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Mortality Investigation of a Free-ranging Baird's Tapir (*Tapirus bairdii*) in a Fragmented Landscape in Northern Costa Rica

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ABSTRACT: In Costa Rica, human–tapir conflicts are increasing, including disease transmission, as Baird's tapirs (*Tapirus bairdii*) move into human-altered landscapes. We investigated the death of a wild male tapir, identifying a systemic *Actinomyces israelii* infection. The potential of this pathogen being an emerging health threat for tapir conservation warrants further study.

The endangered Baird's tapir (*Tapirus bairdii*) is the largest terrestrial mammal in Mesoamerica and plays a key role in seed dispersal. Fewer than 5,000 individuals remain across its range (Mexico–Colombia), mainly because of habitat fragmentation and poaching (Schank et al. 2020).

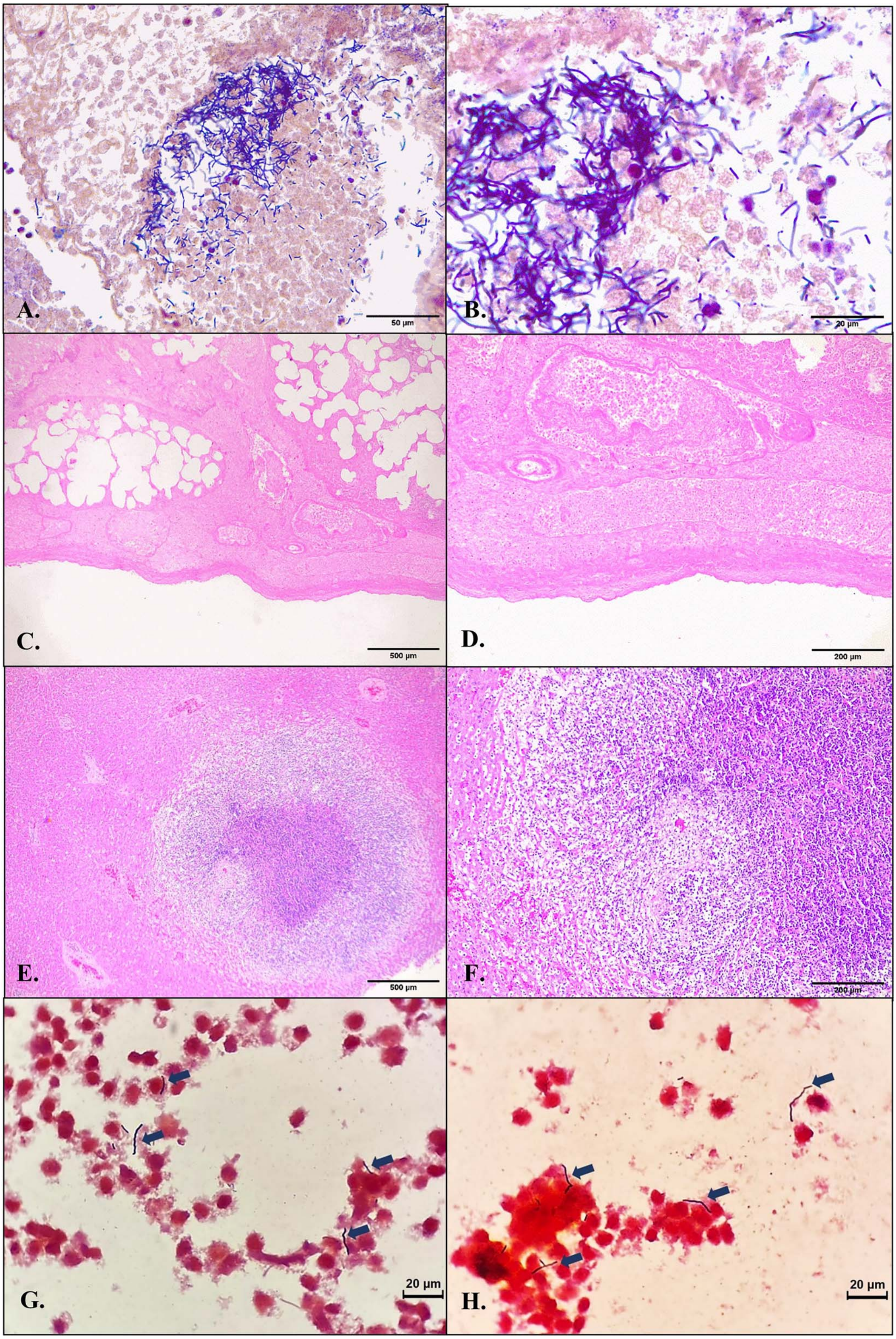
In Costa Rica, tapirs are generally found inside protected areas but have recently been observed wandering in human-dominated landscapes (Schank et al. 2020). Here, tapirs face increased conflict with humans through crop-raiding retaliation, vehicle collisions, and disease transmission from livestock (Gortazar et al. 2015; Rojas-Jiménez 2024). Despite these growing risks, health has not been a major conservation focus, with limited research or surveillance. Most available health data on wild tapirs comes from individuals within protected areas, leaving significant gaps in knowledge (Hernandez-Divers et al. 2005; Arguedas et al. 2019; Rojas-Jiménez et al. 2019).

