

Final Report for "Altruistic warriors: Cooperative cattle-raiding among Turkana pastoralists"

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Project activities

The dissertation grant from the Leakey foundation, in conjunction with an NSF DDIG, allowed me to conduct 9.5 months of data collection in the field. During this grant period, I conducted in-depth interviews with a representative sample of 118 warrior-aged Turkana men which yielded detailed first hand accounts of 88 unique offensive raids. The accounts addressed events preceding the raids, the course of combat, and post-raid events. Interviews were designed so that inconsistencies in the account could be detected and addressed during the interview stage. Among other topics, each participant described how the raid was planned, how combatants were mobilized, how many warriors joined, the range of settlements from which people came, where and when they attacked, how the battle unfolded, whether there were desertions, whether men lagged behind others or did not fire their weapon during combat, how many people were injured and killed, how many livestock were acquired, and what happened to the men who were identified as deserters and cowards. In order to assess inter-subject reliability, I did a follow-up study using snowball sampling in which I obtained first hand accounts from multiple warriors who went on a particular raid. Twenty six warriors participated in this study, and I obtained multiple accounts of 4 raids (included in the total of 118 interviewees and 88 raids). I also conducted vignette studies with a representative sample of 220 warrior-aged men, 60 unmarried women, and 60 married women to explore their reaction to specific acts of warriors in offensive battle. Participants felt strongly about the scenarios presented, and offered elaborate justifications for their judgment of the character. The vignettes provided systematic qualitative and quantitative data on the vital role of community-enforced rewards and sanctions in motivating a warrior's combat decisions. To quantify the impact of warfare on population mortality, I additionally collected data on survivorship of offspring and siblings from the 107 male and 121 female participants. Two hired research assistants helped with recruiting participants, conducting the interviews in the Turkana language and in translating participants' responses. Because risk of raids in nomadic settlements was high, I recruited participants from a town center in north Turkana. Participants were nomadic pastoral Turkana, who frequented the perimeter of town for watering animals, purchasing maize, tea and tobacco from the town and for visiting their settled relatives. Virtually all participants had personally experienced an offensive or defensive raid. The studies were administered in a rented room located between the market area of the town and the watering holes at the perimeter of town. Participants were compensated for their time with 200 Ksh (3 USD) for vignette studies lasting around 30 minutes–1.5 hours and 500 Ksh for the interviews which lasted 3–6 hours.

Results

Mortality due to warfare. The results indicate that warfare is a significant source of male mortality in Turkana society. Between puberty and the start of their reproductive period, 14% of Turkana men die in warfare accounting for 45% of mortality during that life stage. During their reproductive period, 9% of men die in warfare accounting for 60% of mortality during that period. The reproductive period begins with marriage or the birth of a child and ends when a person no longer sires children. Twenty percent of all male deaths (including infants and children) are due to warfare. Men experience mortality from both offensive and defensive warfare. Offensive warfare occurs in the form of raids initiated by the Turkana with the goal of acquiring cattle from neighboring ethnic groups. These raids take two forms—*stealth raids* that involve a few men who aim to find poorly-guarded livestock and take it, and *force raids* that involve larger numbers of men who plan to engage in combat. These large raiding parties surround settlements at night and attack at dawn, or target grazing areas, watering wells, and migrations during the day. Neighboring ethnic groups are also armed, and launch similar attacks against the Turkana. Among adult males 54% of mortality due to warfare occurred in offensive combat and 46% in defense. Women and children do not participate in offensive combat or actively engage in combat during defense, but can be killed during attacks at settlements, at watering holes, and during migrations.

Cost and benefits of raiding. A Turkana warrior who participates in a raid incurs considerable private costs, primarily the risk of injury or death. Based on casualty rates in 47 force raids, a Turkana warrior has a 1.1% chance of being killed on each raid, and a 1.3% chance of being killed if the raiding party encounters the opposition and engages in combat (which occurred in 89% of the force raids). In my sample of 34 stealth raids, 41% involved combat, but none produced any fatalities among the Turkana. The primary goal of an offensive raid is to acquire livestock which is divided after the raid. The average gain per participant is 11 cows in force raids and 3 cows in stealth raids. Combatants may also acquire the firearms and personal belongings of enemies they kill in combat. Rarely, a warrior may kidnap a young boy for use as labor in herding. Raids also create collective benefits that flow to everyone in the community. Retaliatory raids produce deterrence, a non-excludable good. Such raids are not just a byproduct of a desire for loot; revenge is an important motive. One participant said that he joined a raid because a neighboring ethnic group had just raided the Turkana. He did not lose any animals, but said that his brother-in-law lost his, and added, “Even if its not your family, they are Turkanas like me. So we have to go fight back [against] the enemy”. Large-scale force raids can increase access to grazing areas and crucial dry-season watering holes. The precipitating event for one of the largest raids in the sample was a hunter’s discovery that herders from another ethnic group had settled at a watering site that is typically used by the Turkana. The stated goal was to drive them away from Turkana territory. Also, settlements move away from sites of raids, and this can lead to substantial shifts in the territorial ranges of ethnic groups over time.

Scale of cooperation in raids. The Turkana mobilize a large number of warriors for force raids. My data indicate that on average, 315 men participate in a raid, and the median is 248 men. Furthermore, participants in force raids are not all close associates—they are drawn from an average of 5 age-groups, 4 settlements and 3 territorial sections. Territorial sections number about 25,000 people, settlements and age-groups a few hundred. While there are social ties that bridge these groupings, day-to-day interactions typically occur within them. When asked whether they recognized the men gathered for a raid, participants

typically responded that there were some men they knew, and some men they did not recognize. A warrior has on average only 4 of his close kin—father, son, full or half brother, brother in law or full cousin with him on a force-raid. Stealth raids are much smaller averaging 12 warriors. A warrior has on average one close kinsmen with him on a stealth raid.

Free riding in combat. A Turkana man is regularly faced with the option of joining a raid or staying back. Recruitment is informal: a raid is initiated by one or a few men who send word out encouraging men from other settlements to join, and over the course of a few days warriors from various settlements trickle in to the settlement that has initiated the raid. A man can refuse to join the raiding party, but he needs a good reason like the lack of a suitable person to take over herding duties, the need to defend the settlement, being ill, not having a rifle, or having joined recent raids. The raiding party travels on foot for one or more days to the place where scouts have located an enemy settlement. Along the way, men turn back. They may escape at night unnoticed, or tell their age-mates that they are ill, worried about their herds back at home, or have a premonition that they will die on this raid. Such desertions occurred in at least 43% of force raids. This estimate is a lower-bound because it only includes desertions that the interviewee was aware of. Participants said that they would not know of discreet departures by men outside their age-group or settlement. Warriors have many opportunities to reduce their risk during combat. The fighting begins when the raiding party surrounds the settlement, pasture or watering point and opens fire. As soon as the offense gains the upper hand, fast young men begin to drive the cattle towards Turkana land, while seasoned warriors engage in a holding action to keep the pursuit at bay, continuing to fight as they retreat. During combat, men constantly urge each other to stand their ground, fire their weapon and not to run away. In 45% of force raids in which combat occurred, the focal warrior knew of men who lagged behind others during combat, failed to fire their weapons, ran away when the fire-fight began, or retreated too quickly. Again, this estimate is a lower bound because warriors report that they mainly know about the behavior of men standing alongside them. Finally, the jointly acquired loot can be unfairly appropriated. The men driving the cattle homeward are supposed to continue until they are safely within Turkana territory and then wait for the rest of the warriors to rejoin them. Once regrouped, they divide the spoils before they disperse to their respective settlements. Norms specify that members of senior age-groups get a larger allocation than members of junior age-groups, and that men within an age-group get roughly equal shares. However, the loot sharing system failed in 56% of the force raids, and some participants took whatever livestock they were able to drive off. Some men position themselves in the rear, a safe distance away from combat, wait for the vanguard to start releasing the livestock and appropriate the best of the spoils.

Sanctioning of free riders. Informally enforced norms allow the Turkana to partially solve the collective action problem in warfare. In 47% of the force raids in which desertions were reported, at least one of the deserters was sanctioned and in 67% of the force raids in which cowardice was reported, at least one of the cowards was sanctioned. There are two levels of sanctions. When a warrior's behavior in a raid deviates from that of his comrades, he is subjected to informal verbal sanctions by his age-mates, women and seniors. If there is consensus in the community that the act merits more serious sanctions, corporal punishment is initiated. Corporal punishment is severe—the coward or deserter is tied to a tree and beaten by his age-mates. One participant had scars on his torso from being whipped by his age-group more than a decade earlier. During this process the violator is told not to repeat this mistake. Corporal punishment often culminates with the violator pleading for forgiveness and sacrificing an animal from his herd. Sanctioners

do not confiscate the violator's share of the loot. Instead, the loss of the animal represents a "fine" that is then consumed by his age mates and other older men. In force raids, there were 20 violations (combining desertion and cowardice) in which at least one of the violators was sanctioned. In nine of these cases corporal punishment or fines were imposed. In one case only three days had passed since the raid, and there was talk that further sanctions would soon be initiated. Of the nine cases in which serious sanctions were imposed, six involved corporal punishment followed by fines, two involved only corporal punishment, and one involved only a fine. In addition to these nine, in two of the 20 sanctioned cases the coward's share of the loot was reduced at the time of loot division. In stealth raids, only one of the five sanctioned violations involved a fine, and none involved corporal punishment. In a second case there was talk that further sanctions should be imposed but this had not yet been done at the time of the interview (20 days after their return). It is possible that the mechanisms maintaining cooperation in force and stealth raids differ, and collective corporal punishment may be more important in force raids.

