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Livestock Acquisitions Dynamics in Nomadic Pastoralist Herd Demography: A Case Study Among Ngisonyoka Herders of South Turkana, Kenya

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Despite the attention given to social relations in the pastoral literature, the role of livestock acquisitions—additions of livestock to herds through bridewealth, exchanges, gifts, payments, and begging (requests)—in herd build up has usually been assumed to be relatively minor compared to births and relevant mostly when the need for rebuilding arises after major losses. This study is based on an unusual set of data—the reproductive histories of the female cattle, camels, and goats and sheep of 13 Ngisonyoka Turkana nomadic herders in northwestern Kenya, collected in 1987. The article reports on the means by which mothers were added to the herd and how these changed through time. The results suggest that for this population in the late 1970s and 1980s, acquisitions were not merely relevant when disaster struck, but instead were a continuously important component of herd management. The results demonstrate the crucial role of social networks in the survival of Ngisonyoka pastoralists in their non-equilibrial ecosystem. Social exchanges, such as bridewealth, provide a resource security well suited to the challenges of coping with such unpredictable environments. Researchers and policymakers are urged to make efforts to support such indigenous networks if they want nomadic pastoralists to continue their effective use of arid, marginal lands.

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INTRODUCTION

Despite the attention given to social relations in the pastoral literature, the role of acquisitions—additions of livestock to the herd through bridewealth, exchanges, gifts, payments, and begging[4]—in herd build up has usually been assumed to be relatively minor compared to additions from births within the herd.[5] Generally, acquisitions have been considered as relevant mostly when the need for rebuilding arises after major losses, and not as a continuous component of herding management. As a result, the pastoral mode of production has generally been perceived as mostly driven by natural forces and less through social ties and networks. In contrast to this view, data from a 1987 demographic study of Ngisonyoka Turkana herds in northwestern Kenya, presented in this study, support ethnographic evidence that has long suggested that acquisitions **do** make an important contribution to herd growth (Bollig, 1998; Gulliver, 1955; Storas, 1997).

The Turkana inhabit a non-equilibrial ecosystem, driven or controlled by abiotic processes, such as rainfall and water availability (Dyson-Hudson and McCabe, 1985; Ellis *et al.*, 1988, 1993; Leslie *et al.*, 1999; Little *et al.*, 1999; McCabe, 2004). Because of its highly dynamic character, flexibility and opportunism characterize Turkana social organization (Dyson-Hudson and McCabe, 1985; Gray *et al.*, 2001; Little and Leslie, 1999; McCabe, 2004). The insurance and security that comes from a herder's social network is part of this flexibility, and has been a continuing factor in Turkana society (Gulliver, 1955; Johnson, 1990, 1999; McCabe, 1994, 2004). Livestock or herding partnerships (or "stock associates") are part of this network, and are established by birth, affinal relations, and deliberate pledges between bond friends (Gulliver, 1955; Johnson, 1990). Johnson (1999) suggests that for the Turkana, these social networks are dense—that is, many friends are themselves friends with each other, and social relationships vary according to degrees of "friendliness." This criterion may be more significant and treasured than kinship and affinity *per se*. People in active relationships share food, exchange livestock, and engage in mutual labor and leisure. According to Johnson (1999), the size of a herder's social network influences his herding success. McCabe (1994) argues that those Turkana that remain nomadic still depend on each other to maintain their long-term survival in their drought prone environment.

[4]Begging (or a request) is a common and culturally accepted form of social exchange in Turkana, which involves a high degree of reciprocity (Johnson, 1999).

[5]Acquisitions could also result from raiding, but this will not be dealt with here (see Sample and Data characteristics).

Despite this general centrality of social relationships and their role in livestock acquisitions, the importance of socially induced livestock exchanges to herd growth has with few exceptions (e.g., Broch-Due, 1999) remained largely unrecognized and seldom quantified. Acquisitions are channeled through a complex web of exchange networks and come in various forms. The greatest acquisitions of livestock can occur when two families establish ties through marriage (Gulliver, 1955; Johnson, 1999). Bridewealth (literally "stock of marriage") in the name of the groom is transferred to the relatives of the bride. These transfers usually occur over an extended period of time and, for first marriages, symbolize the initial stage of a man's independence as a herd owner. Often, the bridewealth for the first marriage is from animals inherited after the death of the groom's father. For later marriages, the potential bridegroom goes to each of his stock associates and begs from them contributions of all kinds of stock for about half of the bridewealth (Gulliver, 1955). Bridewealth for the Turkana is particularly high: Johnson (1999) found an average transfer of 69 livestock units[6] among 22 herd owners, or 60–80 large animals, compared to a standard of about 20 cattle for most African patrilineages (Bollig and Lang, 1999; Schneider, 1964).[7] Broch-Due (1999) suggests that among the wealthy this number may be driven up to 300 head of stock and explains that this might be because bridewealth among the Turkana is one of the few avenues left in which the interests of the senior generation and the cattle-rich are politically played out. Demographically, bridewealth is important in terms of the balance between livestock and labor. Until all bridewealth is paid, children are the "property" of the father or brother(s) of the mother. Thus, without animals, a herder may have biological children, but not access to the social and economic benefits of his children needed to sustain herd building and management.

Livestock acquisitions through forms of exchange can entail the trading of livestock, daily food sharing, begging, or ceremonial food sharing at feasts, such as weddings. Johnson (1999) finds that Turkana differentiate food sharing from livestock exchange, with livestock exchange occurring much less frequently than food sharing. He also notes, however, that it is often difficult to differentiate the two (some level of friendship is common to both). When livestock exchange is in the form of trade (*akilokony*), different species may be exchanged for each other, and this exchange may involve herders who do not know each other very well. *Akilokony* is a way

[6]Livestock unit: 10 smallstock (sheep/goat) is equivalent to one large stock (cow/camel).

[7]Bollig and Lang (1999) suggest that the neighboring East Pokot have had a much lower bridewealth transfer: "Bridewealth payments, which had increased over twenty and even thirty heads of livestock during the first decades of this century decreased once again to about twelve cattle and thirty heads of small stock."

to diversify the species or adjust the sex ratio within a species of the herd, and it does not necessarily create a strong mutual bond between herders. Another way for an animal to be acquired is through request (*akilip*). This can be categorized as begging or as gifts. The difference between a begged animal and a given animal is contextual and, as will be demonstrated, species-dependent. Begging is a respected form of behavior. *Akilip* transactions involve a mutual association between livestock giver and livestock receiver based on a type of indebtedness.[8] Finally, acquisition can occur as payments received in the form of livestock. This can take place both as the means for settling serious injuries and disputes (Gulliver, 1955), as well as the repayment of debts when livestock was given away to or begged by another herder, or when another herder speared one of the animals for food.