A free-ranging adult male Baird's tapir was found cachectic, lethargic, disoriented, and with several deep lacerations in Sarapiquí, Heredia, on 21 June 2022. National System of Conservation Areas (SINAC) park rangers and farmers transported the individual to a barn; however, it died overnight. The carcass was transported to a field station, where a complete necropsy was performed following biosecurity protocols.

Grossly, the tapir was in poor body condition with multiple skin lesions, including erosions, ulcers, abscesses, and deep lacerations on the neck, axilla, thorax, flank, and caudal dorsum (Fig. 1A, B). Other lesions included a diffusely reddened tracheal mucosa; approximately 3 L of yellow–green purulent thoracic fluid; diffusely dark, consolidated, friable lungs (Fig. 1C); and multifocal darkened areas in the gastric and intestinal mucosa. The liver had many disseminated, 2-mm, yellowish-white nodules (Fig. 1D), and the spleen was enlarged. Samples of skin, trachea, lung, liver, spleen, kidney, stomach, and small and large intestine were fixed in 10% formalin and submitted for histopathology. These samples were processed routinely to produce 4-µm-thick H&E and Gram-stained sections.

Histopathologically, the thoracic skin showed an ulcer extending from the epidermis to the deep dermis, associated with many bacterial colonies, neutrophils, plasma cells, and multiple areas of dystrophic mineralization. The superficial dermis had a lymphocytic infiltrate, with mild pigmentation and areas of ballooning degeneration. Adjacent to the ulcer, the epithelial cells of the epidermis showed areas of ballooning degeneration. In the trachea, lymphocytes, plasma cells, and neutrophils diffusely infiltrated the lamina propria. The lung contained a large number of neutrophils, fibrin, and macrophages within the alveoli, bronchioles, and bronchi. In other sections, alveoli contained amorphous, acidophilic material (edema) with areas of emphysema. Extensive, diffuse areas of necrosis with a large amount of fibrin and neutrophils affected mainly the pleura. Associated with the pulmonary inflammatory reaction were abundant branching

FIGURE 1. Gross examination of a free-ranging adult male Baird's tapir (*Tapirus bairdii*) found by National System of Conservation Areas (SINAC) park rangers on 21 June 2022 at Sarapiqui, Heredia, Costa Rica. (A) The tapir was in poor body condition, with severe dermatological lesions, including erosions, ulcers, deep lacerations, punctures, and small abscesses. These injuries (white arrows) were consistent with those caused by a large predator, possibly a jaguar, at the left axilla (B) and left thoracic region. (C) The field necropsy allowed gross examination of the main organs and cavities, revealing severe pyothorax (white arrow) with approximately 3 L of purulent discharge, and the lungs markedly consolidated and friable, with loss of normal lobular architecture. (D) In the liver are multifocal nodules (white arrow) in the parenchyma with a normal hepatic architecture. Images Jorge Rojas-Jiménez, TapirVet Project.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filamentous Gram-positive bacteria seen mainly in bronchioles and alveoli (Fig. 2A, B). Some pulmonary blood vessels contained fibrin thromb, and the lymphatics were dilated. The duodenal mucosa exhibited moderate lymphoplasmacytic enteritis associated with intramucosal nematode-compatible structures. The liver showed multifocal randomly distributed liquefactive necrosis, with severe neutrophilic infiltration and abundant bacteria within granulation tissue. The hepatic triads exhibited moderate fibrosis and lymphoplasmacytic infiltrates (Fig. 2C). The spleen showed white pulp follicular hyperplasia with apoptotic bodies, moderate lympho- and neutrophilic inflammatory infiltrates, and hemosiderin-laden macrophages in the red pulp. The renal medulla exhibited mild interstitial fibrosis and tubular mineralization. Findings were consistent with septicemia.

We submitted purulent thoracic discharge for bacteriological analysis. Samples were cultured on Columbia blood agar with 5% sheep blood and incubated at 37 C for 3 d in aerobic (5% CO_2), and anaerobic conditions using the Anoxomat system (Anoxomat Anaerobic Jar System, Norwood, Massachusetts, USA). Colonies were Gram-stained and subcultured for identification. Biochemical testing was performed using the VITEK 2 System with the ANC ID card following the manufacturer's recommendations (bioMérieux, Campus de l'Etoile, France). Culture yielded growth of smooth, nonhemolytic colonies (1–2 mm diameter) after 48 h incubation. Microscopy revealed Gram-positive, pleomorphic, branching rods consistent with *Actinomyces* spp. (Fig. 2D). The VITEK 2 identification confirmed the isolate as *Actinomyces israelii*.