Vignette study results on free-riders in combat. A vignette study indicates that cowards are judged more harshly than incompetent warriors. I presented male participants with a story of a warrior who failed to contribute during combat due to cowardice. Another set of participants heard a similar story, but one in which the character's failure was due to lack of skill. Subjects were much more likely to think that cowardice was wrong. They were more displeased by his behavior and would be more willing to criticize and punish him. Subjects were also significantly more likely to terminate beneficial social interactions with the coward. Unlike in the case of an unskilled warrior, they would not stand next to the coward in a raid, lend him a goat if he needed one, entrust their herd under his care, or want their daughters to marry him. I also conducted this study with married and unmarried women as participants, and am currently analyzing the data. In a second study I presented male participants with vignettes describing a warrior who turns back along the way. Participants in one condition were told that the man feared and turned back, and participants in another condition were told that he became ill and turned back. Surprisingly, participants did not consistently distinguish between the fear and illness conditions. One possibility is that because illness is frequently the pretense under which people turn back, the explicit reason given in the vignette scenario did not strongly influence their inference.

Vignette study results on scale of cooperative norms A third vignette study suggests that norms regarding raiding are beneficial at the scale of the ethnolinguistic group, not local communities of familiar individuals. Half of the subjects heard a vignette in which two warriors from the Kwatela territorial section raid animals from the Lukumong—another Turkana territorial section, and bring the loot home to Kwatela land. The rest of the subjects heard a similar vignette in which two Kwatela warriors raid animals from the Toposa—another ethnic group, and bring them home to Kwatela land. Subjects, who are Kwatela themselves, considered the raiding of the Lukumong to be very wrong. In stark contrast, they had very positive attitudes to the warriors who went to Toposa land, even though in both situations their own territorial section benefited at the expense of another group. Thus, norms and their enforcement appear to create behavior that is beneficial to the entire Turkana ethnic group, not smaller groups like territorial sections, even though the Turkana number around 500,000 individuals and many members live hundreds of kilometers away from each other. Consistent with this, even though most young men possess firearms, homicide or internal violence accounts for less than 5% of adult male mortality within nomadic settlements, strikingly lower than mortality from inter-ethnic warfare which is between 50–65% for adult males.

Project Outcomes

The results of this study sheds light on important questions regarding the evolution of cooperation in humans. While most scholars recognize that cooperation takes place in societies lacking a formal political structure, many think it occurs only at a modest scale and its evolution can be explained by kin-based altruism or reciprocity among familiar individuals. Contrary to this, the results of this study suggest that the Turkana sustain costly cooperation in warfare at a remarkably large scale without political centralization, formal coercive institutions, or even a political system based on descent. The punishment of free riders, at least in part, helps sustains such cooperation. These results suggest that large-scale cooperation enforced through the sanctioning of free riders may have been common for a long period of human evolutionary history. My first paper from this work was published in the *Proceedings of the National Academy of Sciences* in which I report on several of the findings that I have described above. In a second paper, which I plan to submit to the journal *Evolution and Human Behavior*, I will describe results from the vignette studies on cowardice and desertion and the demographic characteristics of individuals who are motivated to sanction these acts. I also plan a longer more descriptive paper for publication in *Current Anthropology* or *American Anthropologist* on the nature and organization of Turkana raids. I am grateful to the Leakey Foundation for supporting this project.

Punishment sustains large-scale cooperation in prestate warfare

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Understanding cooperation and punishment in small-scale societies is crucial for explaining the origins of human cooperation. We studied warfare among the Turkana, a politically uncentralized, egalitarian, nomadic pastoral society in East Africa. Based on a representative sample of 88 recent raids, we show that the Turkana sustain costly cooperation in combat at a remarkably large scale, at least in part, through punishment of free-riders. Raiding parties comprised several hundred warriors and participants are not kin or day-to-day interactants. Warriors incur substantial risk of death and produce collective benefits. Cowardice and desertions occur, and are punished by community-imposed sanctions, including collective corporal punishment and fines. Furthermore, Turkana norms governing warfare benefit the ethnolinguistic group, a population of a half-million people, at the expense of smaller social groupings. These results challenge current views that punishment is unimportant in small-scale societies and that human cooperation evolved in small groups of kin and familiar individuals. Instead, these results suggest that cooperation at the larger scale of ethnolinguistic units enforced by third-party sanctions could have a deep evolutionary history in the human species.

public goods | collective action | cultural group selection | parochialism | pastoralists

Over the last 50,000 y, humans have come to dominate the world's biota, in part because we cooperate on larger scales than other mammals. Recent models suggest that informal systems of punishment can maintain cooperation in large groups (1, 2). However, this work leaves two important questions unanswered. First, does punishment actually play an important role in sustaining human cooperation in the absence of formal coercive institutions? In laboratory experiments third parties—individuals who are not the primary party injured by a defection—bear costs to punish defectors (3, 4). However, scholars have questioned whether such punishment exists outside of laboratory settings (5) and, even if punishment does occur, whether it effectively promotes cooperation (6–8). Second, what is the scale of human cooperation? Punishment can sustain cooperation on scales ranging from small kin-based hunter-gatherer bands to large modern states (9). A common view is that the psychology that sustains human cooperation evolved in small foraging bands characterized by modest levels of genetic relatedness and repeated social interactions (10, 11), and this led to a psychology that supports band-level cooperation. According to this view, large-scale cooperation occurs only when this psychology “misfires” in novel modern social environments with coercive institutions. An alternate view is that humans have evolved to cooperate in ethnolinguistic groups (groups with shared cultural norms and language), comprising thousands of unrelated strangers, even without formal coercive institutions (12, 13). According to this view, the scale of human cooperation has been shaped by competition between culturally distinct groups, which led to sanctioning systems that enforce cooperation at the scale of cultural variation. Because much cultural variation is maintained along ethnolinguistic boundaries (14), these models predict cooperation to occur at the scale of ethnolinguistic units. Cooperation on the same scale can also be pro-

moted through genetic evolutionary processes that favor ethnic parochialism (15).

Existing data do not answer these questions. Studies of contemporary hunter-gatherers show that they cooperate extensively in small face-to-face groups (16, 17), and it is evident that politically centralized societies can generate cooperation among thousands of strangers (18). However, numerous societies in human prehistory were larger than those of contemporary hunter-gatherers but still lacked centralized political authority, formal law enforcement, or other coercive institutions. Although ethnographic and oral historical accounts suggest that such societies could mobilize on large scales (19–23), there is little quantitative data on the nature of punishment and the scale of cooperation in these societies (5).

Here we report results from a quantitative study of warfare among nomadic Turkana pastoralists in East Africa that sheds light on these two questions. The Turkana are a large ethnolinguistic group with the social organization of a small-scale society. They are politically uncentralized, egalitarian, and economically undifferentiated. They lack formal or centralized institutions of leadership or coercive authority. They reside in nomadic settlements comprised of households that disperse and aggregate seasonally. The combination of large population size, small-scale social organization, and temporary encampments is not prevalent in contemporary hunter-gatherer populations (22), but did occur in some historically known hunter-gatherers (22, 24, 25). Warfare is a high-stakes form of cooperation. Individual warriors incur the costs of injury or death, but the gains from victory, such as defense, deterrence, or territorial expansion, benefit all. Even when the benefits of victory are not pure public goods (e.g., captured loot), there are still opportunities for shirking during combat that reduce individual risk but also lower the chance of victory. Although archaeological and ethno-historical data showed that war, raiding, and feuding were prevalent in societies without formal political structure (26, 18), few studies address how these societies solved the collective action problem in intergroup conflict.

Based on a representative sample of 88 recent Turkana raids, we find that informal punishment plays an important role in sustaining cooperation in Turkana warfare. Participation in raids has substantial private costs: warriors risk death during combat. The benefits include the jointly acquired loot and nonexcludable benefits, such as deterrence and territorial gain. Cowardice and desertion occur frequently and are punished by the community. Third parties play a critical role in adjudication and meting out punishment, which includes serious sanctions, such as collective corporal punishment and fines. We also find that cooperation occurs at scales much larger than that of foraging bands. Raiding parties are comprised of several hundred unrelated warriors. Participants in

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a raid are not day-to-day interactants. A vignette study suggests that Turkana norms governing warfare benefit the Turkana as a whole, not smaller social groupings, even though the Turkana number a half-million people, most of whom have never met. Our results indicate that human cooperation, sustained through sanctioning of free riders, could have evolved at the scale of ethnolinguistic groups comprising large numbers of unrelated and unfamiliar individuals and suggest that our cooperative and sanctioning psychology should be shaped for such an ancestral social environment.

The Turkana

The Turkana are nomadic subsistence pastoralists who live in the arid savanna of East Africa. They herd cattle, camel, sheep, goats, and donkeys, and subsist on milk, blood and meat from livestock, and maize flour obtained through trade (27, 28). They live in temporary camps, migrating 10 to 50 km in search of fresh pastures and water every 15 to 40 d. The Turkana were estimated to number 476,200 people in 2006 (29). Turkana speakers are divided into 20 geographic groupings, called “territorial sections”. Membership is acquired by birth and entitles herdsman to graze and camp anywhere in the territorial section. Clans are based on patrilineal descent, but Turkana men do not reside with clan members for more than one or two generations. Much more important are age-groups that link men born within a 5- to 6-y period (30). Households that camp together comprise a settlement. In the wet season, households are dispersed. As the dry season progresses, settlements increase in size because households aggregate around scarce water. Political and military authority are not centralized. Senior age-groups and elders have decision-making privileges and arbitrate disputes. There is no hereditary leadership. Leadership roles are taken on by men who acquire prominence through their ability as diviners, their status as warriors, or capacity to make wise migration decisions. Although they play a role in coordinating people for action, such leaders are not vested with coercive authority. The Turkana believe in a supreme being, *Akuj* (31). Diviners and spirits are intermediaries between him and the people. Success and failure of raids can be attributed to the plans of *Akuj*, and warriors sometimes justify their conduct as having occurred according to the will of *Akuj*. The Turkana raid other ethnic groups (28, 32), a practice with a long history (33, 19), although fire-arms began replacing spears in the 1970s. Warriors do not train together, nor is there any formal military command structure. Although commercial cattle-raiding is practiced in some parts of East Africa, community-endorsed, noncommercial raiding is the predominant form of raiding where we conducted the study. Nation-state institutions have minimal influence in this region.