THE ROLE OF LIVESTOCK ACQUISITIONS IN HERD DEMOGRAPHY LITERATURE

The centrality of the balance between labor and livestock demography in nomadic pastoralism has long been recognized (Stennings, 1959; Salzman, 1971; Dyson-Hudson and Dyson-Hudson, 1980; Dyson-Hudson and McCabe, 1985; Fratkin, 1987, 1989; Sperling and Galaty, 1990; Fratkin and Smith, 1994; Shell-Duncan, 1994; Thébaud, 1995; Sieff, 1997, 1999; Leslie and Dyson-Hudson, 1999). Still, this interest has not motivated many studies on the population dynamics of pastoralist herds. Part of the reason for this neglect relates to the difficulty of obtaining herd demographic data. Like the Turkana, many pastoralists believe that overt counting of someone else's livestock is impolite, may harm animals, or bring bad luck. Surreptitious counting is difficult in physically demanding areas and likely to be inaccurate (Dahl and Hjort, 1976; Dyson-Hudson and McCabe, 1985; Leslie and Dyson-Hudson, 1999), although the nurturing of good relationships with the herders can make overt counting possible.[9]

Within the literature that touches upon herd demographic issues, an explicit interest in acquisitions is rare. Although the centrality of livestock was easily identified as the "East African cattle complex" by colonial anthropologists (Herskovits, 1926), interest in the connection between cultural systems and ecological needs was emphasized in the 1950s and 1960s

[8] In an *akilip* transaction "you cannot ask back the same animal that was asked of you until a lot of time passes" (Johnson, 1999). Although the Turkana do not keep equal accounts (a bull for a bull, a heifer for a heifer), they do remember who has asked for what from them.

[9] Researchers have used aerial surveys to sample pastoral areas and the sizes of their livestock herds, but here large errors are also possible due to factors such as seasonal migrations and temporary combining of herds from different families.

(Evans-Pritchard, 1940; Gulliver, 1955; Steward, 1955; Stennings, 1959). Gulliver's descriptions of the Turkana focused in great detail on the networks of kinship, affinal, and bond relationships that comprised herding partnerships. These, according to Gulliver, functioned to provide both emotional support and the right to seek livestock in times of need, including marriage, compensation, fines, and herd build-up:

> The owner, in rebuilding his herd, seeks help from his stock-associates. Periodically a man takes advantage of his rights to beg the gift of an animal or two—possibly to obtain a new bell-ox, bull, goat-buck, or ram. In normal social life there is a more or less continuous giving, receiving and exchanging of animals, mainly for essential requirements, but partly also for its own sake in order to make recurrent expressions of vital relationships. (Gulliver, 1955, p. 198)

Gulliver suggests that in "normal social life" livestock exchange takes on a continuous character. Livestock are taken as the "principle expression of all social relations of real and lasting importance" (p. 52).

With the initiation of the Human Adaptability component of the International Biological Program (IBP) in the 1960s, an interest in the ecosystem concept emerged in anthropology (Barth, 1956; Geertz, 1963; Moran, 1990; Netting, 1986; Vayda and Rappaport, 1968) as well as in pastoral studies conducted within tundra and desert ecosystems settings (Dyson-Hudson, 1969, 1972; Dyson-Hudson and Dyson-Hudson, 1969; Little *et al.*, 1990). Building on earlier criticisms of the economic irrationality of the cattle complex explanatory framework (Deshler, 1953, 1963; Gulliver, 1955; Schneider, 1974), an influential ecological argument against the solely social and symbolic emphasis on livestock came from Dahl and Hjort's *Having Herds* and related publications (1976, 1979), in which the growth dynamics of herds (cattle, camels, and goats and sheep) were mathematically simulated. However, despite their acknowledgment of the existence of social exchanges, no data on livestock acquisitions were incorporated in their growth models.[10] As reasons, they pointed to the lack of available data and the problems of counting, but they also argued that the circulation of domestic stock was mainly aimed at disaster mitigation (as in an insurance policy):

> The recuperative capacity of a household after a major stock loss is dependent on wealth, raiding, and an active set of stock allies, which allow a man to rapidly build up a considerable herd at a critical moment of time. (Dahl and Hjort, 1979, p. 21)

[10]They noted in a brief chapter: "There are of course great problems involved in predicting the evolution of a particular herd. Our calculations concern theoretical possibilities, and can in most cases only apply to large populations. In reality, as every anthropologist knows, pastoral societies are characterized by the constant redistribution of wealth in terms of animals, and no individual's herd grows or declines independently of other herds. Gifts are given or received, animals are borrowed or loaned" (1976, p. 23).

Once more, the infrequent occurrence of livestock acquisitions was attributed to the case of a "critical moment" alone, with the implication that acquisitions do not have a significant effect on herd growth relative to that of reproduction.

In the wake of the sub-Saharan droughts in the early 1970s, an upsurge in literature on nomadic pastoralism in the 1980s emphasized economic development (Fratkin and Smith, 1994; Gray *et al.*, 2001). The capitalist push for "modernization" of the traditional livestock system to commercial beef markets (see, for example, Simpson and Evangelou, 1984) generated a large body of literature on the fertility of livestock, emphasizing measures such as age at first birth, calving interval, and various fertility rates (Butterworth, 1983; Gueye *et al.*, 1982; Mukasa-Mugerwa, 1989; Sabino *et al.*, 1981). In this same period, the longitudinal South Turkana Ecosystem Project (STEP) was initiated, focusing on pastoral management strategies and the impact of pastoralists and their livestock on the structure and productivity of the arid savanna ecosystem (Dyson-Hudson and McCabe, 1985; Ellis *et al.*, 1988, 1993; Little and Leslie, 1999; McCabe, 2004). STEP researchers criticized homeostasis (as in Rappaport, 1967) as an outdated ecosystem model (see also Ellis *et al.*, 1993; Moran, 1990) and focused on adaptive individual strategies that generate collective patterns of behavior. Most of the STEP results pointed at opportunism and flexibility as the key organizational feature of Turkana society (Little *et al.*, 1999). In this context, attention was given to herd demography by McCabe in his 1980–1982 study of herd mobility and post-drought herd recuperation of four Ngisonyoka Turkana families (Dyson-Hudson and McCabe, 1985; McCabe, 1982, 1984, 1987, 2004). This study focused on mobility but included acquisitions as a component of the herd increments needed to pull the four households through times of hardship and recuperation (Dyson-Hudson and McCabe, 1985; Leslie and Dyson-Hudson, 1999). An emphasis on social relations was further sustained by researchers interested in pastoral property relationships (see, for example, Baxter and Hogg, 1990). In the case of the Ngikamatak Turkana, Broch-Due (1990) argued that animal transfers retain references to the original donors, causing each animal to be subject to overlapping claims from different herders. Unfortunately, this study, based on more than 3000 animals, did not report on the role of births relative to acquisition through inheritance, purchase, exchange, gifts, and bridewealth.

