

Unraveling Parasitic Diseases in Domestic Animals Through Differential Diagnosis

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Introduction

The Silent Threat to Domestic Animals

Domestic animals, from dogs and cats to livestock like cattle, sheep, goats, pigs, and horses, are integral to human life, providing companionship, food, and labour. Yet, these animals are under constant threat from parasitic diseases, silent organisms that infiltrate their systems, weakening health, reducing productivity, and sometimes posing risks to humans through zoonotic transmission. Parasites, ranging from microscopic protozoa to wriggling worms and blood-feeding arthropods, trigger symptoms that often mimic other ailments, making differential diagnosis a critical tool. The differential diagnosis is a careful process used by veterinarians to tell one disease apart from others that have similar signs.

Misdiagnosis can lead to ineffective treatments, prolonged suffering, and significant economic losses, millions or even billions spent on vet care, loss of milk, or meat that can't be sold. For example, a dog coughing might actually have heartworms, not a lung infection. Or a sheep with diarrhoea might have coccidiosis instead of a bacterial problem.

Parasites thrive in diverse environments: protozoa like *Giardia duodenalis* in contaminated water, helminths like *Ancylostoma caninum* in soil, and ectoparasites like *Ixodes* ticks in pastures. Transmission varies, faecal-oral for gut parasites, vector-borne for blood parasites like *Babesia canis*. Symptoms often overlap: diarrhoea from *Giardia* or hookworms, anemia from *Babesia*. Factors like age, breed, and immunity influence severity, with puppies

and lambs particularly vulnerable. Climate change expands vector ranges, increasing risks.

Parasitic Diseases in Companion Animals: Protecting Dogs and Cats

Dogs and cats, beloved as cherished companions, are susceptible to a range of parasitic infections due to their natural exploratory behaviors, such as sniffing, licking, or hunting. These activities expose them to parasites that can reside in soil, water, or prey, leading to infections that compromise their health. Beyond the impact on the animals themselves, many of these parasites pose zoonotic risks, meaning they can be transmitted to humans, particularly in households with young children or immunocompromised individuals. Effective differential diagnosis is critical to accurately identify the specific parasite involved, enabling targeted treatment to protect both the pet and its human family. Veterinary professionals rely on a combination of clinical signs, diagnostic tests, and epidemiological knowledge to distinguish parasitic infections from other diseases with similar symptoms, ensuring the well-being of both animals and their owners.

Gastrointestinal Parasites: The Hidden Gut Invaders

The digestive tract of dogs and cats is a common target for a variety of worms and protozoa, which can cause symptoms ranging from mild discomfort to severe, life-threatening conditions. These parasites often lead to symptoms such as diarrhoea, vomiting, and malnutrition, significantly affecting the animal's health and quality of life.

Roundworms: Specifically, *Toxocara canis* in dogs and *Toxocara cati* in cats, are among the most

prevalent gastrointestinal parasites in companion animals. These worms shed eggs in the host's faeces, which contaminate soil and persist in the environment. Puppies can acquire *T. canis* prenatally or through their mother's milk, often resulting in heavy infections, while kittens contract *T. cati* via milk or by consuming infected prey. Adult animals typically become infected by ingesting eggs or larvae from paratenic hosts, such as rodents. Infected animals may exhibit a pot-bellied appearance, diarrhoea, vomiting, and coughing due to larval migration to the lungs. In severe cases, heavy worm burdens can lead to intestinal blockages or perforations. Differential diagnosis is essential to distinguish roundworm infections from bacterial enteritis (e.g., *Salmonella*, characterized by fever) or viral infections like parvovirus, which causes bloody diarrhoea and leukopenia. Diagnosis is typically confirmed through faecal examination, which reveals thick-shelled eggs, though false negatives may occur during the prepatent period. In humans, *T. canis* can cause visceral larva migrans, a serious zoonotic condition.

Hookworms: It include *Ancylostoma caninum* and *Uncinaria stenocephala* in dogs and *Ancylostoma tubaeforme* in cats, are blood-feeding parasites that attach to the intestinal wall. Their eggs hatch into larvae in soil, which can penetrate the host's skin or be ingested. Clinical signs include bloody diarrhoea, anemia (evident as pale gums and weakness), and weight loss, with puppies at particular risk of collapse due to severe blood loss. Differential diagnosis must rule out coccidiosis (identified by oocysts in faeces) or hemorrhagic gastroenteritis, which presents with sudden onset and no parasitic evidence. Diagnosis involves faecal exams to detect eggs and blood tests to confirm regenerative anemia, indicating the body's response to blood loss.

