

Supporting Information

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SI Text

SI Text A. Waorani subsistence was based on manioc slash-and-rot (fields were not usually burned) horticulture, with corn, plantain, peach palm, and peanut as important secondary crops. The meat in their diet came mainly from hunting with blowguns and spears, with peccaries, woolly monkeys, and toucans among the most common game animals. Fishing was a minor activity (1, 2). Medical examination showed that, before infectious diseases arrived, the Waorani were well nourished and very healthy (3).

The precontact Waorani lived in 4 geographically separated, mutually hostile territorial groups. Each of these groups was dispersed in “neighborhood clusters” of communal longhouses (nanicabos), usually separated from one another by a 30- to 60-min walk. The senior males of the longhouses in a neighborhood cluster were often related as brothers, brothers-in-law, or father-in-law/sons-in-law. Each longhouse typically consisted of a dozen people in a single household maintained by an extended family, often focused on a senior man, his wives and unmarried children, and his daughters and their husbands and children. It was customary for each nanicabo household simultaneously to maintain 2 or 3 different longhouses, each having associated gardens, from 6- to 10-h walks apart, and to move among them every few months. In some locations, neighborhood clusters tended to repeat themselves. That is, the same nanicabo households would associate with each other in the several places in that they had longhouses. In other locations, each neighborhood cluster might be unique or a longhouse might be isolated. The distance between one neighborhood cluster and another belonging to the same territorial group of Waorani was usually a matter of walk of a day or two. The minimum distance between a neighborhood cluster and others belonging to hostile territorial groups was ideally maintained at several days walk.

Marriage was prescriptively with a bilateral cross cousin (ki), and was usually arranged by the parents of the young couple, often without their knowledge. If the parents of a bride and/or groom were dead, other close relatives arranged her/his marriage. Second marriages could be contracted at the initiative of the marrying individuals under the rule of the levirate and the sororate. Marriages were most common within the neighborhood cluster. To “marry. . . someone from an unknown group [was] to marry outside the proper pattern. It [did] occur. . . but it [was] viewed as a ‘wild’ marriage” (4). Both polygyny (usually sororal) and polyandry (always fraternal) occurred, apparently in response to fluctuating neighborhood cluster sex ratios. Marriage by violent bride capture, accompanied by the killing of the woman’s family, was an alternative route to matrimony. Among the people we interviewed, over 10% of marriages followed this violent path. The rate of such marriages fluctuated, of course, with the rate of raiding.

Sexual relations were generally permitted between people of the opposite sex related as ki, whether or not they were married to each other, although in precontact times sex was frowned upon for unmarried girls. Probably the most common sorts of extramarital affairs occurred between a married woman and her husband’s brothers, and a man and his wife’s married sisters, although affairs were tolerated between any people related as ki. Because the Waorani believe in partible paternity (5), all of the men sexually involved with a woman around the time of her pregnancy were considered as the fathers of her child. Sexual jealousy appears to have been rare, usually present only if the affair were improper—that is, outside the ki relationship.

Completed fertility was in the unexceptional range for a

natural fertility Amazonian population. A reproductive history interview sample of 93 postmenopausal women who completed childbearing before pacification found a mean of 6.2 live births per woman.

As noted above, the death rate from homicide, particularly Wao-on-Wao homicide, was enormous. The motives for Waorani internal warfare were both simple and complex, as described by Yost (see ref. 4; with comment added in brackets).

As they see it, their warfare is a vendetta. At some point in the distant past one Wao killed another—the reason has long since been forgotten—and the sons of the victim avenged his death. That sparked a long series of revenge killings. . . dispersing the enemy groups over their immense territory. . . The reasons the Waorani give for spearing someone are broad: the death of someone in the forest, an accident which resulted in injury, severe illness, someone getting lost in the forest, frustration at not being allowed to marry, anger resulting from an argument, a series of unlucky events (for example, continued bad luck at hunting), birth of a malformed child, to obtain spouses, to obtain iron tools, the entrance of outsiders or enemy groups into their territory, shaman activity, etc. These are all the final impulse, the psychological impetus necessary to give them the final shove actually to embark upon a raid which could mean their own death. But ultimately, the explanation can be found in the need to avenge earlier killings. . .

Once someone decides to carry out a raid, he will try to enlist followers from his own neighborhood cluster or household and they proceed with determination. Usually they begin shaving and decorating spears, each man making his own distinctive shape and size spear and his own feather design or decorative features. The purpose of the identification marks is to ensure that survivors of the enemy will know without doubt who did the killing and come to fear the killers. [Of course, this blatant identification also serves to perpetuate the vendetta, because the identity of the killers is not in doubt.] As they work, they recall past grievances and work up their anger. . .

