Human Ecology, Vol. 11, No. 2, 1983

Fertility and Pacification Among the Mekranoti of Central Brazil

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Demographers and anthropologists have recently turned their attention to the fertility increases that seem to have occurred with the "demographic transition." This study examines various explanations for historical changes in fertility among the Mekranoti-Kayapo Indians of Central Brazil. Data from pregnancy histories and genealogies suggest that changes in health status, use of contraceptives, lactation periods, and post-partum sexual abstinence are not as important in accounting for Mekranoti fertility as is warfare. Because of high male mortality from war, many Mekranoti women spent a large portion of their reproductive years without a husband, and their fertility was significantly lower as a result. This finding may have implications for demographic changes elsewhere and in other periods of human evolution.

KEY WORDS: fertility; warfare; Mekranoti-Kayapo Indians; demography.

INTRODUCTION

Studies of the demographic transition are of interest to both population specialists who would like to understand current population trends, and to anthropologists who would like to understand the reasons for population expansion throughout human existence. Although early theorists concentrated on changes in mortality rates that might affect population growth, recent researchers have devoted more attention to analyses of fertility changes. Several have noted that fertility often rises when previously isolated groups come into contact with Western societies. This

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0300-7839/83/0600-0227$03.00/0

has been the case for the Nunamiut Eskimo of Alaska (Binford and Chasko, 1976), the Cree Indians of Canada (Romanuik, 1974), the Shipibo Indians of Eastern Peru (Hern, 1976), New Guineans (Rafiq, 1979), and Zairians (Romaniuk, 1980). What accounts for the increased fertility of these groups? Researchers suggest various answers. Some stress improvements in health services that might make women more fertile. Others emphasize dietary changes that could enhance a woman's fertility or shorten lactation periods by allowing supplemental feeding of babies, Still others emphasize social changes such as loss of post-partum sex taboos.

In this study, I examine some of these hypotheses about fertility changes by using demographic data from three different historical periods of the Mekranoti-Kayapo Indians of Central Brazil. Besides the factors mentioned above, I also look at the possible effects of warfare on Mekranoti fertility. Since warfare has played an important role in many pre-industrial societies, it is important to assess its possible effects on fertility in order to obtain an accurate picture of demographic changes with acculturation.

The Mekranoti are a group of 285 relatively unacculturated Indians living in a single village in southern Para, Brazil. As in pre-contact days, their economy is based on slash-and-burn agriculture, hunting, and fishing (see Gross *et al.*, 1979; Werner *et al.*, 1979 for descriptions of subsistence). At the time of my study in 1976–1977, only one Indian spoke enough Portuguese to converse, and none understood money well. The Indians obtained outside merchandise primarily though the Brazilian Indian Foundation which acted as a middleman to trade Western goods for Brazil nuts collected by young men on expeditions every year or two.

As the Mekranoti describe their past, the period before 1953 was one of a great deal of warfare. At this time the Mekranoti fought other Kayapo, as well as non-Kayapo Indians and occasional Brazilian prospectors or settlers. The Mekranoti were constantly on the move. They travelled across the southern part of the Brazilian state of Para from the Araguaia River to the Tapajos. Villages changed sites regularly, and fissions and fusions were frequent.

In 1953, Claudio Villas-Boas, the well known Brazilian Indianist, made the first peaceful contact with the Mekranoti near the Xingu River. Some of the Mekranoti (now called the Txukarramae) remained at the Xingu with Claudio. But a cold epidemic convinced half of the Mekranoti to return to isolation in the forest. (It is this latter group which the Brazilian Indian Foundation now calls the Mekranoti, and it is in this group that I collected my data). After several years in the forest the Mekranoti were again drawn into contact with civilization. This time, it was the prospect of gifts from Chico Meirelles, another well known Brazilian Indianist, that

attracted them to the Cantoco River in the West, but the outbreak of another epidemic sent them back to their forest retreat. From 1953–1966 the Mekranoti made several trips to the Xingu River to receive gifts from Claudio Villas Boas, as well as trips West to obtain goods from Meirelles. But it is doubtful whether these "gifts" compensated for the suffering the Mekranoti experienced as one epidemic succeeded another.

