The demographic reconstruction of an extinct society is a sampling process that may involve several potential sources of error. Aboriginal inhumation practices, soil and other conditions of interment including disturbance of the burials, as well as the care and skill of the excavators may all affect how well a cemetery represents the population that used it. But as Kenneth Weiss reminds us, if an unbiased representative sample cannot be assumed, further demographic analysis is not likely to be productive. In this session in paleodemography, we present one of the largest, homogeneous skeletal populations from anywhere in prehistoric North America. This is the Libben habitation site and cemetery, which is situated on the north bank of the Portage River in Ottawa County, northern Ohio, USA.

Radiocarbon dates point to an occupation from the 8th to the 11th centuries AD. A thousand years ago there was dense elm-ash forest, covering freshwater marshes and very abundant fish and mammal resources. There was cultivated maize and small amounts of shellfish, but the people at Libben relied to a large extent on a trap-and-weir economy. They captured small game from the marshes and great amounts of fish from the river and lake. Muskrat was especially prized. The Libben remains represent year-round, long-term habitation. The garbage pits contained migratory waterfowl and mammals of all sizes including deer at different seasons. These pits reveal proportions of meat resources by weight as well: for every kilogram of dressed poultry, there were four kilos of muskrat and venison meat, but more than twenty kilograms of edible fish.

Each of the skeletons was fully exposed and photographed. Preliminary age,

sex, and pathology were estimated before each burial was taken from its pit. More systematic estimates were determined later. All bulkheads separating excavation squares were carefully taken down with the tiniest burials in mind. Our primary interest is human demographic evolution, and we use this representative site to estimate mortality and age composition of a prehistoric population.

Libben was a permanent fishing village, situated on a sandy knoll, and surrounded by river and marsh. There was a defensive stockade on the marsh side that may have been replaced or repaired as many as three times during the more than two centuries of occupation. The largest dimension of this two-acre site was east-west, with the greatest density of burials in the middle of this dimension. Libben produced 1300 articulated burials, almost always extended, and usually positioned north-south. Burials were found throughout the habitation site. That is, unlike many other Ohio Woodland sites (or modern Christian, Islamic, and Jewish cultures for that matter), there was no segregation of living spaces from burial spaces at Libben. It is clear that there was a continuity from life to death.

Libben is one of the richest recovered assemblages in all of Ohioand includes extensive domestic artifacts, ceramics, and faunal remains. Pottery is coiled and grit tempered, thick, breakable, utilitarian, and not very decorated. There is no variation in type of artifact that corresponds to east-west, north-south, or depth gradients. The site is very homogeneous, and in time depth appears to span about half of the Late Woodland period .

There is considerable evidence of violent conflict, perhaps between villages. However, there is ethnographic evidence from Algonkian-speakers some 300 years

ago, who defended with lethal means their own tracts of hunting land. The obvious cases of visible trauma are probably a portion of the violent deaths at this site. There are several cases at Libben for which cause of death is rather easy to diagnose. These include various bone cancers, traumas, and obstetric accidents. However, the leading identifiable pathology affected children. There are large frequencies of porotic hyperostosis indicating that many young children were chronically anemic at the times of their deaths.

Many of these people, including very young children, went to their graves with accompanying artifacts of various kinds. This was a largely egalitarian society, and death and burial were important rites of passage for all of its members. One type of violation of our "articulation rule" for demographic inclusion is the occasional bundle burial. These are limb bones, skulls, and very little else. These were individuals or groups who may have died some distance from the village, possibly during the winter, and they are included in the cohort. They are important to the demographic validity of this study because they suggest a general effort to return at least the essential remains of all kinsmen back to the home burial ground.

For age-at-death of subadults, the dentitions are most important, then epiphyseal closure, and last longbone lengths and joint breadths. Over half this cemetery comprises subadults. Nearly 18% of the Libben burials are infants, and a large proportion of these are neonates. The other exceptions to the articulation rule are infant skeletons, the parts of which may have been scattered as far as a meter from each other. These were carefully screened, compared, reconstructed, and included in the cohort.

Our laboratories at Kent State University have developed standards for adult age based on the auricular surface, so-called because it is shaped like an ear. This is the iliac (or outer) side of the sacroiliac joint in the pelvis. Unlike other bony sites, the auricular surface exhibits developmental-like changes well into the fifth decade of life, before it is finally dominated by degeneration. The oldest decedents of the Libben cemetery have now been re-aged using only the auricular surface. With the discarding of other skeletal aging sites, the average age of the Libben adults was increased by nearly four years; the average age of the whole cemetery, by two. However, there is a much greater bias in paleodemography. This presentation examines this bias and offers a means to correct it.

