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Authors: OTIS, V. S., and BEHLER, J. L.

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THE OCCURRENCE OF SALMONELLAE AND *Edwardsiella* IN THE TURTLES OF THE NEW YORK ZOOLOGICAL PARK

V. S. OTIS¹ and J. L. BEHLER²

Abstract: The turtle collection of the New York Zoological Park was tested for the presence of intestinal *Salmonella*, *Arizona*, *Citrobacter* and *Edwardsiella* spp. *Salmonella durham* and *Edwardsiella tarda* were isolated from 11 species, representing 37 specimens of the 127 tested, with a resultant apparent rate of infection of 29%. *Arizona* and *Citrobacter* spp. were not isolated.

INTRODUCTION

Since 1946 investigators have reported isolations of *Salmonellae* from turtles.¹⁰ Kaufmann and Morrison⁶ have published a review of the pertinent literature. Since 1966 investigators have isolated various strains of *Salmonella*, *Arizona*, *Citrobacter* and *Edwardsiella* from wild and captive turtles.^{1,3,4,5,12} Several investigations have been made on zoo turtles. Rudat et al.¹¹ have reported percentages of *Salmonella* carriers in the Basel, Bern and Zurich Zoos. In 1968, Lie reported the occurrence of *Salmonella* in the Frankfurt Zoo.⁹ In 1971, Jackson and Jackson reported the frequency of *Salmonella* and *Arizona* in turtles of various United States zoos.² During the fall of 1971, the entire collection of turtles at the New York Zoological Park (Bronx Zoo) was tested for the frequency of intestinal *Salmonellae* and *Edwardsiella*. Feed materials were not cultured as a possible source of infection, since all animals, both positive and negative for the tested organisms, were fed the same diet. Since the purpose of the study was to determine frequency of infection only, no other attempts were made to determine the original source of infection.

MATERIALS AND METHODS

One hundred and twenty-seven turtles were tested for *Salmonellae* and *Edwardsiella*. By gross physical examination all the animals appeared free of obvious disease and, according to their captivity records, had been healthy for their entire duration at the zoo. The specimens had been kept for variable periods of time, ranging from 6 months to 10 years. Most were housed in community tanks, where two or more turtles were housed in one tank.

Cultures were secured with sterile swabs inserted through the cloaca to the colon, transferred to Modified Stuart Transport Medium and held at room temperature for a maximum of 24 hours, until plates could be streaked. (Turtles too small for cloacal swabbing were examined via a culture of freshly obtained fecal material). Cultures were then plated on EMB and HE agars (Pfizer Diagnostics, Clifton, N.J.) and incubated for 24 hours at 37 C. Suspect colonies on each plate were transferred to individual Urease, TSI, Ornithine and Lysine tubes (Pfizer Diagnostics, Clifton, N.J.). All Urease negative, H₂S positive tubes, as well as all H₂S negative tubes that were Ornithine positive and/or Lysine positive

¹ Department of Animal Health, New York Zoological Society, Bronx Park, Bronx, New York 10460, U.S.A.

² Department of Herpetology, New York Zoological Society, Bronx Park, Bronx, New York 10460, U.S.A.

were classified as suspect and mailed to the National Animal Disease Laboratory, U.S.D.A., Ames, Iowa, for serotyping.

RESULTS

Thirty-seven specimens were reported positive for *Salmonella durham*. *Edward-*

siella tarda was found in 15 of these individuals as well. All specimens were negative for *Arizona* and *Citrobacter* spp. The 37 positive specimens represent 2 suborders, 3 families, 9 genera and 11 turtle species. Twenty-nine percent of the zoo collection was positive for *Salmonella* and *Edwardsiella*. Specimens tested and the results are summarized in Table 1.

TABLE 1. Turtles which yielded *Salmonella* and/or *Edwardsiella*.

Classification	No. Positive/Examined	No. Bacteria Present
SUBORDER CRYPTODIRA		
Kinosternidae		
<i>Sternotherus odoratus</i> (Stinkpot Turtle)	1/2	Both
Emydidae		
<i>Chrysemys scripta elegans</i> (Red-eared Turtle)	1/8	Both
<i>Chrysemys picta</i> (Painted Turtle)	1/1	Both
<i>Mauremys caspica</i> (Caspian Terrapin)	1/1	Both
<i>Melanochelys trijuga coronata</i> (Travancore Crowned Turtle)	6/12	Both
<i>Malaclemys kohni</i> (Mississippi Map Turtle)	1/1	Both
<i>Malaclemys terrapin terrapin</i> (Northern Diamondback Terrapin)	2/2	Both
<i>Terrapene carolina carolina</i> (Eastern Box Turtle)	2/11	Both
SUBORDER PLEURODIRA		
Pelomedusidae		
<i>Pelomedusa subrufa</i> (Helmeted Terrapin)	1/1	<i>Salmonella</i>
<i>Pelusios subniger</i> (African Mud Turtle)	1/2	<i>Salmonella</i>
<i>Podocnemis unifilis</i> (Yellow-spotted Amazon Turtle)	20/40	<i>Salmonella</i>

DISCUSSION

This paper is the first report of *Salmonella durham* in turtles. *Edwardsiella tarda* was first reported in turtles by Jackson et al.⁴

The apparent rate of infection at the Bronx Zoo corresponds with figures of Rudat et al.¹¹ for the Basel (26.1%), Bern (30.0%) and Zurich (26.9%) Zoos. This percentage is considerably lower than that reported by Lie,⁹ who found 50.5% apparent rate of infection at the Frankfurt Zoo. The figure reported for the Bronx Zoo is considerably higher, on the other

hand, than the 12.1% apparent rate of infection reported by Jackson and Jackson² at nine zoological gardens in the United States. The significance of these differences is unclear, since previous investigators neglected to describe the housing conditions and tank populations of the turtles tested.

In each case where positives resulted at the Bronx Zoo, the tanks were community type and not equipped with water recirculators. Every turtle in these tanks was positive for *Salmonella durham* and every turtle in one of the tanks was positive for *Edwardsiella tarda* as well, indicating no

species or sex specificity. Of 10 other tanks tested, 7 of which were community type and, 4 of which were equipped with water recirculators, no *Salmonellae* or *Edwardsiella* were found.

Since the animals had been kept for a considerable amount of time under the conditions described, and seemed in general good health, it is assumed that they merely harbored the organisms and were not pathogenically infected. Since some strains of *Salmonella* are less pathogenic than others in man, it is possible that the

same holds true for the reptiles, and only under extreme stress conditions does dysentery result.⁸

Since these microorganisms have been reported, the infected turtles have been removed to two recirculating tanks in an attempt to alleviate the infection, and the infected tanks sterilized. It remains to be seen how long it takes *Salmonella* and *Edwardsiella* to disappear from the lower intestinal bacterial flora. According to Kaufmann et al.,⁷ this may take up to a year.

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