In 1966, a Protestant missionary moved in to live with the Mekranoti in their forest village. The subsequent construction of an airstrip allowed the Mekranoti to make contact with the outside world without the long treks to distant rivers. Although different missionaries moved into the village after 1968, they remained absent for long periods of time. It was not until 1973 that the Brazilian Indian Foundation placed a medical attendant on permanent duty among the Mekranoti. At the time of my fieldwork, the Mekranoti were optimistic about their future. In contrast to other Kayapo groups now struggling to retain their lands (see Gross, 1981), the Mekranoti have not yet experienced threats to the vast areas of tropical forest they call their own.

MEKRANOTI FERTILITY

To assess Mekranoti fertility, I relied on pregnancy histories collected from all the adult women (15 years or older) in the Mekranoti village as of December, 1976. I asked each woman to tell me about all of her pregnancies beginning with the first. I asked about birth dates and death dates, about pregnancies terminated before completion, about the length of nursing periods for each child, and about the mother's observation of sex and food taboos. I was also careful to ask about any suspected cases of abortion or infanticide and about the use of contraceptives.

To determine ages of mothers and of children, I relied on a combination of techniques. First, I constructed an event calendar based on outstanding moments in Mekranoti history. For some of these events I had exact dates, the immigration into their village of a Kayapo faction from another group shortly after 1936, contacts with Claudio Villas Boas in 1953 and 1960, contacts with Chico Meirelles in 1957 and again in 1963, the arrival of missionaries in 1966 and 1968, and the arrival of FUNAI (Brazilian Indian Foundation) personnel in 1973. Through questions about history, I estimated dates for other Mekranoti events, the burning of a village, the split-offs of different factions, and murders. When asking for birth dates on the pregnancy histories, I asked women to tell me when children were born or to describe how big they were when different events occurred. I also asked older informants to give me birth dates for those

people who did not appear in the pregnancy histories. As an alternate measure I also ranked people in terms of birth order. Using a separate card for each person, I asked different informants to tell me over and over again "who was born first "a" or b?" until I had the entire village filed in order. The Spearman's rho between the two different measures was 0.92. Some demographers (Howell, 1976) prefer to "smooth out" the age curve by using models of age distributions for stable populations. As I will attempt to show, the Mekranoti population has not been stable during recent history. Thus, I prefer to keep ages as collected with the event calendar, even though they may contain errors.

In attempting to correct data deficiencies in the collection of pregnancy histories, Bogue and Bogue (1970) argue that it is important to upwardly adjust fertility rates because of possible "forgetfulness" on the part of mothers about children who died within their first year of life. They recommend assuming that reported infant mortality represents only 75% of the true infant mortality. I prefer not to make these adjustments. In their comparison of pregnancy history data with census material for Mexico, Bogue and Bogue found that the unadjusted pregnancy history data were closer to the census data than were the upwardly adjusted figures. The official census data showed an infant mortality rate of 69.9 per thousand live births; the unadjusted pregnancy history data gave a figure of 72 per thousand, and the adjusted rate was 96 per thousand. Thus, despite the contrary conclusion Bogue and Bogue draw from this comparison, the data suggests to me that women may not be so forgetful in reporting deaths of their children as has been supposed. Therefore, I prefer to leave the Mekranoti pregnancy history data as they are.

Figure 1 is a population pyramid for the Mekranoti in December of 1976. It reveals several important facets of Mekranoti history. First, there were 73 adult women as opposed to 63 adult men in the village. As I will argue later, the skewed sex ratio among adults is primarily a result of high male mortality in warfare. Second, the pyramid is "squeezed" for the age periods 10–19. These are people born during the contact years, 1955–1965, which were characterized by numerous epidemics.

Table I shows the ages and number of terminated pregnancies for the adult Mekranoti women. All of the women born before 1955 had gone through at least one pregnancy, and some women had as many as ten or 11. It is too early to tell whether any of the younger women are sterile, but sterility does not seem characteristic of the population.

How has Mekranoti fertility changed over time? Table II presents data on age-specific fertilities for women during the different periods of Mekranoti history. To arrive at these figures, I used the techniques described in Bogue and Bogue (1970). For each historical period, I obtained