The no growth (i.e., stationary) demographic model for Libben is compared to actual South African Kung and South American Ache and Yanomamo mortality and fertility structures. If Libben was reflective of a non-growing population, then it had low fertility like the Kung, and poor adult survivorship like the Yanomama. We think such levels are artificially extreme, and there are other reasons why such a demographic profile is inaccurate.

Anthropologists and demographers know of a widespread cultural practice associated with high fertility, especially in foraging and horticultural populations. Infanticides can be individual or community-based, and the reasons for the practice vary as much as the cultures. Perhaps it is difficult to care for closely spaced children. More probably, girls are not seen as useful food producers, or as effective warriors.

There is a fundamental problem in paleodemography which greatly surpasses osteological aging biases, real or perceived. It is this: How do we choose the annual rate of increase? Without the Malthusian parameter, paleodemography has one too many unknowns, or one too few equations. The traditional presumption of no growth (stationary demographic conditions) is hardly the answer. Whatever the average growth of the prehistoric population may have been, it was filling its cemetery on the basis of both its death rates and the age proportions in the living population. That is, here are many different stable population profiles—from poor longevity/medium fertility to good survivorship/high fertility, and every gradation in between—that could have filled the one Libben cemetery with exactly the same age-class proportions. There is in fact a continuum of solutions to Libben, or to any single prehistoric cemetery. The calculation of a numerical answer for a complete demographic profile requires stable theory and another datum. We take a fertility rate from modern populations, and that choice will determine the full demographic solution: stable growth rate, age structure, and mortality.

James Wood from Pennsylvania State University has surveyed 70 noncontracepting populations, and calculates an average TFR of 6.1 children. We use his moderately skewed empirical distribution to obtain a 50% confidence interval. Also, increasing amounts of female infanticide (unrecovered by the archaeologists) were added to the cohorts depending on fertility level. We apply these three modern fertility performances to the Libben cemetery. For each we obtain a net reproductive rate (daughters per woman), and the three crude rates: birth, death, intrinsic increase. Even the truncated 50% range in fertility produces great variation in demographic profiles.

Not only does fertility predict annual growth rate, it also predicts the once-living age structure, and the complete mortality profile as well. We favor the high fertility model (in fact, it might not be high enough), but carry along the other two to demonstrate the impact of different TFR on all other aspects of a demography based on a cemetery.

Different mortality structures follow from variations in assumed fertilities. For instance, if the TFR was 7, then longevity at Libben was better than 17th century London, even during the non-plague years, and not nearly as good as most western cities right after effective water filtration. The Kung census of 1975 reveals very few dependents per producer. Their low fertility was at least partly due to endemic syphilis. If Libben's 10th century TFR was 7, then it was much like high-growth 20th-century Yanomamo (Venezuela) or the modern Ache (Paraguay).

We see no reason why women at Libben would have averaged fewer than 7 children. This value is actually conservative compared to some of the best studied modern foragers and horticulturalists. Nevertheless, Libben life expectancy is now estimated to be about 30 years (not 20), their average living population was quite young (with a very high dependency ratio), and their annual growth rates were positive and large. Such growth in turn predicts intrinsic doubling-times of less than 30 years, with occasional outmigration of related, extended families, leaving behind a core village of perhaps 110-140 people, who continued to use the cemetery. This estimate of the functional size of the prehistoric fishing village in addition to the TFR of 7.0 years also predicts other aspects of the structure and dynamics of this Late Woodland society.

One of the most important issue in evolution, if not science, is human origins. The primary basis of the emergence of human ancestors more than eight million years ago was not the elaboration of material culture. Nor was it brain evolution. Rather, it was a demographic revolution. Human fertility rates are biologically substantially greater than those of even well-fed, captive chimpanzees. Wild chimpanzee females have interbirth intervals of six years; orang-utans, about eight years. New fossil evidence from Ethiopia demonstrate that very early humans were certainly bipedal. They were probably also hairless, fat-storing , secondarily altricial, and biologically the most r-selected of any hominoid primate that had yet appeared in Africa. The other apes have been declining in numbers and varieties for more than ten million years, along with their rainforest habitats. By contrast, the cercopithecoid monkeys of Africa and Asia as well as at least one lineage of African bipedal ape began to radiate in late Miocene times.

It is the evolutionary nature of human populations to grow. This as well as high variance in effective fertility are the hallmarks of a colonizing species, including the one which has both experienced Pleistocene success and also faces today's demographic crises. For too long, we have accepted without question stationary models in paleodemography, and the mortality and age profiles that they generate. We must now turn our attention to the fertility performances of anthropological populations of the mid 20th century, and incorporate these in our prehistoric models. When we do, we will come to view stationary demographic conditions as the exception, not the rule—in human history, prehistory, and evolution.