Isolation of Salmonella spp. from a Colony of Wading Birds

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mental disease attributed to *Haemoproteus* (Julian et al., 1980, J. Wildl. Dis. 16: 39–44), but subsequently shown to be caused by a *Bacillus* species (Julian et al., 1985, J. Wildl. Dis. 21: 335–337). The bacterium in the present case differed from the *Bacillus* sp. previously described. This organism was larger and contained numerous prominent endospores. Most notably the cell wall had a well defined surface array rather than a thick capsule. The wall was not stained with PAS in contrast to the positive reaction of the *Bacillus*. It is unusual that this organism stained Gram negative in tissue sections, however, the tissues were necrotic and the structure stained were spores rather than the intact bacterium. Swollen sporangia, terminal to subterminal endospores and walls with surface arrays are typical of clostridia. The advanced degree of tissue necrosis (Fig. 2) could produce microaerophilic to anaerobic conditions which would optimize clostridial growth. Taken together these observations suggest that the spore-former may belong to the genus *Clostridium*, but we must emphasize that an unequivocal identification has been impossible. Clinical disease associated with infection of *Bacillus* sp. and *Clostridium* sp. is usually not considered to be highly contagious, commonly affecting individual animals. This animal was not debilitated suggesting an acute primary infection with this organism. Frozen tissues were not available to attempt spore germination for definitive identification of the bacteria. *Plesiomonas shigelloides* is a Gram negative bacterium which is infrequently isolated from a variety of human and animal submissions (Carter, 1984, Diagnostic Procedures in Veterinary Bacteriology and Mycology, Thomas Books, Springfield, Illinois, pp. 77–78). It occasionally has clinical significance, but it is unlikely that it was significant in this case.

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Isolation of *Salmonella* spp. from a Colony of Wading Birds

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Among birds that inhabit marine environments, gulls (*Larus* spp.) are the most widely recognized hosts of *Salmonella* spp. (e.g., Nielsen, 1960, Nord. Veterinaermed. 12: 417–424; Müller, 1965, Nature 207: 1315; Snoeyenbos et al., 1967, Avian Dis. 11: 642–646; Wuthe, 1973, Berl. Münch. Tierärztl. Wsch. 86: 255–256; Kapperud and Rosef, 1983, Appl. Environ. Microbiol. 45: 375–380; Fenlon, 1983, J. Hyg. 91: 47–52; Fricker, 1984, J. Appl. Bacteriol. 56: 499–502). Some other species of marine birds have been found to harbor *Salmonella* spp., also (Steiniger and Hahn, 1953, Acta Pathol. Microbiol. Scand. 23: 401–408; White and Forrester, 1979, J. Wildl. Dis. 15: 235–237; Ferreira Garcia and Schönhofen, 1982, Arq. Biol. Tecnol. (Curitiba) 25: 237–242). Locke et al. (1974, J. Wildl. Dis. 10: 143–145) re-

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ported salmonellosis among six species of egrets and herons in a captive colony in Maryland, USA. *Salmonella typhimurium* was isolated from tissues of many of the birds after death. I report here the finding of *Salmonella* spp. in an active, nesting colony of free-living egrets, herons, and ibises in New Jersey, USA.

In June 1985, feces from 37 nests of five species of wading birds (five great egrets [*Casmerodius albus*], eight snowy egrets [*Egretta thula*], eight tricolored herons [*Egretta tricolor*], eight black-crowned night herons [*Nycticorax nycticorax*], and eight glossy ibises [*Plegadis falcinellus*]) were sampled for *Salmonella* spp. The colony was located on Mordecai Island, Ocean County, New Jersey. Only nests which contained young (1 to 3 wk of age) were sampled. The sampling procedure consisted of swabbing individual nests with a moistened, calcium alginate-tipped swab (Spectrum Diagnostics, Glenwood, Illinois 60425, USA) and inoculating 10 ml filter-sterilized selenite F broth (BBL Microbiology Systems, Cockeysville, Maryland 21030, USA). After incubation at 37 C for 48 hr, broth cultures were streaked onto plates of bismuth sulfite agar (BBL) (Lennette et al., 1980, Manual of Clinical Microbiology, 3rd Ed., American Society for Microbiology, Washington, D.C., pp. 195–219). After 48 hr at 37 C, colonies were picked and transferred to slants of trypticase soy agar (BBL) for 24 hr at 37 C. Each culture was identified by inoculating a Roche Enterotube II (Roche Diagnostic Systems, Nutley, New Jersey 07110, USA). Cultures positive for *Salmonella* spp. were confirmed by the use of polyvalent antisera to *Salmonella* somatic antigens (groups A–D, GIBCO, Grand Island, New York 14071, USA) in a slide agglutination test. Serotyping of *Salmonella* isolates was performed by the National Veterinary Services Laboratory, U.S. Department of Agriculture, Ames, Iowa 50010, USA.