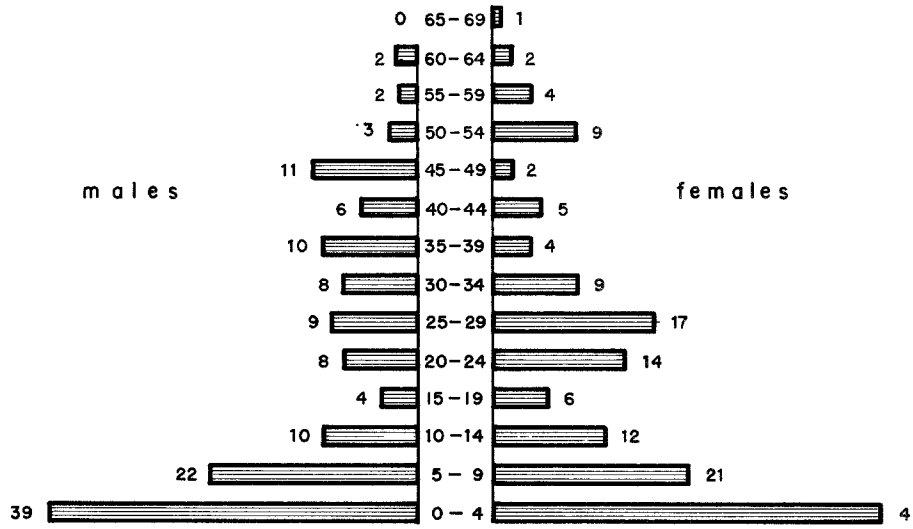

Fig. 1. Mekranoti population pyramid.

Table I. Women's Ages by Births

No. of women	Birth Year	No. of births	No. of women	Birth Year	No. of births
1	1908	4	1	1942	6
1	1912	10	3	1943	17(5+6+6)
1	1913	7	1	1944	3
2	1918	11(5+6)	1	1945	5
1	1920	3	3	1946	12(3+4+5)
1	1921	5	1	1947	5
1	1922	5	1	1948	3
1	1923	8	7	1949	29(1+2+3+4+5+7+7)
1	1924	1	5	1950	20(3+3+4+5+5)
3	1925	17(5+6+6)	3	1951	14(3+4+7)
3	1926	14(2+5+7)	1	1952	5
2	1931	16(7+9)	2	1953	4(1+3)
1	1932	6	6	1954	11(1+1+2+2+2+3)
1	1933	10	5	1955	8(0+1+2+2+3)
2	1935	10(3+7)	4	1957	8(1+1+2+4)
1	1936	6	1	1958	0
2	1937	20(9+11)	1	1961	0
2	1938	12(5+7)			

the number of births to mothers of different ages. I also calculated the number of woman-years spent in the different age categories. Dividing the number of births by the number of woman-years gives the average number of births per year for a woman living in the time period. For example, in the pre-contact years (before 1955), there were 25 births to mothers between the ages of 20–24. There were also 93 woman-years in this period. This means that women aged 20–24 averaged about 0.27 (25/93) births per year, or about 1.34 births over the 5 year age interval. (For the most recent time period I assumed that the girls under 15 years old, whom I did not interview, had had no pregnancies. The Mekranoti call these girls "kurerer," girls who have not had children, to distinguish them from "kra-re," those who have given birth). The length of the age category (in years) times the sum of the age specific fertility rates gives the total fertility. This is the number of births a woman could be expected to go through if she lived to age 50.

Table II shows that in pre-contact years a woman who survived to age 50 could expect to give birth 6.5 times; during the contact years this average dropped to 5.6, and in the post-contact period it soared to almost 8.5.

What accounts for the drop in Mekranoti fertility during the contact years and its steep rise afterwards? As mentioned above, researchers have suggested several factors. I will examine each of these in turn.

HEALTH

Some researchers argue that the health of mothers might account for fertility differences in the societies they studied (Van Arsdale, 1978; Romaniuk, 1980, 1974; Binford and Chasko, 1976; Hull, 1980; Stanhope and Hornabrook, 1974). Romaniuk (1980) uses cross-regional data on syphilis and fertility to support his contention that medical treatment for venereal disease is partially responsible for the increased fertility of Zairians in recent years. Elsewhere, he draws on historical data to argue that medicine, as well as sedentism, are responsible for the better health and higher fertility of the Cree Indians (Romaniuk, 1974).