A few elements of this summary may be expanded for additional clarification. First, no record exists of any intratribal raiding by the Waorani carried out in cold blood. Raiders were always in a white-hot fury when they went out to kill. Second, raiders were never compelled to participate; a man had to be persuaded to join a raiding party, and could opt out of it at any time. There are stories of men deciding in the middle of the trail to abandon the raiding party and return home. However, a boy on his first raid, who was usually brought along by his father or older brother, was in a weak position to resist, even if he did not want to participate. Nevertheless, most boys were eager to go on their first raid despite being afraid. This fear is curious because there is no memory of any Wao raider being killed, or even seriously injured, by the Waorani he attacked. In fact, when Waorani were attacked, they usually seemed not to have fought back—or at least not to have fought back successfully. Recognizing the advantage of their attackers, who virtually always took them by surprise, they fled.

This advantage is made clear in the following description of the course of a typical raid, as synthesized by Yost (4) from many descriptions of individual raids:

... the raiders will remain hidden and wait until a very dark night when silhouettes cannot be seen against the sky through the thatched house. They will approach the house, verify that everyone is sleeping or inattentive, and either burst in or sneak in and kill as many as possible before they can escape. Unless they have agreed beforehand to spare certain individuals for specific reasons, men, women and children are usually all killed. In the total chaos of screaming victims, terrified children, furious, yelling raiders, smoke from trampled fires and the blackness of the night the raiders have to be alert not to spear their own men, and some intended victims escape into the dark forest. After all are dead or have fled into the forest, the invaders pillage the house for blowguns, machetes, axes or any other valuables and then burn the house and leave, either to flee home or, if they think there is good chance for further success, to continue the raid in other houses in the neighborhood cluster.

Despite this level of violence, the plurality of Waorani men participated in only 1 or 2 raids—although hardly any men never participated at all. We know of only one man who reached the age of 20 before pacification who (as far as we are aware) never participated in any raids at all.

SI Text B. Wallis's work (6, 7), supplemented by the research of KL, provides the following account. Around 1946, three teen aged girls fled to the *kowode* to escape what they were sure was their own imminent death by spearing. They were taken to a hacienda near the southwestern frontier of Waorani territory, and held there by an hacendado in conditions approximating slavery. Rachel Saint, a missionary with the Summer Institute of Linguistics (SIL) and the older sister of one of the missionaries slain in 1956, discovered their presence and began trying to alleviate their situation and learn *Wao tededo* from one of these girls in 1955.

In 1958, Saint and Elizabeth Elliot, the widow of another of the slain missionaries of 1956, attempted to make contact with the Waorani. They were preceded by Dayomae, the girl at the hacienda from whom Saint had been learning *Wao tededo*, and by Mintaka and Maenkamu, two of Dayomae's female relatives who had left the Waorani in November 1957. Through their efforts, Saint and Elliot achieved a peaceful contact with Dayomae's relatives in the westernmost territorial group of Waorani in October, 1958. Over the next few months, about 58 of these people, known as the Geketaidi (Geketa's people—Geketa being the most influential man of the group) joined Dayomae, Saint, and Elliot at a settlement they established on the Tewaeno River.

In December 1961, Elizabeth Elliot left the Tewaeno settlement. SIL linguist Catherine Peeke spent two-and-a-half months among the Waorani in 1962 and made shorter visits to Tewaeno annually for the next three years. In 1968, after Peeke completed her Ph.D. in linguistics, she worked among the Waorani until her retirement in 1992.

By 1968, the number of Geketaidi living in and around the Tewaeno settlement had increased to 104. Then, in February, 1968, 12 members of the Piyaemoidi (Piyaemo's band) territorial group joined the Tewaeno settlement. The connection was made by a woman named Onkaye. In June of 1968, she brought an additional 92 Piyaemoidi to Tewaeno. They were traditional enemies of the Geketaidi. Members of the two territorial groups

had killed each other's close relatives, and relations were tense. Nevertheless, they managed to avoid fighting.

(About a year before most of the Piyaemoidi came to Tewaeno, a dispute within this group had led to the massacre of many members of one neighborhood cluster by men of another. The survivors of that massacre fled, splitting the Piyaemoidi into two groups of unequal size: the major group soon moved into the protectorate at Tewaeno, but the other, smaller group lost contact with all other Waorani. Under the leadership of a man named Tagae, they became the Tagaeidi, a small group of "wild" Waorani, whose survivors remain unpacified to this day. They kill anyone who tries to enter into their territory. In the past decade, they have been decimated by raids against them by "pacified" Waorani.)

