

SUNCUS AS A POTENTIAL RESERVOIR OF LEPTOSPIROSIS: THE BLAMING OF THE SHREW†

W.D. KUNDIN,*† E.R. CARLOS,*‡ C.C. TSAI* and G.A. KUECZYNSKI§

* Microbiology Department, U.S. Naval Medical Research Unit No. 2, Taipei, Taiwan, Republic of China.

† Department of Preventive Medicine, University of Washington, Seattle, Washington, U.S.A.

‡ Department of Medicine, University of the Philippines, Manila, Republic of Philippines.

§ Sanitation Department, U.S. Naval Station, Sangley Point, Manila, Republic of Philippines.

INTRODUCTION

Although the role of the rodent as a source of leptospiral transmission in South-east Asia and elsewhere has been subjected to considerable study, little attention has been paid to that familiar commensal insectivore, the musk or house shrew, *Suncus murinus*, family Soricidae.

These ubiquitous little creatures (Fig. 1) are readily found in close proximity to man, in dwellings, outbuildings, villages and grassy areas throughout Asia and the Pacific islands. Because they often come indoors where they may feed on and excrete on their hosts' foods, and because they may in turn serve as snacks for household cats and dogs, they serve as potential sources of infection for man, his pets and his livestock.

It is quite probable that leptospirae have been previously isolated from musk shrews. However, no such reports have been found in the journals, reprints, or references availa-

ble to the authors. Smith *et al.* (1961) isolated no leptospirae from kidneys of 42 Malaysian *Suncus murinus*, but found 2 of 26 sera positive for antibodies.

Aragon *et al.* (1965) isolated no leptospirae from kidneys of 105 *Suncus luzoniensis*, the Philippine variety of *S. murinus*. They did not test sera for antibodies.

A preliminary report of our isolations from Philippine shrews as well as from a number of other hosts has recently been reported. (Carlos *et al.* 1970). Although we consider *S. luzoniensis* to be synonymy of *S. murinus*, this report will use *luzoniensis* as the species name of the Philippine shrews. In the report below evidence is presented of the isolation of leptospirae, two from *Suncus luzoniensis* trapped in the Philippines and two from *Suncus murinus* trapped in Taiwan, Republic of China. Results of a limited number of serologic tests for leptospiral antibodies are also shown.

MATERIALS AND METHODS

Shrews were live-trapped at a pig farm in Chu-Nan, about 35 miles southwest of Taipei, Taiwan, and at the U. S. Naval Station,

† This study was supported in part through funds provided by the Bureau of Medicine and Surgery, Navy Department, for MF 12.524. 009-001A.

The opinions and assertions contained herein are those of the authors and are not to be construed as official or as reflecting the views of the Navy Department or the Naval Service at large.

Sangley Point, on the outskirts of Manila, Republic of the Philippines.

Anaesthetized animals were exsanguinated by cardiac puncture. Bloods were saved for serologic testing. Kidneys were ground up, aliquots of 1:10 were inoculated into Fletcher's medium and observed for 28 days for leptospiral growth. Serologic and isolation procedures were based on the methods of Galton *et al.* (1962).

Positive cultures were subcultured in Korthof's medium for testing against standard antisera and in Fletcher's medium for use as live antigen for immunizing adult rabbits. Provisional identifications made at NAMRU-2 were subsequently confirmed by the Leptospirosis Unit, National Communicable Disease Center, Atlanta, Georgia, U.S.A.

Sera were tested for the presence of leptospiral antibodies using both the macroscopic slide agglutination test and the microscopic agglutination test. In the former test, agglutination by undiluted serum of any of five pools of 15 formalized leptospiral antigens was the first screen for positives. In the latter test, agglutinin titers at a serum dilution of 1:100 or greater of any of 22 live leptospiral serotypes (*L. ballum*, *canicola*, *icterohemorrhagiae*, *bataviae*, *grippotyphosa*, *pyrogenes*, *manilae*, *autumnalis*, *pomona*, *hebdomadis*, *australis*, *tarassovi*, *wolfii*, *javanica*, *cynopteri*, *djasimana*, *butembo*, *patoc* 1, *sejroe*, *medanensis*, and *poi*) were considered positive.

RESULTS

Twenty-eight *Suncus murinus* (Fig. 1) trapped around the confines of a pig farm in Chu-nan, Taiwan, in January 1968 and eleven *Suncus luzoniensis* trapped in the area of the Officers' Swimming Pool (Fig. 2) at the Sangley Point Naval Station, Republic of the Philippines, in September and October

1969, were tested for leptospiral infection. Results are shown in Table 1.