Can differences in health account for the historical variations in Mekranoti fertility? I do not have morbidity rates for the Mekranoti, but I do have data on child mortality which may be just as good as an indicator of health. Table III shows the probability that children would survive different age categories in different historical periods. The data come from the pregnancy histories. I adapted the techniques described by Howell (1976), but rather than show the data by 5 year intervals as Howell does, I broke down the data by year. The need to distinguish different historical periods

Table II. Age Specific Fertility Rates

Mother's age	No. of births to women in age interval	No. of woman-years in age interval	Average no. of births per woman per year
Pre-contact pre 1955			
10–14	3	145	.02
15–19	20	124	.16
20–24	25	93	.27
25–29	15	77	.19
30–34	10	40	.25
35–39	2	19	.11
40–44	3	10	.30
45–49	0	2	.00
Total fertility rate = 6.5			
Contact period 1955–1964			
10–14	7	130	.05
15–19	11	65	.17
20–24	13	52	.25
25–29	12	47	.26
30–34	11	53	.21
35–39	5	58	.09
40–44	1	30	.03
45–49	1	17	.06
Total fertility rate = 5.6			
Post-contact 1965-1976			
10–14	3	129	.02
15–19	41	171	.24
20–24	49	161	.30
25–29	35	99	.35
30–34	22	67	.33
35–39	16	56	.29
40–44	9	64	.14
45–49	1	63	.02
Total fertility rate = 8.5			

requires this yearly breakdown. Column 1 shows the number of males and females entering given age categories during the different historical periods. For example, there were 27 males who passed their first birthday (entering age category (1–2) sometime between 1954–1964. Column 2 shows the number of males and females still within the age category when the historical period ended. For example, of the 27 males who entered age category 1–2 during the contact years, three of them would not complete their second birthday until 1965, the post-contact period. Subtracting column 2 from column 1 gives the number of children who (had they all survived) could have completed a given age category within the historical period. Of the 27 males entering age category 1–2 between 1954–1964, only 24 could have completed this interval within that time period. Column 3

Table III. Child Mortality Rates

	Pre-1955							
	Males				Females			
Age interval	Entering interval within historical period (1)	Still in interval during historical period (2)	Deaths (3)	Percent surviving interval (4)	Entering interval within historical period (1)	Still in interval during historical period (2)	Deaths (3)	Percent surviving interval (4)
At birth[a]	30		1	.97	45		3	.93
0–1	29	3	2	.92	42	7	4	.89
1–2	24	3	0	1.00	31	4	0	1.00
2–3	21	3	1	.94	27	5	1	.95
3–4	17	0	1	.94	21	1	0	1.00
4–5	16	1	0	1.00	20	2	0	1.00
5–6	15	0	0	1.00	18	0	1	.94
6–7	15	1	0	1.00	17	2	0	1.00
7–8	14	0	0	1.00	15	0	0	1.00
8–9	14	1	0	1.00	15	2	0	1.00
9–10	13	1	0	1.00	13	2	0	1.00
0–10				.82				.80

				1955–1964				
At birth	37		4	.89	24		0	1.00
0–1	36	5	7	.77	31	1	3	.90
1–2	27	3	2	.92	31	5	3	.88
2–3	25	4	0	1.00	28	1	0	1.00
3–4	21	1	2	.90	28	3	1	.96
4–5	19	1	1	.94	26	0	1	.96
5–6	17	0	1	.94	25	2	0	1.00
6–7	17	2	0	1.00	25	1	0	1.00
7–8	15	2	0	1.00	24	1	2	.91
8–9	14	2	1	.92	23	0	0	1.00
9–10	12	3	0	1.00	25	3	0	1.00
0–10				.52				.67
				1965–1976				
At birth [b]	84		5	.94	83		4	.95
0–1	84	7	11	.86	80	7	5	.93
1–2	69	9	2	.97	73	14	3	.95
2–3	62	5	2	.96	57	7	4	.92
3–4	56	12	1	.98	49	3	2	.96
4–5	44	7	4	.89	44	11	1	.97
5–6	33	4	2	.93	34	3	3	.90
6–7	29	5	0	1.00	29	6	2	.91
7–8	26	5	0	1.00	22	7	0	1.00
8–9	23	3	2	.90	15	1	0	1.00
9–10	21	5	2	.88	17	2	1	.93
0–10				.51				.58

[a]Does not include three still births of undetermined sex (probably premature).
[b]Does not include nine still births of undetermined sex (probably premature).

shows the number of deaths among children who could have completed a given age interval within the historical period. Of the 24 males who could have completed age category 1–2 in the contact years, two died. This means that 22 out of 24 or 92% of the males who could have passed their second birthday within the contact years survived. The number of males entering age category 2–3 in the contact years includes these 22 survivors plus the three males who were listed as "still in the 2–3 interval" for the pre-contact years. Column 4 shows the percent of children surviving different age intervals within the different historical periods.

