to their reproductive capabilities and milk production. There was no mention of variation by sex in values of small livestock or donkeys. These values would be recognized when trading within the village, clans and preferably when trading with outsiders. It is common for Turkana to trade with resident Somalis, usually in times of need. Somali traders live in the villages and run small shops, keeping food items like maize flour, rice and sugar, along with a few other items like batteries, tea, oil or juice. They will often employ Turkana men or women, most often unmarried men or widowed women, to take care of the livestock they accept in exchange for their goods. Occasionally they will pay cash for livestock, usually when a Turkana needs cash for a health emergency or some family emergency that will require travel outside of the region. The Somali traders are part of a network of Somali families who will periodically collect all surplus livestock and transport them to Central Kenya to get better prices.

It is no surprise then, to see Turkana attempting to enter into similar trade arrangements. As mentioned, Lokangae is in an excellent geographical position, on the periphery of market centers and the Lotikipi plain, an important forage reserve for large numbers of nomadic pastoralists. As a result, Lokangae has been known throughout the region as a trading center for at least two decades. It is important to note that although many Turkana men would like to practice trade full time, without access to transportation and a national sale network their trading business will often fail and they then have to return to traditional pastoralism for subsistence. In Lokangae, the exchange values were different than the other two villages, primarily by not taking in to consideration breeding or milking value of females.

1 cow = 11 goats = 11 sheep = 1 camel = 1 donkey

regardless of sex

Figure 3.4. Livestock equivalencies for Lokangae

When I questioned the group about the value of a milking cow versus an oxen or a bull they were insistent on the equivalencies as noted. When the equivalencies of the other villages were given as examples, a village council member and active trader informed me that they "used to use those numbers as well, in the past" but had since adopted the newer values, suggesting that the other was an outdated method.

Discussion

My findings in the discussion of labor and sizes of livestock are in conflict with others who have suggested that small livestock require higher labor inputs (Fratkin 1989). It is possible that the highly unpredictable and harsh environment of northwestern Kenya calls for increased mobility for cattle in comparison to other pastoralists in East Africa, or that the study methods employed measure something different than the Turkana equate with labor, for instance, intensity or level of knowledge rather than number of herders.

Although Turkana do not practice male coming of age rituals, the term translated as "age-mates" remains important and frequently describes strong social relationships maintained throughout life. Young men, from late teens through to mid-twenties, will be the first household members to migrate with animals. Therefore they are often responsible for herding the cattle. It remains a common practice for a father to give a young male bull to a son who is taking increasing responsibility of small subsets of the household herd. These young men still create songs and dances about their bull and perform them at social events to impress young women. This bull represents their future herd and therefore their future prospects at marriage and family. Although cattle represent high labor inputs, the necessity for dividing households and migration for Turkana, they remain socially, culturally and economically important, thus an important part of an ideal Turkana herd.

Donkeys are almost omnipresent in both actual and ideal herds in all three locations, albeit often in small numbers. Their exchange value is quite high in the local livestock equivalencies. Yet most of the literature on livestock management and pastoralism ignores them. In Turkana pastoralism, the donkey is the only beast of burden.

If a family is going to move households, which will occur a number of times a year in a nomadic household and at least one time a year in most other households, a donkey is almost a necessity. Otherwise women and children will have to carry household items and the woven pole structures that can rapidly be put together to build a house. Without donkeys multiple trips may be necessary or the household will have to move without food or water. This is quite risky since most moves are made at the onset or during prolonged dry seasons when water can be quite scarce. Even household members that move from one household compound to another will often use a donkey to carry small children, food and water. In addition, every Turkana stated that donkeys can be milked and their meat will be consumed if an animal becomes sick or elderly. Few admitted to consuming donkey blood yet reported it as an acceptable practice, suggesting that the preference for donkey food products is low. Donkeys are almost a necessity to a nomadic Turkana family; to women they represent some relief from hard labor and they also serve as a coping mechanism for the entire household during periods of food insecurity.

These equivalencies represent the exchange value of each species, as defined by the herders themselves. There is some difference between the non-trading villages and Lokangae, the trading village. This is probably influenced by more active trading with non-herding residents of the market centers where the primarily value of the animal is the consumable carcass. As traders, they come closest to a neutered valuation of the animal, much like the international livestock units (LU, SSU or TLU). In comparison, the TLU used by Little and Leslie (1999:128) as well as McCabe (2004) is 1 TLU = 1 cow = 1.2 camels while 1 small stock = 0.125 TLU. The Lokangae equivalency is 1 small stock = .09 TLU while 1 cow = 1 camel = 1 TLU.

Groups in all three locations reported that animals are rarely sold solely for the purpose of slaughtering, for instance to a local butcher, but this is an option they are aware of. Tradesmen from central Kenya who are not Turkana operate most of the butcheries in both market centers. Most Turkana households slaughter and prepare meat for their own consumption. I only saw Turkana with monetary income, usually from day labor, purchase meat by the kilogram at a butchery. When Turkana men travel to market towns, they usually stay with relatives and eat with them. If they have traded animals or conducted other business and have cash, they will occasionally pay for a meal at a *hoteli*, a local shop that prepares food over a *jiko* or small charcoal pit.

This exchange value is not equal to market value of different species. As previously discussed, TLU seems to reflect market value by measuring total carcass weight, presumably of a slaughtered animal. The equivalencies discussed here do not approximate indifference value, which would have to be elicited through questions using marginal utility values of each species. However, I feel that many of the variables involved in marginal utility such as available forage, water, labor as well as personal preference for outputs like milk, blood and meat, are also variables in the decision making process of ideal herd management, thus are reflected in this local livestock equivalency.

In discussions of personal preferences, the most common reason Turkana herders gave for inclusion of sheep in their herds is the rapid reproductive rate and relatively low need for health interventions. In particular, they seem to require little to no assistance in giving birth. Unlike Maasai and other pastoralists to the south, Turkana do not to use sheepskins for anything other than mats. I did observe the frequent use of slaughtered

sheep to mark successful childbirth and also in certain healing rituals. In both of these cases the high fat content of the preferred species, Black-faced Somali sheep, is highly desirable (Pratt and Gwynne 1977). The only explanation given by men who did not want high or even equal numbers of sheep as goats was simply one of personal preference.

Goats seem to be increasingly popular in northern Turkana since they are prevalent across the landscape and provide the most frequently consumed meat in the region. This is in comparison to accounts from the 1950s (Gulliver) and 1970s (Pratt and Gwynne) when there were far fewer goats than currently present in Turkana District. Goats reproduce more frequently than camels or cows and, according to the Turkana herders in the three villages, frequently give birth to twins. They do seem to require herders knowledgeable in basic health maintenance. Many households demonstrated knowledge of local medicines used to treat external as well as internal ailments. Goat meat seems to be the most commonly consumed meat. In addition, goats will commonly be accessed for blood for consumption as well as milk.

In the villages where cows were often quite distant, goat milk was the most commonly consumed. Milk, either fresh or sour, is given first to children in households. It is quite common for men and boys who are away from homesteads with herds to consume milk and blood, along with wild fruits, greens, roots and vegetables they prepare themselves. I observed household members, usually young girls, traveling as far as 40 kilometers a day to sell milk in market centers. In other villages young herd boys or girls would occasionally go door-to-door selling milk by the cup, usually focusing on Somalis or visitors who are more likely to have cash. This suggests that any milk beyond that for

children could be considered excess. In times of plenty, usually during unusually long or wet rainy seasons, milk production will be quite high. According to local history, these years of plenty will be remembered by naming that year in descriptive terms. There are several years from the past three decades remembered as "the year the women were white with milk powder", describing a local process of drying milk curds and then pounding them into a powder than can be stored into the dry season. I did not see either the process or the powdered milk, suggesting that this practice is becoming less frequent.

The cultural and social value of cattle has already been described, as has that of donkeys. Turkana do not use camels as beasts of burden and in fact, seem to keep them almost as a coping mechanism for times of drought. Government veterinarians and non-government organization (NGO) workers complain that Turkana camels are almost wild due to their infrequent handling and herding style of free-range browsing. Nonetheless, the Turkana men in all three villages acknowledged that it was desirable to have at least a few camels. In addition to seeing camels browsing in the landscape, I often saw camels hobbled near satellite household compounds and occasionally near herds of other livestock. Reportedly, camel milk is an increasingly important food resource during droughts, maintaining a high concentration of proteins and milk fats well beyond that of goat or cow milk (Dahl and Hjort 1976). Informal discussions with women suggested that goat and cow milk is preferred over that of camel milk yet camels are valued in herds since most would like to continue to have access to them. In addition to milk, camels can be bled for consumption and their meat is also desirable.

Future Research

Although interesting to economic theory, these interviews did not pursue individual preferences or indifference values. In future it would be quite simple to follow up group discussions with individual interviews to compile this information. It would also be desirable to expand the number of sites where these group discussions are held in order to expand the sample size. A larger sample size would allow statistical analysis of findings and allow for more generalizations of the findings. However, as previously mentioned, the findings presented here, even though of a small total sample size remain interesting due to the geographical selection of the three sites and the high degree of consensus on major issues related to herding livestock in northern Turkana District. Anthropological literature supports the validity and reliability of small sample sizes when there is a high level of group consensus (Handwerker and Wozniak 1997).

This research focused on male heads of household, which is the most common household among nomadic Turkana communities. Nonetheless, in semi-nomadic households and in settled Turkana households, it is not uncommon to find female-headed households. Even in male-headed households, the role of women in acquisition and dispensation of livestock is not well understood. Historically the Turkana pastoralist system has been described and classified as centralized, where the head of household has inalienable and sole rights over all livestock (Gulliver 1955; Hakansson 1989) yet this research found some female-headed households who claimed ownership of livestock. The role of women in livestock rights of use as well as ownership needs to be updated. Some organizations working in northern Kenya have suggested that young women will encourage raiding by their desired spouses in an effort to acquire brideprice. Also,

traditional Turkana practices will allot small numbers of livestock to different wives, especially the first wife. What is not clear is how much the woman is allowed to manage that herd. Turkana women, as in many households, are relegated responsibility for maintaining food security for the household, although how she does this with little input into herd management is not clear. For all of these reasons, future research should include a more gendered approach. Similar group discussions should be held with men, women and non-head of household men in order to gain better understanding of household management of livestock and livelihoods. Similarly, a cross-cultural comparison of the same preferences and values would be beneficial from a theoretical as well as a practical point of view. In northern Kenya there are numerous cultural groups who practice pastoralism, not to mention the many other groups in East Africa who are subject to similar environmental vagaries.

The method outlined here established ideal diversity of livestock herds and local equivalencies or ideal market exchange value. Other types of value would be salient in economic as well as cultural theory. Specifically utility value would be of interest to both livelihoods research as well as a better understanding of pastoralist economy. As previously mentioned, indifference values between species as well as age and reproductive potential would also shed light on individual preferences (Kuznar 2000). These findings would be analyzed to determine cross-cultural consensus. Across time, especially in such an unpredictable environment, this type of research would not only contribute to economic and cultural theory but also be of immediate use to organizations working in the region towards sustainable livelihoods.

Conclusion

This research finds a high desirability of herd diversity among Turkana of North Turkana District. The exact mix of species will vary depending on the age of the herder, his need for brideprice and rites of filiation payments, his labor supply, and personal preferences among livestock. It is important that herd diversity be a part of livelihood assessment among pastoralists. A locally defined livestock exchange unit gives more information about local and regional livestock holdings and market interactions than an international unit on which there is little agreement. There would be no misunderstandings about whether production value or exchange value was being measured, as it would simply represent local perceptions of value that take in to consideration the complexities of pastoralism in that region. These comparisons would carry much more meaning for local program management and evaluation. These same values can then be used to describe holdings by weighing species holdings according to the local equivalencies. For example, a household with 10 cows, 50 sheep, 50 goats, 4 donkeys and 6 camels in Lokangae would have a livestock holding of (1x10) + (50x.09) + (50x.09) + (4x1) + (6x1) = 29 local livestock units. This parameter can then be used to compare households within the region or between regions as long as the local livestock unit is understood.

A livelihoods approach that divides assets in to natural, physical, financial, human and social capital is a more useful way of considering wealth, especially when considering wealth as simply one factor in achieving security, either food security or a secure livelihood. Considering assets as a type of capital makes cross-cultural comparisons less difficult. It then becomes a matter of scaling these assets in an ordinal

fashion to create an index (Diamantopoulos and Winklhofer 2001). Participatory methods, like the one presented here, are a simple way of collecting region and culture specific information on physical assets like livestock holdings. The emic nature of valuing livestock includes ecological and social variables. Simple follow-up questions then provide qualitative information to aid in interpretation of quantitative findings.

As long as there is agreement about the classification of assets in to one of the five types of capital, and the scale can be agreed upon, cross-cultural comparisons should be straightforward. An index for each type of capital would provide economic information that is relevant to each region and truly reflects livelihood status. NGOs providing relief, livelihood and development programs will also appreciate quantified and descriptive data to aid in their program management and planning.

CHAPTER 4

NUTRITION AND HEALTH OF TURKANA ACROSS THE LIFESPAN[5]

[5] Watkins, T.Y. to be submitted to Medical Anthropology Quarterly

Introduction

In this article I aim to demonstrate the nutritional status of semi-nomadic Turkana across the lifespan. The challenges and tradeoffs at each life stage will be examined using life history theory in order to demonstrate biological tradeoffs between maintenance of biological functions and growth or other nutritional demands (Panter-Brick 1998). Community level morbidity and mortality data validate theories of the interconnection of nutrition and the biological function of the immune system. Both health and nutrition are compared to regional surveys conducted by multinational NGOs to situate this more extensive health and nutrition analysis with those routinely performed and used to determine policies on health and development projects. The current health, nutrition and livestock health projects operating in the research area during data collection are then discussed based on observations and findings of this research project in order to demonstrate how a more holistic understanding of Turkana livelihoods, across all lifestages, can provide not just a better evaluation but lead to better outcomes. Conclusions are important to evolutionary theories about life history tradeoffs related to human growth and development as well as future relief and development projects related to nutrition, health and livelihoods in the region.

Turkana live in the arid and semi-arid lands (ASAL) of Africa that are of increasing global interest for reasons of ongoing issues with livelihoods (Galvin et al, 2001), food security (Dyson-Hudson and McCabe 1985; Mace 1990) and development (Ellis and Galvin 1994). Food insecurity, often measured through nutritional assessments, has been and remains a key focus of subsistence and livelihood research in East Africa (Fratkin et al, 1999; Galvin 1992; Watkins and Carduner 2002).

This assessment of the nutritional status of semi-nomadic Turkana in Lokichoggio Division, North Turkana District, Kenya is based on anthropometric measurements and household interviews regarding wealth, income, food baskets, dietary diversity, and health of 61 households and their respective members, consisting of 435 individuals. The fieldwork was conducted from August 2006 through July 2007 in northwestern Kenya, encompassing baseline collections near the end of the rainy season of 2006 through the dry season and beyond the onset of rains again in 2007. Cross-sectional analysis of infants, children, adolescents and adults in three different geographic locations with varying access to food aid allows for comparison by household and location, each informative of livelihood strategies. Morbidity and mortality of participating household members also provides insights into the complex interplay of livelihoods, nutrition and health in a highly seasonal environment.

Theory and methods

Nutritional assessments that are conducted ad hoc in order to assess challenges in livelihood and food security generally focus on children under five years of age, since they represent the most vulnerable segment of the population. Relief programs of food aid then target this same population (Prudhon 2002). This process ignores the nutritional stresses during other stages of life, such as middle childhood, adolescence, during pregnancy and lactation and the different nutritional needs of elderly adults (Bogin 1998). Evolutionary Anthropology, specifically life history theory (Panter-Brick 1998), considers the biological trade-offs required during high nutrient dependent times and the potential costs of these trade-offs in short and long term development. Some trade-offs include failure to thrive and wasting in children, leading to stunting and possible social

and psychological development issues if not addressed (Bogin et al, 2007). Later concerns are maternal depletion leading to low birth weight infants who are then at high risk of failure to thrive. From an evolutionary perspective there are trade-offs in decisions regarding maintenance of biological functions, including immune system versus additional growth (Leonard 2000; ShellDuncan 1997). The unpredictable and harsh environment of northern Kenya complicates the Turkana experience of some of these tradeoffs, therefore they make an excellent population in which to study the impacts of life history theory across the major life stages.

Nutritional status is determined by measuring height, weight, mid-upper arm circumference and skinfold thickness[6]. Height was measured using a Schorr board stadiometer, recumbent for infants and children less than 85 cm. Weight was measured with Tanita digital scale and hanging scale for infants. Mid-upper arm circumference was measured in cm using MUAC strips and skinfold thickness was measured with Holtain calipers. These anthropometrics are then translated to indices using EpiInfo software, version 3.3.2 (CDC) and the 1978 WHO/CDC growth reference curves. BMI percentile for age and sex and sum of skinfold percentile for age and sex were derived from National Health and Nutrition Examination Survey I and II (NHANES) published by Frisancho (1989). Further statistical analysis uses SPSS 13.

Life stage categories are based on international standard and behavioral patterns (WHO 1995). Infant is generally considered to be from birth to 24 months. Children are then classified from 25 months to 60 months (5 years). This research is interested in the behaviors and outcomes of middle childhood which here is classified as age 5 to 12 years.

[6] The University of Georgia IRB approved this research, Project # 2006-10650-0

It is not clear when Turkana children experience puberty but cultural indicators such as taking on adult gender roles in the society, it does not occur until after 13 to 14 years of age. Here adolescence is defined as ages 12 to 21 years since research on Nilotes suggests that adolescent growth, especially in males, can continue into the twenties (Eveleth and Tanner 1990; Panter-Brick 1998). Adult is the broadest range, from 22 to 50 years of age. Turkana men and women remain very vital and reproductively active up to the 40s and 50s. Beyond 50 years, women begin to complain of infertility and somatic complaints but remain very productive in households. Men remain reproductively active longer than women but become less vital in household production, specifically livestock management, as they progress into their 50s. Thus, the elderly adult category begins at age 50 years and continues up to the oldest individual. All nutrition indicators are from the final anthropometrics, conducted during May and June after the onset of the long rainy season in all three locations. This sample provides a cross-sectional sample that represents Lokichoggio Division.

A comment is required to explain how age was determined. Turkana do not record the date of birth of infants but it is not uncommon for Turkana children to be seen at the government clinic in Lokichoggio or the AMREF clinic (these two clinics were merged during fieldwork). In either situation a clinic card is purchased and a date of birth of the child is noted. These dates proved to be unreliable and names and dates of birth of siblings were frequently reversed on these clinic cards. To establish a more reliable record, birth mothers were questioned in the presence of other household members and as many siblings as were living in the household. Using local year names and events (see Appendix B), sometimes names for each season of a memorable year, the year of birth

was discussed and decided upon. Then, if the month of birth was not known the birth mother would name the nearest season. Finally, to estimate the day, mothers were asked to choose from the beginning, middle or end of the month in question. This was a very time consuming process and frequently required lining up children to work out birth order. In addition, other adults, usually aunts or grandmothers were consulted. Once determined using this method, older children were asked to remember these dates to be used at clinics, schools or eventually to get a national identification card.

Adults, especially males, frequently had a date of birth noted on their national identification card. In many cases, these cards were issued at the time of conscription into military service. When present, this information was accepted as true. Many times, in the absence of a card, lengthy discussions were held with relatives, age-mates and friends to determine birth year, season and date, much like described above.

The research site and Turkana livelihoods

Turkana District is the northernmost district of Kenya bordering Sudan to the north, Uganda to the west, and Lake Turkana on the east. Turkana District has been culturally divided into northern and southern sections since colonial times (Lamphear 1992) and in early 2007 the government of Kenya officially divided it into North and South Turkana Districts. This research was conducted in North Turkana District where the Mogilla, Songot and Pelekech mountains provide stark relief to the Lotikipi Plains.

Turkana are pastoralists whose livelihoods rely primarily on herding a diverse collection of livestock and nomadism to minimize the risks of patchy and unreliable rainfall supported forage. In addition, they may cultivate sorghum or maize when seeds are available and the soil and rainfall are adequate. Finally, Turkana have a long history

of trade with neighboring agriculturalists in Uganda and their southern border in Kenya (Dyson-Hudson 1989; Gulliver 1955).