Of the 37 nests sampled, two (5.4%) were positive for *Salmonella* spp. The *Salmonella* sp. isolated from a nest of a black-crowned night heron was typed as *S. newport*, and that isolated from the nest of a glossy ibis was *S. typhimurium* var. *copenhagen*.

White and Forrester (1979, op. cit.) reported multiple antimicrobial-resistant *Salmonella* spp. from marine birds in Florida. The two *Salmonella* spp. isolated in this study were tested, by standard methods (Lennette et al., 1980, op. cit.), for resistance to the following antimicrobials: penicillin (10 U), ampicillin (10 μg), carbenicillin (100 μg), cephalothin (30 μg), tetracycline (30 μg), chloramphenicol (30 μg), gentamycin (10 μg), neomycin (30 μg), trimethoprim-sulfamethoxazole (1.25/23.7 μg), polymyxin B (300 U), amikacin (30 μg), and cefoxitin (30 μg); both isolates showed resistance only to penicillin.

The sources of *Salmonella* spp. for the birds of the colony examined in this study were probably within the marine or estuarine environments nearby; these birds all feed on a similar diet of fish and aquatic invertebrates (Willard, 1977, Condor 79: 462–470; Custer and Osborn, 1978, Auk 95: 733–743). *Salmonella* spp. are capable of surviving in salt water, and they may infect fish and marine invertebrates (molluscs and crustaceans) (Janssen and Meyers, 1968, Science 159: 547–548; Heuschmann-Brunner, 1974, Zentralbl. Bakteriol. Hyg., I. Abt. Orig. B 158: 412–431; Minette, 1984, Int. J. Zoonoses 11: 95–104).

Salmonella typhimurium (including var. *copenhagen*) and *S. newport*, the two species isolated in this study, were the first and third most frequently isolated serotypes, respectively, from humans in 1981 (Centers for Disease Control, 1985, 1981 *Salmonella* Surveillance Data [memorandum], 26 pp.). Considering the migratory habits of the avian species studied here, the possibility must be considered that wading birds may act as long-distance vectors of *Salmonella* spp. This would be determined both by the ability of *Salmonella* spp. to become established in

these hosts and the persistence of such infections. The observations of Locke et al. (1974, op. cit.) on salmonellosis in a captive heron colony suggest that these possibilities are likely. The extent to which *Salmonella* spp. infections may limit natural populations of wading birds requires further study.

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Survey for Antibodies Against Various Infectious Disease Agents in Muskoxen (*Ovibos moschatus*) from Jamesonland, Northeast Greenland

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Knowledge of diseases in free-living muskoxen in general is very limited, and nothing is known about the disease condition among the 15,000–20,000 muskoxen living on the northeastern coast of Greenland.

Testing for serum antibodies is often the first step in disease investigation in a population. Thus when nearly 500 muskoxen were immobilized and tagged as a part of a biological study (Clausen et al., 1984, J. Wildl. Dis. 20: 141–145), blood samples were taken from the tarsal vein of 132 apparently healthy muskoxen. There were 35 males and 53 females more than 3 yr of age, five males and five females 2 yr of age and eight males and 11 females born the previous spring.

The blood samples were kept at 0 C in a hole in the ground just over the permafrost. Due to inadequate separation of the serum, heparin was in most cases added to the blood container. Plasma was separated 2–3 days later; streptomycin (about 50 μg/ml) was added for preservation. After the expedition the samples were flown to the State Veterinary Serum Laboratory (SVS) and kept at −20 C until they were tested for antibodies against 16 diseases known to occur among domestic and wild ungulates in the northern hemisphere (Davis et al., 1981, Iowa State Univ. Press, Ames, Iowa, 446 pp.).

No antibodies for any of the following pathogens were detected in the blood samples from the muskoxen.

Blue tongue (BT) virus (126 samples) was tested by an antibody blocking ELISA test using a polypeptide antigen (purified BT virus structural protein p 7 from BT type 10) which is a cross-reacting antigen shared by various serotypes. The reaction is produced by a) the above-mentioned antigen, b) rabbit antiserum for purified BT type virus, and c) peroxidase conjugated antibody for rabbit IgG. Test sera were introduced between steps a and b in a dilution of 1:4. Sera giving an inhibition of the specific reaction of 50% or more were considered positive.

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