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Case Report—

Erysipelas in a Free-ranging Hawaiian Crow (*Corvus hawaiiensis*)

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SUMMARY. We describe a case of erysipelas in a free-ranging endangered Hawaiian crow. The partially scavenged carcass exhibited gross emaciation and petechial hemorrhages in both lungs. Microscopy revealed multiple necrotic foci associated with gram-positive rods in the liver and adrenal, diffuse acute proximal tubular necrosis of kidney, diffuse necrosis and inflammation of proventricular mucosa associated with gram-positive rods, and multiple intravascular aggregates of gram-positive rods associated with thrombi. Culture of the kidney revealed the bacterium to be *Erysipelothrix rhusiopathiae*. The implications of this finding to free-ranging crows remain unclear.

RESUMEN. *Reporte de Caso*—Erisipelas en ciervos Hawaianos silvestres (*Corvus hawaiiensis*).

Se describe un caso de erisipelas en ciervos Hawaianos silvestres en peligro de extinción. Los cadáveres parcialmente consumidos por aves de rapiña mostraron emaciación y hemorragias petequiales en ambos pulmones. El examen microscópico reveló múltiples focos necróticos asociados con bacilos gram positivos en el hígado y glándulas adrenales, necrosis tubular proximal difusa en el riñón e inflamación de la mucosa del proventrículo asociada con bacilos gram positivos y agregados intravasculares múltiples de bacilos gram positivos asociados con trombos. El cultivo de los riñones reveló que la identidad de la bacteria era *Erysipelothrix rhusiopathiae*. Las implicaciones de estos hallazgos en ciervos Hawaianos silvestres no son muy claras todavía.

Key words: Hawaiian crow, *Corvus hawaiiensis*, *Erysipelothrix*, pathology

The 'alala, or Hawaiian crow (*Corvus hawaiiensis*), is one of the most endangered species of birds, with less than 40 birds existing in the wild or in captivity (14). Free-ranging 'alala are presently found only on the island of Hawaii. Speculation as to causes of their decline includes disease (15), lowered genetic diversity, introduced predators, and habitat loss (3,9). Currently, McCandless Ranch, a private holding, is home for the only remaining population of 'alala on the island (9).

Diseases known to cause morbidity in wild 'alala include avian pox, avian malaria (*Plasmodium relictum*), and northern fowl mites (7).

Other than these reports, information on causes of mortality of 'alala is limited because of the scarcity of suitable specimens for postmortem examination. When found, remains of crows are usually either too decomposed or have insufficient tissues to determine cause of death. In some cases, we have observed evidence from skeletons of crows scavenged and possibly preyed upon by raptors (T. M. Work, unpublished data), but we have not been able to diagnose possible antemortem diseases from these cases. Recent efforts to track crows by radiotelemetry have allowed for more rapid recovery of dead individuals in suitable postmortem con-

dition. This paper describes a case of erysipelas in a free-ranging 'alala.

CASE REPORT

History. A young female 'alala was reared from a captive flock in 1996, and a radiotracer was affixed to the bird prior to release in January 1997. The animal appeared normal until 27 October 1997, when its remains were found in the Honokua region of South Kona on the island of Hawaii at 2051 m elevation. The carcass was found in a shallow burrow formed from the root system of a koa (*Acacia koa*) tree. The remains were sealed in a plastic bag and chilled for 24 hr prior to examination.

Evaluation of the carcass entailed a complete external and internal examination. Portions of brain, skeletal muscle, kidney, liver, and lung were individually sealed in plastic bags and stored at -70°C . Selected tissues were fixed in 10% buffered formalin for 48 hr, embedded in paraffin, sectioned at $5\ \mu\text{m}$, and stained with hematoxylin and eosin according to standard methods. We used Grocott's silver, Gram's stain, and iron ferric hemosiderin to detect tissue-associated fungi, bacteria, and iron, respectively (11). To rule out exposure to organophosphate and carbamate pesticides, brain was analyzed for cholinesterase activity (5). Liver was analyzed for lead (10) with detection limits of $0.25\ \mu\text{g/g}$ wet weight. Sections of kidney were thawed and cultured on 5% sheep blood agar and eosin methylene blue agar (Remel, Lenexa, KS) and incubated at 37°C for 18–24 hr. Bacterial cultures were screened and subcultured for identification. Gram-negative bacilli were identified with API-20E (bioMerieux, St. Louis, MO). Gram-positive organisms were further screened with bile esculin agar (Remel), triple sugar iron agar, and NaCl broth. Cultures were identified with API-Coryne (bioMerieux).

Gross pathology. The carcass was partially scavenged and was missing the following tissues: skin and cervical muscle on the left side, portions of the right biceps femoris and semimembranosus, right pectoralis, left masseter, portions of the esophagus, ventral right lung, cranial right rib cage, and entire heart. Both eyes were intact but sunken, and plumage was unremarkable.