Despite the increasing attention to livestock exchange, the idea that acquisitions were merely a form of disaster minimization through a system of social insurance persisted. Mace and Houston (1989) included an exchange component in their population growth simulation of camel and goat herds. With the specific goal of analyzing the strategic timing

of investments in camels or in goats relative to herd size, this component indicated only the adjustment of the mixture of species kept, and none of the other acquisition components.[11] Since the late 1970s, an issue of increasing interest was the wrongly assumed egalitarian ethos of East African pastoralists (Broch-Due, 1999; Dyson-Hudson, 1969; Schneider, 1979; Sieff, 1997). Often pointing out the lack of data, none of these critiques paid explicit attention to the role of livestock acquisitions.[12] In this context, Sieff (1999) provided a rare glimpse of acquisitions among the Datoga of Tanzania, mentioning that 86% of cattle came into herds through birth, while only 3% of cattle were purchased and 11% were gifts. Indeed, the conclusion that successful herd growth is mostly reliant on reproductive rates seemed warranted: "The other processes that result in cattle entering the herd (namely receiving a gift, or purchasing cattle) are negligible; these are not discussed here" (Sieff, 1999, p. 8).

This brief literature survey suggests that despite the lack of data, it has generally been assumed that the role of livestock acquisitions in herd build up is mostly reserved for critical times and herd rebuilding (risk minimization through social insurance) and that acquisition is insignificant relative to the effect of fertility. In the remainder of this article, we present demographic evidence that suggests that the role of livestock acquisitions among the Ngisonyoka Turkana in Kenya is more significant than previously thought.

GEOGRAPHY AND ECOLOGY OF THE NGISONYOKA TURKANA

The Turkana live primarily in the desert and savanna regions of northwestern Kenya, mostly in Turkana District (68,000 sq. km.; population about 450,860 [Kenyan Central Bureau of Statistics, 2001]). The topography consists of dry plains, which form the floor of the Rift Valley, juxtaposed with mountain massifs. A continuous mountain range forms the western wall of the Rift Valley, and other isolated mountain ranges are scattered throughout the district. Elevations vary from approximately 350–400 m in the plains to 2500 m in the high mountains. South Turkana experiences high temperatures, with the monthly mean ranging between 29°C and 31°C

[11] Interestingly, Mace could not validate predictions of the model when she compared it to real data (Mace, 1990). Finding significant regional differences, she suggested this could be explained by biological differences between species (drought susceptibility) or the "mean value" of smallstock, ignoring exchange patterns.

[12] Borgerhoff Mulder and Sellen (1994) continued to emphasize fertility and decrements: ''Pastoral herds have been aptly characterized as subject to both natural increase and catastrophic loss (Fratkin and Roth, 1990) and pastoral society has been deemed concomitantly volatile.''

(Little *et al.*, 1999). Rainfall is very low and unpredictable, in both space and time, with long rains expected to begin in March or April and short rains in November. There much variation in the degree and timing of these seasonal changes, and cycles of disastrously low rainfall or several years of sub-normal rainfall appear to occur at 3–5 year intervals. These periods of drought are associated with decreases in plant productivity that may require several years for recovery (Ellis *et al.*, 1993). The plains are dominated by dwarf shrubs, but may support an abundant cover of annual grasses when rainfall is plentiful. Perennial grasses, trees, and annual grasses are found in the mountains, which receive far more precipitation than the arid plains.

The Ngisonyoka are one of 19 *ngitela*, or territorial sections of Turkana. Ngisonyoka territory lies in the south of Turkana District, circumscribed by the Turkwel River to the north and west, the Kerio River to the east, and the district boundary to the south (Fig. 1). Ngisonyoka herders on occasion also utilize the Loriu high plateau region on the eastern side of the Kerio River. In 1983, roughly 10,000 Ngisonyoka Turkana were estimated to still practice nomadic pastoralism within this area of approximately 11,000 square kilometers (EcoSystems Ltd., 1984) and the population has likely grown since then.

SAMPLE AND DATA CHARACTERISTICS

As one of the STEP researchers, McCabe followed four Ngisonyoka Turkana families on a daily basis between 1980 and 1982. This study provided important information on livestock recovery after the devastating 1979–1981 drought (Dyson-Hudson and McCabe, 1985; McCabe, 1984, 1987, 2004). As a follow-up to this research in 1987, McCabe collected the reproductive histories of the female livestock of 13 Ngisonyoka herders, including the means by which the 91 cattle (*Bos indicus*, or *zebu*), 76 camels (*Camelius dromedarius*), and 157 sheep (*Ovis aries*) and goats (*Capra hircus*) were added to the herds. These retrospective demographic data date from 1987 back to 1972 and provide a rare look at herd demographic processes. All the animals in the sample gave birth to offspring.

The period of analysis was an erratic climatic period (relative to long-term patterns) in which two droughts (1980, 1984) affected the herd population.[13] After the drought period of the early 1970s (1970–1975) the next major drought lasted from late 1979 until early 1981. Only 150 mm of

[13] In South Turkana, the long dry period of 1920 to 1955 was followed by a 20-year sequence of relatively high rainfall with only a few major droughts, including the sub-Saharan drought of the early 1970s (1970–1975) (Ellis *et al.*, 1993; Gommes and Petrassi, 1996). This relatively consistent and benevolent period ended in 1979–1980, when rainfall patterns became erratic.