This research was conducted primarily in Lokichoggio Division, the most northwestern division of Kenya. Households were surveyed in three villages in this region, Nadome, Nanam and Lokangae, each the seat of the sub-location chief for three of the five sub-locations in Lokichoggio Division. General food distributions are based out of Lodwar, the administrative center for the previous Turkana District and the current South Turkana District. Supplementary feeding programs are based out of Lokichoggio. Nadome is 2.2 kilometers by seasonal road from a major highway intersection and Lokichoggio while Nanam is 22.7 km due east by seasonal road. Lokangae is approximately 70 km by foot and 150 km by paved and seasonal road from Lokichoggio and approximately 50 km by seasonal road from Kakuma, a second and smaller trading center. Lodwar is located south of Kakuma along a severely weathered paved road.

Turkana adults continue to face threats to their nutrition and health due to the vagaries of the environment and their livelihood. Much of the work of agriculture falls to the women. Men were observed to aid in breaking up the hard soil but it was left to the women to plant and most importantly, to maintain a thorn fence around the garden in order to keep out animals. The work of agriculture is delayed until the onset of rains, due in part to the softening of the ground but more importantly, to avoid destruction of seeds lying in parched ground waiting for rain. If a crop thrives then work to protect and harvest it will be invested. If the soil choice was bad and moisture is not retained or if the rains prove too little or too late, the fences are left to fall and animals will wander in and graze or browse freely on what may remain in the garden area.

If wild food plants or trees volunteer inside a compound, or more commonly in the thorn fences, they will be referred to as a part of the "garden" and will be protected for household use. Certain neighborhoods of villages or household compounds in the vicinity of wild food resources will have priority access but it was not uncommon for children to ignore this and to collect at their leisure. Often they were chased away by adults in the nearby compounds. Women will travel distances to acquire some wild foods, especially those capable of being dried and stored. These wild foods contribute not only to food access but also to dietary diversity, thus improving the likelihood of micronutrient access and better health (Arimond and Ruel 2004).

Turkana have come to include access to food aid as a part of their portfolio of livelihood strategies. Sick children or adults, nursing mothers and elderly or handicapped relatives will be brought to villages during the community-based targeting exercises of NGOs in an effort to "get on the list" as targeted recipients of food aid. Once on "the list" the household member will list as many relatives as possible as co-residents and store their rations after distributions until they can be claimed. It is also common practice for the Unimix or high-energy bars dispensed for children under the age of five years in supplementary feeding programs to be shared among household members, although the targeted child will be given some priority. No individual ever was seen to or admitted to withholding food from a child in order to cause weight loss or illness with the goal of enrollment in feeding programs.

To varying degrees in all three villages, schools participate in feeding programs. Lokangae, the most remote village lost its school in 2007. It was built with private funds and the community was attempting to support the teacher and his family but failed. The

feeding program of this school was quite spotty since the teacher often claimed the food set aside for the children as his own in lieu of his pay. This continued until classes were canceled and the school ceased to function. The school feeding programs in the other two locations rarely had any fat to add to their lunches and only occasionally had pulses for the children. Nonetheless, children of all ages attended school and consumed their lunches, consisting primarily of maize flour porridge or boiled maize. No competition between adults and children for the prepared foods was ever noted. Usually one or two women were employed to prepare the food and were usually paid with the leftovers. These women were observed literally scraping the pots with their hands, not having held back a significant portion from the children for themselves to eat.

Results: Overview

In the 61 participating households across three locations, all household members were measured using standard anthropometric techniques (WHO 1995). In total 1036 measurements were obtained on 435 individuals across three seasons; wet, dry, and a transitional period between the two seasons. This transitional period served as a baseline for future comparisons. Figure 4.1 illustrates the age range and sex for all participants.

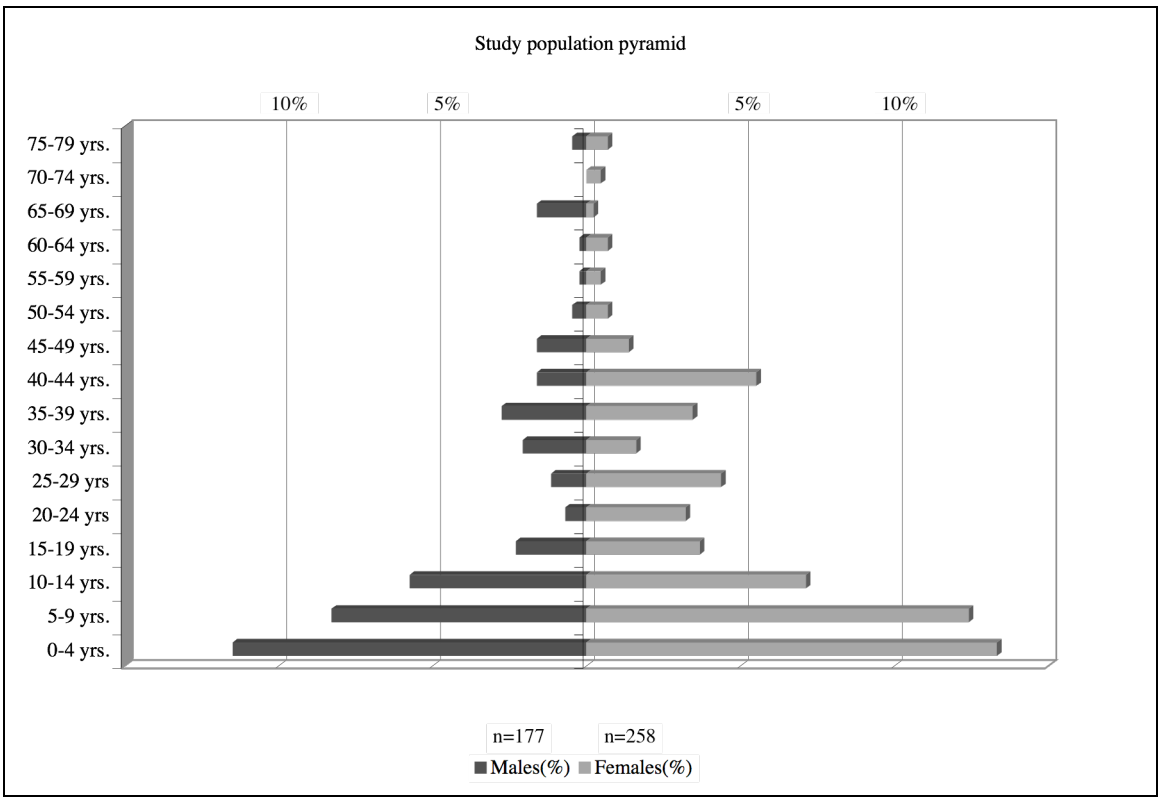


Figure 4.1. Lokichoggio Division survey demographics

When compared to the 2000 Kenya census (Figure 4.2), the study sample differs in several ways. The sample for this project contains fewer males due primarily to mobility between multiple households and inability to enroll them in the project. A few adult men that were present refused participation, reporting embarrassment to be measured “like the children”.

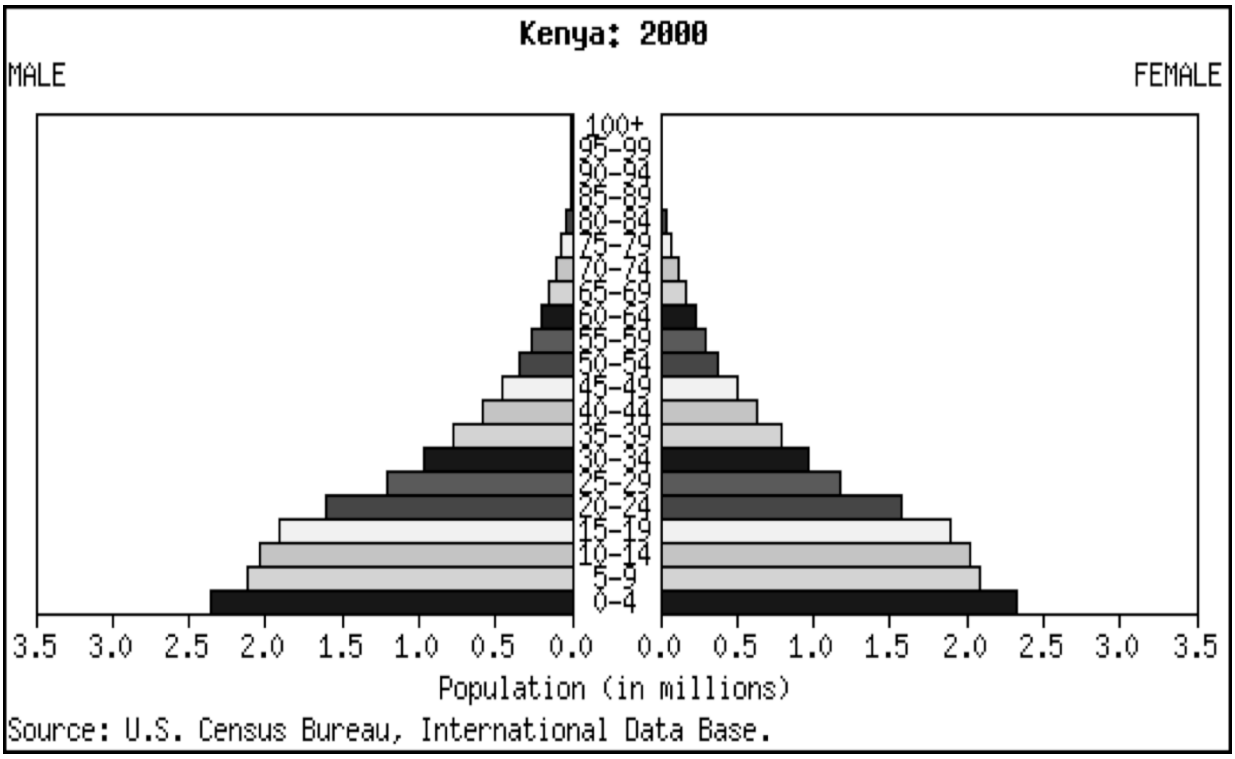


Figure 4.2. Kenya demographics (US Census Bureau)

Kenya has just begun the demographic transition as evidenced by the nearly equal categories of children aged five to nine and 10-14 years. The Turkana study population still shows larger categories of birth to four years and five to nine years old, suggesting they have not yet undergone a transition to lower fertility rates and the expected lower infant mortality rates of a demographic and health transition.

In order to enable comparison of the nutritional status of Turkana to other populations the continuous data of various nutritional indices appropriate to various life stages is generated. An analysis of variance across age groups demonstrates a statistical significance in weight for height (WFH) between infants and children and in body mass index (BMI) percentiles between children, adolescents and adults. The indices are already normalized for age and sex, so any remaining variance should represent variations of individuals. This suggests that each of these life stages is different from the general

population and is experiencing statistically significant experiences of malnutrition, according to the specific biological needs. Children under five years of age were removed from the BMI percentile ANOVA since infants had higher BMI % than the remaining groups and would have accounted for most of the difference of means.

Table 4.1. Nutrition indices across the lifespan

	Age range in years	**N**	**Mean**	**SD from mean**	**Minimum**	**Maximum**	**ANOVA**
WFA Z score	0-2	m-20	-0.71	1.62	-3.31	3.09	F = .112
		f-30	-0.85	1.29	-3.32	1.59	p = 0.740
WFH Z score	0-2	44	-0.62	1.00	-2.9	1.28	F = 4.291
	2-5	45	-0.88	1.06	-2.42	4.29	p = 0.016 *
	5-12	55	-1.17	0.72	-2.36	0.37	
HFA Z score	0-2	44	-0.79	1.53	-5.59	3.55	F = .691
	2-5	45	-0.43	1.48	-3.52	2.74	p = 0.503
BMI % for age	5-12	91	11.53	13.56	0	55.3	
	13-21	35	16.39	20.11	0	81.6	F = 2.107
	22-50	76	14.83	18.69	-5	70	p = 0.05*
	51-76	19	10.68	18.95	-5	80	

(*significant at p=0.05 or less)

All of the z score indices were calculated using the 1978 WHO/CDC growth reference curves calculated with EpiInfo version 3.3.2. BMI percentile for age was derived from National Health and Nutrition Examination Survey I and II (NHANES) published by Frisancho (1989). The next section will consider indices using categories of nutritional status for each life stage.

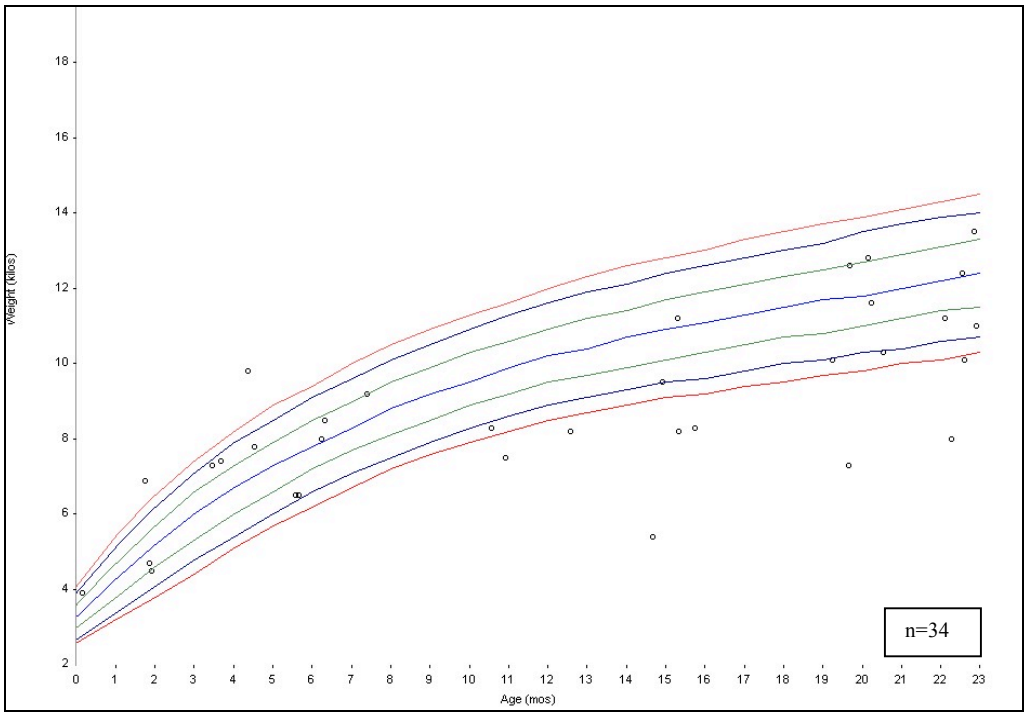


Figure 4.3. WFA male infants

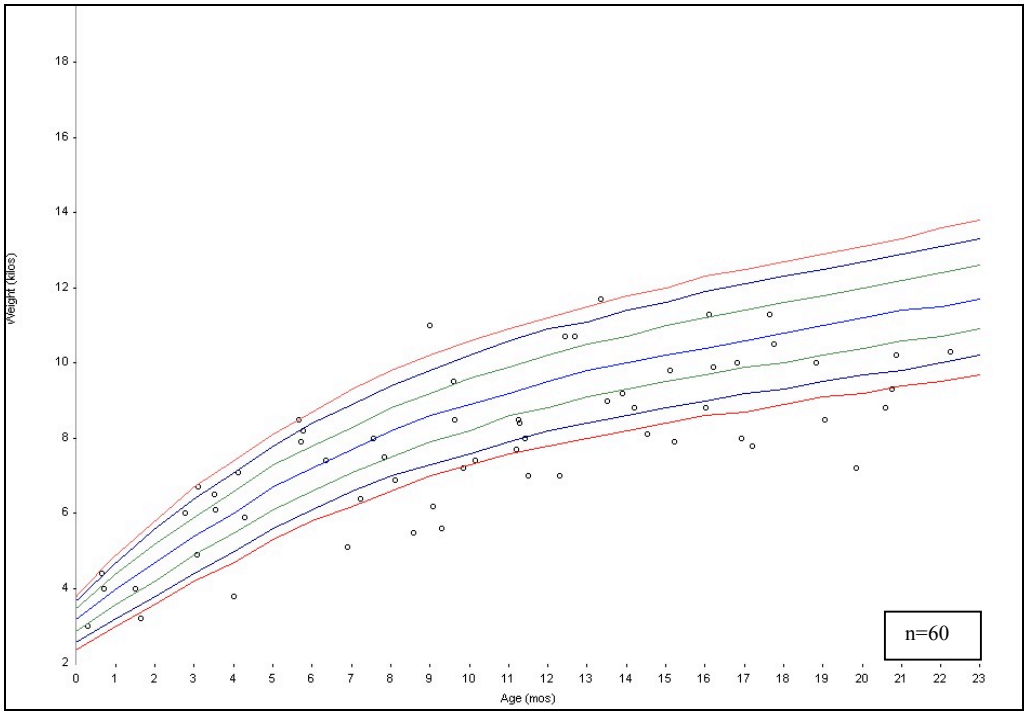


Figure 4.4. WFA female infants

Short-term challenges to nutrition are characterized by either weight loss or failure to gain weight in infants, usually called failure to thrive. In infants this is indicated by a low weight for age (WFA). Figures 4.3 and 4.4 demonstrate male and female infant weights for age according to growth percentiles and n equals the number of measurements of children two years and younger rather than the number of infants. For males, there are 34 measurements on 20 infants and for females there are 64 measurements on 30 infants, both across three measurement periods. Several of these infants were born during the research project, therefore those born later in the project were only captured once. The lower number of measurements for male infants represents a loss to follow up across the seasons.

At birth male weights range across the percentiles, begin to fall into the lower percentiles or even below the fifth percentile by nine months of age and do not begin to regain ranking in percentiles until 15 to 20 months. Many female infants also fall below the 50^{th} percentile between six and 13 months. This time period, between six months to around 18 months, represents a time period when nursing mothers begin to introduce foods other than breastmilk and a younger sibling may begin competing for breastmilk. In addition to weaning or access to less breastmilk, the introduction of foods that may be tainted with unclean water routinely causes diarrheal or other infectious diseases, leading to low WFA and increased mortality (Gray 1996). This interaction between nutritional status and immune system function remains important throughout the remaining life stages (Shell-Duncan 2008).

WFA percentiles are converted to z scores according to standard deviations from a mean. These WFA z scores of individual children during the rainy season, when categorized into "very light", z score of ≤-3 (n=10), "lightness", z score of >-3 and <-2 (n=25), "normal weight", z score between -2 and 2 (n= 11), and "heavy", z score of >2 (n=4) compared with sex (male=20, female=30) are not significant when tested with a Mann-Whitney U test (z = -1.101, 2-sided p= 0.271).

Results: Child nutritional status

These same short-term challenges to nutrition are sometimes better indicated by a low weight for height (WFH) as exact age becomes less certain. Since Turkana, like many people in less-developed countries, do not routinely record dates of birth or even recall them after some time has passed, using age as a health or nutrition indicator is less reliable. For this reason, it is far more common to use weight for height as an indicator of normal or healthy growth, especially for older children.

In this sample 144 individuals met the EpiInfo criteria of ages from birth to 138 months (11.5 years) and from 49 cm to 145 cm in height or length for males and from 49 cm to 137 cm for females to calculate WFH indices. WFH percentiles are converted to z scores according to standard deviations from a mean. "Severe under" represents a WFH z score of ≤-3. "Under" represents a WFH z score of >-3 and <-2. "Normal" represents a WFH z score greater than -2.

Table 4.2. WFH z score categories

	N	Severely undernourished	Under nourished	Normal
Infant (0-2 yrs)	44	4 (9%)	12 (28%)	28 (64%)
Child (3-5 yrs)	45	4 (9%)	20 (44%)	21 (47%)
Middle childhood (6-12yrs)	55	8 (15%)	26 (47%)	21 (38%)
Total	144	16 (11%)	58 (40%)	70 (49%)

(KW test of WFH z-score categories/age groups, chi-square 8.537, df=3, p = 0.036*)

The Kruskal Wallis test compares the subgroups to determine if the mean curve represents the same or different populations. Table 4.2 suggests that the three life stages are different, suggesting that weight for height means are different in the three groups. The higher number of severely undernourished middle children, according to WFH, demonstrates the nutritional challenges and the tradeoff of gaining height at the expense of maintaining weight during this growth period.