In early August, 1969, 56 Baiwaidi (Baiwa's band) joined the Tewaeno settlement. The Baiwaidi were of course traditional enemies of the other two groups, and again the situation was tense. When a polio epidemic broke out in late August, 1969, a man was speared in traditional Wao vengeance for a death by illness. In turn, the killer's sister was speared. A revenge cycle was averted when the original killer himself died suddenly from a seizure a week later. The epidemic eventually killed 16 people and left others crippled. In November, 28 of the Baiwaidi fled Tewaeno and returned to their old territory.

In September 1969, Rosi Jung, a German nurse-midwife, arrived in Ecuador to join Peeke and Saint. She moved to Tewaeno in 1970.

In December 1970, the Baiwaidi who had fled Tiwaeno returned. By early 1972, about 50 members of the Wepeidi, including Wepe himself, had come to live in Tewaeno, while about 200 more remained in their traditional territory.

In 1972, Patricia Kelley, an SIL literacy coordinator, arrived. By 1982, when she left the Wao territory, seven Wao communities were recognized by the Ecuadorian state as "Literacy Centers," with trained Wao literacy instructors.

In 1974, James Yost, his wife Catherine, and their 18-month old daughter moved into Tewaeno. They had another daughter and a son while living there. In 1977, Yost built a house at the newly founded settlement of Tzapino, and still later, in 1978, another at the new settlement of Kiwado. The Yost family migrated among these houses on a schedule similar to the old Waorani semisedentary pattern. Additionally, until the Yosts returned to the United States in 1982, James Yost visited all Waorani settlements at least once a year. Since relocating to the United States, Yost has returned to the Waorani at least once a year in every year except 1991 and 1997.

SI Text C. Warfare-focused ethnographic fieldwork by the authors of the current article began in 2000.

In our sample, structured interviews yielded information on the genealogy, marriage and reproduction, and survivorship of the children for each of the Waorani over age 50. These interviews also elicited the marriage and reproductive histories of the respondents' grandparents, parents, siblings and half siblings. The survivorship of their siblings' children, the marriage and reproductive histories of the respondents' own children, and their siblings' children were also investigated. These data were entered into 2 electronic databases, both constructed by Boster; one that tracks genealogical relationships for all data gathered on known Waorani individuals both alive and dead ($n = 2,445$; a copy of this database was given to the Waorani indigenous organization Organización de la Nacionalidad Huaorani de la Amazonia Ecuatoriana for their use), and one that tracks the circumstances of pregnancy and birth and the sociocultural information surrounding reproductive practices (e.g., partible paternity, birth attendants, etc.) for each interviewee over age 50.

The history of warfare was also obtained in structured inter-

views. For each raid in which a man participated, we gathered the following information: the names of all of the men who participated in the raid, the names of all of the men who organized it, the names of the victims, why the raiders went on this attack, whether women and children were captured, and the relative size of the 2 warring groups. We also requested information about the interviewee's marital and reproductive status at the time of the raid to help us date individual raids and establish their relative chronology. We asked interviewees about the raid histories of their fathers, husbands, and brothers, whether these men were dead or otherwise unavailable for questioning. Data on each individual warrior were entered into an electronic database. There were 550 individual reports of raids, 359 of these were intratribal raids (i.e., raids of Waorani against other Waorani) and 191 were against *kwodi* (8).

In our analysis, the 359 intratribal reports were consolidated into 44 separate raids for which there were multiple reports, and 14 raids for which there was only a single report. A comparison of the lists of people killed in separate accounts, and a comparison of the lists of participants, facilitated this comparison. Summary statistics for each intragroup raid were entered into an electronic database, and written narrative summaries of the circumstances of each raid for which information was available were entered into a text file.

To obtain this information, we interviewed 121 Waorani—56 men and 65 women—the great majority of them age 50 or older. As far as we know, we were unable to interview only 4 individuals in the 50+ cohort—2 women who were not in their home communities when we visited; 1 man who declined to be interviewed because he feared we would tell the police about his raiding history; and 1 woman, possibly suffering from Alzheimer's disease, who told us sadly that she had “forgotten how to think.”