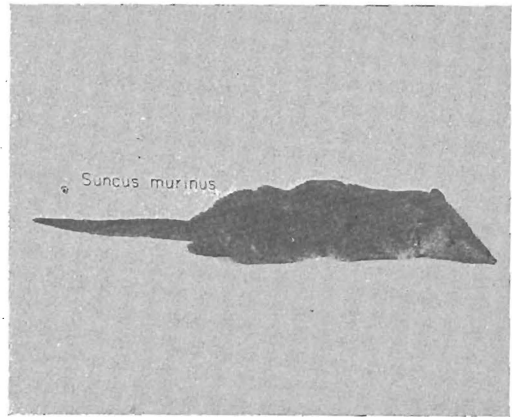


Fig. 1—*Suncus murinus* trapped on Taiwan. Note elongated snout, minute eyes, and stubby tail.

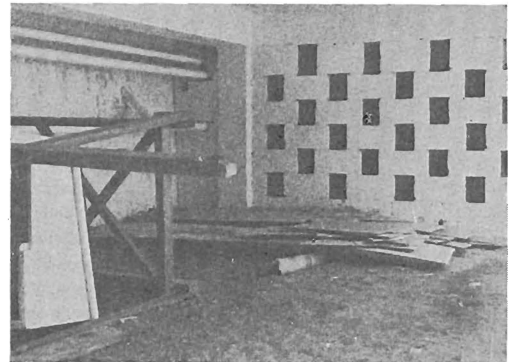


Fig. 2—Area under the officers' swimming pool, U.S. Naval Station, Sangley Point, Republic of the Philippines. The area had been cleaned up earlier, but there were still good sites for shrews to nest.

Positive isolates were made from two Taiwan shrews and two Philippine shrews. Both Taiwan isolates were identified as being indistinguishable from *L. javanica* while the Philippine isolates were found to be *L. grippotyphosa* and *L. bataviae*. Of the 26 Taiwan sera tested, four were positive both by the macroscopic slide agglutination test and the microscopic agglutination test while two of seven Philippine sera tested were

Table 1
Leptospirae in Taiwan and Philippine Shrews, Isolations and Serologic Results.

	Isolation		Serology*	
	Taiwan	Philippines	Taiwan	Philippines
Shrews tested	28	11	26	7**
Shrews positive	2	2	4	2

* Agglutinin titer of 1:100 or greater was considered positive.

** Four contaminated sera are omitted from the table.

positive. Characteristics of the positive results are shown in Table 2. The four positive Taiwan sera reacted against *L. javanica* antigen while the two positive Philippine sera reacted against *L. bataviae* antigen. The serum of the shrew from which

L. grippotyphosa organisms were recovered had a relatively low antibody response against its own isolate. It is felt that this shrew probably had a prior infection of *L. bataviae*.

Table 2
 Characterization of Positive Results.

	Serotype of Isolate	Serotype and Titer of Antibody
Philippine Shrew # 1	<i>Grippotyphosa</i>	<i>Grippotyphosa</i> 1:50 <i>Bataviae</i> 1:400
Philippine Shrew # 2	<i>Bataviae</i>	<i>Bataviae</i> 1:400
Taiwan Shrew # 1	<i>Javanica</i>	<i>Javanica</i> 1:400
Taiwan Shrew # 2	<i>Javanica</i>	Negative
Taiwan Shrew # 3	No isolation	<i>Javanica</i> 1:100
Taiwan Shrew # 4	No isolation	<i>Javanica</i> 1:100
Taiwan Shrew # 5	No isolation	<i>Javanica</i> 1:100

DISCUSSION

Although the Philippine shrew bears the name *S. luzoniensis* it is thought by some to be virtually indistinguishable from *S. murinus*, (Johnson, 1962). The shrew, a native of Asia, has spread, probably due to man, to most of the islands of Southeast Asia (De Vos *et al.* 1956).

Although their life patterns and habits have not been studied in any great detail they appear to occupy an intermediate

ecologic niche between the essentially interior house mouse and the essentially exterior commensal rats. They are found occasionally inside homes but nest and generally forage and scavenge outside in village and farmyard.

In Malaysia they are "confined to the immediate neighborhood of houses", (Harrison, 1955), while on Guam they are trapped not only around dwellings but on hilltops, in jungles, marshes and areas at least a half mile from the nearest housing (Barbehenn, 1962).

The average weight of Malaysian shrews was 50 grams (Harrison, 1955). Those on Guam were only 26 grams, (Barbehenn, 1962). Our Philippine shrews averaged 45 grams while the Taiwan shrews averaged 48 grams. Although shrews are primarily insectivores they have been observed to eat baby chicks, grain, fruit, newborn rodents (Barbehenn, 1962; Harrison and Lim, 1950), earthworms, biscuits, flour and rice (Harrison, 1962). However, since it is a poor climber and probably lacks the propensity to gnaw into cartons, it is much less likely to contaminate human foodstuffs than the commensal rats (Barbehenn, 1962).