Since the sample is so small, not much confidence should be placed in the figures for the percent surviving each age interval in Table II. However, these figures can be used to calculate the overall probability that a live newborn would survive to its 10th birthday. The probability of surviving to age 10 is simply the product of the percent surviving each age interval—listed in the last row for each historical period. In the pre-contact period live newborn girls had an 80% chance of surviving to age ten, and live newborn boys an 82% chance of surviving this long. For males and females combined, the probability is 81%. Under the conditions prevailing during the contact period, a live newborn had only a 60% chance of surviving to age ten. And the post-contact period was no better; only 54% survived to their 10th birthday.

This latter finding surprised me somewhat. At first, I attributed the high mortality of post-contact years to a malaria epidemic that occurred in 1968. But further analysis showed that this was not the case. For the years 1969–1976, which do not include any major epidemics, the mortality rate was still high. The probability of surviving to age ten was only 64%. It is only fairly recently (since the introduction of a medical attendant) that the mortality rate has dropped considerably. Since 1973, 93 out of a hundred live newborns could expect to complete their 10th birthdays.

At this point, it is possible to add a few words about the quality of data presented here. Table III shows that the mortality rates for the earlier ages are similar for all three historical periods. It is for older children that pre-contact mortality seems especially low. This does not support the argument that older women "forget" children who died during their first years of life. If we accepted the "forgetfulness" hypothesis, then we would have to conclude from Table III that Mekranoti women are more likely to forget older children who died than young infants. This seems highly unlikely.

How does Mekranoti health relate to fertility? The drop in Mekranoti fertility from pre-contact to contact years corresponds with an increase in mortality. The directions of these changes would support a "health" argument about fertility, but the degrees of change do not. Whereas

mortality increased sharply after 1955, fertility fell only slightly. Furthermore, the changes from contact to post-contact periods are not at all consistent with the "health" view of fertility. Whereas fertility rose sharply, mortality remained high. The reduction of mortality since 1973 is far too recent to account for the fertility increase that began much earlier. Thus, health does not seem to be behind the changes in Mekranoti fertility.

DIET AND LACTATION

Another factor that may be related to fertility is diet. Binford and Chasko (1976) argue for the Nunamiut Eskimo that an increase in vitamin E, as the Eskimo switched from meat to imported grains, may have increased fertility. A similar switch in diet for the Mekranoti seems unlikely. The Mekranoti continue to subsist exclusively on the foods they produce in their own gardens or acquire from the forest. The major staples are manioc, sweet potatoes, and bananas. If anything, the Mekranoti now eat less corn than they did in the past. The major dietary change is not in the type of food eaten, but rather in the ways food is prepared. In the past, the Mekranoti, who did not make pottery, roasted most of their food. But today the introduction of metal pots has allowed them to boil what they eat. Also, the introduction of large metal griddles has encouraged the toasting of manioc flour. Binford and Chasko (1976) suggest that the switch to boiled foods in cultural evolution may inadvertantly have encouraged higher fertility by allowing mothers to provide supplemental foods to their infants at an earlier age. The result would be a shortened lactation period and shorter birth intervals.

Is there any evidence that the Mekranoti have been nursing children less since they began to use pots? And can changes in lactation account for changes in fertility? Table IV shows the average lactation period for the different times in Mekranoti history. Again, the data come from the pregnancy interviews. In this case, I eliminated from analysis all children who died before weaning, and all children still at the breast. Thus, the table includes only weaned children. (This may lead to a bias in the data toward shorter nursing periods in the latter period. Since I eliminated from analysis all children still at the breast, those who are nursed for longer periods of time are less likely to be included in the statistics. Still, the bias is not likely to be very large since the latter time period includes 12 years, whereas any bias in the data would refer to only the last year or two). The average nursing period appears to have dropped steadily from 19.7 months before 1955 to 16 months in recent years. This corresponds to the steady increase in metal pots in the village. Thus, the data seem to support Binford and

Table IV. Age At Weaning in Mekranoti History

Time period	Average age at weaning (in months)[a]	Number of weaned children
Pre-contact (before 1955)	19.7	63
Contact (1955-1964)	18.5	41
Post-contact (1965-1976)	16.0	83

[a]For the difference between pre-contact and contact, $t = 0.73$, n.s.; for the difference between contact and post-contact $t = 1.7$, n.s.; for the difference between pre- and post-contact, $t = 2.7$, $p < .01$.

