Biographies Etched in Bone

Chimpanzee skeletons reveal memoirs of life in the wild

By BRUCE BOWER

Melissa, one of about 50 chimpanzees living together in Tanzania's Gombe National Park, crawled up a tree and sprawled into her nest of branches and leaves one day near the end of 1987. With her 8-year-old son in attendance, Melissa prepared to die. Nearing 40 – an advanced age for wild chimpanzees – Melissa succumbed to a parasitic infection that had rapidly worsened as she mourned the death of her newborn infant about 10 days earlier.

Several days after Melissa's demise, Jane Goodall – who has studied Gombe chimps for almost 30 years and described their complex social lives in *The Chimpanzees of Gombe* (Harvard University Press, 1986) – instructed members of her field staff to climb into the nest, wrap the lifeless body in a plastic sack and carry it back to their research camp. There, they placed the body in a tin drum. After a few days of strenuous activity by insects attracted to the carcass, Goodall collected and cleaned the bones of the gregarious chimp she had observed for so many years.

Melissa's remains, and those of 22 other Gombe chimps retrieved after their deaths, make up a unique skeletal collection with known sex, age and body weights. Such information is rarely available for primate skeletons in museum collections.

"I began collecting chimpanzee skeletons from the beginning of my research," Goodall told SCIENCE NEWS. "When you're working in the field, you shouldn't waste anything."

Goodall's farsightedness now offers anthropologists a rare opportunity to examine how all sorts of behaviors and experiences influence skeletal anatomy – from diet and number of offspring to specific injuries and illnesses.

"The Gombe skeletons allow us to determine how much about an individual – its species, local population, sex, age at death, life experiences and reproductive history – can be read accurately in bones and teeth," says anthropologist and anatomist Mary Ellen Morbeck of the University of Arizona in Tucson. Goodall has allowed Morbeck and anthropologist Adrienne Zihlman of the University of California, Santa Cruz, access to the Gombe collection.

The Gombe skeletons, like fossil remains of human ancestors, make up a small sample that does not necessarily typify an entire species. But since reseachers can check interpretations of the chimps' bone size and shape against events that influenced anatomy during each of the animal's lives, the results may provide important guideposts for reevaluating skeletal features and lines of descent among hominids, members of the 4- to 5-million-year-old evolutionary family that includes modern humans.

"Our work demonstrates the need to look at individual development and life histories to determine a species' anatomical characteristics," Morbeck maintains. "We've been struck by the extent of individual anatomical variation at Gombe."

She thus questions anthropologists' eagerness to assemble hominid species and family trees from small groups of fossils while largely ignoring the individual tales encased in each skeletal find. The analysis of bones belonging to chimps who were carefully observed for decades "will allow us to go back to the hominid fossil record with fresh eyes," Morbeck predicts, especially since she and her co-workers side with those who consider chimps the closest living relatives of humans.

The Gombe research has already offered a fresh look at chimpanzee anatomy. Scientists recognize two chimpanzee species, *Pan troglodytes* (common chimps) and *Pan paniscus* (pygmy chimps). Gombe residents belong to the former species, although common chimps in other parts of Africa grow considerably larger. Some researchers have speculated that the diminutive Gombe population anatomically resembles pygmy chimps, which may not represent a separate species after all. But Morbeck and Zihlman find that the cranial capacity, tooth size and body proportions of 10 Gombe skeletons lie within the range of 60 common chimpanzee skeletons from other locations and are distinct from measurements of 25 pygmy chimpanzee skeletons.

Reasons for the small bodies of Gombe chimps remain unclear, Morbeck and Zihlman note in the July 1989 PRIMATES. The Gombe National Park provides a drier environment, a smaller food supply and an apparently narrower range of foods than those enjoyed by common chimpanzees living elsewhere, possibly leading to increased competition for food and decreased body size, they suggest. Also, the geographic isolation of Gombe in eastern Africa prevents its inhabitants from breeding with other groups of common chimpanzees, and this may promote smaller bodies by holding down genetic variation.

Anatomical characteristics vary substantially not only from one community to the next, but also from one individual to the next within the same community. Such differences often depend on the timing of diseases, injuries or nutritional deficiencies, which can critically influence survival and reproduction.

Consider two Gombe females, Gilka and Madame Bee, both of whom contracted polio and developed partial paralysis of a forelimb. Computerized tomography and bone mineral scans show that the viral disease created divergent patterns of mineral loss and new bone growth in the two females, report Zihlman, Morbeck and Goodall in the June JOURNAL OF ZOOLOGY.

Gilka developed polio as a growing 7-year-old. The disease stunted her growth, paralyzed her right forelimb and sapped vital minerals from her skeleton — leaving her right forelimb bones much smaller and lighter than those of her left forelimb. Gilka bore four infants before her death at age 19, but none survived. Paralysis of Gilka's limb interfered with infant care during travel and feeding, but her low status among Gombe chimps and her general ill-health, compounded by polio, undoubtedly contributed to the deaths of her offspring, the researchers say. They note, for example, that Gilka's small size and lack of social acceptance made her the object of repeated attacks by another Gombe female, known as Passion, who participated in the killing of Gilka's fourth infant.

Moreover, the researchers assert, Gilka suffered social and emotional setbacks — such as the death of her mother as Gilka reached childbearing age — that perhaps worsened her physical and reproductive problems.

In contrast, Madam Bee contracted polio as a 19-year-old adult, and soon thereafter gave birth to two females who survived into adulthood. Although much of her left forelimb was paralyzed, no stunting occurred. However, the paralysis reduced the heft and mineral content of her left forelimb bones and altered their shape.