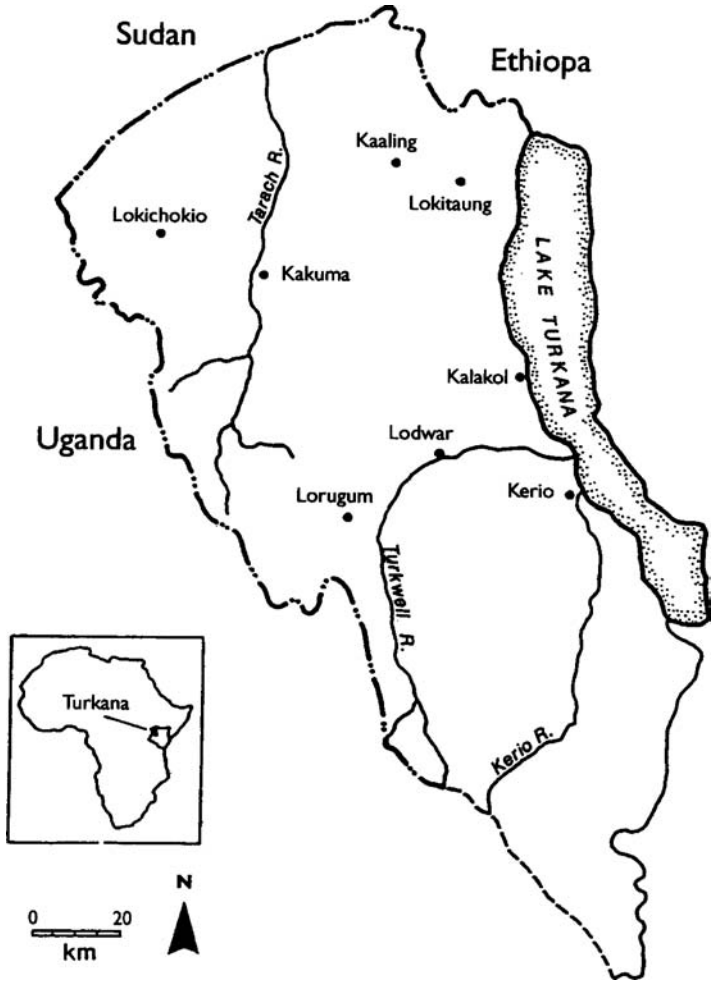

Fig. 1. Turkana District in Kenya.

rainfall was recorded during these 20 months in Lokori, a town within Ngisonyoka territory Losses of 80% of the smallstock (goats and sheep), 40% of the camels, and 90% of the cattle were reported for much of Turkana (Hogg, 1982). Ngisonyoka fared somewhat better than many sections, especially those in the north, but nonetheless lost roughly half of their livestock. Yet another, single year, drought occurred from late 1983 to late 1984 (less than 50 mm of rain in Lokori) but this caused few livestock deaths, because of its short duration (Ellis *et al.*, 1993).

The analysis reported in this paper concerns the origins of the livestock mothers ($n = 324$) as reported by 13 herd owners. The field interviews were conducted by visits to the *awi*—the residential group and main livestock management unit (camp)—of each herder and occasionally at other places. The reason for entry into the herd was reported in the life histories of 78 of the 91 cattle, 61 camels (of 76), and 120 goats and sheep (of 157). The Turkana do not use a regular calendar, so dates were recorded in terms of an "event calendar" (Leslie *et al.,* 1999). Because of the decreasing sample size of mothers at older ages, herd entry data become sparse in earlier years. Also, a herder's memory about older animals might be poorer, so data for more recent years are probably more accurate than those for earlier years. However, the data for most of the animals were cross-checked with other family members and friends. Because livestock are so central to Turkana life and herders know the characteristics and history of each of their animals in detail, we are generally confident in their reporting, especially with respect to the large animals. The sample consists of animals that had succeeded in bearing young. The less fecund and possibly less healthy animals who had not yet given birth in 1987 were not included in the sample, possibly causing truncation bias in the most recent years. This could affect our results if reproductive success varies with the season the animals entered the herd. However, we do not believe that this is likely to have affected our central results.

Acquisitions are defined as animals obtained through bridewealth, begging (*akilip*), gifts, payments, and exchange. *Exchanges* entail the form of trading livestock known as *akilokony*. Such exchanges involve giving up an animal as well as receiving one, so herd size is not necessarily affected. However, because the exchanges are not always simultaneous and are likely to involve different species or sexes, *akilikony* exchanges often do affect herd composition and growth potential, and are relevant to herd build up. None of the herders mentioned acquisitions through raiding. This absence does not mean that the herders in this sample never obtained animals through livestock raids directly or indirectly. During most of this period, the Ngisonyoka had not yet rearmed after a 1979 government disarmament campaign, even though raids by the neighboring Pokot were a significant cause of loss of livestock (De Vries *et al.*, in preparation).[14]

[14] In 1979, the regime of the Ugandan dictator Idi Amin was overthrown. Profiting from this development, Karimojong warriors seized 50,000 guns and much ammunition, some of which quickly made its way through trade networks to groups who raid the Ngisonyoka. Government interventions aimed at controlling this influx of arms resulted in the confiscation of most of the arms of the South Turkana people by the Kenya Government's General Services Unit (GSU) (Little *et al.*, 1999), while their enemies the Pokot and North Turkana bandits were not disarmed.

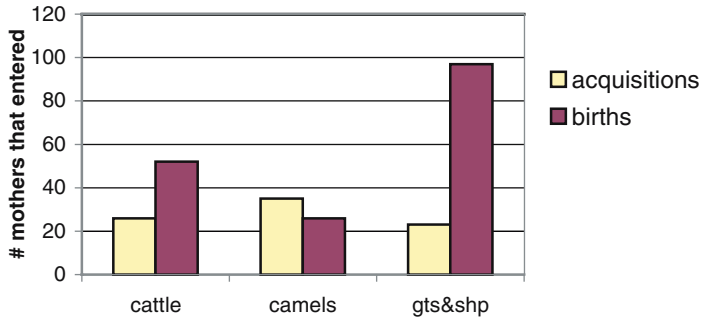

Fig. 2. Reasons for mother's entry into the 1987 herd by species.

THE DEMOGRAPHIC SIGNIFICANCE OF HERD ACQUISITIONS

Of the livestock mothers in the sample, those that entered the combined herds of the 13 herd owners through one of the acquisition components (bridewealth, exchange, gifts, payments, or begging) are compared to the number of mothers that were born into the herds (Fig. 2).

It can be seen that acquisitions are important relative to births, especially in the case of camels, where more mothers entered through acquisitions (57%), and to a lesser but still significant extent for cattle (33%) and goats and sheep (19%). In comparison, Dyson-Hudson and McCabe's data (1985) for a smaller sample of families (see Table I) suggest a less important role of acquisitions for camels (37%) and cattle (7%) (no data for goats and sheep).