Significant gross findings included moderate atrophy of the left pectoralis and absence of

abdominal and subcutaneous fat. The caudal left lung had diffuse red mottling and scattered fly eggs on the surface; the right lung was diffusely red.

Histopathology. Microscopy revealed moderate diffuse pulmonary congestion, hepatocellular atrophy and hemosiderosis, and severe splenic lymphoid depletion. Clumps of gram-positive rods, occasionally associated with thrombi, were seen in capillaries of kidney, liver, adrenal, spleen, and skeletal muscle. Multiple foci of necrosis with little or no inflammation were associated with gram-positive rods in the adrenal and spleen. Marked diffuse acute necrosis of proximal tubular cells was noted in the kidneys. The proventricular mucosa and portions of the underlying muscularis were diffusely necrotic with aggregates of very small gram-positive rods and scattered large septated fungal hyphae. On silver stain, fungi appeared limited to necrotic tissue debris and did not invade underlying muscularis. We did not identify the fungus. The proventricular necrosis was accompanied by a marked mononuclear infiltrate that appeared to accompany bacteria into the muscularis. Small clumps of haphazardly arranged larger gram-positive and gram-negative bacteria ranging in length from 2 to $12\ \mu\text{m}$ and not associated with necrosis were seen in some proventricular glands. A metazoan characterized by an exoskeleton and segmented appendages and identified as a mite was embedded within the muscularis. There was no inflammatory response. Rare fragments of cuticle from similar mites were also noted throughout necrotic mucosa and embedded within muscularis with no inflammatory response. No suitable mite specimen was available for identification.

Microbiology and toxicology. Liver lead concentration was below the detectable limit. Brain cholinesterase was $13.1 (2) \pm 0.1\ \mu\text{mole/min/g}$ of tissue and $15 (2) \pm 0\ \mu\text{mole/min/g}$ of tissue after 18 hr. Culture of the kidney revealed isolates of *Erysipelothrix rhusiopathiae*, *Proteus* sp., *Streptococcus* sp., *Morganella* sp., and *Enterococcus* sp.

DISCUSSION

Gross lesion of erysipelas in birds can range from inapparent to generalized petechiation in multiple organs and fibrinopurulent exudate on organ surfaces and joints (1). Microscopic evi-

dence of intravascular bacteria accompanied by thrombi with little to no associated inflammation, as seen in this crow, is common in other birds; damage to other organs, including the kidney, is also common (1,12). Jensen and Cotter (8) noted that, grossly, eared grebes affected with erysipelas were in good condition with petechiae in subcutaneous and pericardial fat, something not seen in this crow.

On the basis of the severity of the proventricular lesion, we believe that the 'alala in this case acquired the infection through the gastrointestinal tract. The fungus in the proventricular mucosa was limited to necrotic tissue, suggesting a saprophyte and not a primary invader. Larger gram-positive bacteria in the proventriculus were suggestive of megabacteria (6); however, their small size, co-occurrence with various gram-negative flora, small numbers, and haphazard arrangement argued against this as a primary cause of the proventricular lesion. Burrowing mites were occasionally seen in the proventriculus, but the lack of associated bacteria and inflammation suggested these mites were incidental to cause of death and not predisposing to bacterial invasion. We suspect that the acute renal necrosis could have resulted from a combination of dehydration (poor body condition) and bacterial toxemia (13). Lack of evidence of lead poisoning argued against this contaminant as a potential cause of emaciation as seen in waterfowl (2). Although normal brain cholinesterase levels for 'alala are not available, brain cholinesterase levels in this carcass were within limits reported for normal American crows (4). Because of the postmortem condition of the carcass, we suspect that the other bacteria isolated from the kidney were secondary contaminants.

The finding of *E. rhusiopathiae* as a cause of mortality in 'alala was somewhat surprising. 'Alala commonly eat fruit and carrion (9) and presumably would be commonly exposed to this organism, which can survive several days in soil or decomposing tissue (1). Birds may acquire erysipelas through ingestion or breaks in the skin and appear to be more susceptible during climatic extremes or when food is limiting (1,8). The relatively young age of this bird and the stresses associated with adapting to a free-ranging lifestyle probably played a role in increased susceptibility to infection. The animal was in poor body condition, which may have

led to loss of mucosal immunity and invasion by bacteria, saprophytic fungi, and other metazoa. Because erysipelas generally affects birds acutely (1) and because of the acute nature of the lesions, it is unlikely that the bacterial infection caused emaciation.

The importance of erysipelas to survival of 'alala populations is unknown; however, the bacterium has been incriminated in die-offs of other species of wild birds (8). Little is known about erysipelas in Hawaii or in crows. One of us (T.M.W.) has diagnosed the organism as a cause of mortality in various seabirds including dark-rumped petrels and wedge-tailed shearwaters. This report adds another pathogen to the list of diseases threatening wild 'alala. We encourage continued vigilance and sustained efforts to objectively document causes of crow morbidity and mortality and impacts of disease on populations.

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