Chasko's contention that boiled foods may shorten lactation periods. But the data are not consistent with the view that changes in lactation periods are responsible for fertility changes. Fertility decreased after 1955 even though lactation periods were shorter. Also, a comparison of relative fertility and average nursing period for individual women shows no relationship between the two variables. Women who had more births per reproductive year (ages 12–49) were not significantly more likely to have shorter lactation periods per infant ($r = -0.18$, n.s.). This suggests that other factors may be responsible for changes in Mekranoti fertility.

DELIBERATE ATTEMPTS TO REDUCE FERTILITY

One of the reasons for fertility change may be deliberate action. People can use contraceptives, abstain from sex, or perform abortions. But these actions may not always be effective or override other determinants of fertility. In a recent comparison of eight Third World countries, Jain and Bongaarts (1981, p. 91) found that the use of contraception was unrelated to fertility (as measured by birth intervals) in most of the countries studied. Part of the problem may be that contraceptive techniques are not effective. In his analysis of native contraception among the Shipibo Indians of Peru, Hern (1976) found little relationship between fertility and contraception.

The Mekranoti do not use modern contraceptives, but 31 women did report using native teas or "baths" to inhibit conception. Most of them used these native contraceptives only after they already had several live births, but some younger women reported using them before marriage. It is doubtful whether these contraceptives are very effective, and the Mekranoti said themselves that the contraceptives they obtained from the forest did

Table V. Mekranoti Use of Contraceptives

Time period	Number of times contraceptives used	Woman-years	Percent users per woman-year
Pre-contact (before 1955)	8	365	2.192
Contact (1955–1964)	9	322	2.795
Post-contact (1965–1976)	19	681	2.790

not really work. (They insisted, however, that certain contraceptives found in the cerrado regions of Brazil were effective). Table V shows the number of times women used contraceptives during the different historical periods. The number of uses of contraceptives per reproductive woman-year did not vary much in the different historical periods, and certainly could not account for differences in Mekranoti fertility. Also, the number of uses of contraceptives by women was not significantly correlated with their average number of births per reproductive year ($r = -0.17$, n.s.).

Perhaps a more effective form of birth control is sexual abstinence. Romaniuk (1980) argues that increased protein supplies led to shorter post-partum sex taboos and higher fertility in Zaire. Hull (1980) explains the lower fertility of poorer Javanese women as due in part to stricter observations of post-partum sex taboos. And Hern (1976) argues that the effectiveness of contraceptives among the Shipibo is primarily through the sexual abstinence required when using the native contraceptives. Similarly, among the Mekranoti I once asked an informant how a certain plant worked as a contraceptive. "You make a tea with the leaves, drink it, and abstain from sex," he explained. But, like many other societies in the world, the most common form of sexual abstinence among the Mekranoti is the post-partum sex taboo. Is there any evidence that changes in the observation of this taboo may have affected Mekranoti fertility?

Table VI shows the reported length of post-partum sex taboos in different historical periods. In this analysis of the pregnancy data, I eliminated the last birth since post-menopausal women sometimes reported no sex after the last child, and some women were still observing post-partum sex taboos for recent births. The steady decrease in the length of the sex taboos does not coincide with the ups and downs of Mekranoti fertility over time. However, there is a correlation between women's fertility (births/reproductive year) and their average post-partum sex taboo per child ($r = -0.34$, $p < .01$). Thus, although sexual abstinence does not correspond with historical changes in Mekranoti fertility, it does correlate

Table VI. Mekranoti Post-Partum Sex Taboos

Time period	Average length of post-partum sex taboo excluding last birth (in months)[a]	Number of births
Pre-contact (before 1955)	36.7	71
Contact (1955–1964)	33.0	51
Post-contact (1965–1976)	25.6	118

[a]For the difference between pre-contact and contact, $t = 0.63$, n.s.; for the difference between contact and post-contact, $t = 2.1$, $p < .05$; for the difference between pre- and post-contact, $t = 2.2$, $p < .05$.

with individual differences in fertility. Since sample sizes are small in the historical comparisons, the sexual abstinence hypothesis should perhaps not be summarily rejected.

Another deliberate action to avoid births is abortion. Only two Mekranoti women reported attempting abortion. One said she was sick and did not want her unborn child. So she took medicine to make her well, which she knew would cause a miscarriage. Another said she was angry with her husband because he was with another woman. Apparently, the husband fired a short in the air to frighten her and cause an abortion. These abortion techniques do not seem to be very efficient, and with only two reported cases, it is unlikely that abortions could have affected Mekranoti fertility.