Their role in the cycle of zoonotic infections has not been intensively studied. Nothing is known of the diseases and parasites of the shrew on Guam (Barbehenn, 1962). Recently rabies virus was isolated from shrews on Guam (J. W. Glosser and E. P. Yarnell, unpublished results). Shrews have been incriminated as being naturally infected with the plague bacillus *Pasteurella pestis* in India, Taiwan, Cambodia, and China, (Pollitzer and Meyer, 1961). They have apparently not been incriminated as a host for scrub typhus. In a limited study in Indonesia no rickettsiae or *Pasteurella pestis* were isolated from the spleens of 39 (Kundin, to be published). Fifty fleas were recovered from these shrews, 46 of which were *Xenopsylla cheopis*. Fifty-three trombiculid mites (not yet identified) were recovered from the ears of 17 shrews examined.

In spite of the apparent lack of incrimination of *Suncus* in other zoonotic infections, the isolations of leptospirae from shrews trapped in areas where livestock are kept and where people reside (and where they swim) serve to indicate that man may have considerable contacts with this organism through the mediation of the *Suncus*.

The ease with which the leptospirae were isolated from shrews trapped in two widely

divergent islands, tropical Luzon and temperate Taiwan, serves to emphasize not only the ubiquity of the commensal musk shrew but the ubiquity of leptospirae as well. The length of time which a shrew can remain infected and infectious is not known. Since the infected shrews appeared normal at autopsy, it is probable that, as with certain rats, they may remain infectious for life, (Smith *et al.* 1961).

In our studies we found three different serotypes (*javanica*, *grippotyphosa*, and *bataviae*) in the four isolates and serologic evidence of *javanica* and *bataviae*. In Malaysia Smith *et al.* (1961) reported antibodies to *saxkoebing* and *autumnalis* in two seropositive shrews. It thus appears that the shrew may be host to a wide range of leptospiral serotypes.

SUMMARY

Although the isolation of leptospirae from the musk shrew *Suncus* has not previously been reported, the agent was recovered with no great difficulty from two *Suncus murinus* in Taiwan and from two *Suncus luzoniensis* in the Philippines. The Taiwan isolates were both of the *javanica* serotype while the Philippine isolates were *grippotyphosa* and *bataviae*.

Because the shrew is a commensal creature living in close proximity to man, his pets, his livestock, and his food, it is suggested that this little insectivore may play a hitherto unsuspected role in the transmission of urban as well as rural leptospirosis in Asia and the Pacific islands.

REFERENCES

- ARAGON, P. R., JACALNE, A. V. and FAMA-TIGA, E. G., (1965). Isolation of leptospira from rats, dogs and pigs. *Philipp. J. Science*, 94:45.

- BARBEHENN, K. R., (1962). The house shrews on Guam. In Pacific Island Rat Ecology. Bulletin 225, The Bishop Museum, Honolulu, Hawaii, p. 247.
- CARLOS, E. R., KUNDIN, W. D., TSAI, C. C., IRVING, G. S., BATUNGBAKAL, C. and WATTEN, R. H., (1970). Leptospirosis in the Philippines: I. Isolation Studies, preliminary report. *Acta medica Philippina*, in press.
- DE VOS, ANTOON, MANVILLE, R. H. and VAN GELDER, R. G., (1956). Introduced mammals and their influence on native biota. *Zoologica*, 41:163.
- GALTON, M. M., MENGES, R. W., SCHOTTS, E. B., NAHMIA, A. J. and HEATH, C. W., (1962). Leptospirosis: epidemiology, clinical manifestations in man and animals, and methods in laboratory diagnosis. U. S. Public Health Service Publication 951, Washington, D. C.
- HARRISON, J. L., (1955). Data on the reproduction of some Malayan Mammals, *Proc. Zool. Soc. London*, 125:445.
- HARRISON, J. L. and LIM, B. L., (1950). Notes on some small mammals of Malaya. *Raffles Museum Bull.*, 23:300.
- JOHNSON, D. H., (1962). Rodents and other Micronesian mammals collected. In Pacific Island Rat Ecology, Bulletin 225, The Bishop Museum, Honolulu, Hawaii, p. 21.
- POLLITZER, M. D. and MEYER, K. F., (1961). The ecology of plague. In Studies in Disease Ecology, J. M. May, Ed., Hafner Publishing Co., New York, p. 433.
- SMITH, C. E. G., TURNER, L. H., HARRISON, J. L. and BROOM, J. C., (1961). Animal leptospirosis in Malaya: I. Methods, zoogeographical background, and broad analysis of results. *Bull. W. H. O.*, 24:5.