In order to assess stunting, delayed or slowed growth, it is necessary to use the height for age (HFA) index. Stunting represents a longer insult to caloric intake causing growth in height to slow and is evidenced by a low HFA. Biologically, the trade-off is maintaining weight in lieu of growth in height. Children, especially at younger ages, can prove very resilient and stunting is not thought by some to be permanent (Bowie et al, 1980), however the long term social and cognitive effects of chronic malnourishment are more complex since many outcomes used to measure this are also affected by access to education and socioeconomic status (Moodie et al, 1980).

The terms “severe stunting”, “stunting” and “normal” refer to the standard deviations of the z-score recommended by WHO; ≤ -3 is considered severe, >-3 and <-2 is considered stunted and between -2 and 2 is considered normal (1995:271). According to a chi-square test, the increase in stunting from infants to children under age five is

significant at p 0.033* (n=89, df=3), suggesting that the regular seasonal food insecurity is affecting growth patterns, even at this early age.

Table 4.3. HFA z scores

	N	Severe stunting	Stunted	Normal height
Infant (0-2 yrs)	44	4 (9%)	1 (2%)	39 (89%)
Child (3-5 yrs)	45	2 (4%)	4 (9%)	39 (87%)
Middle childhood (6-12 yrs)	91	7 (8%)	16 (18%)	68 (74%)
Adolescent (13-21 yrs)	27	4 (15%)	2 (7%)	21 (78%)
Total	207	17 (8%)	23 (11%)	167 (81%)

(KW test of HFA z score categories/age groups, chi square 5.341, df = 3, p=0.148)

The Kruskal Wallis test is not significant, suggesting that these life stages have similar mean curves of height for age, or they represent one large group. When comparing all age groups in which EpiInfo calculates HFA, the categories lose statistical significance. The percentages of stunting in the middle childhood years is interesting, yet by adolescence the percentage has gone back down, leaving a few severely stunted. This reinforces the plasticity of child growth, suggesting that any stunting that occurs during the middle childhood growth spurt can be recovered, even during the period of rapid adolescent growth, assuming that nutrition is adequate. This cross-sectional data could also represent a cohort effect of adequate nutrition for these adolescents.

Results: Middle childhood and adolescent nutritional status

Middle childhood is classified as age five to 12 and represents a period of growth and change not well addressed in biological and cultural studies. There is a pre-pubescent growth spurt that occurs at this age associated with increased hormone secretion from the adrenal gland (Bogin 1998). As previously mentioned, population studies of nutrition focus on children under the age of five years, since they are perceived to be the most at risk of disease and death due to malnutrition. Some research has

considered growth and body composition in challenging environments focusing on middle childhood and adolescence (Cameron et al, 1994; Gray et al, 2004). Although not naming middle childhood as a separate period, these studies discuss compensatory growth or growth associated with the slower velocity but longer duration of adolescence in nilotes. This compensatory growth is differentiated from catch-up growth that usually occurs in response to environmental stresses such as food insecurity (Cameron et al, 1994).

Adolescence is the next period of rapid growth and development, both biological and cultural, that receives a great deal of attention (Pelto et al, 1999; Schlegel 1995; Worthman and Whiting 1987). Using EpiInfo to analyze anthropometrics of these age groups is quite difficult when working with nilotic people[7]. Biological studies of Nilotes have demonstrated that the period of growth, thought to have peaked by age 18 in other populations, can continue up to 21 or 22 years of age (Eveleth and Tanner 1990; Panter-Brick 1998). EpiInfo calculates body mass index (BMI) and age and sex indices (percentiles and z scores) for BMI only up to age 18. NHANES I and II data, compiled into anthropometric tables for Blacks and Whites by Frisancho (1989) are used for BMI percentiles for age for the remaining population. WHO defines "thinness" as a BMI for age < the fifth percentile and "at risk for overweight" as $\geq 85^{th}$ percentile (1995:271). For this reason I added "at risk for thinness" as below the 15^{th} percentile of BMI for age.

[7] The term 'nilote' or 'nilotic' refers to groups of people who have demonstrated a prolonged adolescent period typified by delayed closure of long bone epiphyses into their twenties. They are usually pastoralists of East Africa.

Table 4.4 BMI for age percentiles for all age groups

	N	Thin	At risk for thinness	Normal	At risk for overweight
Infant (0-2 yrs)	43	5 (11.6%)	13 (30.2%)	22 (51%)	3 (6.9%)
Child (3-5 yrs)	46	14 (3.5%)	13 (28.3%)	17 (37%)	2 (4.3%)
Middle childhood (6-12 yrs)	91	37 (40.7%)	29 (31.8%)	25 (27.5%)	0
Adolescent (13-21 yrs)	35	14 (40%)	10 (28.6%)	11 (31.4%)	0
Adult (22-50 yrs)	76	34 (44.7%)	16 (21%)	26 (34.3%)	0
Elderly adult (51-76 yrs)	19	9 (47.4%)	6 (31.6%)	4 (21%)	0
Total	310	113 (36%)	87 (28%)	105 (34%)	5 (2%)

(KW test of BMI for age percentile/ age groups, chi square 21.158, df = 5, p = 0.001 *)

According to a Kruskal Wallis test, the mean curve of the level of thinness across age groups is significantly different. Infants, and to a lesser degree children, have higher mean BMI percentiles and the largest presence in the BMI greater than 85% category. Children and infants have the lowest percentage of thinness and also have the only higher percentiles that are usually defined as at risk for being overweight. At risk of being overweight is not meaningful in this population since this category disappears in maturity. The periods of middle childhood, here from ages six to 12, and adolescence, from ages 13 to 21, represent periods of rapid physical growth that are very expensive in terms of macronutrients and micronutrients. The highly seasonal diet of Turkana and the frequent food insecurity with skipped meals present a nutritional challenge in the form of periods of low energy intake during this energetically demanding phase of childhood and growth (Galvin 1992). It would seem that during times of food shortages growth in height, demanded by pubescent hormone shifts, continues at the expense of maintaining body weight, resulting in thinness. This finding is consistent with findings in other Turkana studies (Gray et al, 2004) as well as other African studies (Cameron et al, 1994).

Results: Adult nutritional status

The nutritional challenges facing women do not diminish after adolescence. Pregnancy and lactation require higher caloric intakes to provide adequate nutrition to both the mother and the fetus or child. Research conducted in South Turkana reports mean ages at first birth as 23 years and last birth as 40.3 years and a total fertility rate of 7.06 for nomadic Turkana women (Leslie et al, 1999:250, 256). All new mothers were observed to breastfeed and reported introducing goat or cow milk, often combined in a thin maize-flour porridge as early as six months. Full weaning often did not occur until another child was born or until breastmilk production slowed, usually around 18 to 24 months post-partum.

The physically demanding life of pastoralists, both nomadic and semi-nomadic, is reflected in typical male leanness (Galvin 1992). Thinness or leanness can be assessed through BMI. According to WHO guidelines, BMI < 16 is severely thin, 16-16.99 is moderately thin, 17-18.49 is mildly thin, 18.5-24.9 is normal weight and 25-29.9 is overweight. Greater than 30 is considered obese but no Turkana fit into this category.

Table 4.5. Adult and elderly adult BMI categories

	N	Moderately thin	Mildly thin	Normal	Overweight
Adult (22-50 yrs)	f- 57	4 (6.9%)	13 (22.4%)	40 (69%)	1 (1.7%)
	m-21	1 (4.8%)	6 (28.6%)	14 (66.7%)	0
Elderly adult (51-76 yrs)	f-9	1 (10%)	2 (20%)	6 (60%)	1 (10%)
	m-9	0	4 (44.4%)	5 (55.6%)	0
Total	96	6 (6%)	25 (26%)	65 (67%)	2 (2%)

(KW of BMI categories by age and sex df =1, females: chi square 0.069, p=0.793, males: chi square 0.209, p=0.648)

The Kruskal Wallis test is not significant, suggesting that the mean curves of BMI categories for adults are similar and represent one population. As energetic needs of growth slow at the end of adolescence, young adults may be able to store energy surplus and therefore increase weight. This increased weight after height is achieved results in a higher BMI, categorized here as only moderately thin or normal. It is during the phase of adulthood that Turkana females are prone to begin the biological and nutritional challenges of pregnancy, childbirth and lactation. These challenges explain the remaining high levels of thinness during this phase. This is more marked in females than males, noted by the slightly higher percentage of thinness, due to the nutritional demands of reproduction and lactation.

Elderly adulthood, over the age of 50, represents a time when females are no longer reproductively active but will be responsible for large households. This age group is still very active but no longer has the claim to high fat and protein food sources like blood and milk in the absence of reproduction or lactation. As age increases and children become independent, elderly adults become increasingly mobile and may move from household to household throughout the extended family in search of food security. For a lucky few who can maintain control of a significant portion of their wealth in livestock, grandparents may lay claim to grandchildren and their labor, thus explaining the few elderly adults who reach "overweight" status.

In adulthood height has been achieved and although weight may fluctuate, BMI is not a sensitive indicator of loss of body fat, or energy reserves, versus muscle mass, which would occur with serious energy malnutrition. Skinfold thickness primarily measures body fat deposition and can serve as a proxy for energy reserves, which makes

it a good measure of adequate caloric intake and maintenance nutritional status for adults (WHO 1995). Skinfold thickness was measured at the triceps and subscapular area using Holtain calipers. These measurements were then added together and compared to NHANES I and II tables to get percentiles by age and sex (Frisancho 1989). Since the percentiles for age and sex are drawn from tables, it is ordinal but not continuous data. Comparison of the percentiles by category using a Kruskal Wallis test reveals a statistically significant difference between adult and elderly adult males but not females. Turkana men as head of household retain control over livestock, even at older ages. This control could guarantee them continued access to blood and meat. Women only get preferential access to food resources and food during childbearing years.

Table 4.6. Adult and elderly adult sum of skinfold percentiles by age and sex

		N	total	0%	5%	10%	15%	25%	50%	P value
Male	adult	23	32	6	8	2	4	3	0	0.016*
	elderly adult	9		1	1	0	2	3	2	
Female	adult	58	68	25	19	5	5	4	0	0.086
	elderly adult	10		8	0	1	1	0	0	

(KW test of sum of skinfold percentiles by age and sex df = 1, male chi square 5.771, female 2.943)

Body fat deposition may change as an adult ages, with people over the age of 70 years tending to deposit more in the abdominal area and less on arms (WHO 1995). In this sample there are only four individuals over the age of 70. In addition, this index uses the sum of subscapular and triceps skinfolds, partially addressing the potential change in the pattern of fat deposition over time.

Results: Morbidity and mortality – health care delivery

Most nutritional surveys collect mortality data along with nutritional anthropometrics. The Crude Mortality Rate (CMR) is calculated as a ratio of the reported deaths to the study population over the period of the study and is reported as the ratio of deaths per 10,000 people per day. Table 4.7 presents the CMR reported in previous nutritional surveys (UNICEF) of three northwestern Divisions, including Lokichoggio Division.

Table 4.7. CMR for NW Turkana District (UNICEF)

Year	CMR/10K/day
2005	1.5
2007	0.8

A CMR greater than 2/10,000/day is usually a red flag indicating a need for intervention by governments and NGOs working in a region. This study found a CMR of 2.9/10,000/day for the period July 2006 to July 2007. The first three months were retrospective but following seasonal visits were prospective and referred to existing household rosters. Turkana household compositions are very dynamic and it was not uncommon to amend the household roster with each visit. For this reason, mortality could have been over-reported, especially the initial retrospective reports, which may refer to a larger population than the household roster used as the total surveyed population. This study began near the end of a measles outbreak in the region, as Table 4.8 showing cause of death indicates. This outbreak definitely resulted in higher than normal mortality rates that may have been missed by the short-term UNICEF ad hoc surveys.

Table 4.8. Causes of death in Lokichoggio Division (Watkins)

Cause of death	freq
measles	11
unknown	10
at childbirth	7
TB	5
diarrhea	4
malaria	4
pneumonia	3
infection	1
snakebite	1
Total	46

N = 415

According to the 2007 population nutritional survey compiled by UNICEF, measles immunization coverage of children under the age of 5 years in the northwestern Divisions was at 79%, up from 68.2% in a 2002 survey (UNICEF). As children survive past the age of five without immunization or exposure to a disease, the population coverage continues to be diluted. As long as immunization targets and reports only on children under the age of five years, the very slow accretion of population coverage will take decades to reach desirable percentages to prevent outbreaks. The fact that no government provider or NGO in the region records immunization with individual records makes estimation of population coverage more difficult. In observations of health seeking behavior in remote villages, the same individuals are likely to present themselves at each visit, thereby they may be receiving multiple doses of the same vaccination rather than coverage extending to the entire population. A simple calculation of doses given versus estimated population will not adequately reflect population immunization coverage.

According to interview data, young children and pregnant women were at the highest risk of mortality from measles, especially if other illnesses co-occurred. This is as expected, according to research on child survival (Mosely and Chen 1984). A child was

reported to have suffered from vomiting and diarrhea along with the fever and rash of measles. Likewise, a pregnant woman was reported to have suffered from malaria before the fever and rash of measles began. The co-occurrence of other illnesses along with measles contributes to mortality, so both of these incidents were reported as deaths due to measles (Martorell and Ho 1984).

Since the category of unknown cause of death is the second largest this is worth deconstructing. Several elderly people were reported to have died of "stomach trouble" which would probably indicate stomach cancer in light of the absence of refrigeration and the regular consumption of charred meat or meat that has been cooked for several days without refrigeration. There were also two incidences of sudden headache and rapid subsequent death but the ages of the individuals were not specified. This could represent cerebral malaria or meningitis but without further information it is difficult to determine.

Turkana still practice raiding of livestock and most will not travel without at least one person in the party being armed with a gun or rifle (Gray et al, 2003). In spite of this, over the yearlong study period, only one death was reported as a result of a raid, presumably due to a gunshot wound.

In addition to mortality data, seasonal interviews also covered incidence of illness. Each time an illness was reported, it was recorded as an incident, regardless of duration or individual. The interviews were always retrospective and usually covered a 3-4 month period. Questions would begin with children of the household, inquiring if they had been ill since the last visit and would progress through the household members, recorded by name at baseline interviews, and usually end with discussion of the caregiver's health. Follow up questions pursued treatment, if any, the success or failure of

that treatment and the current status of the individual. Some illnesses, like tuberculosis (TB), which have a long time span with or without treatment, were obviously reported more than one time per illness event. Nonetheless the reporting of TB did vary across seasons, depending on relief of symptomatology and treatment (Table 4.10). Table 4.9 demonstrates the causes of illness of a twelve month period from May of 2006 to May of 2007.

Table 4.9 Causes of Illness in Lokichoggio Division (all ages)

Cause of Illness	**Total**
malaria	48
URI	33
other	26
measles	18
diarrhea	11
TB	10
wound infection	6
eye infection	5
Total cases	157

N = 415

Upper respiratory infection (URI) is defined as cough and runny nose with or without fever. Malaria is defined as fever in the absence of URI symptoms. Measles is defined as fever and rash. Diarrhea is not broken down into bloody or non-bloody since Turkana rarely made that distinction. Tuberculosis (TB) was occasionally diagnosed, usually through sputum smears since electricity was rarely available for chest x-ray diagnosis at the clinic/hospital in Lokichoggio. In the absence of a diagnosis, TB is defined as night sweats and a cough, with or without bloody sputum. Wound infections were often secondary to thorns, quite a few of the thorn of *Prosopis julifora,* but could

also be secondary to scorpion stings or snakebites. Eye infection was usually conjunctivitis but often progressed to more serious infections.

Unlike mortality, which did not seem to be influenced significantly by season, morbidity did fluctuate both in rate and by cause of illness according to the season as demonstrated below.

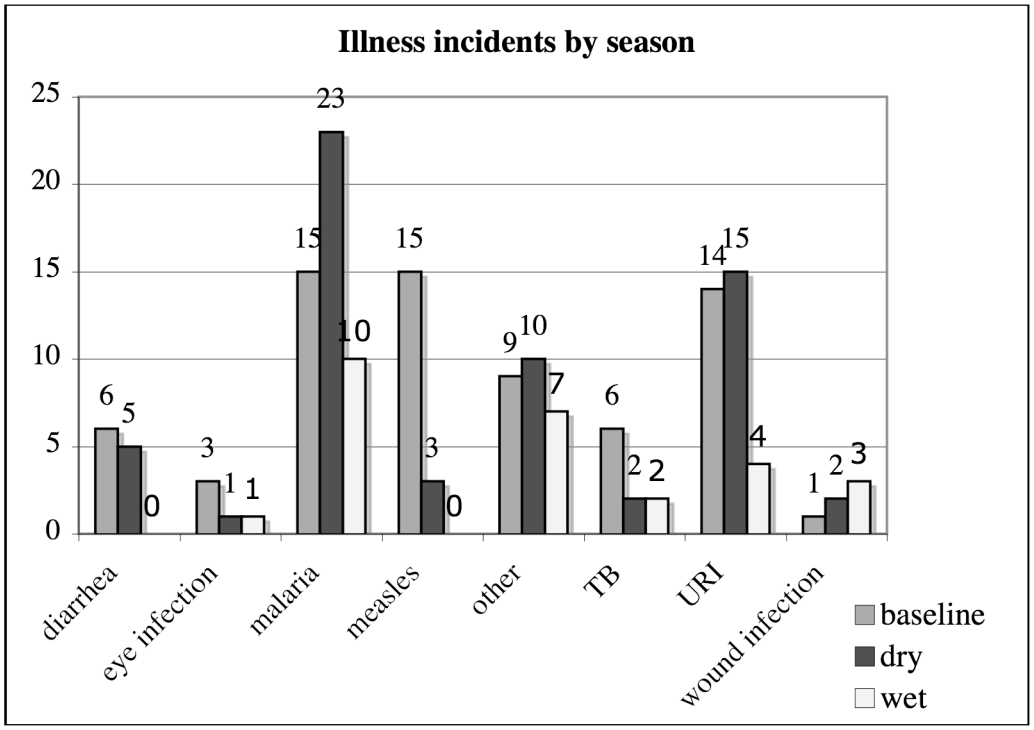


Figure 4.5. Causes of illness by season in Lokichoggio Division

Two seasonal patterns of morbidity deserve further discussion. First, malaria is present in large numbers across the seasons but has a definite spike in the dry season due to the plasmodium lifecycle. Second, the moderate increase in eye infections during the baseline period may be due to unseasonably strong and gusty winds resulting in blowing dust. Eyewear had to be purchased for field workers to allow for them to move around from household to household. Notebooks could be covered by blowing dust to the point

of illegibility in less than 5 minutes while inside traditional Turkana huts. During this time period the government and NGO clinics ran out of ophthalmic medications and were not re-supplied in the following 12 months. Not recorded in the incidence rates are individuals already blinded by previous chronic eye infections.

The category of illness labeled "other" addresses mostly somatic complaints, primarily musculoskeletal complaints and headaches. It also encompasses non-specific gastrointestinal complaints like nausea, vomiting in the absence of diarrhea and stomach or abdominal pain. There were also several women who experienced parturition but this was not classified as an illness unless they experienced somatic complaints during the post-partum period.

Discussion

Food security and nutritional status are the subjects of semi-regular study by the government of Kenya and non-government organizations (NGOs) working throughout Kenya. The Office of the President of Kenya, through the Arid Lands Resource Management Project, conducts bi-annual food security assessments. Ideally these assessments are conducted just after the long and the short rains. According to James Oduor, the Natural Resource and Drought Management Coordinator for the Arid Lands Management Project, these assessments collect information from each District regarding livestock exchange, forage resources for livestock, agricultural production, income, surface water and rainfall (perscomm, 2007). This data is collected using local personnel who are trained in administering questionnaires. The questionnaires are reviewed annually and revised as needed. Unfortunately these assessments do not effectively include human morbidity or mortality data, even that which is available through District

Health Officers. District Veterinary Officers will include information regarding livestock diseases of concern. In addition, there is no systematic evaluation of nutritional status in these bi-annual rain assessments. Staff may be trained in measuring mid-upper arm circumference (MUAC) that gives a rough idea of wasting. However, MUAC, with a fixed cut off point, will often overestimate wasting in younger children and underestimate wasting in older children. It is a good indicator of mortality rates in children under 4 years of age (WHO 1995). In addition, these surveys do not usually use population based sampling techniques, so it is difficult to generalize nutritional or health findings beyond the households and villages where the questionnaires were administered.