Although it would affect mortality rather than fertility, infanticide should also be mentioned at this time. Five Mekranoti women said they had committed infanticide. Two of them killed one of the twins to whom they had given birth. Two others committed infanticide because their husbands left them and they did not want any more children. (I could not elicit an explanation for the fifth infanticide). Two of these infanticides occurred before 1955, one in 1956, and two since 1965. It is also interesting to note that two infanticides were of males and three of females.

WARFARE AND FERTILITY

Although previous writers have seen warfare as affecting population growth (Divale and Harris, 1976; Harris, 1974), their theories tend to concentrate on mortality rather than fertility. Harris (1974), for example,

emphasizes the role of warfare in promoting female infanticide, a custom which he argues would greatly affect population. But among the Mekranoti, there is no evidence of preferential female infanticide. Males are killed as well as females. Also Table III shows that there is no "hidden" (indirect or unreported) female infanticide. Out of 315 reported births, 152 were female, 151 were male, and 12 were born with ambiguous genitalia (probably premature). Thus, as many females are reported born as males. In addition, the chances that a female baby would survive to age ten were just as high or higher than the chances for a male baby.

But warfare may affect fertility as well as mortality. In a cross-cultural study, M. Ember (1974) shows that high male mortality in warfare generally results in a skewed sex ratio in favor of women. Fewer men may mean less intercourse for females and lower fertility. Table VII shows the percent of deaths that were due to homicide for Mekranoti males and females during different historical periods. The data come from genealogies I collected while in the field. I asked informants to give me the names, causes of death, and dates of death for the ancestors of everyone in the village. I requested information for parents, grandparents, parents' siblings, and the descendants of all of these. Table VII shows that, prior to contact, an extraordinarily high percentage of males deaths were due to homicide (42%). This compares to 25% of female deaths. In the absence of female infanticide, these sex differences in war-related mortality would lead to sex imbalance in the population. Indeed, at the time of my stay among the Mekranoti, there were 73 adult women over 15 years old, but only 63 adult men.

Since the Mekranoti are monogamous, an excess of females over males means that many women cannot have husbands. But this does not mean that unmarried women must forego sexual activities. Men commonly have extramarital affairs with the Mekranoti kupry (women who have had children out of wedlock). But it is likely that sex is more difficult for the kupry. Whereas sexual relations between a man and wife can occur in the house at night, sex with a kupry must take place during the day, and special

Table VII. Mekranoti Deaths Due to Warfare[a]

Time period	Males	*N*	Females	*N*
Pre-contact (before 1955)	42%	147	23%	90
Contact (1955–1964)	14%	57	3%	63
Post-contact (1965–1976)	11%	38	0%	30

[a]As percent of total deaths.

Table VIII. Years Without Husbands

Time period	Percent of reproductive years women spent without a husband[a]	Number of women of reproductive age
Pre-contact (before 1955)	51.94	27
Contact (1955–1964)	53.10	38
Post-contact (1965–1976)	32.53	69

[a]For the difference between pre-contact and contact, $t = 0.12$, n.s.; for the difference between contact and post-contact, $t = 2.39$, $p < .05$; for the difference between pre- and post-contact, $t = 2.26$, $p < .05$.

arrangements must be made for a rendezvous. Probably as a result of lower sexual activity, kupry have significantly fewer births per reproductive years (ages 12–49) than do married women ($r = -0.24$, $p < .05$). A high male mortality in warfare and an excess of females means that married women, too, may find themselves without a husband for long periods of time. Husbands may not only die in warfare, but they may also be more inclined to divorce if there are plenty of women to marry.

Is there any evidence that fertility is related to the number of reproductive years a woman spends without a husband? Table VIII shows the percent of reproductive years Mekranoti women were single in different historical periods. The data come from censuses in which I asked informants to give me the dates of marriage and its termination for all the Mekranoti. Prior to 1955, women spent a little more than half of their reproductive years (51.9%) without a husband. They were single for 53.1% of their reproductive years during the period 1955–1965. And they have remained single for 32.5% of their reproductive years since 1965. The changes in time spent married correspond to the changes in Mekranoti fertility. Prior to contact, marriage and fertility were moderate; during contact both were low; and since 1965 both increased sharply. Furthermore, correlational data showed that women who spent more of their reproductive years without a husband generally had lower fertility ($r = -0.54$, $p < .001$).