Results reported here are based on in-depth semistructured interviews with a representative sample of 118 men who were questioned about the most recent offensive raid in which they had participated. This questioning yielded detailed accounts of 88 different raids. We also conducted vignette studies to probe people’s reactions to the acts of fictitious warriors, and reconstructed the family structure of 107 men and 121 women to estimate mortality from warfare. We describe methods, data quality, intersubject variability, and possible biases in *SI Appendix*.

Warfare Is an Important Source of Mortality

Warfare is a significant source of male mortality in Turkana society (Fig. 1). Between puberty and the start of their reproductive period, 14% of Turkana men die in warfare, accounting for 45% of mortality during that life stage. During their reproductive period, 9% of men die in warfare, accounting for 60% of mortality during that period. The reproductive period begins with marriage or the birth of a child and ends when a person no longer sires children. Twenty percent of all male deaths (including infants and children) are a result of warfare.

Men experience mortality from both offensive and defensive warfare. Offensive warfare occurs in the form of raids initiated

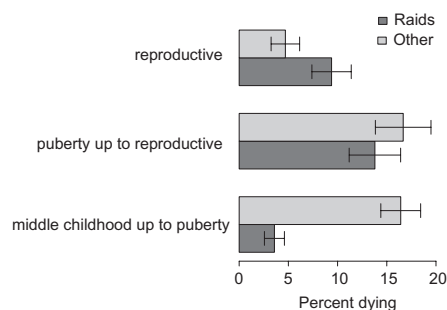


Fig. 1. Percentage of the male population dying from raids and other causes. Estimates are based on survivorship of full siblings and offspring of a representative sample of 107 men and 121 women. The sample consists of 335 individuals in the middle childhood up to puberty category (~6–16 y of age), 174 in the puberty up to reproductive category (~16–32 y of age), and 213 in the reproductive category (~32–65 y of age). Mortality from raids includes offensive and defensive warfare. The reproductive period starts with either marriage or having a child and ends when a person cannot sire children. Mortality in the “other” category is predominantly from disease. Error bars show one SE.

by the Turkana, with the goal of acquiring cattle from neighboring ethnic groups. These raids take two forms: stealth raids, which involve a few men who aim to find poorly-guarded livestock and take it, and force raids, which involve larger numbers of men who plan to engage in combat. These large raiding parties surround settlements at night and attack at dawn, or target grazing areas, watering wells, and migrations during the day. Neighboring ethnic groups are also armed and launch similar attacks against the Turkana. Among adult males, 54% of mortality due to warfare occurred in offensive combat and 46% in defense. Women and children do not participate in offensive combat or actively engage in combat during defense, but can be killed during attacks at settlements, at watering holes, and during migrations.

Participation in Warfare Is Costly and Produces Collective Benefits

A Turkana warrior who participates in a raid incurs considerable private costs, primarily the risk of injury or death. Based on casualty rates in 47 force raids, a Turkana warrior has a 1.1% chance of being killed on each raid (Fig. 2), and a 1.3% chance of being killed if the raiding party encounters the opposition and engages in combat (which occurred in 89% of the force raids). In our sample of 34 stealth raids, 41% involved combat, but none produced any fatalities among the Turkana.

The primary goal of an offensive raid is to acquire livestock, which is divided after the raid. The average gain per participant is 11 cows in force raids and 3 cows in stealth raids (Fig. 3). Combatants may also acquire the firearms and personal belongings of enemies they kill in combat. Rarely, a warrior may kidnap a young boy for use as labor in herding.

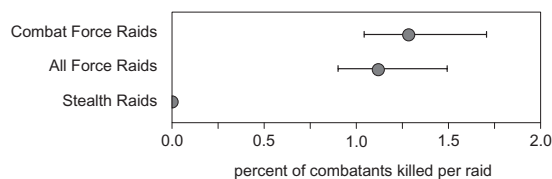


Fig. 2. The risk of dying is the primary private cost borne by those who participate in raids. A warrior’s expected risk of death when he departs on a force raid is 1.1%. If combat ensues, his expected risk of death is 1.3%. Estimates of the per capita fatality rate are based on a representative sample of 34 stealth raids, 47 force raids, and 41 force raids in which combat ensued. Error bars represent 68% confidence interval.

Raids also create collective benefits that flow to everyone in the community. Retaliatory raids produce deterrence, a non-excludable good. Such raids are not just a byproduct of a desire for loot; revenge is also an important motive. One participant said that he joined a raid because a neighboring ethnic group had just raided the Turkana. He did not lose any animals, but said that his brother-in-law lost his, and added, “Even if it’s not your family, they are Turkanas, like me. So we have to go fight back [against] the enemy.” In one raid, the primary goal was revenge, not animals. The raid was initiated quickly after a settlement was attacked so that the enemy would know this attack was retaliation for the recent raid. The warriors set out knowing that they were not likely to acquire animals, and they considered the raid a success even though they returned empty handed.

Large-scale force raids can increase access to grazing areas and crucial dry-season watering holes. The precipitating event for one of the largest raids in the sample was a hunter’s discovery that herders from another ethnic group had settled at a watering site that is typically used by the Turkana. The stated goal was to drive them away from Turkana territory. Furthermore, settlements move away from sites of raids, and this can lead to substantial shifts in the territorial ranges of ethnic groups over time.

Cooperation in Warfare Occurs at Large Scales

The Turkana mobilize a large number of warriors for force raids (Fig. 4). On average, 315 men participate in a raid, and the median is 248 men. Furthermore, participants in force raids are not all close associates: they are drawn from an average of five age-groups, four settlements, and three territorial sections (Fig. 5). Territorial sections number about 25,000 people, settlements and age-groups a few hundred. Although there are social ties that bridge these groupings, day-to-day interactions typically occur within them. When asked whether they recognized the men gathered for a raid, participants typically responded that there were some men they knew and some men they did not recognize. A warrior has on average only four of his close kin—father, son, full or half brother, brother-in-law, or full cousin—with him on a force-raid. Stealth raids are much smaller, averaging 12 warriors. A warrior has on average one close kinsmen with him on a stealth raid.

Free Riding Occurs During Raids

A Turkana man is regularly faced with the option of joining a raid or staying back. Recruitment is informal: a raid is initiated by one or a few men who send word out, encouraging men from other settlements to join, and over the course of a few days warriors from various settlements trickle in to the settlement that has initiated the raid. A man can refuse to join the raiding party, but he needs a good reason, such as the lack of a suitable person to take over herding duties, the need to defend the settlement, being ill, not having a rifle, or having joined recent raids.

The raiding party travels on foot for one or more days to the place where scouts have located an enemy settlement. Along the way, men turn back. They may escape at night unnoticed, or tell

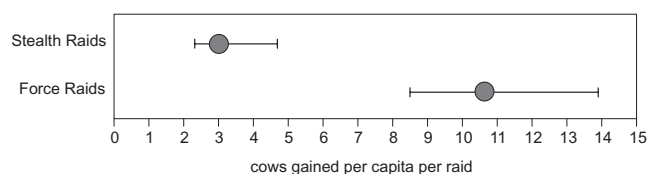


Fig. 3. The primary benefit of joining a raid is the livestock acquired. The average per capita gain in a stealth raid is 3 cows and in a force raid is 11 cows. Estimates are based on the share of livestock acquired by the focal warriors in 34 stealth raids and 53 force raids. Error bars represent 68% confidence interval.

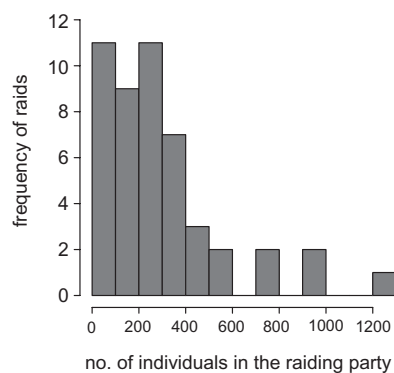


Fig. 4. The number of warriors in a force raiding party. The average size of a force raiding party is 315 warriors and the median is 248.

their age-mates that they are ill, worried about their herds back at home, or have a premonition that they will die on this raid. Such desertions occurred in at least 43% of force raids (Fig. 6). This estimate is a lower-bound because it only includes desertions of which the interviewee was aware. Participants said that they would not know of discreet departures by men outside their age-group or settlement.

Warriors have many opportunities to reduce their risk during combat. The fighting begins when the raiding party surrounds the settlement, pasture, or watering point and opens fire. As soon as the offense gains the upper hand, fast young men begin to drive the cattle toward Turkana land, as seasoned warriors engage in a holding action to keep the pursuit at bay, continuing to fight as they retreat. During combat, men constantly urge each other to stand their ground, fire their weapon, and not to run away. In 45% of force raids in which combat occurred, the focal warrior knew of men who lagged behind others during combat, failed to fire their weapons, ran away when the fire-fight began, or retreated too quickly (Fig. 6). Again, this estimate is a lower-bound because warriors report that they mainly know about the behavior of men standing alongside them.