Similarly, Sieff (1999) reported that 86% of increments to Datoga herds of cattle were through births. An important difference between the data we present here and these two other studies is that the present study included only fecund mothers. These mothers are likely to be considered highly valuable exchange commodities compared to male livestock. The studies done by Dyson-Hudson and McCabe and by Sieff included animals

Table I. Comparison of Acquisitions and Births Based on four Ngisonyoka Families 1980–1982 (from Dyson-Hudson and McCabe, 1985)

	Camels	Cattle	Goats and sheep
Acquisitions	44	3	n.r.[a]
Births	74	41	503

[a]n.r. = Not recorded.

of both sexes and did not report results for each sex separately. Another explanation for this difference can be related to the period of observation of the Dyson-Hudson and McCabe study. Their 1980–1982 data followed a severe drought during which birth rates were depressed, and the large number of births reflect a backlog of recuperating and fecund animals.[15] Finally, a systematic bias might have been introduced by the exclusion of the mothers for which the mode of addition to the herd was not recorded, if the reason for silence on this matter was related to their entry by birth. However, this seems unlikely and we assume the sample to be representative. Overall, the data suggest that acquisitions made a significant contribution to herd growth in the case of fecund mothers during the period of observation, especially with respect to camels and cattle. The obvious relationship between fecundity and births further underscores the importance of these exchanges to the different households.

ECOLOGY AND LIVESTOCK ACQUISITIONS OVER TIME

To investigate period effects, an acquisition ratio is calculated by dividing the number of acquisitions (additions by all means except birth) by the total additions of mothers (acquisitions plus births) in each year. The acquisition ratio for each year from 1971 through 1986[16] is plotted along with normalized rainfall data (recorded at Lodwar) and a normalized livestock condition index (Ellis *et al.*, 1991, 1993)[17] in Fig. 3. The relative sample size refers to the proportion of the combined herd of the 13 herders, censused in 1987 ($n = 252$), and serves as some indication of the confidence warranted by the data in particular years based on sample size.

For the combined herd (all species) and all years together, the total acquisition ratio was 0.32, or 32%. With the exception of 1973, which has a small sample size, the acquisition ratio never drops to zero throughout this period. In general, there seems to be an inverse relationship between the proportion of acquisitions and rainfall, but this was not significant for the entire period (Pearson $r = -0.385$, n.s.). During the first drought period of 1979–1981, generally regarded as one of the worst droughts in memory, this relationship holds. However, for the 1984 drought, regarded

[15] People were not willing to exchange livestock at this time.
[16] 1987 is excluded because the survey was incomplete for this year.
[17] A model that simulated the long-term behavior of the South Turkana ecosystem was produced using local and regional precipitation records combined with remotely sensed normalised difference vegetation index (NDVI) values. This livestock condition index indicates the grazing quality of the environment. The data presented are estimates based on data in Ellis *et al.,* 1991.

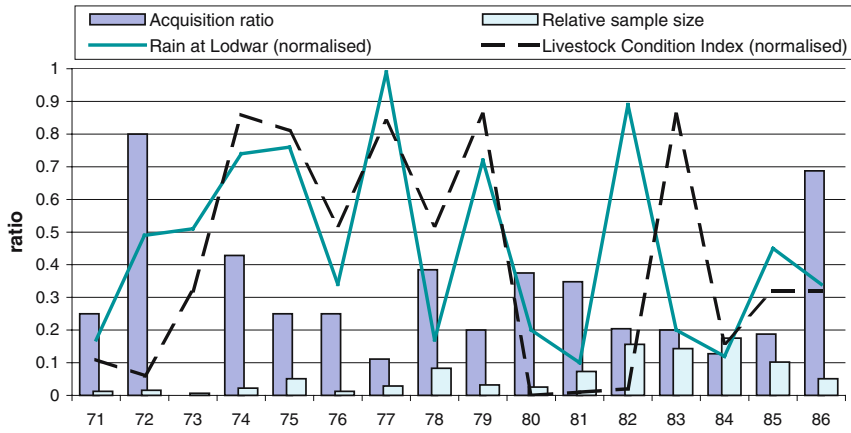

Fig. 3. Acquisition ratio relative to ecological conditions, all species combined.

as serious but minor in terms of herd mortality, this relationship does not hold, and instead the acquisition ratio appears relatively low. Correlation remained insignificant when the acquisition ratio was calculated with a time lag of 1 and 2 years relative to the rainfall (both births and acquisitions were lagged independently, and together). Thus, any rainfall-exchange relationship might be affected by context. Winterhalder has suggested that "a complete explanation of ecological structure and function must involve reference to the actual sequence and the timing of the causal events that produced them" (1994, p. 19). In this case, the intensity and timing of the two droughts together formed a specific historical trajectory. The 1979–1981 drought was intense and long, pushing the pastoral system to its limits. After the drought, livestock fertility probably needed 1–2 years to reestablish itself at normal levels. However, in this case the 1984 drought might have prevented this regenerative process from fully developing, limiting the regenerative capacity of the exchange system. Another explanation could be that the herders sold livestock or repaid debts during the 1979–1981 drought. Such sales and repayment may be made if it looks like a bad drought is developing, since the likelihood of cattle dying is increased and outstanding debts may as well be repaid. This might explain why the herders kept on receiving animals during the 1979–1980 drought period and not the shorter 1984 period. Thus, one would expect to see payments and gifts, and perhaps exchanges, concentrated during the first drought, while begging would occur more frequently in the second. To test these hypotheses, we consider the pattern of acquisition ratios by acquisition cause and species.

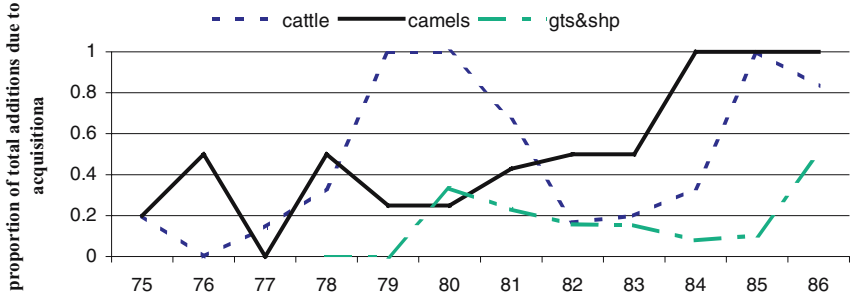

Fig. 4. Acquisition ratio over time for each species.