Madam Bee bore two more infants in her mid-20s, but by then her paralysis had worsened, creating difficulties with infant care. Neither of these offspring survived.

Although small compared with other Gombe females, Madam Bee did not suffer the early emotional trauma or social rejection encountered by Gilka. She died at age 28 after being attacked and wounded by four marauding males from a neighboring chimpanzee troop that had split from the larger Gombe community.

But perhaps the most fascinating skeletal story at Gombe involves Flo, an aggressive, high-ranking and influential matriarch. Unusually successful at attracting males, she gave birth to at least five young, three of whom survived into adulthood. Her death in 1972, at an estimated 43 years of age, garnered an obituary in England's Sunday Times. It also revealed a skeleton larger than most at Gombe — male or female — with longer bones and larger joint surfaces than those of any Gombe male studied, Morbeck points out.

"We see a mosaic of sex differences and an incredible amount of anatomical variation regardless of sex at Gombe," she says.

Uli Goldschmidt/courtesy of The Jane Goodall Institute

Wunda and her little brother Wolfi relax in Tanzania's Gombe National Park.

Anatomical variation lies at the heart of a long-running debate concerning the earliest known hominid species. Many researchers maintain that within that species, *Australopithecus afarensis,* males grew to approximately twice the size of females. Others, however, contend that the different-sized fossils, dating to approximately 3.5 million years ago, actually represent two hominid species. Morbeck argues that Gombe skeletons such as Flo's suggest a need for researchers to reanalyze the skeletal remains of *A. afarensis* and other ancient hominids to establish the anatomical variation of individual males and females.

Flo's skeletal remains also underscore the difficulty of estimating body weights from bone sizes, Zihlman notes. Although Flo had huge bones compared with her compatriots, she weighed slightly less than a smaller but stockier male known as Charlie.

Morbeck and Zihlman, in collaboration with orthopedic surgeon Dale R. Sumner of Rush-Presbyterian-St. Luke's Medical Center in Chicago, also report that four Gombe females ranging in age from about 26 to 43 — including Flo — experienced a pattern of bone loss unlike the osteoporosis observed among human females. Computerized tomography and bone mineral scans of the chimps' thigh bones show they lost more bone in the middle of the shaft, whereas humans lose bone mainly in the femoral neck, just below the pelvic joint.

Causes of bone loss in aging female chimps and humans probably differ, according to the investigators. Osteoporosis in women is primarily associated with loss of the hormone estrogen after menopause. However, laboratory studies have not confirmed menopause among common chimps. Goodall's field observations indicate that Flo had reproductive cycles within 2½ years of her death. Among pygmy chimps, one documented case of menopause exists. An autopsy of a female housed at the Yerkes Primate Center in Atlanta yielded atrophied ovaries and other signs that her reproductive cycles had already stopped.

An impoverished diet — related in part to tooth loss and extreme dental wear documented among older Gombe residents by anthropologist Lynn Kilgore of San Jose (Calif.) State University — may promote bone loss in senior female chimps. In support of this notion, Goodall observed that Flo lost considerable weight and became much less active toward the end of her life. The physiological demands of numerous pregnancies and lactation periods take a further toll on bones, Morbeck says.

Despite the bone loss suffered by Flo, her skeleton shows no evidence of joint degeneration, according to anthropologist Robert D. Jurmain of San Jose State. Jurmain and Kilgore present their evidence in the October 1989 AMERICAN JOURNAL OF PHYSICAL ANTHROPOLOGY.

Jurmain's analysis of 11 adult Gombe individuals finds a remarkably low incidence of bone disease and no changes in the shape or size of spinal bones among Flo and other elderly chimps. Erosion of spinal bones becomes widespread among humans who live beyond 40 years, Jurmain says. Walking upright may increase pressure and strain on the human spinal column and cause bone degeneration, although this possibility has not been thoroughly studied, he adds.

Chimpanzees' fondness for swinging through the trees creates its own skeletal strain. Healed fractures stand out on many Gombe chimp bones, usually as the result of accidental falls from trees or, in a few cases, fights with other chimps. During Flo's lifetime, falls fractured her collarbone, a forelimb and several finger and toe bones.

"Life histories such as Flo's emphasize the importance of synthesizing field observations with data from bones and teeth," Morbeck contends.

Studies of Flo and her compatriots will take on even more significance if recent studies indicating a close genetic kinship between common chimps and humans gain general scientific acceptance. So far, several types of DNA and biochemical comparisons suggesting such kinship have generated considerable controversy over the methods and the interpretations of genetic researchers.

Zihlman finds the evidence for a close

genetic coupling of chimps and humans persuasive. Combining kinship studies with evidence that "Lucy" and other members of *A. afarensis* had chimp-like bodies and chimp-sized brains, as well as dental eruption and maturation patterns much like those of modern chimps (SN: 12/19&26/87, p.408), she argues that the common ancestor of chimps and humans greatly resembled chimps. Thus, she theorizes, the chimp lineage has changed much less in the past 5 million years than the human lineage.

Although Zihlman previously thought pygmy chimps might be the best living model of a common ancestor (SN: 2/5/83, p.88), she says the recent genetic evidence convinces her that some combination of common and pygmy chimp features characterized the mysterious progenitor that chimps share with modern *Homo sapiens*.

Even if the evolutionary pairing of chimps and humans does not pan out, the Gombe work may provide some useful rules of thumb for anthropologists studying fossil hominids without the benefit of recorded life histories for the skeletal remains. "Each Gombe individual has a fascinating biological profile you can read in their bones," Morbeck says. "Speaking as someone who previously studied bones just to see how ancient animals moved around, that was a pretty scary finding." □