Finally, the jointly acquired loot can be unfairly appropriated. The men driving the cattle homeward are supposed to continue until they are safely within Turkana territory and then wait for the rest of the warriors to rejoin them. Once regrouped, they divide the spoils before they disperse to their respective settlements. Norms specify that members of senior age groups get a larger allocation than members of junior age groups, and that men within an age group get roughly equal shares. However, the loot-sharing system failed in 56% of the force raids, and some participants took whatever livestock they were able to drive off (Fig. 6). Some men position themselves in the rear, a safe distance away from combat, wait for the vanguard to start releasing the livestock, and appropriate the best of the spoils.

Free Riders Are Sanctioned

Informally enforced norms allow the Turkana to partially solve the collective action problem in warfare. In 47% of the force raids in which desertions were reported, at least one of the deserters was sanctioned, and in 67% of the force raids in which cowardice was reported, at least one of the cowards was sanctioned (Fig. 7). There are two levels of sanctions. When a warrior’s behavior in a raid deviates from that of his comrades, he is subjected to informal verbal sanctions by his age-mates, women, and seniors. If there is consensus in the community that the act merits more serious sanctions, corporal punishment is initiated. Corporal punishment is severe: the coward or deserter is tied to a tree and beaten by his age-mates. One participant had scars on his torso from being whipped by his age group more than a decade earlier.

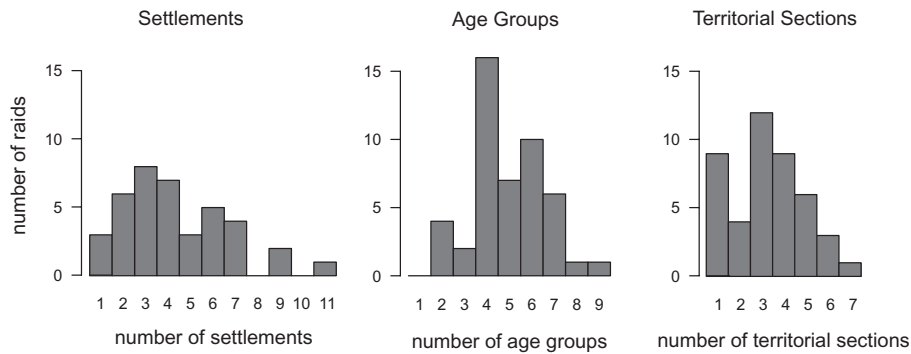


Fig. 5. The number of distinct social units from which participants of a force raiding party are drawn. Settlements, age groups, and territorial sections are social divisions in Turkana society within which day-to-day interactions are most likely to take place. Force raiding parties are comprised of men drawn from an average of four settlements, five age-groups, and three territorial sections.

During this process the violator is told not to repeat this mistake. Corporal punishment often culminates with the violator pleading for forgiveness and sacrificing an animal from his herd. Sanctioners do not confiscate the violator's share of the loot. Instead, the loss of the animal represents a "fine" that is then consumed by his age-mates and other older men. In force raids, there were 20 violations (combining desertion and cowardice) in which at least one of the violators was sanctioned (from Fig. 7). In nine of these cases corporal punishment or fines were imposed. In one case only 3 d had passed since the raid, and there was talk that further sanctions would soon be initiated. Of the nine cases in which serious sanctions were imposed, six involved corporal punishment followed by fines, two involved only corporal punishment, and one involved only a fine. In addition to these nine cases, in 2 of the 20 sanctioned cases the coward's share of the loot was reduced at the time of loot division. In stealth raids, only one of the five sanctioned violations involved a fine, and none involved corporal punishment. In a second case there was talk that further sanctions should be imposed but this had not yet been carried out at the time of the interview (20 d after their return). It is possible that the mechanisms maintaining cooperation in force and stealth raids differ, and collective corporal punishment may be more important in force raids.

The patterns of sanctioning suggest that the system relies on third parties. First, community consensus determines whether someone deserves corporal sanctions. The violator's behavior in the course of the raid is discussed extensively, especially among his local age group. When people from his settlement see the violator, they ask him what happened and why he did what he did. They chastise him for endangering other men and remind him that his fellow warriors died that day in battle. Opinions about whether he should face further punishment often differ. Some

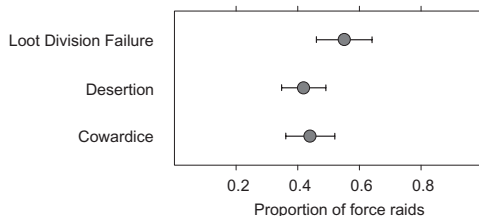


Fig. 6. Proportion of force raids in which free riding in the form of cowardice and desertion was noticed and norms regarding loot-sharing were not followed. The estimate for desertion is based on 49 force raids that were initiated, cowardice is based on 40 force raids in which combat occurred, and loot division is based on 32 force raids in which the raiding party was successful. Error bars show one SE.

may feel he should be excused this time as he has not acted like this before. Others will say his behavior was justified because it allowed him to save himself. Some may feel there is no use trying to change him because he is an inveterate coward. Still others will say that unless he is punished he will continue in these wrong ways. Second, once a consensus emerges, members of the violator's age group are responsible for administering punishment, even if they did not participate in the raid and did not experience the consequences of the violation. Third, the collective nature of the corporal sanctions is important. A sufficient number of age-mates must be present, and imposition of sanctions is often delayed because men are dispersed widely and busy with their herding duties. Fourth, both a failure to mete out justified punishment and second-party sanctioning without prior consensus are met with community disapproval. Finally, both deserters and cowards in force raids face similar corporal punishment. If only the victims of a violation initiate sanctions, we should expect that cowards would be punished by the men they endangered, and that deserters should escape sanctions. In raids numbering hundreds of people fighting without a well-defined unit structure, a desertion does not create a primary injured party with a sufficient motivation to impose sanctions.

The fact that direct punishment creates incentives to contribute to the combat efforts does not imply that it is the only factor sustaining the observed large-scale cooperation. We think that positive incentives—rewarding men who are brave in combat—also play a crucial role. However, rewards for bravery in this ethnographic context, are not associated with a single act. Instead, a warrior accumulates these benefits over a long period. Accurately measuring these diffuse benefits and the diffuse costs associated with indirect sanctions is difficult, and distinguishing the effect of behavior during warfare from the effect of other factors that affect a person's value as a social or mating partner is beyond the scope of the present study. However, we can conclude from the rate of direct punishment that, important as indirect sanctions and rewards may be, they cannot be the full story: if they created sufficient incentives, there would be no need for direct punishment.

Norms Governing Warfare Are Beneficial on Large Scales

A vignette study indicates that Turkana norms governing warfare benefit the ethnolinguistic group, not smaller social groupings in which people are more likely to know each other. Twenty-four subjects, all drawn from the Kwatela territorial section, heard two scenarios. In one scenario, two Kwatela warriors raid animals from the Toposa, another ethnic group, and bring them home to Kwatela land. In the other scenario, two Kwatela warriors raid animals from the Lukumong, another Turkana territorial section, and bring the loot home to Kwatela land. We alternated the order

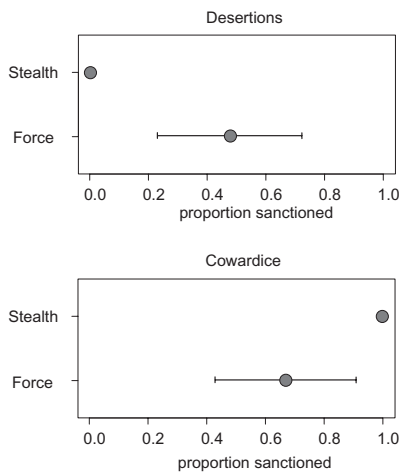


Fig. 7. Rate of sanctioning of reported desertions and cowardice. Sanctions include verbal sanctions, reduction in a share of the loot, or corporal punishment followed by a fine of an animal from the violator's herd to be killed for his age-mates and seniors. The estimates for force raids are based on 19 raids in which desertions were reported and 18 raids in which cowardice was reported. For the stealth raids, there were three raids in which desertion occurred and six in which cowardice was reported. Error bars show one SE.

in which the vignettes were presented. Kwatela subjects had very positive attitudes to the warriors who went to Toposa land to bring animals. In stark contrast, they considered the raiding of the Lukomong to be wrong and were strongly motivated to sanction the warriors who did this (Fig. 8). Even though the subject's own territorial section would benefit from the act, most subjects thought the act was wrong, were displeased with the warrior, and thought he should be criticized and punished. Subjects also wanted to terminate social interactions with the warrior. Most subjects would not stand next to this warrior in a raid, entrust their herds with him, lend him a goat if he needed to borrow one, or let their daughter marry him.

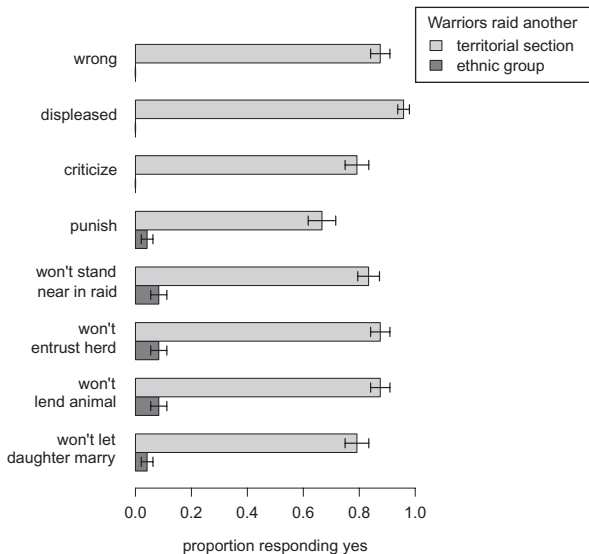


Fig. 8. Vignette study on the scale at which raiding norms are group beneficial. People from the territorial section that the subject belonged to either benefited when two warriors went to raid another Turkana territorial section, or when they went to raid another ethnic group. Bar lengths give the proportion of subjects agreeing with the proposition on the left. Each condition had 24 male participants in a within-subject design, with counter-balanced order. Error bars show 1 SE.