DIFFERENT ACQUISITION PATTERNS FOR DIFFERENT LIVESTOCK SPECIES

Most of the patterns identified so far are aggregates over all species, but the species have different physical and demographic characteristics that may be related to the patterns of acquisition. The average acquisition ratio was 0.46 for cattle (1972–1986), 0.48 for camels (1971–1986), and 0.26 for goats and sheep (1975–1986). From Fig. 4 it can be seen that the acquisition ratio patterns differ by species.[18]

Cattle acquisitions were made during both drought periods (1979–1981 and 1984), although it appears that the peak of exchanges were during the first drought and a year after the second. This follows the pattern observed for the specific historical trajectory of the two droughts for all species together, indicated in Fig. 2 above. For camels, however, the ratio shows no substantial increase in acquisitions around the first drought period, but a strong increase before and during the second. The drought resistance of camels might have something to do with this, causing herders to focus on the exchange of other species foremost. The progressive increase in camel acquisitions throughout the entire period suggests that as the drought trajectory played itself out, camels became increasingly important. The acquisitions of goats and sheep seem to have jumped in 1980 when the major drought was developing. This makes sense, because in general herders try to acquire smallstock after the loss of a lot of animals, because the growth rate for smallstock is faster than large stock (Dyson-Hudson and McCabe, 1985; Mace, 1990; Mace and Houston, 1989; Leslie and Dyson-Hudson, 1999). This pattern is directly associated with the 1984 drought. A dramatic increase in smallstock additions through acquisitions

[18]The data before 1975 are omitted because of small sample size.

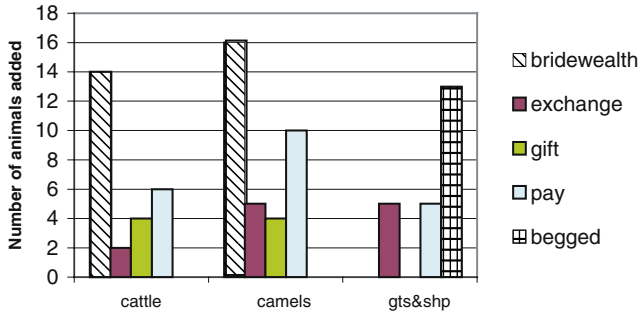

Fig. 5. Number of mothers entered by cause and species, summarized over the entire period.

can be seen about 2 years after the onset of the 1984 drought. Although possibly related to drought, a relationship with disease is hypothized here, since an epidemic disease (*loutokonyen*) struck baby goats and also caused an unusual number of aborted goats.

CAUSE SPECIFIC ACQUISITIONS OF THE DIFFERENT SPECIES

Differences in the means of acquisition underlie the species differences in acquisition ratios seen in Fig. 4. Although reported on in the following sections, these more detailed analyses are limited by relatively low sample sizes. Furthermore, a selectivity bias might have been introduced, because reasons for entry of animals might affect their general treatment and survival probability.[19] The stated reason for additions to herds by species for the total period 1972–1987 for all species is shown in Fig. 5.

It appears that smallstock, often included in bridewealth exchanges, were not acquired by that means during the period of analysis. The symbolic and economic value of camels and cattle is illustrated by their entry as bridewealth and gifts. In contrast, begging is an activity relating only to the acquisition of goats and sheep during this period. The data further suggest that camels entered the herd more frequently as payments and exchange than cattle.

Although sample sizes are generally small, a time series for each species (goats and sheep combined) can with caution provide some insights

[19]For example, studies (Hutchinson, 1996; Broche-Due, 1999) have stressed differences in the ways in which livestock acquired through bridewealth are treated and managed. If this is so, these animals might have a higher (or lower) probability of surviving to the moment of the survey and would be overrepresented (or underrepresented).

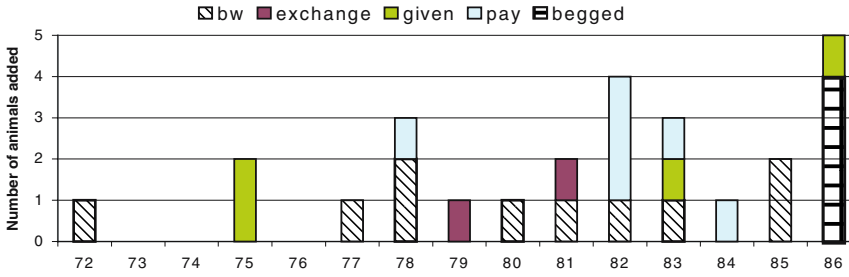

Fig. 6. Causes of increment by year for cattle mothers.

into the different uses of acquisition strategies. The pattern for cattle—most of them heifers when acquired—is shown in Fig. 6.

From this figure it seems that bridewealth acquisitions are distributed throughout the period of observation. Two exchanges concentrated around the 1979–1981 drought years, but none after the 1984 drought. Gifts were not mentioned in drought years, but mothers were acquired as gifts about 2 years after drought years. Three mothers were acquired in 1982 through payments after the first drought period, when bovine pleuropneumonia and Pokot raids haunted the Ngisonyoka. No payments can be seen for the second drought event. No begging for cattle was mentioned, which makes sense since most cattle that would be begged would be males for slaughter and the sample is limited to females. In general, bridewealth appears of crucial importance to cattle acquisitions. Acquisitions other than bridewealth appear somewhat clustered, with an exchange during the first drought, payments after the first drought, and gifts at the latter end. This pattern is different for the 1984 drought, when a payment was still being collected, and bridewealth dominated afterwards.

The emphasis on exchanges as occurring during drought is perhaps better illustrated by the pattern for camels which also shows some effects of the drought period of the early 1970s, shown in Fig. 7. The exchanges were mostly during and at the end of the drought periods, with several mothers that entered during the droughts of the early 1970s and an exchange in 1981. During the 1984 drought two mothers entered as gifts. One older mother camel came in during the early 1970s drought period. As with cattle, payments seemed to be clustered at the tail end and directly following drought years (1980–1982) and 1985, and begging was not mentioned. Bridewealth was not as consistently distributed as with cattle, was non-existent in drought years, and clustered in post-drought years.