The United Nations Children's Fund (UNICEF) is largely responsible for coordinating national or regional nutritional surveys. They attempt to coordinate population samples from each district, often utilizing existing staff of other NGOs providing health or nutritional services in that region. For the past seven years Turkana District has had population level nutritional surveys completed and the results are compiled in the table below. All of these results were shared by the Kenya office of UNICEF although there were many contributors to each report including; Catholic Relief Services (CRS), African Medical and Research Foundation (AMREF), Oxfam, Worldvision and the Lutheran World Federation (LWF). Table 4.10 is a compilation of numerous unpublished reports that were provided by UNICEF.

Table 4.10. North Turkana District nutritional surveys (UNICEF)

	Region	N	GAM <-2 z (95% CI)	SAM <-3 z
2001	Loki/Kak/Oropoi	888	13.5% (11.3-15.9)	1.5% (.8-2.5)
2002 (Feb)	Loki/Kak/Oropoi	888	11.4% (9.4-13.7)	1.2% (0.7-2.3)
2004 (ref only)			16.20%	
2005 (March/April)	Loki/Kak/Oropoi	nr	19.2% (15.8-23.1)	1.5% (0.7-3.2)
2006	Loki/Kak/Oropoi	nr	26.6% (22.4-30.7)	4.7% (2.7-6.7)
2007	Loki/Kak/Oropoi	931	10.3% (7.8-13.5)	1.0% (0.3-2.5)

Each District of Kenya is subdivided into Divisions. Lokichoggio (Loki), Kakuma (Kak) and Oropoi are all Divisions located in North Turkana District. Global acute malnutrition (GAM) has been prevalent for several years and appeared to be worsening until it apparently peaked in 2006.

Table 4.11 summarizes the findings of this research project in Lokichoggio Division in terms similar to the national surveys in Table 4.6. SAM is severe acute malnutrition and represents a WFH z score of < -3, labeled severely undernourished above. GAM is global acute malnutrition and includes both severely malnourished, as previously defined, as well as undernourished which is defined as ≥-3 and <-2 WFH z score.

Table 4.11. Lokichoggio Division nutritional survey (Watkins)

WFH z-score	Frequency	% of total	95% CI
Normal	65	44.8	77.6-87.8
GAM	75	51.7	9.9-19.5
SAM	17	11.7	.3-3.8

The nutritional status of the population of Lokichoggio Division, according to this research, falls somewhere between the status of the 2006 and 2007 nutritional surveys of Turkana District. Both SAM and GAM are slightly higher in this sample than in the larger, regional survey.

Due to the UNICEF regional survey findings all of the NGOs named as contributing to the UNICEF surveys, as well as Samaritan's Purse and Merlin, were actively carrying out feeding programs throughout Turkana Districts. These programs include Therapeutic Feeding Programs (TFCs) for those with severe malnutrition and supplementary feeding programs (SFCs) for moderately malnourished children. Both of these programs target children less than five years of age and breastfeeding mothers of malnourished infants. There has been a distinct shift from in-patient TFCs to home feeding programs, usually consisting of high-protein bars and fortified corn/soya flour (CSB) or UniMix which is a fortified maize flour with sugar added. SFCs target children under the age of five and breast-feeding women with maize flour or UniMix and oil. Communities are usually visited approximately every four weeks and any child under five years of age is screened using MUAC. Moderately malnourished children or children at risk of malnutrition, usually defined by a MUAC cut-off of 12.5 cm then undergo height and weight measurements (Prudhon 2002). If a child is seen to be severely malnourished or has suffered a recent drastic weight loss, they will be dispensed the high-protein bars and followed up at the next visit. SFC screenings and distributions are conducted at specific locations every four to six weeks.

From 2006 Oxfam has assumed responsibility for much of the general food distributions (GFDs) in Turkana District. They moved to community-based targeting (CBT) to reduce the amount of relief food distributed and to target those most at risk, presumably due to shortages in the relief food pipeline. During 2006 and 2007, based on CBT completed in October 2006, distribution of a 75% ration was targeted to 54% of the population (Oxfam, perscomm 2006). Total distribution amount was calculated at the

District level according to 1999 census data. The World Food Program (WFP) calls a 100% daily ration 1960Kcal, 11% in proteins, 20% in fats and the balance in carbohydrates (Prudhon 2002). Carbohydrates usually take the form of CSB, maize flour or occasionally rice or maize. Proteins are usually provided in the form of pulses (dried peas or beans). Fats always are vegetable oil distributed in large five-liter cans. None of these foods are fortified.

Conclusion

Turkana live in a harsh environment characterized by unpredictability (McCabe 2004), as evidenced by the patchy and late onset of the long rains of 2007 and the arrival of a new viral illness that affected small livestock, both of which had dramatic effects on food security in the region. Nonetheless, Turkana incorporate multiple means of livelihood in order to minimize the risk of complete failure due to loss or shortfall of one. This is evidenced by the presence of diverse herds of animals that are constantly moved around the landscape, dynamic households that are reconstituted according to the needs of the herds, agriculture, participation in the varied forms of food aid and collection and consumption of wild foods by all ages across seasons. Discussion regarding household food baskets and recent meals demonstrated skipping of meals as a coping mechanism when shortfall occurs.

The frequent dietary shortfall, monotonous diets that rely on unreliable resources like food aid that is delayed for weeks or rainfall that is also delayed for weeks all lead to precarious nutrition and health status for individuals. This precarious position is evidenced by the seeming failure to thrive of infants as they endure premature weaning and their growth begins to falter. As infectious disease gains entry through consumption

of foods other than breastmilk, infant mortality can begin to increase. Risks of mortality already increase in the presence of malnutrition.

If given adequate nutrition, growth can return due to developmental plasticity but the chronic unpredictability of a diverse and adequate diet will plague children up to adolescence as evidenced by low WFH measurements and stunting in middle childhood and adolescence. When in a malnourished state, mortality threatens, as evidenced by the borderline CMRs reported by UNICEF over time and the high mortality rates during a measles outbreak.

Turkana have adjusted to the continuous threat of caloric shortfall by delaying the physiological response of sealing the growth of long bones in order to allow for more time to recover from stunting of height in their formative years (Eveleth and Tanner 1990). The cultural practice of delaying marriage and childbirth also allows for females to recover before the nutritionally demanding exercises of childbirth and lactation (Leslie et al, 1999). Some have called the pattern of growth during middle childhood into late adolescence compensatory growth, a physiological adaptation to the prolonged adolescent growth phase (Cameron et al, 1994; Gray et al, 2004). The trade-offs between childbirth and lactation involve breastfeeding decisions made by Turkana women. Gray describes this decision-making in terms of human adaptation and the trade-off between quality of offspring versus quantity, leading many Turkana women to abruptly cease breastfeeding an older child in favor of reproduction or a younger child (Gray 1996)

Turkana have come to include access to food aid as a part of their portfolio of risk minimization. Sick children or adults, nursing mothers and elderly or handicapped relatives will be brought to villages during the CBT exercises of NGOs in an effort to

"get on the list" as targeted recipients of food aid. Once on "the list" the household member will list as many relatives as possible as co-residents and store their rations after distributions until they can be claimed. It is also common practice for the Unimix or high-energy bars dispensed for children under the age of 5 years in supplementary feeding programs to be shared among household members, although the targeted child will be given some priority. No individual ever was seen to or admitted to withholding food from a child in order to cause weight loss or illness with the goal of enrollment in feeding programs.

In spite of the array of livelihood methods used by Turkana, the evidence of low skinfold percentiles in adults suggests that they also suffer from dietary shortages and malnourishment. Illness and mortality in small livestock during the dry season of this research project probably contributed to better nutritional status, measured as skinfolds in adults, while availability of milk during rainy season would impact infant and children skinfolds. The poor access to health care and immunization programs also continuously exposes the entire Turkana population to high risks of mortality from communicable diseases.

This more extensive nutritional survey of a Turkana population, beyond five years of age, demonstrates chronic food shortages and challenges to nutrition and health across the lifespan. Trends suggest the trade-offs between sustained growth in height versus weight gain are a continuous battle from birth through late adolescence. Turkana, like other nilotes, have a prolonged adolescence that has been hypothesized to allow for an extended period of compensatory growth. The cultural practice of later marriage and childbirth also allows for this period of compensatory growth and possibly reduces the

risks of complications like cephalopelvic disproportion or other dysfunctional labor problems that can contribute to maternal and newborn mortality (Tsu 1992). In spite of biological accommodations of prolonged adolescence and compensatory growth phases, levels of stunting and thinness persist into adulthood for a few Turkana.

Turkana have culturally modified livelihoods methods to address the unpredictable environment. These practices continue to change as the government and NGOs impact their environment. Nutritional monitoring programs, coordinating regular reporting mechanisms with the District Health Officers and NGOs supporting health and nutrition programs, would be more efficient at detecting nutrition or health issues of concern than ad hoc population surveys. Population level nutritional surveys are expensive and by focusing only on nutrition and growth indicators can miss other important elements of food security and livelihoods, like the small livestock virus and late rainy seasons. Coordinating district wide surveys proceeds at its own pace and is usually not timed according to rains or other environmental factors. Attempts to include these elements in analysis and interpretation will often fail due to ignorance of events occurring in a distant and remote region of the country from the capital and administrative offices where reports are usually compiled. This makes year-to-year comparisons and trends difficult to consider without lengthy discussion and caveats.

At the same time, links between health, nutrition and environment remain unrecognized and unaddressed by health care providers, both government and non-government. This is patently clear in the case of eye health and vision throughout Turkana District and also in the measles outbreak. Even though extended households were disrupted by measles mortality, a vaccine campaign carried out by the Ministry of

Health in association with UNICEF and other NGOs provided only Vitamin A and Polio vaccines, an element of millennium development goals, which are a priority for international funders. The campaign was a part of the Kenya extended program for immunization (KEPI) and mobilized experienced government and NGO staff using NGO resources supported by UNICEF funding. It was argued that there was no cold chain[8] to support other immunizations, like measles. Yet this KEPI program was conducted at the same time as the government veterinary team, coordinated by the District Veterinary Officer and using UNICEF and other NGO support, was immunizing hundreds of thousands of small livestock for *peste des petits ruminants* (PPR) virus, a process which required a cold chain.

Due to the findings of decreased SAM and GAM in the population surveys, there were discussions about discontinuing both child feeding programs and any population level programs. School feeding programs were the only food aid not at risk of ceasing. This ignores the fact that abnormally high consumption of dying and dead livestock was occurring during the time period of the ad hoc nutritional survey. It also ignores the fact that diminished herd size will affect food security of a pastoral population in the upcoming year. The Arid Lands program was beginning a restocking program but it was limited to eight animals per household, ten households per village and the criteria for selecting these households was never clearly described by the chiefs or village councils.

[8] Immunizations that use a live virus require a constant temperature in order to maintain the viability of the virus, thus usually requiring refrigeration from production through administration.

Better coordination of data collection as well as program management will enable government and non-government officials to have better knowledge of the condition of the food security, health and nutritional status of constituents and to better target programs. Data collection should be conducted across the lifespan to assess coping mechanisms and impacts of programs. Children under five years of age have long acted as the "canary in the coal mine" but they seem to have also become the focus of intervention. This ignores the physical, social and psychological challenges that older children and adults continue to face in pursuit of livelihoods in arid climates.

CHAPTER 5

HOUSEHOLD ECOLOGY OF TURKANA AND CHILDREN'S CONTRIBUTIONS TO SUBSISTENCE [9]

[9] Watkins, T.Y., to be submitted to Human Organization

Abstract

Turkana are pastoralists of northern Kenya who use multiple livelihood strategies to live in a disequibrium ecosystem. Although they increasingly incorporate sedentary behaviors into their lifestyle, they remain pastoralists, becoming semi-nomadic in practice. Turkana children mimic diversified livelihood strategies of their parents by incorporating behaviors that give them access to food outside of household provisioning. Children from middle childhood, an often ignored yet important stage of physical and social development, were observed and behaviors analyzed and compared with nutritional outcomes to determine who accrues benefits of these behaviors. Behavior of children is considered by season and by sex while life history theory of prolonged juvenile development and embodied capital aid in analysis of observed behaviors.

Children's roles within a household are very dynamic, not only due to their own rapid growth and development, but also in relation to other household members. Household ecology is further complicated by polygyny and multiple households maintained by a single head of household in Turkana society. How Turkana children negotiate middle childhood is important to a better understanding of pastoralist children's growth and development as well as how children learn about gender roles, livelihoods and their environment. This is important from a theoretical perspective of childhood studies, child foraging and development studies of education and learning.

Introduction

Turkana are pastoralist in the arid and semi-arid lands of northern Kenya. This research focuses on semi-nomadic Turkana of North Turkana District where a diversity of livelihood strategies is employed. Children mimic their parents by employing a diverse array of strategies, not only within their households but also to supplement household provisioning. Most anthropological studies of children's nutrition have focused on the role of parental and household factors, such as parent's feeding strategies (Gray 1998), or malnutrition as the outcome of household food shortages (Sellen 2000). There is a growing realization that children's worldviews and actions may crucially shape their nutritional status (Draper and Hames 2000) and health (Berman et al, 1994; Bronfenbrenner and Ceci 1994). Children have been observed to forage, scavenge, beg, access food aid programs, or work within households, all strategies used in order to increase opportunities for access to food (Baker and Hinton 2001; Bird 2000; Bock 2002b; Little 2002).

Successful strategies should lead to better nutritional status and subsequent improved health status (Eveleth and Tanner 1990). Within pastoralist societies, men and boys are more likely to use strategies related to livestock care while women and girls are more likely to use strategies surrounding household activities (Fratkin 1987).

Increasingly, it is understood that children living under subsistence conditions can be knowledgeable about resources in their environment as well as methods of extraction and processing (Blurton Jones et al, 1994; Chipeniuk 1995). This fits with the theory that children are more than simply passive social actors, even in difficult circumstances such as an unpredictable and harsh environment (Panter-Brick 1998). Rather, they exercise

their own agency and actively shape their roles and contributions to the household and the greater society (Bird-David 2005; Harkness and Super 1994; Super and Harkness 1986).

This research uses methods and theory from Human Behavioral Ecology and Nutritional Anthropology to consider Turkana children's contributions to self and household livelihoods. The focus is on middle childhood, from four to 12 years of age, bridging the gap between government and non-government organizations (NGOs) and adolescence, when many children begin to function as adults. The time allocation method of direct observation allows for detailed data collection and comparisons across seasons in the highly unpredictable ASALs. This research specifically addresses gender roles and time allocation as well as children's foraging behaviors, here inclusive of several strategies to gain access to food outside of household provisioning.

First the research sites will be presented, including environment and history of the region that impact livelihoods. Child development theory including household production of health and developmental niche theory and evolutionary ecological theories of foraging, optimality and life history complement the analysis of research findings. Methods of data collection are then presented along with a description of the participants. The results of observations of index children are presented as frequency of observed incidents as well as percentage of time spent in each coded behavior. Where children spend their time is also important so location is recorded for each index child. These results are considered first by season, since livelihoods and nutritional status of the region are affected by seasonality, and the by sex of the participants. Gender roles influence labor in most pastoralist groups and this also plays an important role in Turkana

households, even at young ages. The analysis and discussion section then uses nutritional status (Watkins, in press) as an outcome of children's status, using developmental niche theory in an attempt to further distinguish household roles. Major debates regarding embodied capital and life history theory are addressed in the conclusion.

Background and theory

Turkana are pastoralists who live in the arid and semi-arid lands (ASAL) of northern Kenya, primarily in the Turkana Districts. North Turkana District is the northernmost district of Kenya and borders Sudan to the north, Uganda to the west and Lake Turkana to the east. Turkana District has been culturally divided into northern and southern sections since colonial times (Lamphear 1992) and in early 2007 the government of Kenya officially divided it into North and South Turkana Districts. The Turkana Districts lie in the northern Rift Valley and consist mainly of lowland plains with altitudes between 300-800 meters (McCabe 2004). These plains are broken by dramatic mountain ranges that can rise to 2,200 meters and by lower lava hills, lava flows and rocks. This research was conducted in North Turkana District where the Mogilla, Songot and Pelekech mountains provide stark relief to the Lotikipi Plains.

Turkana use three ecological regions, the mountains as a refuge for water and forage, plains for extensive pastoralism and riverine systems for permanent and semi-permanent settlements. Three research sites were chosen with slightly different ecological circumstances. Lokangae is on the perimeter of the Lotikipi plain and Nanam is along the Nanam river. Nadome is also along the Nanam river, further upstream but is also at the foot of the Mogilla mountain range. In addition, each village is successively closer to trading centers and relief and development bases.

The subsistence mode of pastoralism is well adapted to the ASAL region. Agriculture is important to the south at higher altitudes and to the west, closer to Lake Victoria, both to subsistence and to production for markets, both local and international. In northern Kenya involvement in regional or international markets is primarily through contact with non-government organizations (NGOs). These NGOs are often dedicated to relief and development primarily in southern Sudan. United Nations (UN) organizations and other NGOs have used northern Kenya as a base of operations for southern Sudan as well as for relief and camps for refugees. Kakuma, in North Turkana District, has been the home of one of the largest refugee camps for more than twenty years. These operations provide employment opportunities for Turkana, usually in the form of day labor and menial jobs like security and the most basic cleaning and grounds maintenance. Kenyans from central, southern and western Kenya monopolize support industries like trucking, housing and dry goods. After the peace accord in Sudan in 2005 NGOs, especially UN organizations, began to relocate to Sudan, leaving fewer opportunities for wage labor in northern Kenya.

Many Turkana households have employed multiple modes of subsistence in pursuit of a livelihood. Although considered pure pastoralists by some (Herskovits 1926), Turkana will plant sorghum or maize when they have access to suitable soil and when there is adequate rainfall. Due to the unpredictability of the environment (McCabe 2004), they do not invest large amounts of time or labor into agriculture. In North Turkana District, especially around Kakuma and Lokichoggio, the base of operations for many NGOs operating in south Sudan, wage labor has become a viable method of reentry to pastoralism for those who have suffered loss of livestock due to drought, floods,

disease or raiding (Broch-Due and Anderson 1999). These same trading centers have also served as magnets for sedentarization of segments of Turkana populations since they are often the bases of operations for feeding programs within Kenya. Nomadic, semi-nomadic and sedentary Turkana households can access wild foods to supplement household food baskets (Watkins in press).

It has long been suggested that pastoralism is a labor intensive subsistence practice, thus its coexistence with polygyny, allowing for access to more laborers for each household (Holden and Mace 2003; Smith 1992). The need for increased labor is multiplied by the species rich Turkana herds that are divided by grazing and browsing needs of species and often sub-divided into smaller groups such as milking and non-milking animals (Dahl and Hjort 1976). Labor is usually divided according to sex with women, girls and small children tending to stay closer to homesteads, often managing the milking animals and their offspring while men and boys will range farther, often in camps of their own for days or weeks (Fratkin 1987). Although set in fairly specific gender roles, the type and amount of labor that children contribute will obviously change as they mature and in relation to other household members (Fratkin 1989).

This household ecology, especially considering the dynamic positions of children (Super and Harkness 1986) in polygynous Turkana households is an important part of the research undertaken in North Turkana District in late 2006 and early 2007. The developmental niche theory, applied to child development, suggests that at different ages and according to gender, a child will fill a specific niche in the ecology of the household. As each member of the household ages and develops, as individuals enter and exit the immediate household, the niches and roles will continue to change. Gender roles and

caregiver practices are filtered through cultural and community norms. The particular development niche in the household ecology will contribute to the nutrition and health of individual household members (Harkness and Super 1994).

The complex households and dynamic relationship of Turkana livelihoods and the environment lends itself well to a human behavioral ecology approach which relies on evolutionary theory to study human behavior within a context of their environment (Winterhalder and Smith 2000). This approach uses concepts and methods adapted from ecology such as optimal foraging, time allocation and energetics (Cronk 1991). Time allocation is an excellent way to differentiate gender roles as well as to address changes in labor and time across the lifespan (Gross 1984). In this research, observation using focal follows of index children from the period of middle childhood is used to yield qualitative and quantitative data of time allocation, access to resources, methods of acquiring information and play during waking hours of children.

