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Aspiration pneumonia in an American black bear

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Abstract: Information regarding American black bear (*Ursus americanus*) mortality caused by disease is limited. Pneumonia is a common respiratory disease that affects many species of wildlife and can result in death. In February 2011, we investigated the death of a yearling male black bear and determined cause of death to be aspiration pneumonia. We found sections of lung were diffusely congested and edematous. A bacterial culture of lung tissue revealed numerous colonies of *Klebsiella* spp., *Alcaligenes faecalis*, *Aeromonas* spp., *Corynebacterium* spp., and *Streptococcus* spp. The mixed bacterial colonization of the lungs associated with minimal inflammation is consistent with terminal aspiration of gastrointestinal contents resulting in aspiration pneumonia. Documentation of aspiration pneumonia in black bears can be useful for future researchers interested in the effects of disease on bears.

Key words: American black bear, aspiration, disease, Michigan, pneumonia, *Ursus americanus*
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Wildlife diseases are part of a broad range of issues facing wildlife managers and are increasingly important in wildlife conservation (Roffe and Work 2005). Wildlife disease can result in mortality in populations (Young 1994); yet disease-induced mortality is often ignored or dismissed by wildlife

biologists (Bolen and Robinson 2003). American black bear (*Ursus americanus*) mortality caused by disease is not well documented (LeCount 1987). Black bears have tested positive for many diseases including brucellosis, toxoplasmosis, tularemia, leptospirosis, trichinosis, encephalitis, and Rocky Mountain spotted fever (Binninger et al. 1980, Dunbar et al. 1998). Although many diseases have been reported that can lead to death, none have appeared to contribute greatly to regulation of black bear populations (Pelton 2003).

Pneumonia is a well documented respiratory disease occurring in numerous wildlife species including bighorn sheep (*Ovis canadensis*; Wehausen et al. 2011), mountain gazelle (*Gazella gazella*; Berkowitz et al. 2010), short-tailed weasel (*Mustela erminea*; McDonald et al. 2008), and African lion (*Panthera leo*; Tefera 2003) that can lead to death. In some species, pneumonia has resulted in high mortality (Kreeger 2000) and occasionally complete loss of herds (e.g., bighorn sheep; Foreyt and Jessup 1982). Researchers have also documented pneumonia in grizzly bear (*Ursus arctos*; Cluff 2005), spectacled bear (*Tremarctos ornatus*; van der Hage and Dorresteijn 1994), and sun bear (*Helarctos malayanus*; van der Hage and Dorresteijn 1994); however, published reports of pneumonia in black bears appear to be lacking.

We describe a case of aspiration pneumonia in a yearling male black bear in Menominee County, Upper Peninsula of Michigan, USA (45°34'14"N, 87°20'47"W). This observation was part of a larger study examining multi-scale resource selection by carnivores and white-tailed deer (*Odocoileus virginianus*). Major land-cover types within the study area include upland hardwoods, lowland hardwoods, lowland conifer swamps, upland conifers, aspen (*Populus* spp.) stands, agriculture, wetlands, and occasional patches of berry-producing shrubs (e.g., raspberries [*Rubus* spp.], and blueberries [*Vaccinium* spp.]).

Black bears were captured using barrel traps (Kohn 1982) or foot snares (Johnson and Pelton 1980) during May–July 2009–11 and also restrained in dens the following winter. On 9 August 2009, we captured, immobilized with Telazol (7.0 mg/kg; Fort Dodge Animal Health, Fort Dodge, Iowa, USA), and radiocollared an adult female black bear. Following immobilization, we located the bear weekly until she entered her den. On 24 February 2010, we immobilized this bear in the den and

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weighed and measured her as well as her 3 cubs-of-the-year (2 females, 1 male). All bears appeared healthy and in good physical condition. On 10 February 2011 we again visited her den, and immobilized, weighed, and measured her as well as her 2 female yearlings. Following immobilization, we returned all 3 bears to the den without incident. We then located the carcass of the male yearling within 0.5 m of the den, covered beneath 3.5 cm of snow and under branches of a fallen eastern hemlock (*Tsuga canadensis*). The carcass was in good physical condition and did not exhibit signs of decomposition. We did, however, note a puncture wound (5.5 x 3.0 cm) on the dorsal side of the right manus in the mid-length area of the third and fourth metacarpal with a 12.0 x 5.0 mm depressed area adjacent to the puncture wound. No other injuries were observed. We collected the carcass and submitted it to the Michigan Department of Natural Resources Wildlife Disease Lab for postmortem examinations. Additional examinations were conducted by Michigan State University's Diagnostic Center for Population and Animal Health.

