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SURVIVAL OF DUCK PLAGUE VIRUS IN WATER FROM LAKE ANDES NATIONAL WILDLIFE REFUGE, SOUTH DAKOTA

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Abstract: An isolant of duck plague herpesvirus from the Lake Andes Refuge outbreak was seeded in raw and filter-decontaminated water from two locations on the refuge, held at 4 C, and assayed for infectivity intermittently over a period of 2 mo. From an initial level of about 10^5 PFU per ml, infectivity in the filtered samples uniformly dropped to about 10^4 PFU per ml. Infectivity in the raw samples declined much more rapidly; infectious virus remaining at the end of 2 mo (ca. 10^1 PFU per ml) was only about 0.01% of that originally seeded.

INTRODUCTION

Duck plague, also known as duck virus enteritis (DVE), is an acute contagious herpesvirus infection that occasionally erupts in anseriform birds and causes significant mortality in domestic waterfowl (Leibovitz, 1971). According to Friend and Pearson (1973), who briefly reviewed the history of the disease, known outbreaks of DVE throughout the world have, with one exception, been restricted to domestic or captive waterfowl. The sole exception occurred during 1973 among wintering wild ducks and geese on the Lake Andes National Wildlife Refuge, South Dakota. That epizootic was notable, because it involved a large number of free-flying birds. In all, the mortality from the Lake Andes epizootic was over 40,000 wild anseriforms — principally mallards *(Anas platyrhynchos platyrhynchos).* Nothing on this scale has recurred; in fact, although outbreaks of DVE are recorded each year among captive or domestic flocks, the disease has not been found again in wild waterfowl either at Lake Andes or elsewhere in North America.

Undoubtedly, one factor contributing to the unprecedentedly large mortality at Lake Andes was the dense concentration of wintering birds; as many as 100,000 mallards were estimated to be present on the limited open water areas of the refuge. Other features that probably contributed to the epizootic were the shedding of large quantities of virus in feces and other body discharges of the diseased birds and the low winter temperatures that favored survival of viral infectivity in such materials. The duration of infectivity in natural environments has not been investigated. Under laboratory conditions Hess and Dardiri (1968) determined that at 22 C viral infectivity of the DVE agent in a 20% homogenate of chorioallontoic membranes in Hanks' balanced salt solution was lost within 30 days.

Our purpose was to determine the survival times of duck plague virus at 4 C in raw and in filter-decontaminated water samples from the Lake Andes Refuge.

MATERIALS AND METHODS

About 1 yr after the 1973 outbreak, water samples were collected from Lake Andes proper and from Owens Bay, the initial focus of the DVE epizootic. The Bay receives water from an artesian well, which is the source of water for Lake Andes, and facilitates water management on the refuge. The samples were collected in clean glass jars and mailed

without refrigeration to the National Fish Health Research Laboratory, where they were held at 4 C. Several hundred ml of each sample were passed through 0.45-μm membranes for decontamination and comparable volumes left unfiltered. The four resulting samples were each inoculated with a cell-associated fraction of the fourth cell culture passage of cloned virus to give an initial value of about 10^5 PFU per ml. The virus was isolated by us from a victim mallard provided by S.R. Berlinger, Manager of the Lake Andes Refuge. We identified the virus serologically as DVE by plaque-reduction neutralization test, using antiserum provided by Dr. E.A. Carbrey, U.S. Department of Agriculture, Veterinary Services Diagnostic Laboratory, Ames, Iowa. We carried out the virological assay of filtered and unfiltered water samples using 60-mm dish cultures of CCL-141 duck embryo fibroblasts, and following the plaquing procedures described by Wolf et al. (1976). Over a 2-mo period, water samples were held at 4 C and 0.1-ml subsamples were assayed on duplicate plates of serial 10-fold dilutions.

RESULTS AND DISCUSSION

Duck plague virus seeded in the two filter-decontaminated water samples taken from the Lake Andes Refuge uniformly retained about 10% of its initial infectivity at the end of the observation period. After 60 days at 4 C, about 10^4 PFU per ml remained (Figs. 1 and 2). In contrast, much less virus could be demonstrated in the two samples of raw water. About 0.1% of the initial infectivity remained at 30 days post-inoculation and about 0.01% at 60 days. The final values were 10^1 PFU per ml or less (Figs. 1 and 2). Although the unfiltered water

