Plague Antibody in Large African Mammals

DOUGLAS H. GORDON,1,2 MARGARETHA ISAACSON,2 AND PAUL TAYLOR1
Blair Research Laboratory, Salisbury, Zimbabwe Rhodesia,1 and the South African Institute for Medical Research, Johannesburg 2000, Republic of South Africa2

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Plague hemagglutinating antibodies to a titer of 1:1,024 were demonstrated in 6.6% of buffalo and 0.3% of elephant sera tested 1 year after a plague epidemic in the same area.

Serological surveys for indirect hemagglutinating antibodies to the fraction 1 antigen of Yersinia pestis are recommended for the detection of plague foci and for monitoring the efficacy of control measures (14). Although the isolation of Y. pestis is rare, antibodies remain detectable for long periods of time and provide a means of evaluating epizootic and enzootic plague (1).

Plague in Zimbabwe Rhodesia was first reported in humans from the Wankie area in 1974 (3). Cruickshank et al. (5) gave preliminary data on the extent of the epizootic based on a general survey of human, dog, and rodent sera which has since been extended to cover most of Zimbabwe Rhodesia (P. Taylor et al., manuscript in preparation). Cavanaugh et al. (2) recommended regular testing of rodent sera as a sensitive means of detecting a change in a plague focus. In southern Africa, Hallett et al. found 17 of 38 species of small mammals to have positive titers of 1:8 and higher to plague (9). Taylor et al. (in preparation), however, found dogs to be the most useful animals for monitoring plague, in agreement with Rust et al. (12). The role of wild game and domestic stock in the epidemiology of plague has not been extensively investigated. Previous studies have reported high antibody titers to Y. pestis in swine (11) and that plague has occurred in camels (7, 10) and in a horse (8).

For this study serum was collected from 330 elephants (Loxodonta africana), 391 buffalo (Syncerus caffer), 16 zebras (Equus burchelli), and 5 sable antelope (Hippotragus niger) during a culling operation in August to September 1975 in Wankie National Park (lat. 18°40' S, long. 26°50' E), Zimbabwe Rhodesia. The serum samples were tested independently with microtiter equipment at the Blair Research Laboratory and the South African Institute for Medical Research for antibodies against Y. pestis fraction 1 antigen. Antigen and sensitized cells supplied by the Center for Disease Control in Fort Collins, Colo., and the indirect hemagglutination and hemagglutination inhibition tests described by Swanepoel et al. (13) were used at the Blair Research Laboratory. Locally produced fraction 1, standardized to, and conforming with, the antigen of the Walter Reed Army Institute of Research, was used at the South African Institute for Medical Research. The methods used were those described by Chen and Meyer (4).

The test results are presented in Table 1 and the range of titers is given in Table 2. The test for indirect hemagglutinating antibody to the fraction 1 antigen of Y. pestis is considered specific and, when correctly performed, overcomes the problem of cross-reactions (1). The reliability of the results is corroborated by our similar findings on independent testing using reagents produced in the United States and South Africa, respectively. Although a lower percentage of antibody titers was found at the Blair Research Laboratory in the buffalo, a pattern of low prevalence of plague positives is nevertheless indicated in this species. Most of the titers in the buffalo sample were in the range of 1:16 to 1:64, but titers as high as 1:1,024 were obtained. The sable antelope and zebra sera, which were collected from the same locality as the buffalo sera, were all negative, but the small sample size precludes any meaningful comparison. No tissue samples were cultured for Y. pestis. Rodents sampled from Wankie National Park just before the epizootic, in September 1974, had no detectable antibodies to Y. pestis (13), although Y. pestis was isolated from a hare, two squirrels, and a Rhabdomys pumilio (four-striped field mouse) collected the following month (3). The large-mammal sera were collected during August and September 1975, and presumably the antibody levels are the result of infection contracted during the epizootic of late 1974. Taylor et al. (in preparation) found no antibodies in rodent samples taken from the same vicinity in late 1975.

The presence of plague antibodies in buffalo raises the question of routes of transmission and
potential host capacity in other large feral mammals as well as domestic animals such as cattle. Although de Meillon et al. (6) considered the vector capacity of *Ctenocephalides felisstrongylus*, *Echiodaphaga larina*, and *Pulex irritans* found on cattle to be nil, the recognized role of *Pulex* in plague transmission and the uncertainty in flea alpha taxonomy underscore the need for further investigations. The infestation of large mammals by *Xenopsylla* and other known plague vectors has not been studied in Zimbabwe Rhodesia, although large mammals acting as incidental hosts may play a significant role in the dispersal of infected fleas.

The interpretation of the results is complicated by the unknown degree of persistence of antibodies and the degree of susceptibility in buffalo and elephants as these animals have not previously been reported to harbor plague antibodies. The relatively high percentage of positives in buffalo as compared with rodents and dogs (Taylor et al., in preparation) clearly demonstrates the exposure of wild mammals to plague during the course of an epizootic. Whereas buffalo are generally limited in distribution to the national parks, they may play a significant role in the rapid spread of plague within these areas. The transmission of plague is generally considered to be primarily rodent to rodent, but the extensive and rapid spread during the course of an epizootic may be more readily accounted for by the movements of larger mammals. The results reported here serve to emphasize the susceptibility of large mammals to plague and the importance of further investigation into the role of non-rodent hosts in the biology of plague.

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**LITERATURE CITED**


**TABLE 1. Results of tests on Zimbabwe Rhodesian large-mammal sera for indirect hemagglutinating antibody to fraction 1 antigen of *Y. pestis***

<table>
<thead>
<tr>
<th>Species</th>
<th>Total no. tested</th>
<th>No. positive</th>
<th>% positive</th>
<th>No. with nonspecific reactions</th>
<th>% of nonspecific reactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffalo</td>
<td>391 (278)</td>
<td>26 (8)</td>
<td>6.6 (2.9)</td>
<td>82</td>
<td>21.0</td>
</tr>
<tr>
<td>Zebra</td>
<td>15 (16)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sable antelope</td>
<td>5 (5)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Elephant</td>
<td>330 (288)</td>
<td>1 (1)</td>
<td>0.3 (0.3)</td>
<td>2</td>
<td>0.5</td>
</tr>
</tbody>
</table>

*Values in parentheses are results from the Blair Research Laboratory.*

**TABLE 2. Reciprocal of plague indirect hemagglutination titers in buffalo and elephants***

<table>
<thead>
<tr>
<th>Species</th>
<th>No. of specimens with titer:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Buffalo</td>
<td>365 (270)</td>
</tr>
<tr>
<td>Elephant</td>
<td>330 (287)</td>
</tr>
</tbody>
</table>

*Values in parentheses are results from the Blair Research Laboratory.*