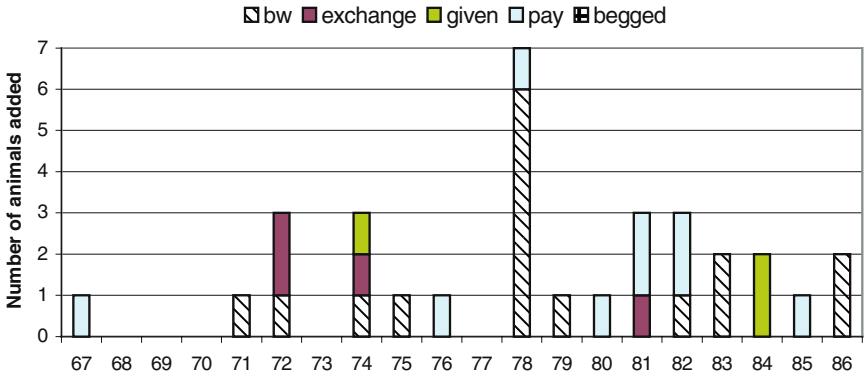

Fig. 7. Causes of increment by year for camel mothers.

Finally, the time series for goats and sheep is displayed in Fig. 8. As shown earlier, no mothers entered the herds as bridewealth. This finding contrasts with detailed data on the rebuilding of a herder's herds and bridewealth payments which shows that goats are important in this respect (McCabe, 2004). Reason for this lack may be that goats and sheep have a shorter life span and there may not have been many bridewealth payments as people recovered from the 1984 drought. Possibly, goats and sheep that came into the herd as bridewealth might have been eaten or sold before the census was taken. Exchanges can be seen to have occurred mostly during the 1980–1981 drought years, and in the year after the 1984 drought. In contrast, payments and begging were mentioned as reasons throughout the period. Many mothers were begged after the 1980–1981 drought when pneumonia (*loukoi*) had struck the goats, as well as in 1986, after and during

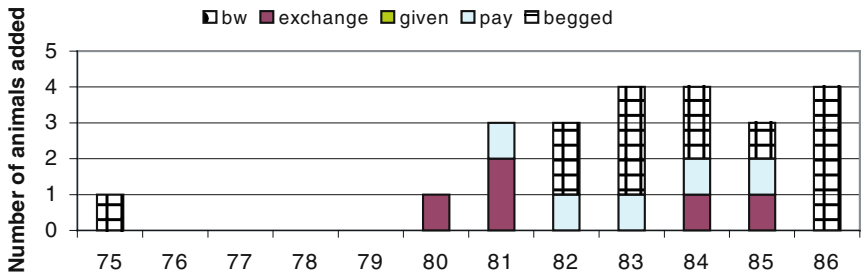

Fig. 8. Causes of increment by year for smallstock mothers.

Table II. Wealth Distribution and Herd Building Component by Herder

Herder	SSU[a]	Species[b]	Birth ratio[c] (1)	Acquisition ratio[d] (2)	Unknown	Ratio difference (1 – 2)
A1	275.9	A, B, C	0.43	0.27	0.30	0.16
A2	216.5	A, B, C	0.59	0.41	0.00	0.17
E1	71.4	A	0.41	0.09	0.50	0.32
L1	68.1	A, B	0.67	0.33	—	0.33
A3	59	A	0.38	0.14	0.48	0.24
M1	57.8	B	0.30	0.08	0.62	0.23
L2	51	A	0.50	0.33	0.17	0.17
E2	36	A	0.62	0.38	—	0.25
L3	35.7	B	0.40	0.40	0.20	0.00
E3	31	A	0.13	0.57	0.29	– 0.43
N1	5.4	B,C	0.60	0.15	0.25	0.45
M2	1.7	C	0.75	0.25	—	0.50

[a]Standard stock units.
[b]A = cattle, B = camels, C = goats and sheep.
[c]Number of births divided by the total additions of mothers (acquisitions plus births).
[d]Number of acquisitions divided by the total additions of mothers (acquisitions plus births).

an epidemic disease (*loutokonyen*) struck baby goats and which also caused an unusual number of aborted goats.

DIFFERING PATTERNS OF ACQUISITIONS AMONG HERDERS

Herders differ with respect to their acquisition strategies, and these differences are related to herd composition and wealth.[20] The distribution of wealth is expressed in terms of the standard stock unit (SSU), a unit that expresses productivity of different species relative to that of a cow. For Turkana, Leslie and Dyson-Hudson (1999) have suggested that camels be treated as 1.7 SSU and smallstock as 0.1 SSU. The wealth distribution and the importance of the herd building components for each herder, arranged by wealth in SSUs, are listed in Table II. As can be seen in this table, for most of the herders the means of livestock addition was not recorded for a substantial proportion of their herd (the "Unknown" category). In particular, in the cases of herders E1, A3, and M1, this proportion is large enough to have a significant effect on the results (respectively 0.50, 0.48, and 0.62).

[20]Data on 72 animals had to be removed for this part of the analysis because the identity of the herder was not recorded in the dataset, and it remained unclear if this was an independent household. The animals were all goat and sheep mothers, of which 51 were born in the herd, 4 acquired by exchange, 11 by begging and 2 as payments. These animals have been included in all other (herder independent) analyses.

Because it is impossible to remedy this problem, it is assumed that the distribution of the unknown part reflects the distribution of the larger structure of the herd of each of these herders.

Table II shows that acquisition accounts for a substantial proportion of livestock additions (all species combined) for most herders, ranging from 9 to 57%. This table also suggests how herd structure can influence management strategies. As can be seen in the last column, from A1, the wealthiest herder, through E2, the differences between the proportion of mothers added through birth relative to the proportion of mothers added through acquisition ranges from 16–33%. This difference however disappears with herder L3. A reason for this might be that although E2 and L3 both have similar numbers of SSUs (36 and 35.7, respectively), E2 is mainly a cattle herder, while L3 focuses on camels, and consequently has higher reliance on acquisitions, as noted before (see Fig. 9). Herder E3, who only started herding cattle independently in 1982, had a low proportion of mothers entering his herd through birth. Finally, herders N1 and M2, with the lowest SSU, are actually goat and sheep herders. As seen from Table II, herd increments of sheep and goats are less reliant on social relations than all increments of cattle and camels.

