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Source: Journal of Wildlife Diseases, 7(2) : 130-132

Published By: Wildlife Disease Association

URL: <https://doi.org/10.7589/0090-3558-7.2.130>

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THE FREQUENCY OF *SALMONELLA* AND *ARIZONA* MICROORGANISMS IN ZOO TURTLES

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Abstract: A screening survey of turtles for the presence of cloacal *Salmonella* and *Arizona* microorganisms was made in nine major zoos and zoological gardens. Six *Salmonella* serotypes and one *Arizona* serotype were recovered from 14 species representing 5 turtle families. The apparent rate of infection was 12.1%.

INTRODUCTION

During the summer months of 1969, a study was conducted of the enteric flora of captive turtles. An examination was made of specimens in the reptile collections of the following nine major zoos and zoological gardens in the United States: California (San Diego Zoological Gardens, San Francisco Zoo, Steinhart Aquarium), Florida (Jacksonville Municipal Zoo, Ross Allen Reptile Institute, St. Augustine Alligator Farm), Illinois (Lincoln Park Zoo), Missouri (St. Louis Zoological Garden), Wisconsin (Milwaukee County Zoological Park). The primary objective of the investigation was to determine the frequency of *Salmonella* and *Arizona* microorganisms in zoo populations of turtles of various species. Additionally, it was hoped that future studies of other enteric forms which were isolated and placed into stock cultures might prove of value in elucidating the role of these bacteria in the health and physiology of turtles.

MATERIALS AND METHODS

One hundred twenty-four turtles were examined for the presence of *Salmonella* and *Arizona*. Most of these turtles had been in captivity for an extended period of time, were feeding regularly, and were apparently healthy. Samples were collect-

ed by inserting a sterile swab directly into the cloaca of the animal. Swabs were then placed directly into tubes containing 5 ml of Selenite-F Enrichment Medium. The inoculated tubes were incubated from 18 to 36 hours at the ambient temperature of the mobile laboratory which varied from approximately 20 C to 35 C. Following incubation, cultures were plated on Desoxycholate Agar and resulting suspect colonies transferred to Kligler's Iron Agar slants. Kligler's positive tubes were shipped via air to Mississippi State College for Women where routine biochemical screening tests for the isolation of *Salmonella* and *Arizona* cultures¹ were completed. Subsequent to the screening tests, all H₂S positive, urease negative, indol negative, ONPG (O-Nitrophenyl Beta-D-galactopyranoside) positive and negative isolates were submitted for serotypic analysis.

RESULTS

Salmonella and *Arizona* organisms were isolated from the cloacae of 15 (12.1%) of the 124 turtles examined. Taxonomically, these 15 individuals represent 14 species, 13 genera, and 5 families. Both of the two existing suborders of turtles are thus represented. Table 1 shows the 6 serotypes of *Salmonella* and 1 serotype of *Arizona* together with the associated species of turtles from which

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they were isolated. These organisms were cultured from aquatic, semi-aquatic and terrestrial turtles.

In a previous pilot study made at three zoos,² we reported *Salmonella* Group C₁ (from *Geochelone denticulata* and *Geochelone elegans*) and *Salmonella* Group

E (from *Geochelone denticulata*) because facilities for complete serotyping were not available to us at that time. Since then, we have identified these isolates as *Salmonella offa* and *Salmonella anatum*, respectively.

Table 1. Bacteria, and turtle species with which they were found associated.

Salmonella bredeney

Geochelone elegans (Indian starred tortoise)

Salmonella drypool

Chelodina longicollis (common snake-necked turtle)

Deirochelys reticularia (chicken turtle)

Salmonella houten

Dogania subplana (Malayan soft-shelled turtle)

Geochelone denticulata (South American forest tortoise)

Gopherus polyphemus (gopher tortoise)

Podocnemis unifilis (yellow-spotted Amazon turtle)

Salmonella newport

Emydoidea blandingi (Blanding's turtle)

Kinosternon bauri (striped mud turtle)

Salmonella san diego

Chelus fimbriatus (matamata turtle)

Salmonella thompson

Platysternon megacephalum (big-headed turtle)

Trionyx triunguis (African soft-shelled turtle)

Arizona 24: 25-26

Emydoidea blandingi

Graptemys barbouri (Barbour's map turtle)

Macrochelys temmencki (alligator snapping turtle)

DISCUSSION

From the results of our survey we infer that the prevalence of *Salmonella* and *Arizona* in the enteric flora of zoo turtles is moderately high. If permanent laboratory facilities for culturing and preliminary isolation had been available at the sites rather than mobile laboratory facilities, the recovery rate may even have been somewhat greater. Most of the

serotypes presented are routinely encountered in diagnostic laboratories; however, Dr. Billie O. Blackburn (personal communication, March, 1970) informs us that *S. houten* and *S. offa* are rarely isolated in his laboratory. As far as we have been able to ascertain, neither of these serotypes had previously been reported from turtles. Even though apparent rates of infection are only moderately high, we feel that a potential hazard

may exist where water contaminated by turtle fecal material is in close proximity to the food or standing water supply of mammals. At one location, the curator was interested in creating a "natural assemblage" consisting of South American freshwater dolphins and large river turtles, *Podocnemis*. While these mammals and reptiles may occupy a common body of water in nature, we suspect that confinement together in a large aquarium may not be comparable to occurring naturally together in a river in terms of

concentration of bacteria per unit volume of water. Since *Salmonella* can be pathogenic in some mammals, we feel caution should be exercised in confining rare and expensive species of mammals with turtles whose potential for excreting *Salmonella* has been demonstrated. Additionally, keeper personnel whose duties bring them directly in contact with turtles should be warned of the human health hazards of unhygienic practices in handling the animals.

Acknowledgements

We are greatly indebted to the National Animal Disease Laboratory and the following personnel who made the serotyping of cultures possible: Drs. B. O. Blackburn, L. J. Pate, E. L. Pope, and L. J. Wilbur. Appreciation is expressed to the following zoological collections personnel who kindly allowed us to examine the specimens in their care and in many cases materially assisted us with the sampling procedures: R. Allen, E. Almandarz, N. P. Baldwin, R. Dempster, W. I. Drysdale, J. Fairington, L. Gomez, R. F. Gray, C. Hoessle, D. Hoffman, S. Joseph, A. Koukoulis, R. Lacer, C. Lightburn, J. Mallick, C. Mecha, M. Myers, R. Miller, R. T. Reuther, K. Schoenrock, C. E. Shaw, G. Speidel, Mrs. H. Zacher, and D. Zucconi. Appreciation is also expressed to Dr. M. Fulton for constructive criticism and advice, and to Miss L. L. Jordan for technical laboratory assistance. This research was supported in part by an MSCW Faculty Research Grant.

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