

PECOS NATIONAL HISTORICAL PARK MAMMAL SURVEY DATA HELP SOLVE HANTAVIRUS MYSTERY

By ROBERT R. PARMENTER

IN THE AUTUMN OF 1992, THE PECOS National Historical Park in northeastern New Mexico began a collaborative wildlife survey with University of New Mexico biologists Dr. Robert R. Parmenter and David C. Lightfoot. The purpose of the baseline survey was to evaluate the vertebrate and invertebrate fauna of the newly acquired Forked Lightning Ranch, which surrounds the existing park. However, with the survey only into its first year, a sudden and unexpected need for the wildlife data emerged.

In the spring of 1993, scientists at the Federal Centers for Disease Control and Prevention (CDC) in Atlanta enlisted the aid of the park project scientists to assist in identifying the ecological relationships of the recent epidemic of Hantavirus Pulmonary Syndrome (HPS) in the southwest. A previously unknown species of hantavirus (family Bunyaviridae) caused the newly identified disease that resulted in 45 deaths.

Hantaviruses comprise the virus group responsible for hemorrhagic fever in Asia and Europe. However, instead of the more typical kidney malfunctions associated with hemorrhagic fever, the new HPS virus (named "Sin Nombre"—Spanish for "without name"—by the CDC) caused rapid and severe respiratory collapse. During 1993, the mortality rate for HPS victims was near 60%. Originally thought to be restricted to the Four-Corners region of New Mexico, Colorado, Arizona, and Utah, the disease has now been documented in 18 states, spanning the continent from the west coast to Florida and New England.

Virologists at CDC identified the virus in June, 1993. The investigating scientists immediately suspected that, as with other

Hantaviruses, the likely vector for the disease would be a rodent. Preliminary serological (blood) tests on field-caught rodents from the epidemic region revealed the presence of the virus in several species of deer mice (*Peromyscus* [figures 1 and 2]), wood rats (*Neotoma*), and chipmunks (*Eutamias*) (Childs et al. 1994).

In view of the rodent connection with this disease, medical investigators and public health officials needed ecological information on the deer mouse and other native rodent species. Anecdotal information from residents in the afflicted areas suggested that rodents were exceptionally abundant over the winter of 1992-93, and officials speculated that, if true, the increased potential for rodent-human contact and disease transmission might account for the sudden epidemic.

Biologists with the University of New Mexico and the National Park Service were the only scientists having long-term data on rodent communities in the region. At the request of the CDC and New Mexico Health Department, these researchers provided detailed demographic analyses from 1989-93 for the 22 rodent species inhabiting central and northern New Mexico. The data showed 10-fold population increases in various *Peromyscus* species, wood rats, and chipmunks during 1992 and early 1993. Population increases occurred simultaneously in grasslands, desert-shrublands, and woodlands. Comparisons of the rodent data to regional climatological data indicated that the rodent population dynamics were



Figure 1. This adult deer mouse (*Peromyscus maniculatus*), collected during the biodiversity baseline survey at Pecos, is one of several rodent species that carries hantavirus, an organism that causes severe respiratory collapse in humans. Rodent populations increased 10 times during 1992-93 spreading hantavirus and killing 45 people.

positively associated with the 1992 El Niño and the above-average precipitation during the winter of 1992-93.

These results provided a possible answer to the question of why the epidemic had occurred when and where it did. With exceptionally high densities of rodents in New Mexico in the spring of 1993, the probability of human-rodent contact was substantially increased, permitting a concomitant increase in disease transmission. Parmenter presented the study findings in mid-July, 1993, at a Hantavirus conference at the CDC Headquarters in Atlanta, and continued follow-up monitoring into 1994.

In addition to addressing the present-day questions on rodent population dynamics, rodent specimens collected during the Pecos project have also contributed to answering another question: Is the HPS Sin Nombre virus a "newly evolved" virus, or has it actually been in the region for years? The University of New Mexico Museum of Southwestern Biology routinely collects rodents for museum specimens from all of its study sites. Under the direction of Dr. Terry L. Yates, Curator of Mammals, field crews collected tissue samples (heart, liver, kidney, spleen, lung, blood) and chromosomes from rodent specimens each year, which were then archived in ultra-cold museum freezers. University of New Mexico biologists are now collaborating



Figure 2. The author holds an adult pinyon mouse (Peromyscus truei) during mark-recapture studies at the national historical park. The respirator, goggles, and gloves are standard equipment for rodent surveys now!

with UNM Medical School researchers and CDC scientists in examining the archived rodent tissues to determine if the virus has indeed been present historically, though undetected, in the regional rodent populations, or if additional new viruses are present.

To date, we think that different “species” or strains of the virus infect different rodent genera, and that the phylogenetic relationships among the rodent and virus groups exhibit a high degree of similarity; this indicates a potential coevolutionary history between rodents and hantaviruses in North America (see Hjella et al. 1994). Scientists are still analyzing tissue samples taken from the park, along with even older samples from the museum and Texas Tech University. These studies promise to contribute consider-

ably to our understanding of the biology of hantaviruses in nature.

Researchers are also using the results of these analyses to develop rodent-virus sampling strategies and disease prevention plans for human populations. New techniques for dealing with rodents in field studies and human dwellings have been developed in collaboration with CDC scientists (e.g., Mills et al. 1995). They are employing predictive relationships to ascertain the likelihood of a sustained population outbreak for the rodents in New Mexico, and to estimate the effectiveness of possible control measures to reduce human-rodent contact. These predictions, along with continued up-to-date measurements of rodent populations at various New Mexico study sites, will contribute insights and direction to the strategies and contingency plans developed by regional public health officials to battle future HPS epidemics.

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