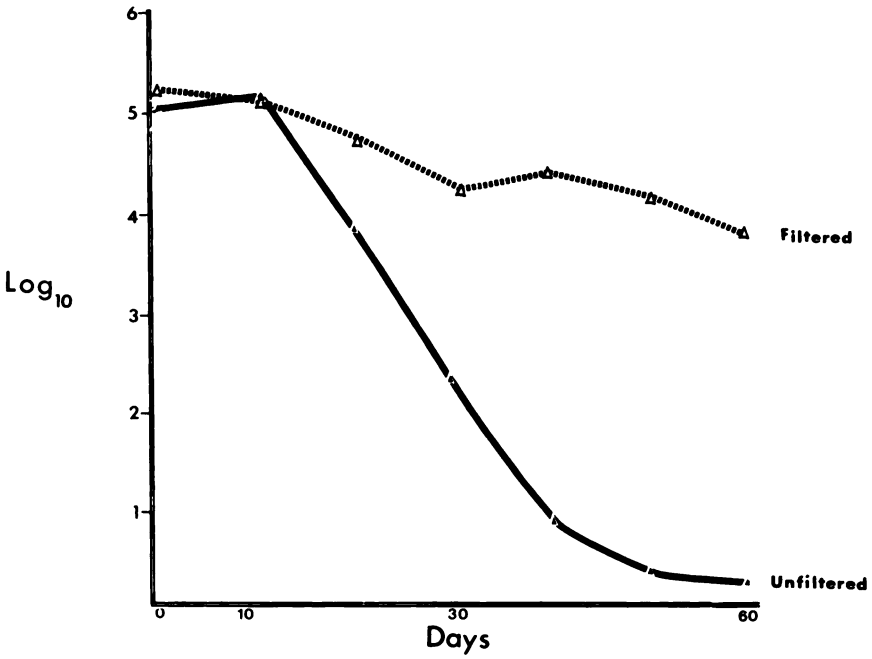

FIG. 1. Survival of duck plague virus at 4 C in filtered and unfiltered waters from Lake Andes proper in the Lake Andes National Wildlife Refuge, South Dakota.

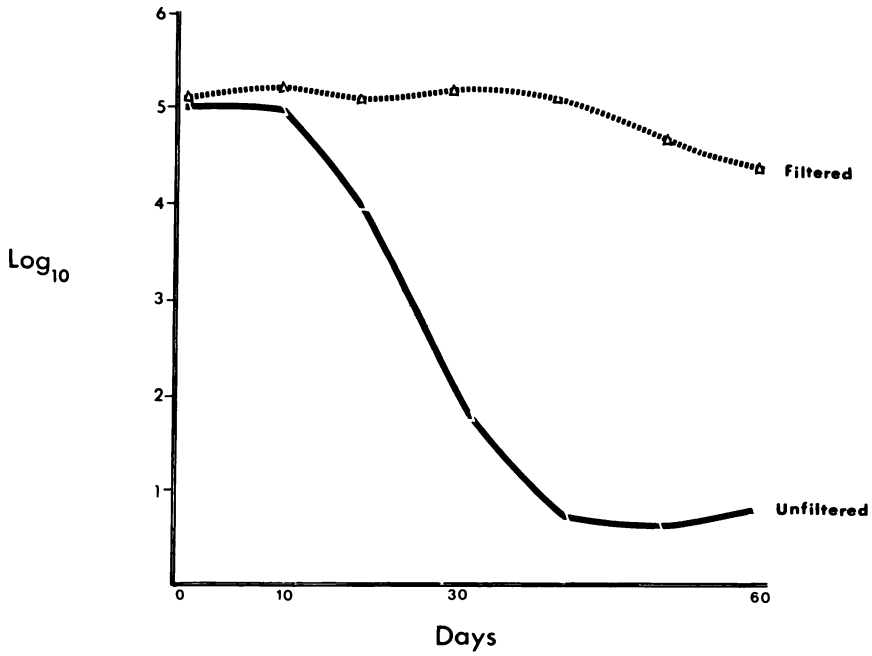

FIG. 2. Survival of duck plague virus at 4 C in filtered and unfiltered waters from the Owens Bay site of the Lake Andes National Wildlife Refuge, South Dakota.

sample did not become cloudy or obviously contaminated, the more rapid decline in infectivity might have been due in part to microbial activity, or to adsorption of virus on particulate materials, as has been well documented for enterovirus (Gerba et al., 1980).

The DVE herpesvirus shed in feces and other body discharges is undoubtedly diluted when the materials are deposited in water. Nevertheless, at low temperature infectivity can persist for at least 2 mo. Materials shed on land — especially under winter weather conditions — are not diluted, and infectivity may or may not persist longer than in water. Our conclusion that factors other than the mere presence of virus were surely involved in this unique epizootic of duck plague is strongly supported by the fact that to date no other outbreaks of DVE have been recognized among free-flying wild waterfowl at Lake Andes or elsewhere.

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