3. RODENT ECOLOGY AND EPIZOOLOGY

Murid rodents (order *Rodentia,* family *Muridae*) are the natural hosts and reservoirs of hantaviruses. The fossil record provides evidence for the presence of murid rodents for at least the past 20 million years in North America and 3.5 million years in South America (*8*). Murids are currently found in a wide variety of habitats throughout the Americas. They shelter in burrows or crevices, under logs or other objects, in hollow trees or logs, or in nests built on the ground or in bushes or trees. Although principally nocturnal, they may be diurnal and are usually active throughout the year. Females often produce several litters annually, and breeding may occur throughout the year in warm regions. Most individuals probably live less than two years; however, the high reproductive potential of certain species sometimes results in a large increase in population. This is often followed by a sudden drop in numbers when food supplies in a given area are exhausted. These fluctuations may show a periodicity of around three or four years in some species and habitats (*8*).

Rodents of the murid subfamily *Sigmodontinae,* implicated as hosts of HPS-causing viruses, are primarily associated with rural environments, but some are considered habitat generalists. The propensity of rodents to enter human habitation and surrounding buildings is important. This characteristic of the deer mouse was an underlying factor in the 1993 epidemic in the southwestern United States. Fortunately, some common rodents closely associated with humans (e.g., the common house mouse, *M. musculus*) belong to other subfamilies and are not important reservoirs of hantaviruses.

Each hantavirus is generally associated with a single rodent host species. Thus, the range of its predominant rodent host species restricts the distribution of any particular virus. Viral distribution may occur throughout the host range or may be restricted to a smaller portion of the range. High levels of concordance exist between host and hantaviral phylogenies, supporting the long-term and likely coevolutionary relationship between virus and host. This observation adds further evidence to support the ancient presence of New World hantaviruses in the Western Hemisphere. Except for a single virus, which may be associated with an insectivore, each major branch of the viral phylogenetic tree is associated with a different subfamily of rodents (*4, 5*). All known HPS-related hantaviruses of the Western Hemisphere are associated with the *Sigmodontinae* subfamily of *Muridae* rodents. Several other viruses commonly found in North America are associated with the subfamily *Arvicolinae* but are not known to cause human disease. Old World hantaviruses responsible for HFRS are associated with the subfamily *Murinae* or some members of the subfamily *Arvicolinae.*

Hantavirus infection in the natural rodent host results in chronic, apparently asymptomatic infection. Despite the presence of serum neutralizing antibody, infectious virus may be persistently shed in rodent urine, feces, and saliva.

Horizontal transmission via infectious aerosols among rodents in the laboratory is well documented (*9, 10*). In the field, rodent seroprevalence generally increases with body weight, and therefore age, highlighting the predominant role of horizontal transmission in viral maintenance within reservoir populations (*14*). The frequency of wounds has also been shown to be correlated with antibody seroprevalence in rodents, suggesting a role for biting and aggressive encounters in viral transmission among rodents (*11*). Pups of infected dams demonstrate circulating maternal antibodies, but no definitive evidence of vertical viral transmission exists. Thus, the maintenance of hantaviruses in their rodent reservoirs is mainly through infections acquired during post-weaning intraspecific aggressive encounters.

The view of a single virus infecting a single rodent species may be somewhat oversimplified (*12*). Numerous studies have reported high rates of hantaviral infection among several members of a single genus (*13*). For example, while *P. maniculatus* is agreed to be the

primary reservoir for SNV, *P. boylii*, *P. truei*, and *P. leucopus* have also shown high rates of antibody reactive to SNV (*14*). This observation could represent circulation of a related virus and cross-reactivity to SNV-specific assays, or genuine infection with SNV among other *Peromyscus* species. One explanation for such observations is that in instances of high rodent density and increased probability of interspecific encounters, viral transmission to secondary host species (i.e., "spillover") may occur (*14*). Conversely, in instances of low rodent density and decreased probability of interspecific encounters, nonprimary rodent host species are less likely to show evidence of secondary infection. The taxonomy of New World rodents requires further work to separate and define individual species and their virus associations.