The period of middle childhood, here defined as between the ages of four and 12, is nutritionally demanding due to the mid-growth spurt (Panter-Brick 1998). During this time period Turkana children contribute to household and livestock labor and production. Who accrues the benefit of that additional labor will be assessed through nutritional outcomes that represent physical embodied capital in the form of growth in mass and muscle (Kaplan 1997). Most NGO and government surveys and programs target children under the age of five years. In urban areas health and social programs may target adolescents, leaving the large period of social and physical development of middle childhood unaddressed. It is during middle childhood that children take on increasing responsibilities, act independently and begin to learn about the environment outside of

the household compound. Knowledge and skill acquired during this period represent investments in functional embodied capital that will, in future, optimize reproduction in Turkana society (Kaplan 1997). In addition, this learning, primarily informal and often through play, contributes to the child's ability to incorporate multiple strategies to access food and the future adult's ability to diversify livelihood strategies (Bock 2002b).

In July and August of 2005 exploratory research among Turkana communities in northern Turkana District found children practicing multiple strategies to gain access to food or resources that could provide food. These included begging in trading centers, scavenging, foraging for wild foods, assisting in household chores and care of livestock and working for food or money. This collection of practices, a portfolio of livelihood strategies, could be compared to an investment portfolio in the stock market exchange (Markowitz 1952). Through diversification, of the risk of failure or the risk of success, a child is theorized to be optimizing overall benefit, in this case access to food and nutritional status (Smith and Winterhalder 1992b) . This theory of diversification has been applied to various livelihoods practices in unpredictable environments (Ellis 2000), making Turkana incorporation of pastoralism, agriculture and wage labor an excellent case study.

Participants and methods

Sixty-one Turkana children (27 boys, 34 girls) between the ages of four and twelve years were randomly selected to serve as index cases from 61 households in three different locations. Households were selected opportunistically from three villages, each successively further from the largest trading center of Lokichoggio and situated in different ecological regions. Selection of individuals also depended upon consent from

the head of the household, the caretaker and the children themselves. Child selection was affected by efforts to maintain an even relationship of male and female index children as well as a range of ages. Table 5.1 is a breakdown of index children by age, sex and location.

Table 5.1 Index children

Location		**Sex**		**Age**								
	#	**male**	**female**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Nadome	21	9	12	2	2	1	5	1	6	0	2	2
Nanam	20	10	10	3	0	4	1	0	3	2	5	2
Lokangae	20	8	12	2	2	3	1	3	2	2	2	3
Total	61	27	34	7	4	8	7	4	11	4	9	7

Turkana do not routinely record dates of birth. For the purposes of this study the years of birth were achieved by assembling two local event calendars, one for Lokichoggio and the other for the Lokangae/Lotikipi plain region (see appendix C). Specific dates were then estimated by beginning middle or end of the rainy and dry seasons or month if recalled.

Every household has its own ecology, created and modified by both the head of household and the primary caregiver, and its own niches that are defined in relation to other household members (Super and Harkness 1986). Younger children require more care while middle children can begin to contribute to their own care or possibly the care of siblings. Older children increasingly assume responsibility for much of their own care and often contribute significantly to household maintenance or production (Kramer 2002). Younger children are born and older children become increasingly mobile between compounds. Each index child is classified as older, middle or younger in relation to other household members.

Marriage and settlement patterns are influential in household ecology. Most Turkana men are polygynous and therefore developmental niches are complicated not just by birth order but also by wife order and location of residence. Of the participating households there are 78 married or once married adult females. Of these 78, 45 are first wives, 16 are second wives, one is a third wife and 16 are widowed. A second or third wife and her children can be affected by the death of other wives or children or by preferential behavior of the household head. Even when baseline demographic data takes note of wife and birth order, this may not fully explain access to resources.

Observation of index children took place from 7:00 am until 9:00 pm during a dry season and again during a rainy season. Observation windows were ideally to last either four or five hours each. Field assistants were trained in observation techniques including observing quietly with minimal interaction, recording techniques, coding schemes and in some cases, use of handheld computers for recording observation codes. Observation windows of four to five hours were schedule randomly by drawing the identification number of an index child and time frame, morning, afternoon or evening, from a hat. The observation schedule was affected by availability of the index child (sometimes observation had to be rescheduled or the windows were shortened due to child mobility between households) and field assistants. Young girls, below ten years of age, were usually observed by one female field assistant and this sometimes proved to limit the scheduling of observations according to the randomization.

Coding schemes are based on participant observation of Turkana households conducted in 2005 and are broken into three groups; location, events and behaviors. Location was coded as “home compound” which is usually clearly circumscribed by

brush fences, “other compounds” which could be a relative or friend’s compound, “village” which can be an open area where meetings take place, shops or open space between household compounds, “school” which is usually located in a compound, or “bush” which is almost any area outside of the village and may include rivers, water points or areas between compounds but outside of the village. One of the three villages had a brush fence around the entire village. A second constructed one during the research. The third village is the most remote and there was no difficulty discerning the village area from the surrounding plains. The coded locations are common to dispersed compounds of nomadic Turkana, rural villages that are also often widely dispersed and settled villages around trading centers.

Events are specific types of behaviors with discrete beginnings and endings that may occur within behaviors or in isolation. “Self-foraging”, “sharing” and “consuming” were all coded as events. “Foraging”, “working”, “working for food”, “begging”, “scavenging”, “study”, “idle” and “play” were all codes for behavior that could be of long or short duration. Foraging is distinguished from self-foraging by observing the ultimate benefactor from the behavior. Here self-foraging is coded when a child immediately consumes any return, or when the return is commonly immediately consumed in the case of no return. Foraging is coded when any return is carried back to a household for sharing, coded as stashing by Hawkes et al (1995b).

Of the 61 index children originally selected, observations were completed on 57 children over the dry season and 58 children for the rainy season. One household declined further participation after baseline data collection and partial dry season observation. One child moved to live with relatives in a distant location after baseline

visits and no observations were completed. Two other index children were lost to follow up due to household and individual movements. Actual length of observation per child varied from nine to 15 hours, depending on access to the child. Children are very mobile, not only in the village but between homesteads and satellite compounds. Observation periods were abbreviated by time spent locating a child and occasionally by the need to maintain safety of field assistants by not requiring them to travel alone at night at the end of observation periods.

Results: Comparison by season

How children gain access to food and where they contribute labor depend largely on where they spend their time. Table 5.2 is a comparison of time spent in the various coded locations across the dry and rainy seasons of 2007.

During the dry season, from January to mid-March, 57 children were observed for an average of 774 minutes each (12.9 hours). During the rainy season, from April to June 2007, 56 children were observed for an average of 805 minutes each (13.4 hours). On average, observations began at 7:00am and lasted until 9:00pm or until the child went to bed. Children were often still in bed or just rising at 7:00am and most were either sleeping or lying in bed by 9:00pm. The observations were performed in three shifts of five hours with the third ending at 9:00pm or until the child went to bed.

Table 5.2 Average percentage of time by location

	Dry season location	**Rainy season location**
Home compound	53%	51%
Other compound	15%	16%
Village	5%	9%
Bush	17%	17%
School	10%	7%

During the dry season of early 2007, an average of around 53 percent of the observed time was spent at the home compound. The second most common location was the bush at 17 percent. Rainy season locations were quite similar in that slightly greater than half of the observed time was spent in the home compound. On average, children spent slightly more time at school during the dry season. In Kenya, government primary schools are supposed to be in session from January to April and May to August. During the rainy season data collection period only one school was open. There were no secondary schools in any of the study areas although one was constructed but not open and a second was being constructed, both outside of Lokichoggio, the largest trading center in the Division. It appears that time spent in school during the dry season was shifted primarily to time spent in the village or, to small degrees, at home or other compounds during the rainy season.

Table 5.3 Seasonal differences in percentage of time in location

N=56	**Correlation coefficient**	**significance**
Home compound	0.154	0.119
Other compound	0.158	0.112
Village	0.118	0.182
Bush	0.383	0.001*
School	0.236	0.033*

(Spearman's rho *significant at p=0.05 or less)

When the range of time spent in the five coded locations is considered across the 56 index children who had observations completed in both seasons, time spent in bush and time spent in school are statistically correlated. This suggests that the time previously spent in school in Nadome and Nanam shifted to time spent in the bush. Since Lokangae did not have regular classes in either season index children from Lokangae should not have experienced this shift.

Coding of observations of index children included events and behaviors in addition to location. Self-foraging, sharing and consuming were defined as discrete events that could occur during behaviors or in isolation. They were usually of short duration and could occur several times in or out of sequence. The remaining incidents were defined as behaviors usually lasting a longer duration. Both frequency and duration of events and behaviors were recorded. Frequency of coded incidents will be considered first.

Table 5.4 Behavior and event frequency by season

Codes	**Frequency**				
	Dry season	**Rainy season**	**Total**	**df**	**Chi-square sig.**
working	921 (51%)	879 (49%)	1800	484	0.445
play	948 (54%)	808 (46%)	1756	360	0.569
idle	666 (59%)	467 (41%)	1133	272	0.032*
consuming	488 (50%)	492 (50%)	980	156	0.334
study	155 (56%)	124 (44%)	279	72	0.001*
begging	103 (53%)	91 (47%)	194	36	0.249
sharing	69 (49%)	71 (51%)	140	16	0.524
work for food	12 (20%)	49 (80%)	61	4	0.001*
self-foraging	17 (36%)	30 (64%)	47	15	0.999
foraging	20 (43%)	26 (57%)	46	9	0.797
scavenge	8 (62%)	5 (48%)	13	6	0.003*

(frequencies of behaviors, crosstabulation * significant at p=0.05 or less)

The frequencies shown in Table 5.4 are summaries of event and behavior counts across all observed index children. The chi-square significance is the result of a crosstabulation analysis in SPSS of these frequencies across seasons. Study behavior frequencies are statistically significant across seasons and are also interesting when compared with time spent in locations across seasons. It has already been noted that less time was spent at school during the rainy season. Formal learning also occurs outside of school, but with less frequency: older siblings teach younger siblings how to write letters and numbers as well as how to draw common animals such as cows or camels. This behavior was included in the "study" code. Study behaviors also involved church related activities such as catechism since these were often taught during regular school hours or in common buildings outside of school hours. Study behaviors diminished from 155 incidents in the dry season to 124 incidents in the rainy season. Study behaviors were almost as likely to occur away from school as at school.

Idle, play and work frequencies were reduced in the rainy season. Of these only idle frequencies is significant. This can largely be explained by the cooler environment after rains began as well as less time at school. During extremely hot and harsh weather conditions children and adults can often be found sheltering, either in the home compounds, under trees or bushes in the village or near the rivers. During school children were commonly observed to be sitting idly staring out of windows. With the onset of rains school was no longer in session and children were seen to be running and playing at home, in the village and in the bush.

The change in total incidents of working for food can be credited to a significant change in behavior of one child. During the rainy season observations, the father of this child had just died. She began to spend the majority of her time at another compound where she helped out with household tasks and received food and housing in return. Incidents of scavenging were reduced during the rainy season, when hungry children were able to self-forage, primarily for wild fruits. This suggests that scavenging is of lower preference to self-foraging in acquiring food or water for most children. Scavenging behaviors usually consist of gathering refuse, most commonly liquid or powdered drink containers or food containers, and licking or sucking for any remaining food or water. Obviously the caloric return for this type of scavenging is quite low.

Both self-foraging, where any returns of foraging were immediately consumed by the child, and foraging, where returns were carried back to the home compound to be shared with the family, increased from the dry season to the rainy season, though not at a significant level. There were some fruits available during the dry season but most wild greens and vegetables were not. These were just becoming available as observations ended in June. Two of the three locations experienced long delays in the onset of the long rains and wild foods were just becoming available as the data collection ended. It is possible that the availability of wild foods affected the number of incidents recorded.

Though not statistically significant, total incidents of begging diminished slightly during the rainy season. It is worth noting that the majority of incidents of begging are for water rather than food. In the harsh ASAL environment, access to water is limited. Water is generally more plentiful during the rainy season so less begging was required by children when they are away from their home compound.

The duration of each event and behavior was recorded. In Table 5.5 The percentage of time for each incident is the total time spent in a behavior averaged by the total children observed for that season, 57 for the dry season and 56 for the rainy season. This calculation better represents the amount of time, by percentage of total time observed, and spent in each behavior. A paired t-test analysis by index children showed percentage of time spend idle and in study behaviors to significantly different across seasons.

Table 5.5 Behavior and event percentage of time by season

Codes	Dry season	Rainy season	t	2-tailed Sig
working	31%	35%	-1.767	0.082
play	33%	36%	-1.282	0.205
idle	17%	12%	3.101	0.003*
consuming	10%	9%	1.585	0.118
study	5%	4%	-6.055	0.001*
begging	2%	1.5%	1.591	0.117
sharing	1%	1%	.037	0.970
work for food	1%	1%	-.932	0.355
self-foraging	0.3%	1%	-.790	0.433
foraging	0.4%	1%	-1.049	0.299
scavenge	0.2%	0.6%	1.319	0.192

(df = 56 for all pairs in paired t-test, * significant at p=0.05 or less))

Percentage of time in work suggests a trend with a significance of 0.082 but the correlation of dry to rainy season of 0.058 is significant at 0.001*. This positive correlation supports increase in average percent of time in working behaviors from dry to rainy season. Similar correlations exist for play (correlation = 0.443, sig = 0.001*) and scavenging (correlation = 0.471, sig = 0.001*).

As would be expected, self-foraging and sharing both represent small amounts of the total observation time since they are usually discrete events of short duration. Consuming events are also generally of short duration but due to their frequency they added up to around ten percent of total time. In arid lands access to and consumption of water are very important, therefore these events include both food and water consumption. Foraging events, where any returns were shared with household members, also represent very little of the total time observed. Many of these events involved hunting and netted little returns. Birds (unknown species) and squirrels (probably the Kenyan Tree Squirrel, *Paraxerus palliates*) were most often pursued by boys, usually with stones or slingshots, but with little success. Both boys and girls climbed trees in search of eggs with slightly greater returns.

Children spent a large percentage of their time in work, play and idle behaviors, usually moving frequently between the three states with idle time as the only significant behavior across seasons. It was quite common for children to seek shade and rest during the middle of the day during the dry season. Temperatures would reach more than 37.8 º Celsius and there were frequent high winds and blowing dust. Mid-day naps or idle time were more common following heavy work like carrying ten or 20 liter jerricans of water a distance of one to two kilometers from the river. During the rainy season children spent less time in idle behaviors. Temperatures are cooler as rains begin. They no longer seek shelter and rest at the hottest point of the day.

During the rainy season school was no longer in session in Nadome or Nanam. The percentage of time spent in study behaviors is significant at the individual level when seasons are compared. Foraging and self-foraging have both increased, although

marginally. Children were occasionally observed to collect wild greens and take them home for household consumption. There was more fruit available for immediate consumption.

In looking back at frequencies, there was a decrease in incidents of work, play and study from the dry to rainy seasons. Yet there is an increase in percentage of time spent in work and play from dry to rainy seasons and a decrease in percentage of time spent in study from dry to rainy season. During the dry season, incidents of play, work and idle behavior interrupted periods of study while at school. When school is no longer in session, incidents of study, either with siblings or alone, now interrupt work, play or idle behavior.

Results: Comparison by sex

Across the entire study duration and including both the dry and rainy seasons, observations were conducted on an average of 25.5 boys for an average of 1,521.8 minutes (25.4 hours) and 31.5 girls for an average of 1,578.7 minutes (26.3 hours).

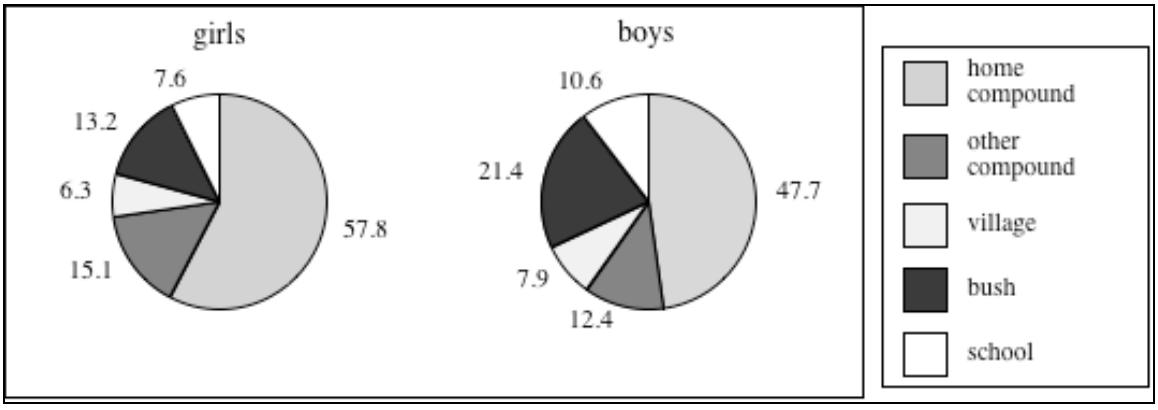


Figure 5.1 Percentage of time in location by sex

On average, girls spend more time at home while boys spend more time in the bush. A t-test of mean times spent in the five coded locations of the 57 index children observed across both seasons reveals that home compound (df = 56, t= -2.335, p= 0.023*) and bush (df=56, t=2.966, p= 0.004*) are both significantly different between boys and girls.

On average, girls spend less time at school. Though not significant this follows trends across much of sub-Saharan Africa of low numbers of girls in regular attendance at schools (Bock 2002b; Meeker and Meekers 1997). Later comparisons of behaviors will elucidate what behaviors are taking place in these various locations.

Table 5.6 Total event and behavior frequency by sex

Codes	**Frequency**				
	girls	**boys**	**total**	**df**	**chi-square sig.**
working	1132	656	1788	29	0.005*
play	926	821	1747	28	0.009*
idle	632	469	1101	23	0.177
consuming	548	394	942	18	0.635
study	127	151	278	15	0.046*
begging	116	74	190	8	0.820
sharing	79	50	129	6	0.214
self-foraging	19	28	47	5	0.158
foraging	12	33	45	4	0.021*
scavenge	4	12	16	4	0.278

(frequencies of behaviors, crosstabulation * significant at p=0.05 or less)

The behavior code of "work for food" is not included in Table 5.6 since the frequency for boys was only one in comparison with 30 separate incidences for girls. The low frequency for boys does not allow for statistical comparison based on a chi-square. Girls show higher frequencies of work than boys. This would explain the larger amount

of time girls spend inside compounds and the type of work they do. Their work involves primarily cleaning which consists of sweeping of the huts and compounds, washing dishes and utensils and less often, washing of clothes. They usually aid in food preparation. Only rarely do children under ten years of age assume full responsibility for food preparation. Work around the household compound and in other compounds usually consists of care of younger children and may include simply holding or soothing or may include feeding, bathing or dressing them. Girls have more frequencies of idle time and play but, when percentage of time is factored in it becomes evident that girls spend more time at work, punctuated by idle and play time.

Behaviors to gain access to food and water appear to differ between boys and girls. Boys self-forage, forage and even scavenge more often than girls yet this does not lead to more incidents of consuming. Girls are far more likely to beg or work for food or water than boys and this does lead to more incidents of consuming. If this is considered along with where time is spent, it does not seem to follow that spending more time inside compounds, presumably closer to household food stores and food being prepared, guarantees access. Access must still be granted through begging or occasionally through scavenging. Scavenging usually consisted of going through refuse but at least one incidence of a child sneaking food from a cooking pot was coded as scavenging. The behavior of begging included requests for food or water or crying for food or water. Simply being present and consuming when food was served, even if in a compound other than "home", was coded as consuming rather than foraging or begging.

Interestingly girls seem to share food more often than boys. When considering foraging behaviors in comparison to location, it makes sense that boys resort to these behaviors when away from their home compound, especially when in the village or bush. It is important to note that since villages are often located near water sources such as rivers, fruit trees are often located either in or on the fringes of the village, so foraging is as likely if not more likely to occur in the village as in the bush.

Boys are slightly more likely to engage in study behavior than girls. Any behavior where an individual appeared to be paying attention and was actively participating in shared information was coded as study behavior, whether in a formal setting or not. Considering the difference in time spent in school between boys and girls, the frequency of study for girls is interesting, suggesting that their study is occurring outside of a formal setting.

When considering total amount of time spent in each behavior averaged by number of incidents it is easier to differentiate duration of incidents. Table 5.6 shows the average time spent in each behavior by girls and boys. A t test compares the mean percentage of time of each individual girl and boy for each coded behavior. The t-test first checks for equality of variance with a Levene's test. The t test is completed with a separate t value and degrees of freedom, even if the Levene's test finds the variances are not equal. These are noted with a # sign before the t value.

