Highlights of the Report on West Nile Virus in Equids in the Northeastern United States in 2000

A full report on WNV in Equids in the Northeastern United States in 2000 is available from the USDA: APHIS: VS Centers for Epidemiology and Animal Health website.

The first new world outbreak of West Nile virus (WNV) in equids occurred in the northeastern United States in 1999. Following investigations in 1999, it was recognized that important questions regarding exposure and occurrence of disease among equids in this region remained unanswered. Thus, states with confirmed WNV equine cases in 2000 were requested to participate in a case-control study coordinated by USDA: APHIS: VS. This study was designed to gather information from premises with equids that developed clinical signs of WNV infection in 2000, as well as from premises that did not have confirmed disease due to WNV infection in their equids. In addition, a spatial analysis was conducted to describe the geographic and ecological aspects of case premises. Factors included in the spatial analysis were precipitation, temperature, and locations of case premises relative to equine inventories, WNV-infected mosquito pools, WNV-infected birds, elevation, ecoregions, and vegetation.

Case-Control Study Highlights

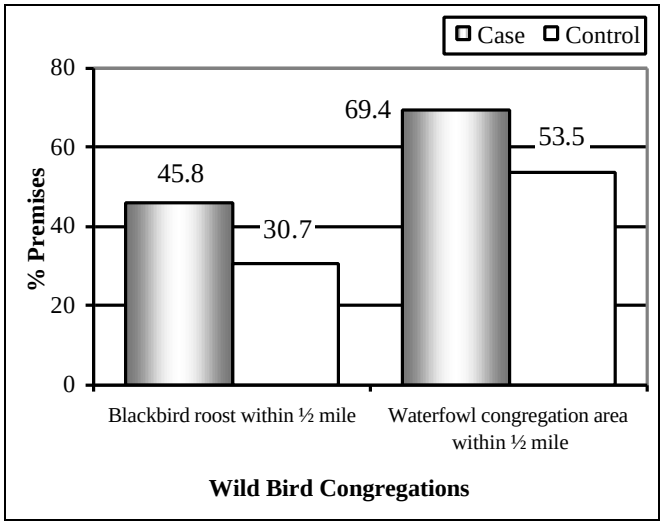
The study consisted of gathering questionnaire data regarding equine management and environmental conditions, as well as collecting serum samples and information on individual equids. Premises in the following states participated in this study: Connecticut (n=40), Delaware (n=28), Massachusetts (n=9), New Jersey (n=59), New York (n=3), Pennsylvania (n=7), and Rhode Island (n=4).

One goal of the study was to determine if there were any premises-level factors that were associated with evidence of exposure of their equids to WNV (cases). Another goal was to evaluate factors associated with exposure of individual equids on case premises.

A case for this study was defined as any equid identified with exposure to WNV. A case premises was any premises with one or more cases. A total of 1,487 equids were tested for serum antibodies to WNV as part of this study. Test results were used to define premises as cases or controls. In a few instances, serologic testing was not possible (horse died), but the premises had been previously confirmed by USDA: APHIS: VS with an infected equid. Of the 49 case premises (those with USDA: APHIS: VS confirmed equids in summer 2000 or serologic evidence of exposure to WNV) in the case-control study, nine had more than one case equid: five premises had two case equids, three premises had three case equids, and one premises had five case equids. Eight of the 49 case premises had one equid that was seropositive but had no equids with clinical signs of WNV infection. There were 101 control premises.

Findings of note included marginally significant associations between case premises and the presence of blackbird roosts and waterfowl congregations within ½ mile of the premises (Figure 1). Insect control methods at the premises or at the horse level were not associated with infection status. This could be the result of a failure to determine specific ingredients of insect sprays or a true lack of insecticidal benefit (for example, it is difficult to get complete coverage of an animal the size of a horse, and to be effective, many insecticides require frequent application).

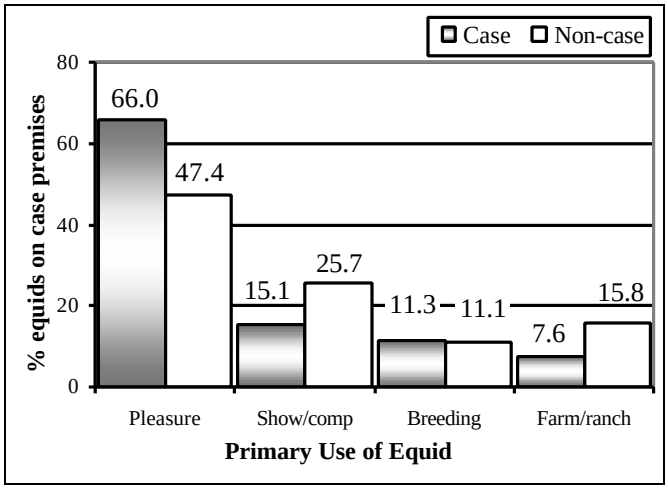
Figure 1. Percent of premises versus presence of bird congregations within ½ mile of premises



In addition, based on survey results, it would appear that most insect control efforts were directed at fly control which may not be effective in reducing exposure to mosquitoes (likely vector of WNV).

At the animal level on case premises, case equids were more likely to be used for pleasure, and less likely to be housed in stalls at night than non-case equids (Figure 2). Perhaps pleasure horses were more likely to be exposed to the vector; for example, trail-riding activities may increase exposure to mosquitoes.