All 56 interviewed men provided genealogical information. However, 13 did not report a usable raiding history. In all, 46 male interviewees had been on raids and 43 provided us with usable personal raiding histories. All 65 interviewed women provided genealogical data. Additionally, 56 provided their completed reproductive histories. Eight did not, but we were able to acquire their reproductive histories from their husbands. We obtained accounts of raiding for 95 different warriors: the 43 interviewees who provided usable personal raiding histories, plus 52 deceased men whose raiding histories were provided by interviews with one or another combination of their widows, brothers, sons, daughters, grandsons, and fathers.

Although we are well aware that a perfect accounting of all of the raids in which our informants or their close relatives participated is impossible, we believe that our data represent the best approximation of raiding histories that can be acquired by non-Wao investigators. We cross-checked the information provided by separate informants, and we also reinterviewed people when we found discrepancies in their reports.

SI Text D. Summer Institute of Linguistics (SIL) linguist Catherine Peeke lived in the settlement of Tewaeno from 1968 to 1992 working on a New Testament in *Wao tededo*. In addition to her language studies, she took notes whenever genealogical information emerged in conversations with her informants. She transferred these notes to 3 × 5 sized pieces of paper, each focused on a single individual, and recorded his/her parents, siblings, spouses, and children, or (usually) some subset of that information. These sheets also often contain codes for group affiliation, cause of death, and other matters. When Dr. Peeke retired, she turned over her notes to James Yost, who made them available to the WLHP.

Yost, also with the SIL during his years with the Waorani, visited all settlements repeatedly between 1974 and 1982. He recorded genealogical data in a more common ethnographic

style, with extended genealogies tracing wider kin linkages among individuals. Most of his genealogical information had been entered into an electronic database before the WLHP began. A final cleaning of the database was performed by Boster in 1999.

Yost also possessed records on the demography of various Waorani groups, including the names, sexes, and age estimates of their members, along with notes on family composition. These data had been gathered by missionaries working in the field at various dates right after first peaceful contact in 1958. Although spotty, these early rough censuses of individual groups were quite helpful. By late 1977, at which time 227 Waorani had been registered with the Ecuadorian National Department of Civil Registry, missionary efforts to determine birth dates had become more systematic. In 1980, Yost himself made a more complete census of pacified Waorani individuals, which proved very useful to the WLHP.

Genealogical reconstruction for the Waorani is not an easy task. Every individual has several—typically 4 to 6—names, and often uses different names at different life stages, and in different social and geographical contexts. Furthermore, people are named after their grandparents (and in Wao kinship terminology, the same-sex siblings of a grandparent are also labeled as grandparents). Until faced with the necessity of Ecuadorian registration, the Waorani did not have surnames. In the late 1970s, Catherine Peeke worked with the Waorani to establish a system of surnames based upon paternal ancestors.

The members of our research team who were new to the Waorani made a deliberate choice while collecting the WLHP genealogical information to remain blind to the previous genealogical work by Peeke and Yost. After the 2000–2001 fieldwork was completed, Beckerman, Erickson, and Yost began the process of correlating the 3 genealogical sources (WLHP, Peeke notes, and Yost notes) to produce a single “canonical” Waorani genealogy. To this end, they met in the United States at various times from 2002–2005 and worked through the genealogies of all 95 warriors in the raiding database, comparing and correlating their data.

Contradictions among the data sources were dealt with in several ways. Children who were stillborn or died young were included in a parent's genealogy if they were mentioned in any 1 of the 3 sources, on the grounds that such cases are known to be commonly suppressed or forgotten, worldwide. Where the father of a child was in question, the child was assigned to the mother's husband—even if it were known that she had had a sexual relationship with another man—on the grounds that the husband would have had more frequent sexual access on average. We tackled other discrepancies by making a judgment about which record was provided by the informant in the best position to know. In general, closer relatives were held to be more reliable, and primary relatives best of all, although James Yost was able, on the basis of a decade of living with the Waorani, to identify some individuals as unreliable and others as exceptionally good informants, and their reputations in this regard were taken into account.

Genealogical questions about which serious doubt remained were dealt with in additional interviews in later field trips in 2002–2004 as well as by an April 2002 meeting in the United States in which 2 elderly Waorani women, chosen from our most knowledgeable genealogical informants, were flown to the United States along with the two Ecuadorian national members of the research team, for a 5-day session of data cleaning and verification with the U.S. members of the project. Catherine Peeke also participated in this session, as did 2 other SIL missionaries, Rosi Jung and Patricia Kelley, who, as noted above, also had lengthy field experience with the Waorani.