The scale at which norms are group-beneficial has a big impact on Turkana demography. Homicide or internal violence accounts for only 1% of adult male mortality within nomadic settlements, substantially lower than interethnic warfare that accounts for 50% of adult male mortality (from the same dataset as Fig. 1; “adult” refers to “puberty up to reproductive” and “reproductive” life stages). The suppression of within-group violence is noteworthy because most young Turkana men possess firearms, and have the opportunity to use force to resolve conflicts and acquire goods from other members of their society. We also think this pattern is not a recent feature of postfirearm warfare; ethnographers described norms that promoted raiding other tribes and deterred violence within tribes even during the period when combat was conducted with spears (19).

Conclusion

Although most scholars recognize that cooperation takes place in societies lacking a formal political structure, many think it occurs only at a modest scale and its evolution can be explained by kin-based altruism or reciprocity among familiar individuals. Contrary to this, Turkana sustain costly cooperation in warfare at a remarkably large scale without political centralization, formal coercive institutions, or even a political system based on descent (34). The punishment of free riders plays a role in sustaining this large-scale cooperation. Punishment is based on informal third-party sanctions. Although cultural norms specify how free riders should be treated, the enforcement of these norms requires the participation of the community at large, and no particular individuals are invested with the authority to implement sanctions.

The pattern of cooperation and sanctioning observed among the Turkana has important implications for understanding the origins of human cooperation. Sanctions can sustain cooperation on a wide range of scales. Thus, a full explanation of human cooperation must specify the processes that determine the scale at which norms sustain cooperation. Our results are not consistent with the view that human cooperative psychology—the mechanisms that motivate individuals to cooperate and to sanction free riders—was shaped by evolution at the scale of foraging bands. Turkana society lacks formal coercive institutions and the Turkana live in small nomadic settlements in which the cues of membership are much like those of foraging bands. Therefore, a psychology evolved to sustain cooperation in foraging bands should cause the Turkana to mobilize for raids at the scale of settlements. Instead, Turkana raiding parties are mobilized from multiple settlements, age groups, and territorial sections yielding large groups of warriors who are not kin or day-to-day interactants. Furthermore, norms governing warfare and their enforcement by third parties appear to create behavior that benefits the entire Turkana ethnolinguistic group at the expense of smaller social units. This finding is striking because the Turkana number around 500,000 individuals who commonly live hundreds of kilometers away from each other and never interact. Our results suggest that the human cooperative psychology was shaped by processes that have favored cooperation at the scale of ethnolinguistic groups comprised of large numbers of people who are not necessarily related to or familiar with each other. The evolution of cooperation at this scale requires a different kind of explanation. Cultural group selection is one possibility that predicts cooperative outcomes to occur at the scale of cultural variation, such as the scale of ethnolinguistic groups. An alternate solution relying on genetic transmission is presented in ref. 15.

These facts also shed light on the distribution of warfare across species. Warfare can create benefits in a wide range of ecologies. Because large war parties are likely to defeat smaller ones, on average, larger war parties will be more profitable if the collective action problem inherent in warfare can be solved. Thus, the scale at which the collective action problem can be solved constrains the scope of warfare. Patterns of warfare across animal

societies are consistent with this claim. In most mammals, individuals participate in collective violence only in small groups, or with kin. For example, chimpanzee border patrols typically involve 5 to 15 males of the same community (35). In contrast, costly large-scale intercolony combat is common in a range of eusocial insects. The fact that humans are able to solve the collective action problem in large groups may explain why combat involving groups of hundreds of warriors on a side has been documented in hunter-gatherers (22–24, 36, 37) (see *SI Appendix, Section 5* for more examples).

These results imply that large-scale cooperation may have been common for a long period of human evolutionary history. The Turkana cooperate in large-scale combat without political centralization and formal institutions. This fact suggests that early human societies could have done the same. Moreover, warfare is

only one domain of collective action, and is particularly costly to individual participants. Although there could be something unique about warfare that facilitates cooperation, it is plausible that if societies can solve the collective action problem in large-scale warfare, they can also solve myriad lower-stakes collective action problems, and this ability likely played a critical role in the ecological success of our species.

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Supporting Information: Punishment sustains large-scale cooperation in pre-state warfare

Sarah Mathew and Robert Boyd

1 Recruitment and administration of study

The data were collected during 9.5 months of field work by Sarah Mathew from 2008–2010. Participants were a representative sample of adult men reliant on nomadic pastoralism for their livelihood. We recruited them in a town close to the ethnic border frequented by nomadic Turkana who live in the surrounding 50 km radius. Recruitment was done with the help of trained local Turkana research assistants. The RA approached potential participants, briefly introduced them to the study, and then asked them to participate. If they agreed, they were brought to the study site described below. We conducted the study in the town center because the risk of raids in the surrounding nomadic settlements was high. We did not recruit from the settled Turkana population in this town center as they are Turkana who have actively pursued schooling and professions outside the pastoral sector, or were forced out of subsistence pastoralism after droughts, epidemics or raids. Nomadic Turkana frequent the perimeter of the town center for a variety of reasons as it is an important trading center and is adjacent to dry season watering holes. Herders from surrounding nomadic settlements frequent the market to sell an animal and purchase tobacco, tea, sugar and flour. Turkana women come to sell milk and collect relief food. Nomadic Turkana periodically come to town to visit their settled relatives. A river runs along the perimeter of town. The wells dug in the dry bed of the river provide water for

surrounding nomadic settlements and so herdsmen frequently bring their livestock for watering to the perimeter of town from where we can recruit them. To ensure that our sample is representative of herders within the town perimeter on a given day, we aimed to recruit using the following procedure to the extent that circumstances allowed: First, we specified the age-group that the participant should belong to. Then the RA went to one of the locations where nomadic herders visiting town are found. He approached the first person of the pre-specified age-group that he saw that he could reasonably approach. A potential participant was considered as being “reasonably approachable” if the RA could approach him without causing offense, rudely interrupting an ongoing conversation, or bringing undue attention to the act. If a person refused to participate, the RA repeated the process. We cycled through multiple age-groups and recruiting locations, to prevent drawing participants from the same network cluster. Circumstances did not always allow this procedure when there were too few members of an age-group around on a particular day. In these cases, after making a reasonable attempt, the RA picked the next available nomadic herder from any age-group he saw.

Virtually all Turkana in our potential subject pool have experienced an offensive raid first-hand at least once. So we did not have to rely on snowball sampling in the study except to recruit multiple individuals who participated in the same raid (to estimate inter-subject variation; see Section 3.7).

All studies were conducted at the study site—a room located between the market area and the watering holes. This prevented onlookers and an audience of peers, which minimized biases towards norm-compliant responses. Participants were compensated for their time with 200 Ksh (3 USD) for vignette studies lasting around 30 minutes–1.5 hours and 500 Ksh for the interviews which lasted 3–6 hours. Studies

were administered in the Turkana language. A local Turkana research assistant was present along with the researcher. For the semi-structured interviews, questions were framed by the researcher, the RA then asked the participant the question in Turkana, and translated the participant’s response immediately to the researcher, before the next question was asked. A digital recording of each participant’s response was also obtained and a fraction of these were translated independently by another local research assistant. Gaps in the first translation were filled using the second translation from the digital recording when possible. For the vignette study, the RA narrated the scenario and questions to the participant in the presence of the researcher.

2 Population mortality (data reported in Figure 1)

2.1 Data collection

Population mortality was estimated by reconstructing the family structure of participants. Among the 113 male participants recruited in the interview study, 6 participants did not meet internal consistency checks while responding to the demographic questions, and so were dropped from the study. Participants listed all their offspring and full siblings. We asked for all live births in these categories to be reported. Three reported still births were excluded. For each live birth that was listed we asked whether the person was still alive. If they were, we obtained a description of their current life stage. If they had died, we asked how they died, and asked for a description of their life stage at the time of their death. Participants, and their wives and parents were not included in the sample to avoid bias in the mortality estimates. Wives and parents are drawn from the population who survived to reproductive age. Parents are more likely to be individuals who have survived long in their reproductive life

stage and produced more children, thus contributing more to the participant pool. Using only offspring and siblings of participants provides an unbiased estimate of mortality to the extent that deaths occur independently within a family. Interviews of 107 participants yielded a sample of 446 males across the three life stages (222 in the middle childhood to puberty life stage, 86 in the puberty to reproductive life stage, and 138 in the reproductive life stage). We did a similar study with 125 female participants (64 married and 61 unmarried women) . Four of these participants did not meet internal consistency checks and so were dropped from this study. We asked women about their full siblings and offspring when the schedule allowed. Otherwise, married women were asked only about their offspring, and unmarried women were asked about their full siblings. This yielded a sample of 276 males across the three life stages (113 in the middle childhood to puberty life stage, 88 in the puberty to reproductive life stage, and 75 in the reproductive life stage).