Actinobacteria are long, filamentous, Gram-positive, anaerobic or facultative bacteria, commonly found as commensals on the skin, oral mucosa, and nasopharynx. This class includes several veterinary pathogens, such as *Actinomyces viscosus* in dogs, *Actinomyces bovis* in cattle, and *Actinobaculum suis* in pigs (Markey et al. 2013; Mauldin and Peters-Kennedy 2016). In horses, closely related to tapirs, actinomycosis results from opportunistic infections following skin or mucosal trauma and is associated with mandibular lymphadenitis, abscesses, fistulous withers, and poll-evil (Mauldin and Peters-Kennedy 2016). In free-ranging animals, pathogens such as *A. bovis* and *Trueperella pyogenes* cause pyogranulomatous inflammations such as "lumpy jaw" or suppurative lesions in the lung, udder, or uterus (Mauldin and Peters-Kennedy 2016). Actinomycosis typically presents as abscesses, ulcerated nodules, and draining tracts with fibrous masses, often on the head, neck, or limbs. We hypothesized that *A. israelii* entered through damaged esophageal mucosa and spread hematogenously, causing pyothorax, fibrino-suppurative and necrotizing pleuropneumonia, and necrosuppurative hepatitis. However, skin invasion as a primary entry point with subsequent dissemination cannot be excluded. *Actinomyces israelii* has not been reported to infect wild or domestic animals (Mauldin and Peters-Kennedy 2016). Experimental infections have been conducted in mice (Behbehani et al. 1983; Sumita et al. 1998). Its pathogenicity stems from cohesive colonies of branching filaments embedded in an extracellular matrix, helping evade phagocytosis (Figdor et al. 1992). This is the first report of *A. israelii* infection in a wild animal in Costa Rica. Differential diagnoses include *Nocardia* spp. and *Bacteroides* spp., which cause similar lesions via inhalation or ingestion of plant fibers. *Mycobacterium* sp.

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FIGURE 2. Review of histopathological findings of a free-ranging adult male Baird's tapir (*Tapirus bairdii*) found by National System of Conservation Areas (SINAC) park rangers on 21 June 2022 at Sarapiqui, Heredia, Costa Rica. (A) Lung, histopathology: branching filamentous Gram-positive bacteria morphologically compatible with *Actinomyces* spp. in a zone of necrotic debris. Gram stain. 1000×. (B) Lung, histopathology: Severe necrosuppurative and fibrinous pleuropneumonia with intralesional bacteria. See the emphysema and subpleural lymphangiectasia. H&E. 100×. (C) Liver, histopathology: Severe necrosuppurative hepatitis. H&E. 1000×. (D) Cytologic examination of purulent exudate: Branching filamentous Gram-positive bacteria (black arrows) morphologically compatible with *Actinomyces* spp. from the tapir pyothorax sample. Gram stain. 1000×. Images courtesy of and copyright LAPAVET Pathology Laboratory at the School of Veterinary Medicine San Francisco de Asís, Coronado, San José, Costa Rica; Bacteriology Laboratory of the National University (UNA), Heredia, Costa Rica.

infection was also considered, but lesions were suppurative, not granulomatous. Based on lesion morphology and local reports, skin injuries were probably <1 wk old, and they were consistent with those caused by a large predator, possibly a jaguar (*Panthera onca*; Pérez-Flores et al. 2020, 2022). Jaguars are known to inhabit a nearby reserve, and jaguar livestock predation has been reported in the region (SINAC pers. comm.). None of the injuries had penetrated the thoracic cavity. Necropsy and histopathology results suggested that the tapir was already ill before the attack. Although jaguars are known to prey on juvenile tapirs, reports of predation on adults are rare (Pérez-Flores et al. 2020). This case probably involved an opportunistic attack on this weakened, chronically infected individual that was nevertheless able to escape (Pérez-Flores et al. 2022).

In humans, *A. israelii* causes actinomycosis following dental disease or poor hygiene. Its occurrence in tapirs or other wildlife remains unclear (Valour et al. 2014). This case highlights the importance of health monitoring in free-living tapirs, especially as human–tapir interactions increase, and the value of collaborative efforts among nongovernmental organizations, universities, communities, and authorities. Comprehensive mortality investigations are essential for understanding threats and improving conservation strategies for endangered species at the human–wildlife interface.

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