During the laboratory examination, we placed samples of lungs, heart, liver, kidney, and spleen in 10% buffered formalin. We sectioned samples at 5 microns and stained them with hematoxylin and eosin (Carson 1997). All sections were reviewed for anomalies by a board certified (American College of Veterinary Pathologists) veterinary pathologist. We also prepared fresh lung samples for aerobic bacterial culture by streaking sterile lung samples onto blood agar plates and incubated plates at 37°C in a 5% CO₂ incubator.

From gross examination, we determined the bear was in good physical condition based on abundant fat deposits. We observed no subcutaneous hemorrhaging at the puncture wound first observed at the den or the depressed area on the manus, suggesting injuries occurred post mortem. We noticed congestion in both lungs, especially the right lung that was dark maroon in color. The liver and spleen were normal but the gall bladder was enlarged with bile. The stomach contained a small amount of opaque liquid, brown to maroon in color, and the intestinal tract had a small amount of dark green and tan mucoid material present.

During microscopic examination, we found sections of lung were diffusely congested and edematous. Multiple airways contained numerous mixed colonies of small bacilli, large bacilli, and cocci (e.g.,

Klebsiella spp., *Alcaligenes faecalis*, *Aeromonas* spp., *Corynebacterium* spp., *Streptococcus* spp.; Fig. 1), which extended into adjacent alveoli and were associated with fibrin and low numbers of mixed inflammatory cells. We noticed sections of both kidneys contained low numbers of tubules, which contained yellow birefringent crystals that were rectangular in shape and were arranged radially; this presentation was consistent with these crystals being calcium oxalate crystals. Consequently, we evaluated a kidney for calcium concentrations using inductively-coupled argon plasma emission spectroscopy (Stowe et al. 1986) and found slightly elevated levels (147 ppm; Puls 1994). Sections of the heart, liver, and spleen were morphologically normal.

We suspect the yearling male bear died in the den and was removed by the adult female, which grasped the yearling with her teeth, inflicting the puncture wound and depression on the yearling's manus. Based on gross and microscopic examinations, we concluded this yearling male black bear died from aspiration pneumonia. Aspiration pneumonia is a pulmonary infection characterized by inflammation of the lungs and airways to the lungs typically caused by inhalation of a foreign material (e.g., gastrointestinal contents), and is often characterized by presence of bacteria (Marik 2001). The genera of bacteria we observed in lung cultures also supported aspiration pneumonia. *Klebsiella* spp. are gram negative bacterium commonly found within the pharynx and, similar to *Alcaligenes faecalis*, are common inhabitants of gastrointestinal tracts (Podschun and Ullmann 1998). *Aeromonas* spp. are gram negative, facultative anaerobic rods typically found in water and known to cause enteritis (Merino et al. 1995). *Corynebacterium* spp. and *Streptococcus* spp. are ubiquitous bacteria present on skin, upper gastrointestinal tract, and the environment (Getting et al. 1944, Burkovski 2008). Such a diverse isolation of gram positive and negative bacteria, none considered primary pathogens, is typical for the mixed infections encountered following aspiration of gastrointestinal contents (Caswell and Williams 2007). Foster (1999) identified inhalation of gastrointestinal contents to be a possible cause of aspiration pneumonia in goitered gazelles (*Gazella subgutturosa*) and Arabian mountain gazelles (*Gazella gazella*). The mixed bacterial colonization of the lungs associated with minimal inflammation as we observed is consistent with terminal aspiration of gastrointestinal contents leading to aspiration pneumonia (Caswell and Williams 2007).

