

BACTERIAL PNEUMONIA IN FREE-RANGING  
BOG TURTLES, *GLYPTEMYS MUHLENBERGII*, FROM  
NORTH CAROLINA AND VIRGINIA

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**Abstract:** Necropsy of two wild-caught bog turtles, *Glyptemys muhlenbergii*, found freshly dead in 1982 and 1995 under similar conditions in North Carolina and Virginia revealed large numbers of bacterial aggregates in the lungs, and suggested bacterial pneumonia as the primary cause of death. Diseased specimens of *G. muhlenbergii*, once necropsied, should be deposited in museums for use in investigations of regional patterns of emerging wildlife pathogens. This is the first report of pneumonia in bog turtles in the southern portion of their range.

**Key Words:** Bog turtle; *Glyptemys muhlenbergii*; bacterial pneumonia; disease; mortality.

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Population declines, as a result of disease in wild turtle populations, have been documented for musk turtles, *Sternotherus depressus* (Dodd, 1988) and desert tortoises, *Gopherus agassizii* (Jacobson et al., 1991, 1995). Natural causes of mortality are difficult to assess in most wild turtle populations. Aquatic and semiaquatic turtles are especially difficult to study in this regard because they are rarely found freshly dead for necropsy. The bog turtle (*Glyptemys muhlenbergii*), a small freshwater turtle found in sphagnum

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bogs and marshy meadows in the eastern United States, is difficult to study naturally because of its secretive habits. Its range is discontinuous, with disjunct northern and southern populations (Conant and Collins, 1998). Existing populations in the southern portion of its range are believed to be in peril because of habitat loss and collection for the pet trade (Tryon and Herman, 1990; Mitchell et al., 1991; Mitchell, 1994). Northern populations of this species are listed as threatened under the U.S. Endangered Species Act, and southern populations are listed as threatened by similarity of appearance (U.S. Fish and Wildlife Service, 1997). All southern states within the range of this species list it as endangered or threatened (Levell, 1997). Two cases of natural death attributable to disease in this rare species were noted in 1982 and 1995.

*Case 1.*—L. Luckett and D.W. Herman observed a freshly dead adult male bog turtle (carapace length 101.9 mm, plastron length 81.6 mm) on 28 May 1982 in Macon County, North Carolina at 1215 EDT. This turtle was found in an alder (*Alnus serrulata*) thicket on a sphagnum moss mound presumably basking. Ambient temperature was 26°C. The turtle's eyes were open and clear, and his legs were pliable. No apparent injuries or trauma were evident, although two small leeches were observed attached to the left rear leg in the inguinal region. The turtle was wrapped in damp paper towels in a plastic bag and placed in a cooler on ice.

A necropsy was performed at the Atlanta Zoological Park (Zoo Atlanta) by Dr. M. Silberman upon arrival on 29 May 1982. Formalin-fixed tissues were sent to the University of Georgia, College of Veterinary Medicine, for analysis there. Dr. P. Long examined the tissue samples histologically. The primary diagnosis was chronic granulomatous bacterial pneumonia because of the presence of large numbers of gram-negative bacterial aggregates in the lungs.

*Case 2.*—A gravid, adult female bog turtle (carapace length 84.8 mm, plastron length 62.4 mm, body mass 110 g) was found freshly dead on 29 May 1995 in Floyd, County, Virginia, by B.D. Horne. The turtle was found at 1330 EST in full sun on a bank of sphagnum moss; shell dry and all limbs and neck extended. Ambient temperature was 28°C. Limbs were pliable and eyes were open and glazed. No external signs of trauma were apparent. The collected turtle was refrigerated four hours later and sent the next day wrapped in paper towels on dry ice to Dr. D.K. Nichols (ZooPath Institute) in Purcellville, Virginia, for necropsy.

External examination revealed that the skin, shell, musculoskeletal system, and body orifices appeared healthy, as evidenced by adequate amounts of coelomic fat stores. Each of the oviducts measured approximately 120 mm in total length. Two shelled eggs were dissected from the left oviduct (27.5 and 30 mm total length) and one from the right oviduct (30 mm). The lungs were congested and contained small amounts of caseous yellow-white material within the mesobronchial lumen. The stomach contained a small amount of brown-black fibrillar to chitinous material and the entire intestinal tract was empty except for a small amount of greenish-brown mucoid material. The gall bladder was distended with bile. Samples from major organs (except the brain, spinal cord, and eyes) were fixed in 10% buffered formalin and processed routinely for histopathologic examination.

Microscopic examination of the lungs revealed multifocal interstitial infiltrates of heterophils and macrophages with fewer lymphocytes and plasma cells. Several of the airways contained large aggregates of degenerate inflammatory cells and necrotic debris with scattered colonies of coccobacillary bacteria. The kidney had tubules containing mineralized concretions and the liver was congested. Other organs were unaffected.

Primary diagnosis was moderate multifocal, subacute broncho-interstitial pneumonia. Although the exact cause of death could not be determined, the pneumonia was a significant lesion and was probably severe enough to be fatal. Although no cultures were performed, the bacteria responsible for the pulmonary infection were likely a gram-negative organism such as *Pseudomonas* sp. or *Aeromonas* sp. The empty intestinal tract and large gall bladder indicated that the animal had not eaten recently before death. The pneumonia may have caused the turtle to stop eating, although female turtles frequently become anorexic around the time of oviposition (Fowler, 1980).

## DISCUSSION

Significance of these case reports is threefold. First, these are the first reported cases of death due to pneumonia in natural populations of bog turtles in the southern portion of their range. Second, the bog turtle is a secretive species, making basic life-history data, such as fecundity and mortality, difficult to collect. Elucidation of causes of mortality in wild populations of endangered bog turtles is needed if proper management and protection can proceed. Although habitat loss and collection of wild animals for the pet trade have been implicated in bog turtle declines (Ernst et al., 1994; Mitchell, 1994; Mitchell et al., 1991), further study is needed to address the importance of all threats, including disease, in declining populations. Disease transmission could potentially have measurable effects on mortality and fecundity rates, yet little is known of their role in wildlife population dynamics (Jacobson, 1997; Jacobson et al., 1995; Flanagan, 2000).

Thirdly, our specimens may implicate an important role of infectious disease in the mortality of wild bog turtles. Bacterial infections commonly lead to death in captive turtles (Keymer, 1978; Cooper et al., 1985; Crawshaw, 2000), yet much less is known about infectious diseases in wild populations. Dodd (1988) documented a decline in the federally threatened flattened musk turtle (*Sternotherus depressus*) to which he attributed an undiagnosed disease. Basking, which was previously undescribed in *S. depressus*, was associated with the diseased turtles. Warwick (1991) also suggested that sick ectotherms raise their body temperatures to expedite healing and fight off further infection. Supporting evidence for turtles has been documented in *Terrapene carolina* and *Chrysemys picta* (Monagas and Gatten, 1983). Both of the bog turtles we describe were apparently basking prior to death to raise their body temperatures. Although basking is not an abnormal behavior in this species, these small turtles are seldom found completely exposed to full sunlight. All researchers studying bog turtles should consider basking individuals as suspect and evaluate each one closely for evidence of sickness. All turtles found dead should be collected immediately and necropsied by a qualified veterinarian. Diseased specimens of *G. muhlenbergii*, once necropsied, should be deposited in museums for use in investigations of regional patterns of emerging wildlife pathogens.

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