2.2 Possible biases in mortality estimates

Mortality estimates can be biased if people are unwilling to talk about family members who have died, or if they tend to forget children who have died. Both biases would cause us to under-estimate mortality. If these factors are more likely to affect children who died in disease rather than raids, it will lead us to over-estimate raid-related mortality. Here we discuss the mitigation of these factors in our estimates.

Grief for relatives who have died prevents people from bringing up these facts if they have no reason to. Therefore, when asking people about family structure, we acknowledged to them that we understand this may be difficult, but that it is one of the issues that our study is focused on. Therefore it was important for us to know of all their live births (or the live births of their mother or wives). We found that

most participants were forthcoming and willing to talk about those who died after we framed the discussion this way.

As a further precaution, we used multiple methods of counting to check for consistency in their responses. First, participants were asked to list the total number of live births. Then they listed the total number of male and female children and the total number of children who are living and who have died. Then they listed the total number of living male, living female, died male and died female children. This allowed us to tally their totals in two ways, and check between these two for consistency. Finally, they were asked to list all the children in the order of their birth, telling us if they are male or female, living or died. We then asked them to provide the life stage for each living child, and for each child who died we asked about the cause of death and life stage at which they died. While this method does not solve the problem that children who are truly forgotten will consistently not be mentioned, it provided participants multiple opportunities to recollect and it gave us the chance to resolve inconsistencies in their accounts.

Combat deaths are more noteworthy and so parents and siblings may be less likely to forget individuals who died in raids than from illnesses. It is also plausible that younger siblings come to hear of older brothers who died in battle from stories their parents and others tell them, but may not hear of ones who died of illness. However, we think under-reporting of disease mortality due to this will be strongest for infant and early childhood deaths, not adult mortality. For parents, death of adult children will on average be more recent than death of infants, and so is less likely to be forgotten. Also, losing an older child is more uncommon than losing an infant, and so may be more memorable. Also, the longer a child lived the more likely the sibling we interviewed was around at the time the individual died. For all these reasons we

think that this bias will be strongest for infant and early child mortality rather than the life stages that we report in Figure 1.

Our child mortality estimates do not indicate strong under-reporting of disease mortality. Our data show that 49% of male children and 46% of female children die from illness before they reach middle childhood life stage (i.e. before reaching about 6 years of age). This falls within the range of child mortality in natural fertility populations without reliable access to medical care, suggesting that the extent of under-reporting of disease mortality must not be very strong. If it was not very strong for infancy and early childhood, then it is even weaker for disease mortality at older ages for reasons we discussed earlier.

2.3 Life stage versus age

We used life stage to approximate age categories, because participants could reliably provide life stage information for their family members, but could not reliably report the age or the Turkana calendar year of birth of all their family members. The start of middle childhood represents the age at which children transition from the stage when a child is mostly playing in the homestead, to one in which the child begins to leave the homestead to do chores. Thus, boys were categorized as being in middle childhood if they had started to herd goat kids on their own. This transition occurs around 4–7 years of age, depending on the child’s development, household needs and number of other siblings around. When an individual diverged prominently from the life stage of others of his age, he was categorized by his age, not life stage. For instance, if a man cannot sire children but other men of his age can, he is categorized as being in the *reproductive* life stage, rather than as a *post reproductive* male.

2.4 Classification of mortality causes

Deaths that occurred in the course of a raid, but that were not induced by the enemy, were not classified as mortality from raids. These included four cases of death due to thirst (or exhaustion) during the travel to or from the raid, and one case of a killing of one Turkana by another in the course of a quarrel that ensued over loot division (which was classified as internal violence).

3 In-depth interviews (data reported in Figures 2–7)

3.1 Data collection

We used in-depth semi-structured interviews to elicit a detailed account of events that occurred in a raid. Interviews were the only feasible means to obtain data on what happened during raids because raids cannot be safely or legally observed. Interviews were structured in three stages. First, we asked demographic questions about the participant's family composition, age-group, clan, territorial section, settlement, degree of reliance on the pastoral economy, livestock wealth, recent migration trajectory, history of participation in raids, livestock losses from raids, and frequency of participation in group defense. Second we asked questions aimed at reconstructing the participant's offensive and defensive raiding history. After obtaining a chronological ordering of the last few offensive raids that the participant had joined, we obtained an elaborate account of his most recent offensive raid. We did this because the participant is more likely to accurately remember details of his most recent raid and also because it ensures that our data are not biased towards raids that were particularly memorable. The interview is semi-structured and we ask questions that allow us to

re-construct a detailed picture of the events that occurred. Among other topics, each participant described how the raid was planned, how combatants were mobilized, how many warriors joined, the range of settlements from which people came, where and when they attacked, how the battle unfolded, whether there were desertions, whether men lagged behind others or did not fire their weapon during combat, how many people were injured and killed, how many livestock were acquired, and what happened to the men who were identified as deserters and cowards.

We obtained first-hand accounts from 118 participants which yielded data on 88 different offensive raids. This sample was built in two stages. In the first stage, using the recruitment procedure detailed in Section 1, we recruited 113 participants. Six participants did not meet internal consistency checks while responding to the demographic questions, and so were dropped from the study. Among the 107 remaining participants, we asked 11 for a detailed summary of their raiding history and this did not leave time for them to elaborate on their most recent raid. Thus 96 participants were asked to give a detailed account of their most recent raid. Of these, two had never joined an offensive raid, and one had last joined an offensive raid about 30 years ago and could not provide specifics about the event. Thus, we have 93 participants who provided us a detailed account of their most recent raid. The data file for one of these 93 participants was inadvertently overwritten. Among the 92 participants remaining, the most recent raid of 12 participants overlapped and they provided information only on four unique raids. (These 12 participants are the informants of the first four raids in Tables S1 and S2). Thus we have detailed first hand accounts of 84 different raids. Eighty three of these raids are the most recent stealth or force raid the participant joined. One raid is not. The participant was keen to discuss this raid in particular because he had become engaged in a prolonged fire-fight with a person

he knew in the opposition. While personally memorable to the subject, the raid was not unique in other ways and so we have retained it.

The second stage was a follow-up study in which we used snowball sampling to recruit multiple individuals who had participated in the same force raid. Our goal was to evaluate inter-subject reliability and variation in force raid accounts. Twenty-six participants were recruited for this study and they provided first-hand accounts of four unique force raids (the last four raids in Tables S1 and S2).

When we had multiple accounts of one raid, we used the following system to aggregate the data: we averaged the values from the multiple participants for the number of fatalities, loot gained, size of the raiding party, number of settlements, territorial sections and age-groups, and number of close kin. We used the maximum value across participants to estimate the proportion of raids in which desertion or cowardice was observed and proportion of raids in which desertion or cowardice was sanctioned. Thus, for instance, if at least one participant reported that they observed cowardice, the raid was categorized as one in which cowardice was observed. If at least one participant reported that individuals identified as cowards were sanctioned, the raid was categorized as one in which cowardice was sanctioned. For three other variables—whether or not the loot division system failed, whether combat occurred or not, and whether it was a stealth or force raid, there was no variation among subjects.

3.2 Categorizing raids into stealth versus force

Raids where number of participants were fewer than 20 men were prototypical of stealth raids, and raids where number of participants were 50 or more were recognizably force raids. Ten of the 88 raids in our sample were intermediate in size comprising 20–50 participants. We categorized these as stealth or force using the following rule:

if the raiding party initiated or intended to initiate an exchange of fire, it was categorized as a force raid unless the participant explicitly said that this was a stealth mission. Using this schema, 4 of the 10 intermediate sized raids were categorized as force raids—the party size of these raids were 28, 30, 47 and 49 warriors. The raiding party size of the remaining 6 raids were 22, 28, 30, 30, 40 and 46 warriors. They were categorized as stealth raids because participants were explicit that this was the strategy. In 4 of these 6 stealth raids (raiding party size of 28, 30, 40 and 46) the raiding party initiated fire-exchange.

3.3 Raids with over 1000 people

Five raids where participants estimated the size of the raiding party to be over 1000 people were excluded from the size estimates as these reported estimates were not consistent with other measures of the size of the raiding party (like the spatial span when seated or walking and number of subgroups involved). These 5 raids are also excluded from the casualty rate estimates because calculating the casualty rate required knowing the size of the raiding party. Data from the multiple accounts of a single raid (described in section 3.7) also indicate that estimates in the range of a few thousand are not in line with what other informants said, and so 5 such estimates were excluded when aggregating the data for each raid (see Table S1). Other estimates from these 10 participants were retained because these participants are not outside the range of what other informants say with regards to their other assessments (see Table S1).

We do not think excluding these estimates causes us to underestimate the size of the raiding party by much. Rather, we think that the people who provided these estimates were not in a position to assess accurately for one of several reasons. They may have joined the raiding party in the late stages of the gathering, or even after the

raiding party began walking, and therefore were absent when some form of numerical assessment was made. Often, while the raiding party is gathering, the numerical strength is assessed by counting various subgroups who have arrived and who cluster themselves by sitting under different trees. These clusters are typically age-group based, but when the geographical span is large and the numbers high, people also aggregate according to the areas and territorial sections they come from. So, for instance, the assessment is made by saying, 50 men from this settlement have come, 30 men of this age-group, 20 from another age-group, and so on, which provides a rough estimate for the total gathering. Individuals who arrive at this gathering at late stages, either because they heard the news late, or they had to travel somewhere to find a family member to take over herding duties, or made visits to friends to borrow food and bullets for the raid, would have missed this. Their estimates may thus be based on simply estimating the size of a crowd. Under these situations, we think that those individuals who reported very high numbers and whose estimates of size were inconsistent, gave qualitatively incorrect numerical estimates.

3.4 Data transformation procedures

When participants provided a range for the size of the raiding party, we took the midpoint of the highest and lowest value in the range.