Male mortality in warfare probably interacted with mortality from disease to produce the unstable marriage situation of contact years. Prior to contact, women found themselves single primarily because of the shortage of men. The war-related sex imbalance continued into the contact period even though warfare was reduced. But high mortality from epidemic diseases meant that many men and women lost their wives or husbands through death. The delays while people searched for new mates added to the years women spent single. Since contact, however, the sex ratio has

gradually become more balanced among the younger generation, so that women can find husbands more easily.

Both post-partum sex taboos and years without husbands predict individual differences in fertility. These two predictor variables are unrelated to each other ($r = 0.03$, n.s.) and analyses of partial correlations shows that both variables continue to predict fertility even while controlling for the other (The r between fertility and post-partum sex taboos, while controlling for years without husbands is -0.39, $p < .005$. The r between fertility and years without husbands, while controlling for post-partum sex taboos, is -0.57, $p < .001$). Thus both factors seem to be important in accounting for individual differences in fertility among Mekranoti women.

CONCLUSION

The Mekranoti data suggest that fertility changes over Mekranoti history may be due in part to sexual abstinence resulting either from post-partum sex taboos or, more importantly, from a lack of husbands. Sex imbalances resulting from high male mortality in warfare, and subsequent disruption of marriages by disease and death left many women without spouses for long periods of time. The Mekranoti findings are in line with other studies that found lower fertility associated with male absence. Hull (1980) for example, attributes part of the lower fertility of poorer Javanese women to more frequent marital disruptions. And in their studies of historical changes in fertility among the Nunamiut Eskimo and the James Bay Indians, Binford and Chasko (1976) and Romaniuk (1974) attributed lower fertility partially to male absence due to trading expeditions and subsistence rounds. (Based on the results of a computer simulation to assess the effect of male absence on fertility, Binford and Chasko (1976) concluded that dietary changes were more important than male absence. But since they did not do a comparable computer simulation to assess the effects of diet on fertility, this conclusion seems premature).

The Mekranoti are unusual in having monogamy together with high male mortality from warfare. Usually, warring societies are polygynous (Ember, 1974). With polygyny, women can find husbands despite an imbalance in the sex ratio. It is interesting to speculate on the effects warfare might have on fertility in polygynous societies. I suspect that the effects would be similar to the Mekranoti case. Many researchers have documented lower fertility among polygynously married women in the societies they studied. This is the case for the Temne (Dorjahn, 1958), for rural Nigerians (Oyemade and Ogunmuyiwa, 1981), for the Lufa of New Guinea (Stanhope and Hornabrook, 1974), and for Zairians (Romaniuk,

1980). Perhaps the major difference between monogamy and polygyny is that fertility is more evenly distributed among women in polygynous societies. With monogamy, women without husbands (such as kupry) bear the brunt of the fertility losses.

If warfare does reduce fertility, then population specialists and anthropologists might consider the effects of pacification on the demography of the groups they study. Also, anthropologists might consider some of the possible effects of warfare on fertility throughout cultural evolution. Although there are no systematic data available, anecdotal evidence does suggest that horticultural societies may suffer greater male mortality in warfare than societies with intensive agriculture. Some of the highest male mortality rates we know of come from horticultural societies, such as the Yanomamo, the Jivaro, the Dani, and, I might add, the Kayapo. M. Ember's (1974) cross-cultural study of male mortality in war does not include enough societies to provide an adequate test of this hypothesis, but his data are suggestive. Fifty percent of the horticultural societies in his sample had high male mortality in war. Only 30% of the societies with intensive agriculture had high male mortality. Also, a cross-cultural study by C. Ember (1981) showed that fertility in societies with intensive agriculture is generally higher than in horticultural societies. Thus, there may well be a cross-cultural correlation between male mortality in warfare and fertility.

Future studies might concentrate on documenting the relationship between mortality rates, sex ratios, and fertility in various societies. As data accumulate on these, as well as other fertility-related variables for many different places around the world, we will be better equipped to make broad generalizations about the reasons for the demographic changes that have occurred throughout cultural evolution, and that continue today.

ACKNOWLEDGMENTS

I thank N. Flowers, C. Ember, N. Howell, and an anonymous reviewer for their comments on this paper. I also thank the following for their help during my period of fieldwork among the Mekranoti: D. Gross, N. Flowers, M. Ritter, G. Verswijver, R. Thomson, K. Jefferson, M. Stout, F. Leoi, R. C. de Oliveira, and G. Zarur. Fieldwork was generously supported by NSF grants, BNS 76-03378 and BNS 78-25295. However, responsibility for the paper rests with me.

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