From Fig. 9 it can be seen that herders rely on different types of acquisition. There seems to be an increasing diversity of types of acquisitions with wealth. Bridewealth is a source of animals among all herders, but seems to be more important for the wealthier and poorest cattle and camel herders. All but one of the eight livestock exchanges involved herders who have a diversified portfolio of livestock. Herder A1 obtained three camels, each for 12 male goats, one female camel for a castrated male camel, and one female cow for six male goats. Herder E2 also obtained one cow for small stock (unknown exchange rate). Herder N1 engaged in an unequal exchange of a male goat for a female goat. Herder L1 received a female camel in

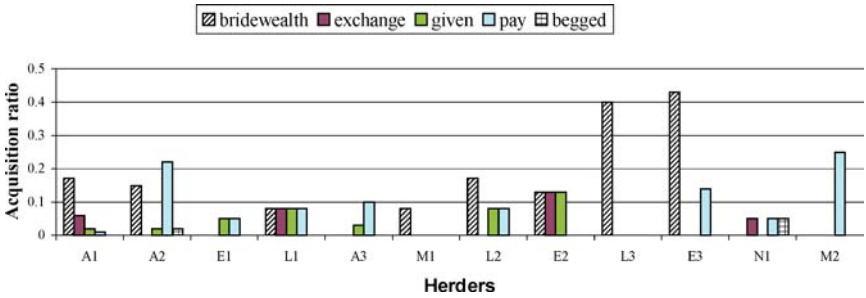

Fig. 9. Acquisition ratio by cause for each herder arranged by wealth (arrranged from left to right in order of decreasing wealth).

exchange for a castrated male camel (and this was also part of a payment for a speared camel in the past). Most of the exchanges suggest as reason upstocking (small stock for large stock) or adjusting the sex ratio of herds, with male goats used as payment currency.[21] When trying to rebuild a herd after the loss of a lot of animals, a herd owner frequently tries to exchange large stock for goats, which have a faster reproductive rate. More mothers were reported given to herders with less wealth, but not to any of the poorest sheep and goat herders, nor to herders E3 and L3 who had very low birth rates among their livestock and were in need of acquisitions (see Table II). The latter can be explained by the categorization of their gifts as bridewealth.[22] The amount of payments seems substantial for herder A2, but not for the other wealthier herders. A larger proportion of the additions came from payments for E3 and M2, the poorer herders.

CONCLUSION

The survey conducted in 1987 recorded the means by which 324 female livestock (cattle, camels, goats, and sheep that gave birth) were added to the herds of 13 Ngisonyoka Turkana herders. Results show that the contribution of socially induced acquisitions of fecund mothers in herd build up has been considerable and less marginal relative to additions from natural increase than previously assumed. This was particularly the case for cattle and camels. The results support ethnographic evidence that livestock acquisitions should not be seen as strategies that are only helpful in rebuilding herds after a devastating drought or other calamities such as raids or epidemics. Instead, acquisitions are a continuous component of herd build up that exhibit a complex pattern showing variation over time and among herders and livestock species. As in the classic demographic equation in which both migration and fertility are considered components of population growth, it seems sensible to consider herd build up in the livestock system to be driven by both acquisitions and births.

Although the association between acquisitions and rainfall appeared negative in general, the correlation between these variables was not statistically significant, perhaps because of historical contingencies Each of the two observed droughts (1979–1981 and 1984) seem to have had a different relationship to the herd acquisition patterns. Attention to the historical trajectory as a whole seemed therefore more appropriate than focusing on isolated drought periods. The results further show that means of acquisition

[21] Differences in age are important factors in this process, but such data were not available.

[22] Herder L3 had been herding for quite some time, since he mentions that his cattle have been separated since 1974 in North Turkana. In the 1987 interviews he only talks about his camels.

differed by species. Summarized over the entire period, bridewealth and payments mattered most for large stock, while smallstock were more frequently acquired through begging. During the 1979–1981 drought, preference was given to the acquisition of cattle and goats and sheep, while after this drought and during the 1984 drought camels were increasingly emphasized. During the drought trajectory, direct exchanges were most important in the midst of drought conditions, with the other sources clustered around the droughts. Bridewealth was important throughout the entire period for large stock. The difference in acquisition patterns for each species was further complicated by the differences in management styles and herd composition of each herder. On average, most herders relied on acquisitions for about a quarter of cattle and camels, although the poorer large stock herders relied more on acquisitions, while smallstock herders relied on it less. The sources of livestock varied widely among the herders, with greater diversification for wealthier herders and an increased dependence on bridewealth for the wealthiest and poorest large stock herders.

These results provide further historical support for the importance of long-tested systems and institutions that underlie livestock exchange. From a herd demographic perspective, social networks were and are likely still crucial assets in Ngisonyoka herders' adaptive management strategies. The behavior of these acquisitions networks has to be understood relative to the timing of historical disturbances, the characteristics of the different species, and the idiosyncratic and diversified portfolios of the different herders. Perspectives that do not take into account this complex role of social networks might miss a crucial historical component of herd building that helps explain the survival of some herders and the failure of others. Researchers have shown that the introduction of famine relief and commercialization challenge the persistence of pastoralist social networks (Bassi, 1990; Broch-Due, 1990; Campbell, 1999). McCabe has demonstrated (1990, 1994) how these exchange networks, especially those based on bridewealth, can be undermined when herders and their families join famine relief camps. When compared to this historical baseline, altered structures of indigenous social networks might prove to have unintended consequences. Those working to alleviate hostility and famine for peoples in drought prone areas might see the need for famine relief rise and raiding increase. Those who are interested in the development of tourism and wildlife conservation might be faced with an increase of disease epidemics and the loss of a cultural asset when management and use of marginal landscapes by nomadic pastoralists disappears. Ellis *et al.* (1993) suggest that the most important single development procedure to promote persistence in non-equilibrial ecosystems may be to solidify the connections between the pastoral ecosystems and the sources and sinks of external resources. In addition, this research suggests

that care for the preservation of social networks and further understanding of the temporal role of acquisitions is crucial in helping the herders to survive or even flourish in non-equilibrial ecosystems. Social exchanges, such as bridewealth, provide a resource security well suited to the challenges of coping with such unpredictable environments. Researchers and policymakers should take such indigenous networks into account if they want to understand and promote effective use of arid, marginal lands by pastoralists.

The results presented here pertain explicitly to one population during a period that ended some 15 years ago. Although there have been some important changes (notably, increased violence and raiding) in South Turkana in the 10 years since two of the authors (McCabe and Leslie) have worked there, we expect that acquisitions of livestock through the means described here have continued to be an essential part of herd management. The claim we make based on our results concerns the potential and likely importance of acquisitions, not the ubiquity of that importance. Herd dynamics should be studied more closely in other contexts. If acquisitions are found not to be crucial in other cases, the question is then, why not?

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