Livestock gained was primarily in the form of cows. When goats and donkeys were obtained, they were converted into cows using the exchange rate prevalent in north Turkana.

When an estimate of the minimum is given (denoted in Table S1 with a “+” following the estimate), we used the minimum as the actual estimate. For instance, suppose the informant says that 3 people were killed from his settlement, and he also heard

that there were people from other settlements who died, but he does not know the number. We denote this in the table as “3+”, and in the data analysis this is replaced with “3”. This procedure biases some estimates as we discuss next.

3.5 Possible biases in estimates

The estimates for the per capita casualty rates and number of settlements in a force raid are likely to be low estimates. For the number of Turkana who died in a raid, participants may not always have known of casualties among warriors from other territorial sections or far away settlements, especially if the raiding party did not regroup for loot division. Also, casualties that occurred at the beginning of a battle are more widely known because combatants are closer together. Deaths also occur in the later stages of combat, as the raiding party has begun retreating and combatants are dispersing with the enemy in pursuit. Warriors may not hear about casualties from the later stage of the battle if they and the victim are from different territorial sections. Nonetheless, loss of life is a key focus of conversation after raids, and so more often than not, people eventually hear the reports from other territorial sections and distant settlements about how many were killed. So, we do not expect this bias to be too large.

For the number of settlements, participants were able to refer to individual settlements from their own localities using the name of the leader of that settlement. However, when people came from more distant lands, particularly outside of the territorial section of the participant, the participants often referred to the geographic areas these men hailed from, rather than their settlements. This means, if more than one settlement comes from the same geographic region, the participant may not know if there was only one, or whether there were actually two or three different settlements

there. Thus our estimates of the number of settlements represented in a raiding party may be smaller than the actual.

The estimates of desertion and cowardice rate were obtained by asking the interviewee to report on the behavior of fellow combatants. This method could lead to over-reporting of free-riding if the interviewee exaggerated the failure of others in order to enhance his own performance. However, we do not think that this resulted in a substantive over-estimation in our study. Several factors contribute to our assessment. One, if impression-management is occurring, it is unclear whether it will lead to over or under reporting. It is true that being better than his peers increases a man's status. But it is also true that a man's status is linked to the status of his age-mates. Consequently, men are proud not only of their personal performance but also that of their age-mates in battle. Age-groups are collectively shamed and praised for the cowardice and bravery of their men in combat. Putting down one's age-mates is not a characteristic means to raise one's status. These motivations may cause participants to under report rather than over report the failures of their age-mates. Two, we framed the questions relating to cowardice and desertion without highlighting the comparative aspect of their and his conduct. Participants were not asked to evaluate their own "performance" in the raid, only to narrate on the course of events as it unfolded. Thus, we tried to treat desertion and cowardice as events, rather than an evaluation of self and other. Three, participants were not just providing a Yes/No answer to the questions. They were providing a narrative account. When they talked about cowardice they also had to describe the events that comprised it: what the violator's act was, in what stage of combat did it occur and how others reacted to it. On occasions when participants would speak in vague generalities, they were reminded that we wanted to hear about events and persons specific to this particular

raid. Four, overall participants were very forthcoming during the interview, and freely talked about their lack of success in getting any loot, in the defeat of the raiding party and of raids that were aborted half-way without combat. One participant told us that he was a coward on that raid and was being encouraged by the rest. One participant told us about having returned on the way due to an illness. Another participant told us how he was punished. This gives us some grounds to think that the elaboration of what happened on the raid was not perceived by participants as an opportunity for bragging. Finally, we think that a more significant factor is that participants could not be aware of all the desertions and cowardice that happen in large force raids involving hundreds of warriors. They are aware of what happens in a smaller group—typically men they were standing alongside, age-mates, and settlement members. This is why despite the concern of over-reporting, we think that the estimates for the proportion of raids in which desertions and free-riding occur are under-estimates, and should be interpreted as a lower bound.

3.6 Missing data

In some instances, data from a participant is missing. In many of these cases, time constraints prevented us from completing the interview in full. Various factors gave rise to such constraints—time of day, how long the previous participant took, how long earlier stages of the interview of the participant took, and whether the participant had to leave in a hurry in order to reach his settlement before dusk. In other cases, participants were not in a position to observe or hear about the detail being asked them. For instance, if a participant arrived at the raid just as it was departing, he may not know the various settlements from which people arrived. If the participant was injured in the raid and had to be brought home early, he may not know about

cowardice in combat. If the participant’s homestead was far from the rest, he may have left for home soon after and not been around to hear of sanctions, or casualties. In these cases, the missing data do not bias the estimate. The one case where we expect missing data from a subject to bias the estimate is for the number of settlements. Some participants said that there were “many” settlements in that raid, but could not give a number. Such estimates were treated as missing data in our analysis. It is likely that estimates of “many” were given for raids in which people came from a large number of settlements causing us to underestimate.

3.7 Inter-subject variation (data presented in Tables S1 and S2)

Tables S1 and S2 show the estimates provided by different participants who talked about the same raid. (Section 3.1 describes how this sample was compiled). The raw estimates of size (provided in Table S1) show what the participants have said. The transformed estimate shows what entered the data analysis. When estimates of over 1000 were provided, see Section 3.3 for the procedure we followed. For desertions and cowardice and sanctions against them (Table S2), even when multiple participants in one raid reported that they observed cowardice and desertions, participants were each referring to a different set of individuals. When participants only gave an estimate that there were “many” (for instance in Table 1, under the column “# of settlements”), this is treated as an n/a in the data analysis. Items coded as “d/k” (Table S1) indicate that the participant responded that he does not know (i.e. he is aware that he does not possess the accurate state of information). Blank cells in Tables S1 and S2 are missing data because we did not ask the question either due to time constraints, or because it was evident that the participant could not have known about this particular aspect.

In the case of sanctioning, participants were not asked the sanctioning question when they were referring to cowardice or desertions for which they would not have been in a position to know whether sanctioning occurred. For instance, it may have been too early after the raid for punishment to have been meted, the violators were from another area, or the subject only vaguely heard that some other wing had some incidence and does not know much more. For the last two participants of Raid 7, we could not finish the full interview due to time constraints.

3.8 Confidence Interval Estimation

For the per-capita fatality per raid and per-capita loot gained per raid, the data were not normally distributed. So we did an ordinary non-parametric bootstrapping procedure, and calculated the confidence interval of the mean using the bias-corrected accelerated method.

4 Vignette Study (data reported in Figure 8)

Participants in the vignette study are told a short hypothetical story. Then we ask them to narrate the story back to us. This ensures that the participant understood the story, and also allows us to examine what aspects of the story the participant finds most relevant. We then ask participants a series of questions that elicit their judgment of the character and reaction towards his act.

Each question has two stages—an “open response” stage, and a “forced choice” stage. We first obtain the open response, in which the participant freely elaborates in his response to the question. To ensure that we do not let participants talk until we have heard what we want to hear, we consider an answer to be complete when the

Table S1: Multiple accounts of the same raid. Each row shows the scale and fatality estimates of one interviewee. Our estimate of the time that lapsed between the raid and the interview is shown in the “Recency” column.

Raid	Recency	Size (raw)	Size (transformed)	# of territorial sections	# of age-groups	# of settlements	# died
1	1 day	200	200	3	4	many	d/k
	2 days	200	200	3	4	3	d/k
	3 days	130	130	1	4+	3	0
	1 month	100	100	3	5	3	1
	1 month	250	250	3	4	4+	1
	3.5 months	104	104	2	2	3	1
2	4 days	500	500	4	5	many	0
	5 days	250	250	4	3	many	0
3	12 years	1000+	1000	3	6	3	80
	12 years	900	900	4	d/k	3	38+
4	23 years	d/k	n/a	4	6	4	0
	23 years	1260+	1260	3	6	3	0
5	9 months	200	200	4	7	6	2
	9 months	d/k	n/a	5	11	6	7
	9 months	350	350	4	5	5	7
	9 months	500 or 1000	n/a	5	7	7	7
	9 months	3000	n/a	4	7	7	6
	9 months	240	240	4	6	6	20
	9 months	d/k	n/a	3	5	3+	2
	9 months	400-500	450	4	7	7	4+
	9 months	4000-5000	n/a	4	7	8	7
	9 months	300	300	6	6	9	2+
6	5 months	250	250	5	7	10	5
	5 months	280	280	3	7	8	5
	5 months	4000	n/a	3	5	9	5
	5 months	250	250	2+	7	4	5
	5 months	250	250	3	7	5	3
	5 months	200	200	4	6	8	2
7	3 days	200, 240-300	250	5	8	9	0
	3 days	150	150	4	7	10	0
	3 days	4000-5000	n/a	6	8	8	1
	3 days	300	300	d/k	8	9	1
	3 days	250	250	4	8	8	1
	3 days	200	200	6	9	9	0
	3 days	200	200	3			1
	3 days	300	300				1
8	10 months	100	100	3	5	4	2+
	10 months	140	140	d/k	3	4	3

Table S2: Multiple accounts of the same raid. Each row shows the reports of one interviewee to whether free-riding and sanctioning of free riders occurred, and the share of the livestock they obtained on the raid.