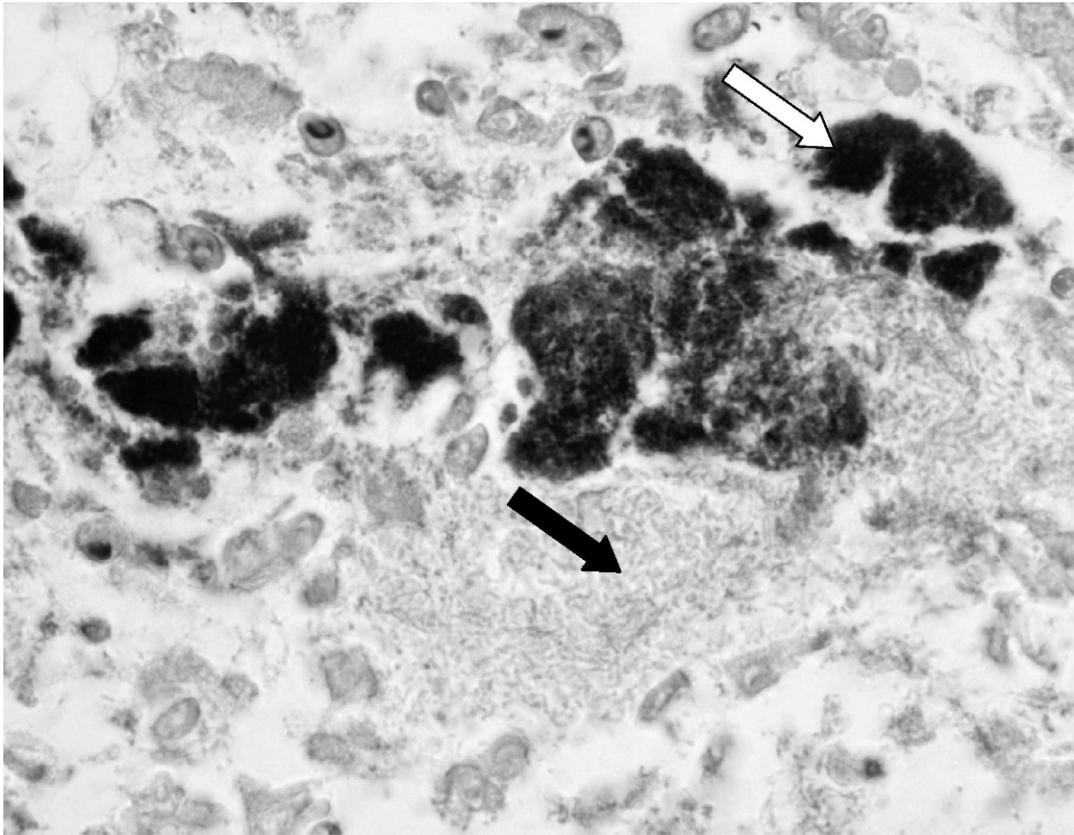


Fig. 1. Gram stained section of lung from a black bear (x100), from the Upper Peninsula of Michigan, Feb 2011. Gram-positive cocci and Clostridial rods (white arrow) were identified in the lungs as were gram-negative enteric bacilli (black arrow).

Other studies of aspiration pneumonia in wildlife have also reported lung congestion and presence of cocci (Cork et al. 1999, McDonald et al. 2008).

The scattered calcium oxalate crystals present in the kidney were not associated with tubular necrosis and thus were unlikely to cause death. The slight elevation in calcium also suggests calcium oxalate poisoning was unlikely (Zarembski and Hodgkinson 1967). Presence of calcium oxalate may have been from consumption of Jack-in-the-pulpit (*Arisaema triphyllum* [Family Araceae]). Jack-in-the-pulpit contains calcium oxalate crystals (Bierzychudek 1984), occurs in our study area, and is consumed by black bears during spring and summer (Kasbohm et al. 1995).

Although disease-induced mortality in black bears is poorly understood (LeCount 1987) and diagnosis of mortality can be problematic (Pelton 2003), pneumonia is a well documented disease in many

species and should be considered when diagnosing mortality in black bears. Pneumonia-induced mortality has had deleterious effects on various wildlife species including Canada lynx (*Lynx canadensis*; Wild 2006), northern fur seal (*Callorhinus ursinus*; Calambokidia 1985), and bighorn sheep (Foreyt and Jessup 1982). However, lack of previous documentation of pneumonia in black bears suggests the overall effects of pneumonia on black bear populations may be negligible.

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