Figure 2. Percent equids on case premises versus primary use of equid



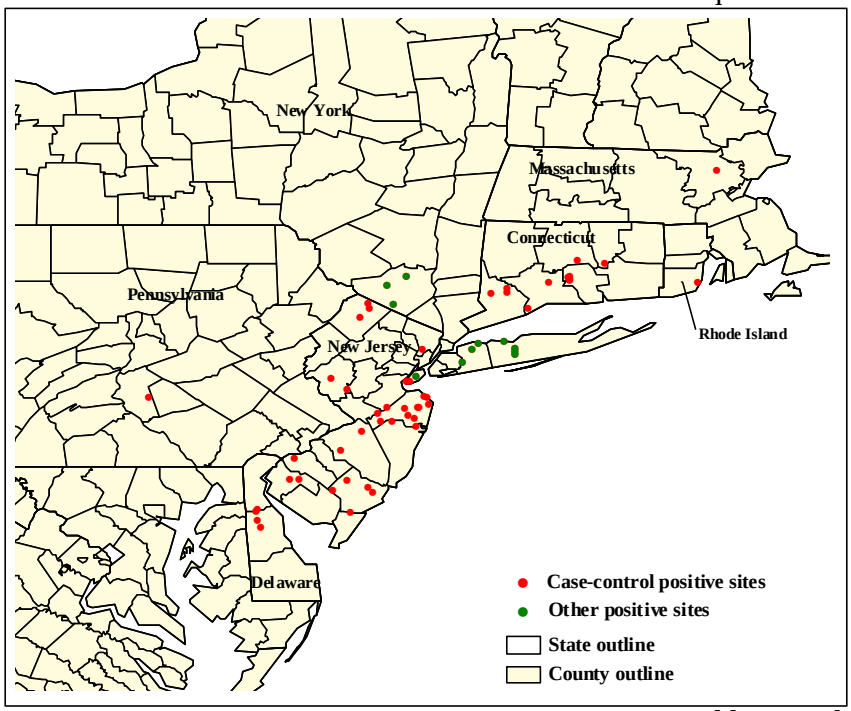
The clinical signs consistent with WNV infection were observed in a small percent of serologically negative horses. This is not surprising as the neurologic signs of WNV infection are not unique and can be caused by other agents or diseases. However, in the northeast region, any horse with neurologic disease should be investigated for a diagnosis of WNV infection based on the rarity of neurologic signs in seronegative horses.

Spatial Analysis Highlights

Case-control study results suggested that two factors, proximity to communal bird roosts and congregations of waterfowl, might be associated with virus transmission to equids. To follow up on these observations, a spatial analysis of geographic data was conducted on affected premises. Initially, affected sites were compared with respect to weather patterns, proximity to clinical human cases, location of counties reporting this virus in mosquitoes, and the distribution of infected, free-ranging birds. Secondly, tests aimed at determining spatial clustering were conducted to identify areas where infection may have resulted from common sources. Finally, the spatial analysis was extended to ecological factors, such as terrain elevation and vegetation patterns, to determine habitat characteristics where virus transmission from vector mosquitoes to equids had occurred.

Spatial analysis methods were applied to premises data from the case-control study, as well as to geographic information about other case sites with USDA: APHIS: VS confirmed cases that did not participate in the case-control study. Nearly 90 percent of all case premises were located in the states of New Jersey, New York, and Connecticut; therefore, a much larger geographic area was involved in this outbreak compared with 1999. No specific pattern could be determined regarding when and where a new case was likely to occur. However, the occurrence of a case was shown to be associated with equid demographics and the geographic distribution of dead birds found infected with WNV.

Cluster analysis studies showed that case premises over the entire area were clustered and six smaller areas were identified as possible sub-clusters. Based on evidence from the case-control study, which suggested that communal bird roosts and congregations of waterfowl were more frequently associated with affected premises, our spatial analysis showed that communal blackbird roosts and waterfowl congregation areas were generally associated with each case sub-cluster. This spatial evidence suggests that one or more endemic foci of virus activity may exist in the area represented by a sub-cluster. For example, an endemic focus might be a sylvan communal bird roost where virus amplification in an avian population would precede infection of mosquitoes capable of infecting equids. It could not be determined from the present data whether potential endemic foci could provide a habitat suitable for long-term maintenance of WNV.



Ecological aspects of the spatial analysis showed that most case premises were located in lower elevations of a gently sloping coastal plain, characterized by broadleaf forests and clay soils. This area is also characterized by slow flowing drainage systems, which provide ideal conditions for marsh and swamp habitats. Satellite imagery was used to characterize vegetation in the vicinity of case premises and features common to all sites were identified through vegetation classification methods. Whether the vegetation feature common to each sub-cluster is a wetland habitat has yet to be determined.

Conclusions

Based on the spatial analysis of case-control and other data, exposure of equids to WNV is a geographically clustered event. Within regions of virus activity, exposure of individual equids appears to be a chance event. Consequently, immunoprophylaxis, when available, is warranted for equids in regions where foci of WNV are likely to be found. This is similar to the approach used in protecting equids from infections with the viruses that cause eastern equine encephalitis and western equine encephalitis. Other recommended mitigation methods include reducing the size of vector mosquito populations, especially in areas near communal blackbird roosts or waterfowl congregation areas.

Because there are many unanswered questions about equid exposure to infected mosquitoes in and around epizootic foci, future studies of affected equid premises should include an ecological assessment of the surrounding area. It is important to determine which species of mosquitoes feeding on equids are also infected with WNV. In addition, the infection status of free-ranging birds in the vicinity of an affected premises needs to be determined. The location of communal bird roosts or congregations of waterfowl relative to a site with an infected equid needs to be determined more precisely.

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