Raid	Desertion	Desertion Sanctioned	Cowardice	Cowardice sanctioned	Loot division failed	Per capita gain
1	no	n/a	yes		n/a	0
	no	n/a	no	n/a	n/a	0
	yes		yes		n/a	0
	no	n/a	yes	yes	n/a	0
	yes	no	yes		n/a	0
	no	n/a	no	n/a	n/a	0
2	no	n/a	no	n/a	n/a	0
	no	n/a	no	n/a	n/a	0
3	yes	no	yes	yes		2
	yes	no	no	no		15
4	yes	no	no	no	no	10 cows, 20 goats
	yes	no	no	no	no	48 cows
5	no	n/a	no	n/a	yes	0
	no	n/a	no	n/a	yes	0
	no	n/a	no	n/a	yes	8 cows
	yes	no	no	n/a	yes	0
	no	n/a	yes	yes	yes	1 cow
	no	n/a	no	n/a	yes	4 cows
	yes	no	yes	no	yes	1 cow
	no	n/a	no	n/a	yes	2 cows
	no	n/a	yes	yes	yes	0
	yes	yes	no	n/a		0
6	yes		yes		yes	5 cows, 3 donkeys, 8 goats
	yes	no	yes	yes	yes	5 cows
	yes	no	yes	yes	yes	8 cows, 2 donkeys
	yes	no	yes	yes	yes	7 cows
	no	n/a	no	n/a	yes	2 cows
	no	n/a	no	n/a	yes	5 cows
7	no	n/a	n/a	n/a	yes	2 cows
	yes	yes	yes	yes	yes	2 cows
	yes	yes	yes	yes	yes	2 cows
	no	n/a	yes	yes	yes	2 cows
	yes	yes	yes	yes	yes	2 cows
	no	n/a	yes	yes	yes	0
8						0
	yes	yes	yes	no	yes	5 cows
	yes	yes	yes	no	yes	5 cows

participant pauses for 3–5 seconds. The 3–5 second time interval was estimated by the RA by silently counting up to three. If the participant hasn't begun speaking in this interim, we ask him if there is anything else he wants to add. If he says that there isn't, we proceed to the second stage. Otherwise, we continue to record his response, until another 3–5 second pause. In the forced choice stage, we ask him to decide one way or the other—for instance, to decide whether it is correct or wrong. We use the two-stage method because participants may provide fairly complex judgments in the open response stage, positing that there were elements of the act that were justified and elements that were wrong. In the second stage we force a choice, which allows us to infer which direction the participant leans towards. In cases where the participant is still ambivalent in the forced choice stage, we repeat the forced choice question once more. If he is still undecided, we proceed to the next question.

4.1 Scenario for raiding another ethnic group

Once upon a time there was a Turkana man called Etabo from Mogilla. One day, Etabo said to his friends – “why can't we go and look for animals in Toposa land.” So they left. When they reached the land of the Toposa, they found Toposa cows grazing, being herded by two shepherds. So they fired their weapons, killed the shepherds, and raided all the animals. They drove the animals back to Mogilla where they came from. This is the story of Etabo.

4.2 Scenario for raiding another territorial section

Once upon a time there was a Turkana man called Lopeyok from Mogilla. One day, Lopeyok said to his friends – “why can't we go and look for animals in Lukumong

land.” So they left. When they reached the land of the Lukumong, they found Turkana cows grazing, being herded by two shepherds. So they fired their weapons, killed the shepherds, and raided all the animals. They drove the animals back to Mogilla where they came from. This is the story of Lopeyok.

4.3 Questionnaire and instructions

Now I want to read you a story, and afterwards hear from you about what you’ve heard in the story. There is no correct answer that we are looking for, other than your own opinion. Have you understood? Listen carefully.

Once upon a time there was a Turkana man called Etabo from Mogilla. One day, Etabo said to his friends – "why can't we go and look for animals in Toposa land." So they left. When they reached the land of the Toposa, they found Toposa cows grazing, being herded by two shepherds. So they fired their weapons, killed the shepherds, and raided all the animals. They drove the animals back to Mogilla where they come from. This is the story of Etabo.

Have you understood the story or do you want to hear it again?

You still remember the name of the character? Who?

Now, can you repeat the story that I’ve just read to you?

Now we want to hear from you about the Etabo I just read to you about. You will be asked a question to which you should answer at length, not briefly. Thereafter a second question will follow and you will choose briefly, saying whether it is like that, or it is not like that.

- 1 What Etabo did was correct or wrong? Why?

Now, choose one: it is correct or wrong?

2 Are you pleased or displeased with Etabo? Why?

Now, choose one: you are pleased OR displeased

3 Will Etabo be praised or criticized? How?

Now, choose one: he will be praised OR criticized

4 Will you say anything to Etabo if you meet him? What?

Now, choose one: you will tell OR you won't tell

5 Should anything be done to Etabo? What?

Now, choose one: Something will be done OR Nothing will be done

If yes: Who should do this? How?

6 Should his age-mates advise him? How?

6 Now, choose one: He should be advised OR He should not be advised

7 Will Etabo change his behavior in the future? How?

Now, choose one: He will change OR He won't change

8 Will you tell others about what Etabo did? What?

Now, choose one: You will tell OR You won't tell

9 Will you be next to Etabo in a raid? Why?

Now, choose one: You will be beside OR You won't be beside

10 Will you trust Etabo to herd your animals? Why?

Now, choose one: You will trust OR You won't trust

11 Will you lend Etabo your animal for future repayment? Why?

Now, choose one: You will lend OR You won't lend

12 If Etabo wants to marry your daughter, will you accept? Why?

Now, choose one: You will accept OR You won't accept

In the second vignette that the participants listen to, we use the same procedure but skip the long instructions. Instead we just say, “Now I’ll read you another story. Listen carefully.” We alternated the order in which the stories were narrated, such that half the participants heard the “raid another ethnic group” vignette first, and the other half of the participants heard the “raid another territorial section” vignette first.

4.4 Vignette data analysis

The data in Figure 8 show participants’ response in the forced choice stage to 8 of the 12 questions that were asked—questions 1-3, 5, and 9-12. The remaining 4 questions are ones in which an affirmative or negative response in the forced choice stage does not signify the motivation to sanction or not. We will present the results from qualitative data analyses on these responses and the open response of the other questions in a future publication.

We had one undecided response in the forced choice (in the *raid another ethnic group* condition) and this was coded as 0.5 (where Yes = 1 and No = 0).

One participant (from the *raid another territorial section* condition) was excluded because he gave contradictory responses in the open response and forced choice stage

in 8 of the 11 questions, and this was likely due to confusion about why the question was being repeated twice. A few participants (10%) reverse their opinions on at least one of the questions. We did not exclude these responses as they did this for only 1–3 questions at most, and it seemed that a change of mind rather than confusion was behind such reversals. These reversals occurred in both directions (switching from wanting sanctions to not, and vice versa).

A between-subject comparison yields similar results to the within-subject comparison shown in Figure 7.

5 Reports of large-scale combat in hunter-gatherers

[1] reports that Russian explorers to the Aleutian islands were attacked by Alutiiq war parties comprising 200 warriors armed with bows, arrows and shields in one attack and up to 340 warriors in another attack (p. 39). Prior to contact, there was ongoing warfare between the Unangan and Alutiiq, and entire settlements could be destroyed during raids between them. Based on ethno-historic and oral historical reports, Maschner summarizes (p. 39) that “large numbers of men participated in warfare with several hundreds of individuals involved in some battles.”

[2] discusses a first-hand account of a battle that occurred in early 18th century between the Shoshones and the Blackfoot Indians. This battle occurred prior to the arrival of horses and guns. The informant recounts that there were 350 warriors on their side, and the size of the Shoshone opposition seemed larger to him (pp. 34–35).

[3] discusses a battle involving 700 participants that took place between people inhabiting the Clarence River Valley in Australia (p. 59).

[4] discusses a raid in which 86 Yurok raided the the Hupa, and the return raid

involved “about 100 raiders” (pp 50–52). There is also an account of a Mojave raid against the Apache involving 200 Mojave and a number of other groups (pp. 751–53). These groups had a few horses.

[5] reports that inter-societal conflict between the Eskimo and Athapaskan speakers in Western Alaska included “open battles with dozens or (rarely) even hundreds of combatants” (p. 18). More than one village could mobilize for defense. Burch reports that in one raid “a large invading force reportedly was spotted far enough from its target to give runners time to recruit reinforcements from another village” (p. 20).

[6] reports that Cree Indians living near the Albany river would join forces with the ones living near Moose river, to launch attacks against the Inuit. He reports of such a raid that occurred in 1736, where “Seventeen canoes from the Albany River area and eight from the Moose River area embarked on this expedition, suggesting a party of approximately fifty warriors (assuming two persons per canoe)” (p. 45).

[7] discusses an account of a party of 9 Spanish soldiers who were attacked by a group of 60 Chumash warriors (p. 91). Later on, when one of the 60 men was captured, he recounted the composition of the party, which reveals that they were mobilized from six different villages (pp. 92–93). In another encounter, Johnson reports that “a party of at least 58 men from Castec and 7 other interior Chumash and Yokuts rancherias” attacked a party of 28 people.

[8] describes a prominent battle between two nomadic foraging populations in the Central Australian Desert—the Walbiri and Waringari. The battle was over a few water wells and the territory around it that the Waringari were using. Meggitt describes that “...in a pitched battle for the possession of the water the Walbiri drove the Waringari from the area, which they incorporated into their own territory. By desert standards the engagement was spectacular, the dead on either side numbering

a score or more” (p. 42).

[9] reports on an attack that wiped out a whole camp of Aranda, a nomadic hunter-gatherer population in the Central Desert in Australia. Strehlow describes (p. 125), “A large party of avengers drawn from the Matuntara area along the Palmer River, and from some Southern Aranda local groups, was accordingly assembled...”. All but three people in the camp were killed by the attackers.

[10] discusses a raid that occurred in 1875 in the Central Desert in Australia where 80–100 men, women and children were killed by a raiding party of 50–60 warriors (p. 163).

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