Table 5.7 Percentage of time in behaviors by sex

Codes	Girls	Boys	t	2-tailed significance
working	39.7	24.8	6.017	0.001*
play	28.7	39.5	#-4.523	0.001*
idle	14.6	14.6	-0.70	0.945
consuming	8	10.9	-4.023	0.001*
study	3.9	5.2	-1.189	0.239
begging	1.4	2	-1.964	0.054
sharing	1.4	1.4	-0.107	0.915
self-foraging	0.4	0.7	-1.320	0.192
foraging	0.4	0.8	-1.632	0.108
work for food	1.4	0.02	0.940	0.351
scavenge	0.05	0.2	#-1.390	0.176

(# equal variances not assumed in t test, * significant at p=0.05 or less)

The percentage of time girls spend doing work is apparent in comparisons of average percent and are also significant in the individual t test. When considered along with time spent in locations it becomes clear that girls spend significantly large amounts of time doing household work in and around compounds. Boys spend an apparent percentage of more time at play and this is significant when individuals are considered. When considering percentage of time by location, boys spend a great deal of time at play in the village and bush. In spite of the higher number of frequencies of play in girls, the percentage of time indicates that girl's play is interrupted by work and other behaviors.

The significantly higher individual percentage of boys spending time consuming than girls must be moderated by the earlier observation that boys spend time away from home compounds and frequently beg for water. The more time spent in consuming may be partially explained by water consumption than by food consumption. However, since girls are more likely to clean up after household meals, as a part of their household work inside the compound, boys may take more time over these meals than girls.

The amount of time spent idle does not vary greatly when compared by sex or by individuals. It is important to note that some of the work that boys do, especially that of caring for livestock, allows for a good deal of idle time that is usually spent in play. It is difficult to code obvious play behavior as work, even if done in the vicinity of livestock.

The differences between total time spent in a behavior in comparison to the number of incidences support the conclusion that girls spend more time doing work that is punctuated by play, idle or study behavior. Boys spend more time playing punctuated with work, idle or study behavior.

Nutritional outcomes of behavior

The previous section presented descriptions of the focal follow observations of index children averaged across seasons and sex. Detailed notes regarding each behavior inform these descriptions. In this section, statistical analysis of specific events and behaviors is presented and the observation notes again inform interpretation.

In order to test the hypothesis that children's own agency, by seeking out food for their own consumption, outside of household livelihood strategies has an effect on their own nutrition certain behaviors were aggregated and then compared to body mass index. The index child frequencies of events and behaviors related to gaining access to food were summed into one category. This category includes "self-foraging", "sharing", "foraging", "scavenging", "begging" and "working for food". This aggregation of behaviors is similar to urban foraging studies in Mexico or Nepal in which foraging is expanded beyond collecting plants foods or hunting to include many behaviors with the ultimate goal of food acquisition (Baker and Hinton 2001; Lee 2007). In this analysis, the sum of these frequencies is analyzed using linear regression analysis in SPSS 13 in

comparison with the final, wet season, body mass index (BMI) for age percentile as the dependent variable. BMI for age percentiles, an index of nutritional status, was calculated using EpiInfo 3.3.2 (CDC) and the 1978 WHO /CDC growth reference curves. All of the anthropometrics and the final observations were completed in late May and early June of 2007 and represent the culmination of 12 months of research. In essence, the final anthropometrics represent any accrued benefits of prior events and behaviors.

The first step of the analysis calculates a Pearson's correlation or Pearson's R (n=56 index children). The R square is 0.109, indicating a positive relationship. This positive correlation simply proves they increase together but does not suggest that BMI for age percentile is a direct result of these behaviors or any nutritional return. As the behaviors to access food increase, so does the BMI percentile of the child. It is unlikely that a child with a higher BMI, a better-nourished child, would undertake some of these behaviors. As suggested by frequencies across seasons, scavenging is not a highly desirable behavior. Begging is more common when feeling hunger as it often occurred while food was being prepared or near an expected mealtime. If a child is satiated with recent consumption, begging would seem less likely to occur. The R square of 0.109 means this regression model of food seeking behaviors across the dry and rainy season of 2007 explains 10.9% of the increase in BMI percentile measured during the rainy season of 2007, suggesting that human behavior and nutrition are linked but are part of a very complex pattern of growth and development.

The final step of the regression analysis is an analysis of variance (ANOVA) of the dependent variable, BMI for age percentiles, and the independent variable, sum of food related events and behaviors. There is a significant linear relationship (Beta = 0.329,

p = 0.013*) between the nutritional status of the index children and their food seeking behaviors. As the number of food seeking behaviors increases they are more likely to gain better nutritional status. This would seem to be very logical but it is important to remember that not all food seeking behavior resulted in a consuming event. Boys spent more time in foraging and self-foraging behavior that did not always lead to consuming events. Also, begging did not always lead to consuming. Thus, the behavior of food seeking is more important in this analysis than any single consuming event. Children that repeatedly seek access to food are more likely to eventually consume and therefore enjoy better nutritional status (higher BMI for age percentile). Those children who employ fewer food seeking behaviors, either in type or number, may be less likely to gain eventual access to foods and their growth and nutrition may slow, resulting in lower BMI for age percentile unless another factor intervenes. Unfortunately this regression analysis does not include reliable methods of household provisioning or health status, both likely to be important factors in child growth. In addition, the finding could be a result of observation bias and incidental to the particular day of observation. In the event of poor nutritional status, lower BMI for age percentile would be evidenced by loss of body fat or muscle mass, lower weight for height (WFH), "wasting", or slowed growth, resulting in a low height for age (HFA), "stunting". In the shortest term, loss of body fat can be evidenced by decreased skinfolds or mid-upper arm circumference (MUAC).

In seeking to further understand differences in roles according to sex and household ecology, each child's relationship to siblings was defined as "among the oldest", "middle" or "among the youngest" birth order. "Among the oldest" means they were the oldest boy or girl in the home compound of interest. It is very common for

Turkana heads of household to have multiple households, consisting of a homestead and satellite compounds. A co-wife or occasionally an older daughter usually manages satellite compounds. Although occasionally observations were completed at satellite compounds, it was far more common to find the index child at the homestead in the village. Oldest children, boy or girl, were often mobile among the compounds. "Oldest" came to mean among the two oldest boys and girls to account for the movement of older children to meet labor requirements of multiple households.

"Middle" is the largest category since it is the easiest to define. On rare occasions all of the older siblings might be gone from a household compound, leaving a middle child to aid in household or livestock work, but this was a temporary condition.

"Among the youngest" is also dynamic since several mothers of index children had babies during the data collection period. Thus the two youngest members of the household were defined as "among the youngest" but this time regardless of sex since at this age, sex has little impact on roles in a household.

As mentioned above, girls are more likely to be found working in a household compound than boys. This work often consisted of care of siblings and aiding in food preparation. Boys will aid in care of siblings, but it is more common for girls to take on this role. In order to consider the developmental niche theory, testing the relationship of sibling care by older children and subsequent opportunities for sharing had on individual nutrition, ANOVA of BMI for age percentile and birth order were conducted using SPSS 13. The relationship is extremely significant at $p < 0.001^*$ ($n = 230$, $df = 2$).

Since girls were observed to share more often than boys, crosstabulation of BMI percentile categorized by percentile and birth order were considered by sex. Categorizing children into meaningful groups of nutritional status can communicate community or population status more clearly than a distribution around a mean. Considering these groups by age and sex allows for discussion of how various behaviors may contribute to nutritional status.

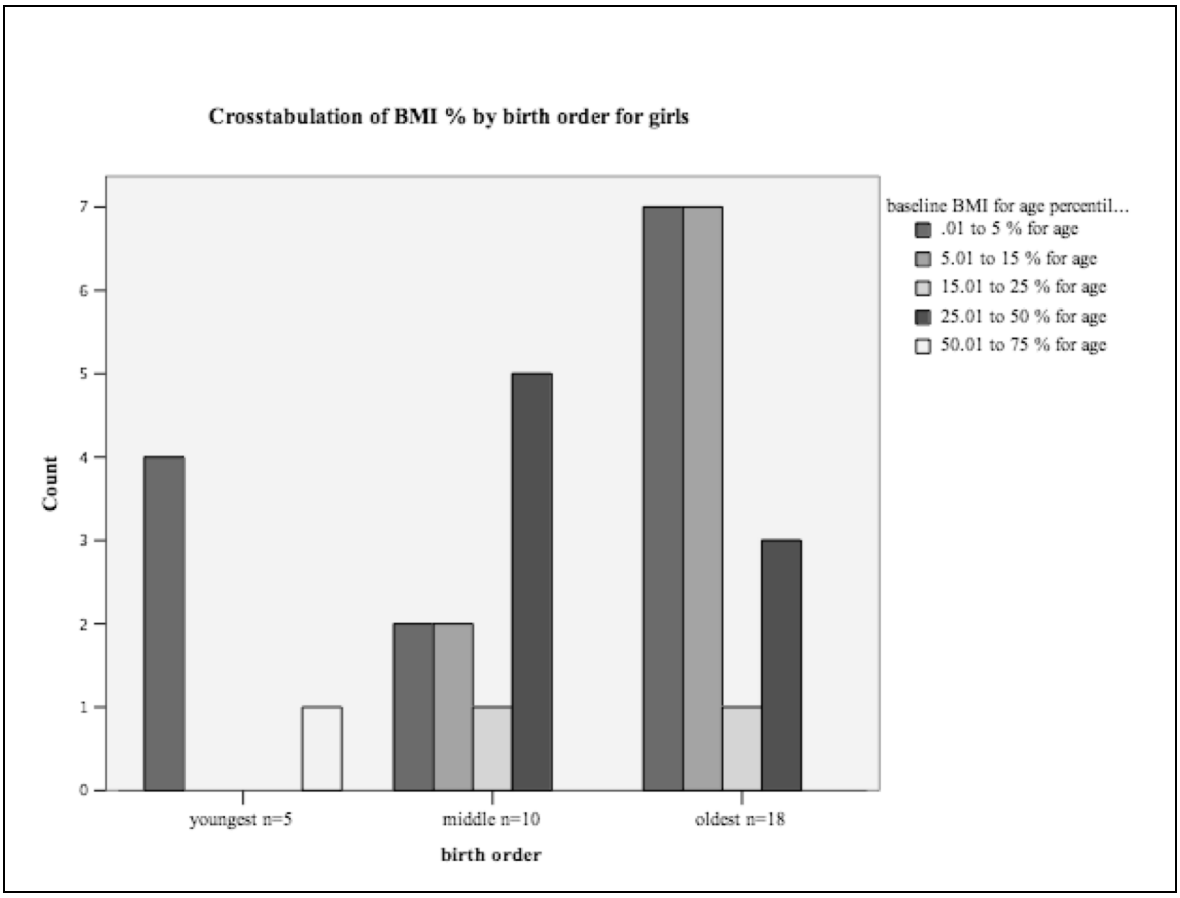


Figure 5.3 Crosstabulation of BMI for age percentiles by birth order for females (n = 33, df = 8, p 0.042* eta = 0.343)

Girl middle children reap the benefits of sibling care without the added energy expenditures of responsibility for younger children that older girls incur. This may explain the larger number of middle children with 25 to 50th percentile BMI or higher, considered a normal BMI. The added energy expense of household work and sibling care could explain the prevalence of lower BMI percentile for age of older girls. Girl youngest children exist at opposite ends of the spectrum of nutritional status. They have the only presence in the 75th percentile or higher BMI percentile in this analysis. As the youngest children in the household they enjoy high priority access to nutrient rich foods like milk (Gray 1998). In households with poor food security or no access to high fat foods from livestock, this benefit would be lost, possibly explaining the youngest girls at the severely thin level of 0 to 5th percentile BMI. There are many factors that affect nutritional status but according to eta, birth order explains 34.3 percent of the variation in this sample, supporting the importance of developmental niches. Other factors such as gender roles, household provisioning with possible preference for males or differential access to food depending upon location and type of labor must explain variation for Turkana boys since the same graph is almost equal for the three birth orders and the relationship is not statistically significant ($n = 26$, $df = 10$, 2-sided chi square = 0.720).

Conclusion

Turkana children exhibit some of the same risk reduction strategies that their parents do. They employ multiple strategies in order to secure access to food and water. Many of these strategies are undertaken independently by the children and in the company of other children. This observation could support theories of cultural

transmission of knowledge (Dobbert et al, 1984) or children mirroring strategies they see their parents practicing.

There are a few differences in behavior patterns by season. Idle time is highest during the hot, dry season, largely a factor of a harsh and unpleasant environment. Study behaviors are highest when schools are in session but do not cease when not in school. Kenya school schedules are the same, whether in an agricultural community or a remote pastoral community. Boys are more likely to attend school than girls. Nonetheless, girls will actively "study" even if not allowed to go to school. It was quite common for children to teach children numbers, letters, songs and drawing, all common topics of education in school settings. This suggests that peer-to-peer education could be successful in this population.

Motivated children may travel several kilometers in order to attend school. Turkana children are so frequently unsupervised, either in their work around households or with livestock and in school attendance, that they have a lot of control over their own time allocation. If a child is chosen by his/her parents to attend school but he/she does not want to, they will often spend the day playing in the village, bush or in other compounds. If a child is chosen by his/her parents to work at home or with livestock, they can often sneak away and listen at doorways or windows of the school. Other children will assist them in learning by drawing in the dust and providing feedback on progress. Though not related to specific theory of child development, how pastoralist children learn is important to government and NGOs working on education in developing countries.

When compared with nutritional status indicators, children who were observed using multiple strategies to gain access to food outside of household provisioning were positively correlated with higher BMI at a statistically significant level ($p= 0.013^*$). A portfolio that includes multiple strategies to gain access to food, even in middle childhood, can optimize risk minimization (Markowitz 1952). This combined with the amount of time boys spend at play in the village and bush and girls spend working in compounds supports the theory that children actively learn how to be future adults in their society through various means, including play and work (Bird and Bird 2002a; Bock 2002b).

Turkana children were observed to move freely around the landscape, between their home compound(s), the compounds of relatives and friends, the village, school and the surrounding bush area. Some of this mobility and independence would be expected to diminish at times of civil insecurity (Pike 2004). There were few significant differences in location across seasons and only minor differences by sex. In discussions with village chiefs and elders as well as parents the option of limiting children's movements was mentioned. However, even after raiding events in the regions, children were still sent to distant water points and to care for livestock. During observations children were not seen to restrict their movements. During the research period of mid-2006 to mid-2007, civil insecurity did not seem to limit children's movements around the landscape.

Children, both boys and girls, are knowledgeable about livestock and their care, sometimes using that to gain access to milk. They are knowledgeable enough about the environment to access wild foods for consumption. They most often immediately consume foraged foods, thereby accruing that nutritional benefit for themselves rather

than sharing with the household. This is also supported by the relationship between the use of multiple strategies to access food and a better nutritional status and follows findings by Panter-Brick (1998) and Chipeniuk (1995).

Turkana girls are more likely to share foods, including foraged foods, often but not exclusively with relatives. Individually, no one behavior offered enough benefit to significantly impact nutritional status. However, when behaviors to gain access to food were summed, it is possible to see a better nutritional outcome. Since every behavior does not result in increased access, analysis concludes that the behavior, or the child's willingness and ability to perform that behavior are important. This also supports the theory that knowledge and skill, or embodied capital, are important elements of becoming a nourished and healthy adult (Bock 2002a).

In spite of independent movements and time allocation, Turkana children begin to take on gender roles common to pastoralist populations in East Africa at an early age. Girls are more likely to perform household tasks in their own compound or in others. Rarely this work can be exchanged in reciprocity for food, as is common for adults. The practices of sharing and cooperating on household labor prepare young girls for life in a polygynous household, supporting theories of embodied capital specific to the Turkana culture. Boys begin to take on increasing responsibility for livestock at early ages and are more likely to be found in the bush. In addition, they spend more time in the village with other boys and men.

While children are receiving most provisioning from caretakers, during the human prolonged juvenile period, they are not only growing, adding mass and strength, measured in this study by nutritional status, but also gaining ecological knowledge and

skills in various livelihood strategies that include wild foods, wage labor and herding of various livestock. These represent investments in physical and functional embodied capital (Kaplan 1997). The gender differences of children from four to twelve years of age evidenced in this study, where time is spent and the types of behaviors engaged in, reflect culture specific gender roles of adult Turkana.

Not only does the sex of a child affect roles, but also birth order. Older children assume greater responsibility, sometimes with unclear benefits to their personal health and nutrition as is the case with some older girls. Younger children enjoy additional care from older siblings in addition to that of the parents. As children assume these roles it begins to affect their access to food and resulting nutritional status, both through intake of calories and expenditure of calories through work. Middle children seem to get the benefits of extra care without the costs of increasing responsibility or energy expenditure of older siblings. This relationship is clearer in girls than in boys. This combination of gender and birth order and their effects on nutritional status support the developmental niche theory as well as the household production of health since nutritional status is commonly liked with immune system function and mortality of infectious diseases (Berman et al, 1994; Super and Harkness 1986).

There are many influences on the nutritional status of children. This research has focused on a few aspects of household ecology and been able to demonstrate some relationships but more work needs to be done in order to better comprehend the multiple influences on behavior. Middle childhood is often overlooked in research, literature and development programs even though it is a very dynamic period of growth and social development. Turkana children exhibited independent agency in time allocation by

location and behavior, which is significant to social and biological development during middle childhood. Social roles and household dynamics also clearly impact nutritional status of children, thus households and communities.

Further study to elucidate other significant contributors will aid in better nutrition and health of Turkana children, households and communities, as well as other pastoralist groups of East Africa. Due to the richness of the qualitative data collected using the human behavioral ecology methods of time allocation through direct observation, future analysis of this data set can be conducted including economic factors like livestock wealth or access to income through wage labor. In addition, further analysis and research will aid in expanding the knowledge and understanding of the childhood experiences of humans, from a biological and social perspective.

CHAPTER 6

CONCLUSION

Introduction

The introductory chapter and the four manuscripts in this dissertation represent a two-pronged perspective on Turkana livelihoods in ASALs of northern Kenya; the traditional approach to household livelihoods and a second approach focused on middle childhood experiences in Turkana culture and how they contribute to their own and their household livelihoods. Since it is impossible to consider Turkana pastoral production outside of the challenging environment in which they live, ecology plays an important part in the social production of knowledge, production of capital leading to a livelihood, nutrition and biology of Turkana and children's roles in household production. A part of the environment of northern Turkana is the influence of government and non-government relief and development program and policy. These programs and their current policies are addressed in the analysis and discussion of each chapter.

Chapter one provides an overview of the larger dissertation research project, including theoretical background and framing of the research questions and methods used in data collection. This chapter is also the source of important ecological and environmental information about the region, from a historical point of view as well as concurrent with the data collection period. The introduction also provided political ecological and ethnographic background for Turkana District and Turkana people.

Chapter two expands upon the importance of ecological knowledge and how that may influence nutrition and health outcomes by focusing on wild foods. The domain of knowledge regarding wild foods is quite strong and shared across locations, sex and age. This chapter begins a critique of development in the region that ignores not only local knowledge but also more importantly, the possible contributions it could make to health and development of the region.

Chapter three continues this comment on development by focusing on valuation and quantification of livestock, especially among pastoralists. A participatory approach is demonstrated that yields culture and region specific valuations that might better reflect real impacts on livelihoods.

Chapter four introduces nutrition and health as measures of outcome of livelihoods, serving as a measure of the success or failure of livelihood portfolios. This chapter uses a cross-sectional method to consider nutrition and health across the lifespan of Turkana using life history theory and biological tradeoffs of each life stage. The analysis section discusses research findings in comparison with UNICEF surveys as well as a critical analysis of relief and healthcare delivery in the research area.

Chapter five focuses on the period of middle childhood using household production of health and developmental niche theory to explore livelihood strategies of children. Nutritional data serves as an outcome measure to assess the success of index children's strategies. Life history theory as well as child development debates contribute to the analysis and conclusions.

Whereas each chapter addresses the topics of household ecology, livelihood portfolios, nutritional ecology and child development individually, in this final chapter I describe the crosscutting issues of household ecology, nutritional ecology and child development using findings from each aspect of the research project. The conclusion then draws from each chapter and analysis presented in this chapter.