When the genealogical analysis of the 95 warriors and their primary and secondary relatives was well underway, efforts

began to assign birth and death dates to these individuals. This task relied heavily on SIL records, particularly censuses and government registrations, and WLHP field notes. WLHP genealogical and reproductive history notes provided the birth order of members of sibling sets, as well as information on whether each member of each sibling set was born before or after peaceful contact with the territorial group of their parents. However, only persons born after peaceful contact had their actual birth dates recorded.

The estimation of the precontact birth dates was difficult. The methods accepted as providing the most robust birth date estimates for populations without written records (9–11) rely on creating a list for the entire population with all living individuals ranked in age, based on collation of informant statements as to relative ages of pairs of individuals. From such a list, and some absolute dates tied to the births of individuals, birth dates can be estimated by means of stable population models and/or the fitting of a regression equation to the known birth dates, the subsequent interpolation of the unknown individuals between the known dates and a final readjustment to the regression equation.

Two problems emerge when using these methods with the Waorani, one theoretical and one ethnographic. The use of stable population models to interpolate birth dates on an age-ranked list depends on the assumption that birth and death rates have remained reasonably constant. But we know that Waorani death rates have fluctuated wildly as a result of intermittent massacres. Even if we had an age-ranked list, the theoretical basis for interpreting it by means of stable population theory is lacking. Furthermore, it is not possible to create such a list. Because at first contact the Waorani were divided into 4 mutually hostile territorial groups that went to great effort to avoid each other, and because even some neighborhood clusters within territorial groups had been scattered by raids and had not seen each other for years, people born before pacification simply do not know whether they are older or younger than most other prepacification members of the population.

SIL records provided one source of information to ameliorate these difficulties. Nearly as soon as each territorial group was peacefully contacted, SIL missionaries took a census of the new contacts, and estimated their ages. Additional censuses were taken in later years. Estimated ages in these censuses were, of course, most reliable for the youngest children, decreasing in accuracy with age. However, the missionaries usually took considerable care with the census age estimates of people with whom they were in close contact, probing for evidence that could link a person's birth date or developmental age to a known historical event. The Waorani are often rather good at recalling developmental markers—remembering, information such as “my mother told me that my first teeth were erupting when the soldiers killed Itaeka.” These well-dated persons provided anchor dates for our reconstruction of their siblings' birth dates.

Reproductive records for the years just after pacification for each of the 4 territorial groups, combined with estimated ages of young children at the moment of contact, led to the unexceptional conclusion that surviving, live-born Waorani children were on average spaced about 3 years apart in traditional times. The same sources indicated that a stillbirth or an infant death was usually followed by another child in about a year. The plurality of Waorani girls married around 13 or 14, with first birth often taking place about a year later. Of course, some girls were considerably older when they married, and a marriage did not always produce a prompt birth. Reproduction often lasted until a woman was around 50. These rules of thumb, along with informant statements of relative age for people who had spent their childhoods together, were used to assign birth dates to people who did not survive to be included in any census.

Postcontact death dates were known from SIL records in almost all cases. Precontact death dates were approximated by acquiring an estimate of the age at which the precontact individual died. An informant familiar with the deceased person was asked to identify a living person who was about the same age as the deceased, at the time of death of the latter.

Further fieldwork in 2003 and 2004 was thus focused on cases in which the data in hand were inadequate for the reliable estimation of precontact birth and death dates. We sought out the informants most likely to be knowledgeable about the problem cases and tried to obtain from them relative age comparisons of well-dated and undated people. We also asked how old someone was at the time of a known event. The success of our inquiries depended, of course, on finding an informant from the same group as the undated person.

For the longitudinal analyses reported below, it was necessary to estimate not only the births and deaths of relevant individuals but also the dates of particular raids in which the 95 warriors had participated. Many raids could be dated with reference to someone who had been killed in a given raid. Additional information elicited by the raid interviews, particularly the age of the warrior's last-born child when he had taken part in a given raid, was also helpful in assigning dates to raids. A few absolute dates could be gained from newspaper reports of raids on *kowode* (e.g., a raid on a military camp), and then those could be used to establish relative dates for other raids, as well as births, deaths, and other significant Waorani events.

Given the obstacles mentioned above, it is inevitable that our estimates for birth and death dates, and for when raids occurred, are less accurate than we would like them to be. The farther back in time our estimates go, the less reliable they are. The dataset we were able to compile is inadequate for the sort of fine grained demographic analysis that Howell (10) and Hill and Hurtado (11) conducted among the !Kung and the Aché, respectively. Nevertheless, we believe that these uneven data are adequate for the coarser and more robust statistical treatments we employ here.

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