Household Ecology

The introductory chapter describes details of the environment of Lokichoggio Division, North Turkana District, Kenya and how Turkana have used this environment in the past as well as how the environment has shaped Turkana livelihoods. The pattern that emerges is a dynamic one, demonstrating how Turkana have adopted new subsistence practices and are trying to integrate to regional markets. Turkana men still self-identify as pastoralists, even while working in day labor jobs in Kakuma or Lokichoggio. Many are able to invest earned income into livestock and re-enter *adakars,* resuming a semi-nomadic lifestyle. Chapter three describes preferences and practices of herd diversity and demonstrates the importance of livestock to Turkana identity.

The homesteads and satellite compounds originally described by Gulliver (1955) bear a remarkable resemblance to those found in this research project in 2007. This is remarkable in that Gulliver worked in a "closed district" still under British colonial rule whereas 2007 is four decades post independence with opportunities for participation in local and regional market exchanges. The options for market integration are limited at many remote Turkana villages, as described by two of the research sites described in Chapter three. Yet the different livestock equivalencies of Lokangae, the third research

site, show some degree of integration with the larger markets with a neutered valuation of livestock more geared for market exchange than building a herd.

Probably the most interesting development for Turkana settlement patterns is the strategic location of a homestead compound in a location with a high potential for access to food aid or other development and relief projects. This was so common across the 61 participating households that it can be classified as a livelihood strategy. This research has attempted to catalogue various strategies used by Turkana individuals in attempts to understand how income, food, access to food or livestock are assembled into a livelihoods portfolio. This language comes from literature on risk minimization (Winterhalder et al, 1999) and dovetails nicely with Ellis' (2000) approach to diversified livelihoods As NGOs narrow the targeting of food aid projects, the strategy for inclusion becomes less reliable for significant caloric contributions to extended family diets, yet it proves worthwhile often enough that it is now a part of many household portfolios. Individuals travel and relocate in a stated desire to "get on the list" as aid recipients. Other family members travel, especially elderly or small children "to be measured", hoping to be enrolled in feeding programs. Parents encourage children of all ages to attend school, not only in hopes of learning Swahili, English, mathematics, reading and writing but also to access school feeding programs.

Not only is the market and economical environment changing but Turkana Districts have suffered from extensive invasion of an introduced species, *Prosopis juliflora* (Mwangi and Swallow 2005; Stave et al, 2003). Turkana now use the wood of this species in construction of fences and temporary household constructions such as visitor's huts or kitchen huts. Small livestock, camels and donkeys routinely browse the

leaves and seedpods of *P. juliflora*. This has led to some unfortunate circumstances. First, donkeys are incapable of digesting the insoluble fiber of the *P. julifora* seedpods, leading to intestinal blockages and death. Numerous households across the region point to donkey skins and report the donkeys dying from consuming these seedpods. The next unfortunate circumstance arising from small livestock browsing on these seedpods is a seed prepared for germination by passage through the intestinal tract and deposition along with fertilizer. Small livestock pens, used for overnight containment, are thick with seedlings of *P. juliflora.* The presence of *P. juliflora* along rivers and streams demonstrates the longevity of these seedpods in the ASALs of northern Kenya (Stave et al, 2003). Other research suggests that *P. juliflora* prefers disturbed environments, explaining its omnipresence along roads and paths throughout northern Kenya (Jadhav et al, 1993). This invasive species that is well adapted to ASALs represents a very real threat to maintenance of grasslands important to the seasonal migration of pastoralists. Both women and men repeatedly voiced this concern in every location. The chief of Lokangae reported a dramatic change in the Lotikipi plain since his childhood, and he was a young man in his late 20s. He stated, "I don't know what will come of this place in another 10 or 20 years. If this continues you will come and find no Turkana here, only this tree."

Turkana have demonstrated a plasticity of livelihood strategies, incorporating new livestock and increasing herd diversity, including access to relief and aid into settlement patterns and opportunistically exploiting day labor to their own means of maintaining access to livestock. This is in opposition to other pastoralists who have been more reluctant to add species to herds (Lamphear 1988; Pratt and Gwynne 1977) or who have

replaced livestock almost completely with wage labor (Glickman 1974) This plasticity is required for their survival in a dynamic social, political and physical environment. In order for policy to affect them positively, this plasticity and the array of strategies they employ should be considered in any assessment of livelihood or projects to ameliorate livelihoods.

Nutritional Ecology

Chapter four presents a cross-sectional snapshot of the nutritional status of the study population comprised of the members of 61 household from three of five sublocations of Lokichoggio Division, North Turkana District. The study population is made up of individuals from every stage of development, from infants to elderly adults. Here I would like to introduce seasonality into the discussion of Turkana nutritional ecology and continue the discussion of the interactions of household ecology and nutrition.

Anthropometric data collection was comprised of three measurement windows, a baseline measurement at recruitment of households and individuals during September and November of 2006 at the transition between the long rains and the dry season, dry season measurements in January and February of 2007 and wet season measurements in April, May and June of 2007 at the onset of rains. Seasonal movements of livestock and household members have already been described in the Introduction as well as in Chapter three. Chapter two describes the Turkana diet and contributions of wild foods to macro- and micro-nutrition. Since stunting, evidenced by low HFA, and wasting, evidenced by low WFH or WFA may take more than a few months to manifest, skinfold thickness measurements of subcutaneous fat serve as a proxy for energy reserves that would expect

to be depleted during periods of inadequate caloric intake to meet energy needs, as would be expected across seasons in the Turkana Districts (Little 2002).

Measurements of skinfold thickness at the triceps and subscapular areas using Holtain skinfold calipers were summed, then normalized for the population by percentiles for age and sex using NHANES data (Frisancho 1989). Skinfold measurements are a good indicator of short-term seasonal changes to dietary intake or negative balance of caloric intake to energy expenditure since they measure energy reserves in the form of stored subcutaneous fat (Boye et al, 2002; WHO 1995). Since the sum of skinfold percentiles were derived from tables and not calculated, a non-parametric analysis is used to compare seasonal measurements. A Kruskal Wallis test ranked the means of the seasonal measurements, baseline (n = 359), dry (n = 326) and wet season (n = 337), and revealed a statistically significant difference (p= 0.049*) in chi-squares (total N = 1022, df = 2, chi-square 5.601).

The largest difference is between baseline measurements in late 2006 and the wet season measurements in May, June and July of 2007. There was a steady increase in the sum of skinfold percentile means over time. This is remarkable in that it would be expected to find significantly lower energy reserves during the dry season when herds are more dispersed, lack of forage and water cause stress resulting in less off take of milk or blood for human consumption and less willingness to slaughter for consumption due to the upcoming rainy season fertility and anticipated reproduction. In addition, a few seeds or nuts from wild foods may be available but greens and most fruit would not be available. As explained in Chapter three, northern Kenya was experiencing a small livestock disease outbreak leading to high mortality rates of sheep and goats. Turkana

were consuming sick and dying animals during the dry season, a time when livestock would normally not be slaughtered for consumption. This contributed to high energy reserves in the form of stored body fat during the dry season.

Household ecology, as well as seasonality, has an impact on nutritional status. Turkana, as semi-nomadic pastoralists, have complex households that are often scattered across the landscape. At baseline interviews the household position for each participant was determined. These positions were categorized according to role, as in head of household, wife number, child of which wife, adopted or relation to wife or husband of household, resulting in ten coded positions. Location in the landscape and the associated access to wild foods, as described in Chapter two, and household position, which may determine access to foods, should both affect energy reserves, here measured as body fat storage in subcutaneous skinfolds. Skinfold measurements of the triceps and subscapular area using Holtain skinfold calipers were summed and then categorized according to NHANES percentiles by age and sex (Frisancho 1989). Linear analysis (univariate ANOVA) of skinfold thickness percentiles, dependent upon location in the three research sites and household position, was used to determine how these variables are related using SPSS 13. Household positions can be broadly divided into adult and child groups, as is seen in Figure 6.1. To account for these two groups, the analysis was run twice, using 13 years of age as the cut off, the same break in age between middle childhood and adolescence. The final, wet season skinfold measurements were used in the analysis. For children, from infancy through middle childhood, the model including both location and household position ($n = 224, df = 6, F = 4.232$) is significant with a p of 0.001*.

Tukey's post hoc analysis reveals that the difference between children of the first wife and resident children who are relatives of the wife is the most significant. Most of the children in the category of "relative of the wife" are nieces or nephews and may be resident in order to gain access to school or to aid in household labor. The adjusted R squared value of 0.165 suggests that household position in combination with location in one of the three villages explains 16.5% of the difference between the sum of skinfold percentiles. For adolescents and adults the model including both location and household position ($n = 179$, $df = 12$, $F = 3.110$) is also significant with a p of 0.001*. The adjusted R squared is 0.255, suggesting that household position and location together explain 25.5% of the difference in the sum of skinfold percentiles in adolescents and adults, more so than in children under 13 years of age.

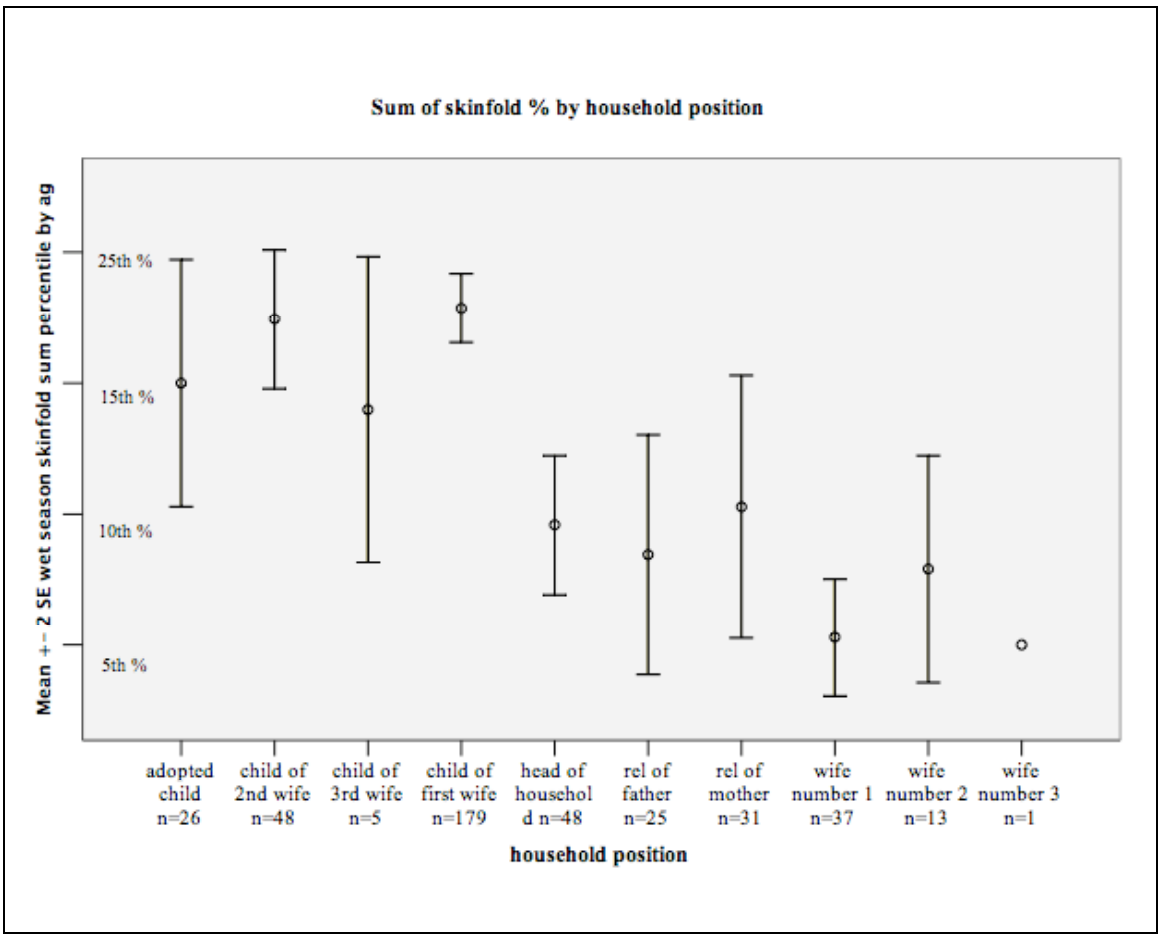


Figure 6.1 Sum of skinfold percentiles by household position

The comparison of the sum of skinfold percentile means is interesting in that head of household seems lower than would be expected, assuming preferential access to food, especially from livestock. The assumption that access to livestock could influence nutritional status is born out when considering the mean sum of skinfold percentiles by locations (Nadome = 13.41, Nanam = 13.758, Lokangae = 17.245), assuming that Lokangae's proximity to the Lotikipi Plain equals access to more livestock and their resources. A lower BMI of heads of households (80% of which are male) could be explained by the high energy expenditure of this wet season. Several of the male heads of

household were moving around the landscape, between homesteads, satellite compounds and trading centers. This can mean walking upwards of 20 km per day in a hot and dry climate.

Being a child of a second wife versus child of a first wife shows no difference in the means. Interestingly, adopted children seem to fare well as far as energy reserves can indicate. Child of a third wife and third wife do appear to have a disadvantage, at least when it comes to energy reserves. The relationship between first, second and third wife is difficult to understand but male head of household preferential treatment, workloads of individuals as well as individual agency would all be factors to consider. Finally, relatives of mother, usually an older relative like a parent, aunt or uncle, seem to fare better than relatives of the father. Since the mother/wife figure is physically around the household compound more than the father/husband and has primary responsibility for food preparation and dispensation, this could explain the difference.

Tukey's post-hoc analysis reveals that location in Nadome, closest to a trading center and less likely to have household holdings of livestock but some income, and Nanam, approximately 22 kilometers from the same trading center and more likely to have household holdings of livestock but little opportunity for income, are statistically related to skinfolds percentiles, or more energy stores in the form of body fat ($n = 212$, $df = 1$, $p = 0.004$*). When considering all three locations statistical significance is $p = 0.066$ ($n = 337$, $df = 2$). Comparison of means shows a steep decline between Nadome and Nanam, with Lokangae returning to the median. A diet higher in carbohydrates is typical of settled Turkana and is explained by access to wage labor income and markets (Gray et al, 2004). This higher consumption of carbohydrates in Nadome explains the higher

skinfold thicknesses. It is possible that Lokangae, positioned closer to the Lotikipi plain and more livestock (goats, sheep, camels and cattle) has better access to milk, blood and meat, leaving Nanam in between, with less access to wage labor and the ability to purchase carbohydrates and less access to the Lotikipi plain and associated livestock.

Child Development

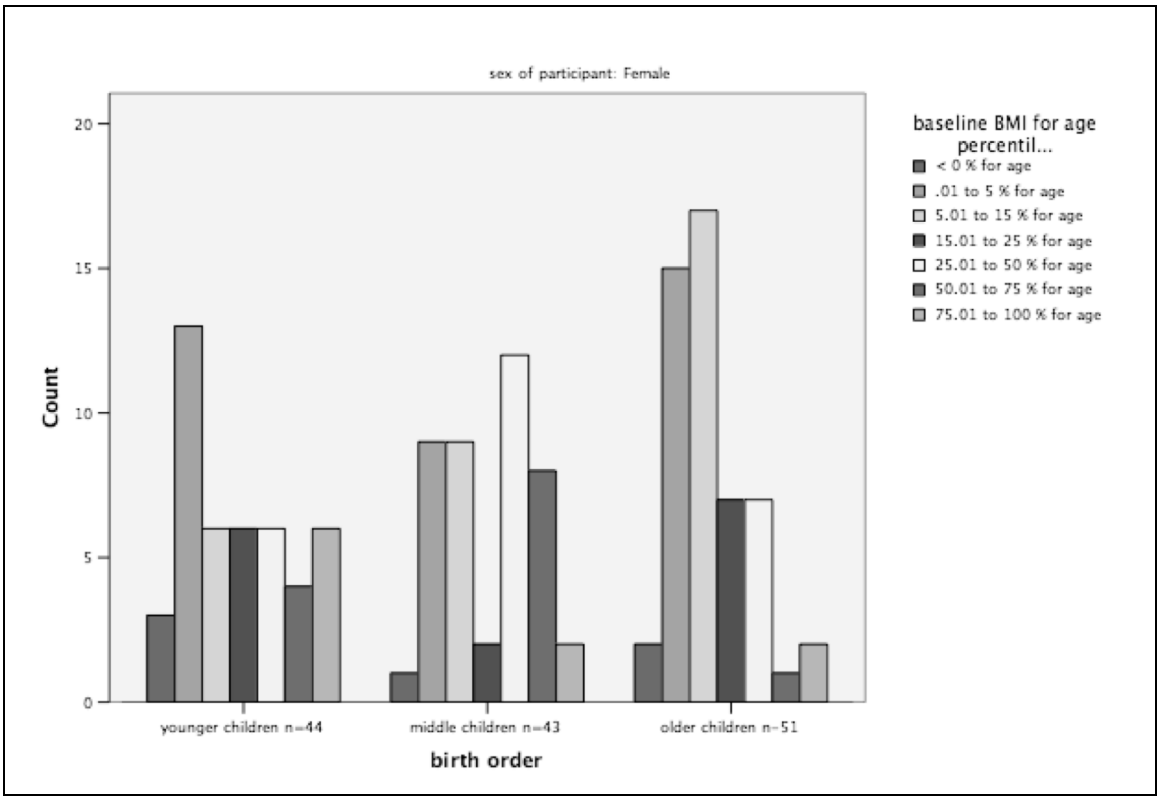
Each household makes its own decisions about movements, composition of homestead and satellite compounds, wild food collection, preparation and storage and has variable access to wage labor. The social standing of household members in the community is also variable. Some women belong to community cooperatives and can serve on village committees that have impact on relief and development projects. Men have leadership positions in *adakars,* village councils and can serve as administrative officials. All of these variables affect the larger household, forming a household ecology that affects health and nutrition (Berman et al, 1994).

Within the discussion of household ecology and how it relates to health is developmental niche theory in which Super and Harkness (1986) suggest that children's roles within the household, and contribution to household ecology, are dynamic and related to gender, relation to siblings and other household members as well as a child's individual agency. In seeking to analyze development niche as it operates in complex Turkana households, each child's relationship to siblings was defined as "among the oldest", "middle" or "among the youngest" birth order.

"Among the oldest" means they were the oldest boy or girl in the home compound of interest. Oldest children, boy or girl, were often mobile between homestead and satellite compounds. "Oldest" came to mean among the two oldest boys and girls to

account for the movement or absence of older children to meet labor requirements of multiple households. “Middle” is the largest category since it is the easiest to define. On rare occasions all of the older siblings might be gone from a household compound, leaving a middle child to aid in household or livestock work, but this was a temporary condition. “Among the youngest” is also somewhat dynamic since several mothers had babies during the data collection period. Thus the two youngest members of the household were defined as “among the youngest” but this time regardless of sex since at this age, sex has little impact on roles in a household.

Chapter Five describes index children’s time allocation by location and behaviors. Girls were more likely to be found working in a household compound than boys and were observed to share more frequently than boys. Girls’ work often consisted of care of siblings and aiding in food preparation. Boys will aid in care of siblings, but it is more common for girls to take on this role. In order to consider the relationship of this sibling care by older children and subsequent opportunities for sharing had on individual nutrition, crosstabulation of BMI percentiles categorized by percentile and birth order were considered by sex and found to be significantly related ($n = 138$, $df = 12$, chi-square $= 21.992$, $p = 0.038$*).



6.2 Crosstabulation of BMI for age percentile by birth order for females

As in the smaller group of index children, girl middle children reap the benefits of sibling care without the added energy expenditures of responsibility for younger children that older children incur. This explains the larger number of middle children with 25 to 50th percentile BMI or higher, considered a normal BMI. The added energy expense of household work and sibling care could explain the prevalence of lower BMI for age percentile of older girls. Girl youngest children exist across the spectrum of nutritional status. They have the largest number of individuals in the 75th percentile or higher BMI percentile in this analysis. This sub-group of well nourished younger children probably represent infants, or birth to two year olds, who receive care from most household members and have high priority access to nutrient rich foods like milk (Gray 1998).

There are many factors that affect nutritional status but according to eta, birth order explains 21 percent of the variation in this sample. Other factors such as household wealth, food baskets or male access to food must explain variation for Turkana boys since the same graph is almost equal for the three birth orders and the relationship is not statistically significant (n = 97, df = 12, 2-sided chi square = 10.425, p = 0.579).

Life history theory can also contribute to interpretation of these findings. According to the developmental niche theory, the relationship between siblings in a household can influence health and nutrition. Observation of Turkana children in middle childhood detects gender roles affecting time allocation and nutritional status even at these young ages. Life history theory proposes adapting biological development to optimize reproduction, yet biologic studies of nilotes, including Turkana, have demonstrated a prolonged growth phase, in essence postponing reproduction. Turkana girls are rewarded for cooperative behavior, as in sibling care or the work girls do around households, in a polygynous society, while Turkana boys are encouraged to spend time in the bush and to learn about the environment and livestock. Their time to reproduction is delayed and there is no reward for early maturation. In this analysis, there is no reward for incurring growth in height at the expense of weight, or expending all of the energy stores of males.

Conclusion

This dissertation has demonstrated how Turkana of northern Kenya continue to accommodate ecological and environmental changes in their unpredictable and harsh homeland. Their pastoralist livelihood remains important to social identity but a diverse array of livelihood strategies allows for a degree of plasticity evident in their settlement

patterns and herding practices from sedentary to nomadic. Historically Turkana have incorporated a diverse array of species into their herds, even changing the variety of cattle that is so important to their pastoralist identity. Cultural practices regarding social relations such as marriage, brideprice and age cohorts persist, but in subtly different forms to accommodate a new political and social environment. Certainly challenges remain, and persistent misunderstanding of their livelihood strategies by government and non-government agencies does not aid economic development of the region. Each chapter of this dissertation includes information on how these programs and policies have impacted settlement, livelihoods, nutrition, health and experiences of childhood. Better practices of evaluation and monitoring of Turkana livelihoods and programs have been presented here.

Chapter two provides the beginnings of important nutritional information on the contributions of wild foods to Turkana nutrition and health. In the ASALs of northern Kenya, or East Africa, wild foods can never be described as abundant but they are adapted to the unpredictable environment and, with ecological knowledge about region and season of availability, paired with local knowledge about preparation and storage, they could remain a valuable source of dietary diversity. Learning about these resources that are adapted to ASALS and promoting their continued use seems more productive than introducing non-native species that require more inputs of time, labor and resources like soil improvements and water that are rare. The example of *P juliflora,* which remains unaddressed by science or policy in this region, should be a strong deterrent or at least serve as a warning against introducing non-indigenous plants to this environment.

However, in spite of the problems with *P. juliflora,* Turkana plasticity has incorporated the wood and fruit of this species in to their livelihood practices.

The widely shared domain of knowledge of wild foods among Turkana is an excellent case study of local ecological knowledge and domain analysis. As such, it offers future opportunities for research of consensus studies or transmission of knowledge. As a model of ethnoecology, it also offers opportunities for cataloguing this local knowledge as a reference for scientists as well as future generations of Turkana or other pastoralists. This research project was only able to complete nutritional analysis of 22 wild foods from 18 species, leaving many more for future analysis.

Chapter three provides the most applicable method of understanding the importance of diversity and risk minimization. Turkana, as well as other pastoralists, have documented strategies of managing their environment through nomadism, *adakars,* and dividing of herds. This analysis on herd composition, using a participatory method, allows for assessments of herds, diversity and labor that are useful to academic studies of risk minimization, economic theories of price, value, utility, indifference and risk as well as livelihood policies and programs.

This participatory method could be expanded to specifically address indifference values and marginal utility of various species or combinations of species in specific environments. Livelihoods programs could compose indices to better evaluate herd diversity and measure impacts of projects.

Since food security, here referring to access to food as well as the resources that provide food, is clearly a part of livelihoods, Chapter four is an important element of any discussion on livelihoods. I use nutritional and health status as a measure of the success

or failure of a livelihood portfolio. Life history theory, primarily through the short-term biological tradeoffs of maintaining growth and health, allows for a true cross-sectional analysis of Turkana nutrition across the lifespan, rather than using one vulnerable group as a proxy for the population. Over time, the index population of children under the age of five years has become not just the proxy for the entire population but the isolated target of nutrition and health interventions. This practice discounts the nutrition and health of every other member of the population. Since NGOs are working with government agencies on health and nutrition programs in the region, there should be more consistent data collection and sharing to monitor community nutrition and health and to avoid the need for annual ad hoc surveys. These surveys are expensive, take manpower and other resources away from other programs and too often occur in isolation of other livelihood surveys.

Better documentation of nutrition and health across the lifespan through prospective data collection would provide valuable evidence of the true biological and social tradeoffs experienced during growth and development in an unpredictable environment with cyclical and sometimes chronic food shortages. This could then provide valuable insights in to evolutionary ecology, life history and child development. In addition, timely interventions could promote growth, development and health across the lifespan.

The interest in middle childhood in this dissertation grew out of the observation of NGO and government programs targeting children up until the age of five years. Questions arose about how children from four to 12 years accessed food, formerly provided by feeding programs but which disappeared after they turned five. The focal

follows of Turkana children in middle childhood demonstrated the amount of independent agency and the array of behaviors that mirror the diverse array of livelihood strategies of adults. When compared with the nutritional status in Chapter four, the impact of individual‘s behaviors proved to be significant. Some factors, like civil security, that had been expected to constrain agency, did not have an effect. Other factors, like season and birth order do prove to be important. The most influential factor on children’s behavior and nutrition seems to be gender. Even young children exhibit gender specific time allocation by place and across seasons.

Life history theory, especially regarding embodied capital and gender roles toward successful reproduction provide insights into not only behaviors but also the biological impacts of those behaviors. Developmental niche theory and household production of health and nutrition are also valuable tools in considering birth order and household position of individual children and adults in complex Turkana households. Future analysis of specific play behaviors of boys and work behaviors of girls should address in more detail theories of embodied capital and children’s learning.

The household ecology, nutritional ecology and child development examined in the study population in this chapter are important for a better understanding of Turkana livelihoods and are generalizable to other pastoral populations in ASALs, contributing to anthropological theory on pastoral modes of production and livelihoods. By focusing on middle childhood, this research adds to anthropological literature on both the biology and culture of childhood. Finally, by incorporating analysis of participatory research and including a life history approach to nutritional ecology while working alongside

development and relief projects in the field, this research contributes to literature of the anthropology of development and applied development projects.

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APPENDICES

APPENDIX A. NUTRITION ANALYSIS OF TURKANA WILD FOODS

APPENDIX B. LOCAL EVENT CALENDARS

APPENDIX C. WILD FOODS BY SCIENTIFIC AND LOCAL NAME

APPENDIX A. NUTRITION ANALYSIS OF TURKANA WILD FOODS

Local Name	Scientific Name	Family	Description	% Moisture	% Protein	% Fat	% Fiber	Total Ash /minerals	% Carbo-hydrates	Vit A mg/100g	Vit C mg/100g
Erut	*Maerua decumbens*	Capparidaceae	dried fruit	8.37	20.75	0.89	1.25	2.08	66.67	0.11	135.95
Ekolese	*Cucumis prophetarum*	Cucurbitaceae	dried fruit	9.1	18.13	6.9	21.63	11.54	32.7	0.55	85.4
Edapal-dried	*Dobera glabra*	Salvadoraceae	dried nut	8.63	20.4	1.55	2.03	5.79	61.6	0.14	173
Edung	*Boscia coriacea*	Capparidaceae	dried fruit	7.72	21.01	1.79	1.8	3.64	64.04	0.03	496.9
Edapal eminae	*Dobera glabra*	Salvadoraceae	tree sap	15.5	5.17	1.2	0.35	5.8	71.98	0.02	71.69
Edapal	*Dobera glabra*	Salvadoraceae	red flesh/ fruit							0.82	145.85
Edapal	*Dobera glabra*	Salvadoraceae	fresh-nut	42.6	11.26	0.34	1.54	3.28	40.98	0.27	1344.76
Elamach	*Balanites pedicullaris*	Balanitaceae	fresh nut	67.64	4.39	0.73	4.59	1.88	20.77		
Edome	*Cordia sinensis*	Boraginaceae	fresh fruit	80.7	1.98	0.51	1.1	1.22	14.49	12.18	129.28
Ngakalalio	*Ziziphus mauritiana*	Rhamnaceae	fresh fruit	48.26	2.67	0.78	2.85	2.39	43.05	50.43	.033
Ekadela	*Coccinia grandis*	Cucurbitaceae	fruit	84.9						4.62	56.86
Ekolese	*Cucumis prophetarum*	Cucurbitaceae	fresh fruit	84.7						0.16	415.3
Ebolo	*Cucumis figarei*	Cucurbitaceae	fresh fruit	83.15	3.44	2.41	4.68	2	4.32	13.83	.015
Ekaletelete	*Portulaca oleracea*	Portulacaceae	leaves and stems	89.7	2	0.59	1.32	2.47	3.92	0.57	173.07

Local Name	Scientific Name	Family	Description	% Moisture	% Protein	% Fat	% Fiber	Total Ash /minerals	% Carbo-hydrates	Vit A mg/100g	Vit C mg/100g
Murere	*Corchorus trilocularis*	Tiliaceae	leaves	72.9	6.24	0.75	2.25	3.61	14.25	3.35	650.15
Akapurait	*Ipomea mombassana*	Ipomaceae	leaves	81.8	5.16	0.46		2.16		2.93	255.8
Dodo	*Amaranthus hybridus*	Amaranthaceae	leaves	76.3	6.48	0.63		4.26		4.35	1344.8
Ekamongo	*Leptadania hastata*	Asclepiadaceae	leaves	60	7.04	2.15	4.66	5.75	20.4	3.47	64.52
Loarikimak	*Adenia volkensii*	Passifloraceae	leaves	86.8	3.94	0.67	1.37	1.88	5.34	3.54	272.65
Eosin Aikeny	*Justicia uncinulata*	Acanthaceae	leaves	86.3	3.27	0.5	1.77	2.96	5.2	5.25	5.93
Egilae	*Vatovea pseudolablab*	Papilionaceae	leaves							17.04	2.050
Egilae	*Vatovea pseudolablab*	Papilionaceae	tuber	75.07	0.26	2.47	0.26	1.151	19.52	27.17	0.130

These nutritional analyses were completed on specimens collected in North Turkana District in 2006 and 2007 where they were cleaned and prepared as if for consumption. They were then transported to University of Nairobi, Upper Kabete Branch, in iced coolers for preservation during the 36 to 48 hour journey. Analysis was conducted by Jeremiah M'thika and Rosemary Kamau of the Laboratory in the Department of Food Science, Nutrition and Technology.

APPENDIX B. LOCAL EVENT CALENDARS

Local event calendar for Lokichoggio/Lopiding region

Year/ Ekaru	Turkana name	Year/ Ekaru	Turkana name
2005	Nangolenyang	1967	Torongdol
2004	Akiporo e ngor	1966	Ekarumama / Pusikou
2003	Kanyangiro	1965	Aribokin / Ebolo / Etop
2002	Arama Ngutuk Akuru	1964	Lolewa / Ngatuk kirionok
2001		1963	Elachit/Emusugut / Eur ka Areman
2000	Munyes/Lotukoi	1962	Kibek bek / A Apeikiru
1999	Kidopo/ Logaara	1961	Achaka ekipul / Epotipot / A akiro kirion
1998	Ebabei	1960	Ngamotor / Lorookino
1997	Ejokopi	1959	
1996	Echut	1958	
1995	Lokenyae / Ngikoi / Ngakinei ka ngikaala a nangokuo	1957	
1994	Ngakimia / A atom a napus a Liwan / Nakodoopus / Lokopir	1956	
1993	Epoli / Apeikiru / Ngakalel	1955	
1992	Lokere / Lobolibolio Abwangeta Ngitoposa ekisil a Narus	1954	Ekuwom Nyang
1991	Erengui / Nakwajom / Ngakipi Ekisil a Loketer a Nadapal	1953	
1990	Arikirik / Eregae	1952	
1989	Ebom / Lokichuma/lokiyo	1951	
1988	Edidingait / Apuwongimoe / Nagilgil	1950	
1987	Lowyepwa / Echoto Etiriwae Kadwaran / Enyota	1949	
1986	Nyonga/ Erongonyang/ Ekineimanang	1948	

1985	Ameritaruk / Apetarere Maalim	1947	
1984	*Topos* / Akorio / Lonyagalem/ Anjamea angolol Ngikoporea alo kugu Letea	1946	
1983	*Lokalemoe* / Ngidin / Ngimomua	1945	Ekapesipesit
1982	*Ekanarimug* / Lokalimoe /Kiroirook	1944	
1981	*Angiken* / Ngakolil / Ekamarimug / Kilejok	1943	
1980	Lopiar	1942	
1979	Longoroi / Emarea nangolenyang ngitunga	1941	
1978	*Alibatuo* / Abwangunet atom be epen alo Uganda / Atonia Kenyatta	1940	
1977	Angichowa	1939	
1976	Akiporo ngorok	1938	
1975	Amagekimet / Ekisil angitoposa	1937	
1974	Ibore akwaan / Ngitwol / Namagal	1936	
1973	Aribokin	1935	Erupe Angakot Alomeyan
1972	Nangorok / Akoro	1934	
1971	Loleewa	1933	
1970	Kimududu / Kibekebek	1932	
1969	Elachit / Emarere ngitunga	1931	
1968	Edome/Arengedome/aritae	1930	Elongore

This calendar was derived from a calendar constructed by Lokichoggio administrative officials for the 1999 census. Multiple names in one year represent different seasons. Local names provided by informants from Nadome are in italics. This calendar was compiled in September, 2006.

Local event calendar for Lokangae / Lotikipi Plain region

Year/ Ekaru	Turkana name	Year/ Ekaru	Turkana Name
2006	Puru	1974	Amugikimet
2005	Ngakalel	1973	Aribokin
2004	Adip	1972	Erupe Ekoromwae
2003	Epoo	1971	Kibekbek
2002	Angakipi	1970	Lolewa
2001	Ebeibei	1969	Kimududu
2000	Kengoran	1968	Torongdol
1999	Munyes	1967	Lokichuma
1998	Logaara	1966	Pusukou
1997	Etwang Akwee	1965	Erengedome
1996	Loketer	1964	Ekolese
1995	Epol	1963	Etop
1994	Lobolibolio	1962	Ekurut
1993	Tuyunae	1961	Apain
1992	Etiriwae Kadwaran	1960	Atomke Areman
1991		1959	Erupe Akuyo
1990	Arikirik	1958	Epotipot
1989	Nakodopus	1957	Akiru kirion
1988	Akorio	1956	Emusugut
1987	Apuwongimoe	1955	Ngamotor
1986	Echoto	1954	Ngakalel
1985	Nakatuman	1953	Esurut
1984	Ekamarimug	1952	Akwa Esurugait
1983	Ameritaruk	1951	Nawolojem
1982	Ngichokaen	1950	Eloch
1981	Erupe Ngikoparean	1949	Lojala
1980	Kilejok	1948	Edupanyang
1979	Lopiar	1947	Napelap
1978	Longoroi	1946	Lokulit
1977	Erupe Ngijie	1945	Lotira
1976	Angichowa	1944	Itawos
1975	Akipor Ngorok	1943	Erupe Ngakile

These year names represent a consensus between the administrative chief of Lokangae, members of the Lokangae village council and village elders. This final draft was completed in June, 2007.

APPENDIX C. WILD FOODS BY SCIENTIFIC AND LOCAL NAME

Scientific Name	**Family**	**Local name**
Acacia mellifera (Vahl) Benth.	Mimosaceae ^	*Ebenyo*
Acacia nubica Benth.	Mimosaceae ^	*Epetet*
Acacia reficiens Wawra.	Mimosaceae ^	*Eregae*
Acacia senegal (L.) Willd.	Fabaceae ^	*Ekunoit*
Acacia seyal Del.	Mimosaceae ^	*Ekoromait*
Acacia tortilis (Forssk.) Hayne	Mimosaceae ^	*Ngitit*
Adenia volkensii (Harms)	Passifloraceae *	*Loarakimak (TYW08)*
Amaranthus graecizans L.	Amaranthaceae *	*Lokiliton*
Amaranthus graecizans L.	Amaranthaceae *	*Loyei Ngorok (TYW03)*
Amaranthus hybridus L.	Amaranthacea *	*Dodo (TYW02)*
Balanites aegyptiaca (L.) Del.	Balanitaceae ^	*Eroronyit*
Balanites pedicullaris Mildbrix Schlecht.	Balanitaceae ^	*Elamach*
Balanites rotundifolia(Van Tiegh.) Blatt.	Balanitaceae ^	*Ebei*
Berchemia discolor (Klotzch) Hemsl.	Rhamnaceae ^	*Emeyen*
Boscia coriacea Pex.	Capparidaceae ^	*Edung*
Brachystelma johnstonii N.E. Br.	Asclepiadaceae *	*Eputen*
Cissus rotundifolia (Forsk.) Vahl	Vitaceae *	*Lorodo*
Citrullus lanatus (Thunb.) Mansf.	Cucurbitaceae +	*Namunye*
Coccinia grandis (L.) Voigt	Cucurbitaceae *	*Ekadela (TYW07)*
Cocculus hirsutus (L.) Diels.	Menispermaceae ^	*Lokito Kayep*
Corchorus trilocularis L.	Tiliaceae *	*Murere (TYW04)*
Cordia sinensis Cam.	Boraginaceae ^	*Edome*
Cucumis dipsaceus Spach	Cucurbitaceae *	*Eome*
Cucumis figarei Nand.	Cucurbitaceae *	*Ebolo (TYW05)*
Cucumis prophetarum L.	Cucurbitaceae *	*Ekolese*
Dobera glabra (Forssk.) Poir.	Salvadoraceae ^	*Edapal*
Dregea Schimperi (Decne.) Bullock	Asclepiadaceae *	*Loderekae*
Ficus sycomorus L.	Moraceae ^	*Echoke*
Grewia mollis Jass.	Tiliaceae ^	*Epat*
Grewia tenax (Forssk.) Fiori	Tiliaceae ^	*Engomoo*
Grewia villosa Willd.	Tiliaceae ^	*Epongae*
Hydnora abyssinica Schweinf. (H. johannis Becc.)	Hydnoraceae *	*Aurengo*
Hyphaene compressa H. Wendl.	Palmae ^	*Engol*

Ipomea mombassana Vatke	Ipomaceae *	*Akaporait*
Justicia uncinulata	Acanthaceae *	*Eosin Aikeny (TYW09)*
Kedrostis gijef (J.F. Gmet.) C. Jeffrey	Cucurbitaceae *	*Edadalasikin*
Leptadenia hastata (Pers.) Decne.	Asclepiadaceae *	*Ekamongo (TYW10)*
Lycium europaeum L.	Solanaceae *	*Ekerereu*
Maerua decumbens (Brongn.) DeWolf	Capparidaceae ^	*Erut*
Meyna tetraphylla (Heirn.) Robyns	Rubiaceae +	*Esugumaran*
Portulaca oleracea L.	Portulacaceae *	*Ekaletelete*
Prosopis juliflora	Fabaceae +	*Ebekut*
Rhus natalensis Krauss	Anacardiaceae ^	*Ekadeteo*
Salvadora persica L.	Capparidaceae ^	*Esekon*
Solanum villosum Mill.	Solanaceae +	*Suuya*
Sterculia Africana (lour) Fiori	Sterculiaceae ^	*Epete(t)*
Tamarindus indica L.	Caesalpiniaceae ^	*Epeduru*
Tribulus cistoides ssp cistoides	Zygophyllaceae +	*Esuguru (TYW01)*
Vatovaea pseudolablab (Harms) Gillett	Papilionaceae *	*Egilae*
Ximenia americana L.	Olacaceae ^	*Elamae*
Ziziphus mauritiana Lam.	Rhamnaceae ^	*Ekalale*

Local names are those given by local informants in Lokichoggio Division, North Turkana District in July of 2005. There are multiple spellinga of these names in various references. Some species were identified with voucher specimens that are stored at the Kenya Resource Center for Indigenous Knowledge at the Museums of Kenya in Nairobi. These are marked (TYW) next to the local name.

* (Agnew 1974)

^ (Beentje 1994)

(Dharani 2002)

+ (Maundu et al, 1999)