Whipworms: The *Trichuris vulpis* primarily affect dogs, residing in the caecum and large intestine. Their thick-shelled eggs are highly resilient, surviving in soil for years. Infection occurs through ingestion of contaminated soil or material, leading to chronic diarrhoea, weight loss, and dehydration. These symptoms can mimic inflammatory bowel disease (which lacks eggs in faeces) or *Clostridium* overgrowth (diagnosed via toxin tests). Faecal sedimentation is the preferred diagnostic method to detect whipworm eggs.

Protozoal Parasites: Protozoal parasites make gastrointestinal diseases in animals even harder to diagnose. *Giardia duodenalis* infects both dogs and cats, with cysts transmitted through contaminated water. The trophozoites attach to the small intestine, causing watery diarrhoea, bloating, and malabsorption, particularly in young or stressed animals. Differential diagnosis includes distinguishing *Giardia* from dietary intolerance (no cysts present) or bacterial overgrowth (requiring culture). Diagnostic methods include zinc sulfate flotation for cysts and ELISA for antigens. *Cryptosporidium parvum*, a zoonotic protozoan, causes self-limiting diarrhoea in immunocompetent animals but can be severe in puppies and kittens, leading to profuse watery diarrhoea and dehydration. Its oocysts are resistant to chlorine, complicating environmental control. Symptoms overlap with *Giardia*, but acid-fast staining and PCR are used to identify *Cryptosporidium* oocysts and confirm the species. *Cystoisospora* species infect puppies and kittens, with oocysts ingested directly or via paratenic hosts. These parasites invade intestinal enterocytes, causing bloody diarrhoea and vomiting. Differential diagnosis involves ruling out parvovirus (via antigen testing) or hookworms (via egg detection). Faecal examination confirms the presence of oocysts. *Toxoplasma gondii* primarily affects cats, which serve as definitive hosts, shedding oocysts after consuming infected prey. Other mammals, including dogs and humans, act as intermediate hosts, harboring tissue cysts. While symptoms are rare in healthy animals, congenital toxoplasmosis in kittens can cause ataxia and seizures. In dogs, differential diagnosis from neosporosis (*Neospora caninum*, which causes paralysis) relies on serology and molecular testing.

Respiratory and Cardiovascular Parasites: Breathing and Heart Troubles

Parasites affecting the respiratory and cardiovascular systems of dogs and cats can cause significant health issues, ranging from chronic cough to life-threatening heart failure. These parasites often require specialized diagnostic techniques to differentiate them from other conditions with similar clinical presentations.

Lungworms: In cats, such as *Aelurostrongylus abstrusus*, are contracted through ingestion of infected snails or slugs. They cause coughing and dyspnea, with larvae detected in faeces via the

Baermann technique. Differential diagnosis includes ruling out asthma (no larvae) or bacterial pneumonia (*Bordetella*, identified via culture). *Troglostrongylus brevior* is a related but more pathogenic lungworm in cats, with similar diagnostic approaches. In dogs, *Angiostrongylus vasorum* (French heartworm) is transmitted via slugs and causes coagulopathy, coughing, and bleeding as larvae migrate to the right heart. Symptoms include respiratory distress and anemia, requiring differentiation from heartworm (*Dirofilaria immitis*, detected via antigen testing) or trauma. Diagnosis involves the Baermann technique for L1 larvae and antigen ELISA. *Capillaria aerophila* affects both dogs and cats, with eggs inhaled or ingested, leading to chronic cough. Faecal examination reveals bipolar eggs resembling those of *Trichuris*, but their distinct morphology aids differentiation.

Heartworms: *Dirofilaria immitis* is transmitted by mosquitoes, is a significant concern in dogs and, to a lesser extent, cats. Adult worms reside in the pulmonary arteries, causing chronic cough, exercise intolerance, and right heart failure in dogs. In cats, heartworm-associated respiratory disease (HARD) can present with acute respiratory signs and vomiting. The microfilariae develop into adults over 6-7 months. Differential diagnosis in dogs includes cardiomyopathy (distinguished via echocardiography), while in cats, asthma or thromboembolism must be ruled out. Diagnosis relies on antigen testing and imaging.

Ectoparasites and Vector-Borne Diseases: Skin and Systemic Assaults

Ectoparasites, such as fleas, ticks, and mites, not only cause localized skin issues but also serve as vectors for systemic diseases, posing significant risks to companion animals.

Fleas: *Ctenocephalides felis* cause pruritus and, in heavy infestations, anemia. They also transmit tapeworms (*Dipylidium caninum*). Differential diagnosis involves ruling out allergies, which lack visible fleas. Skin tape tests can detect flea eggs or debris.

Ticks: Such as *Ixodes* and *Rhipicephalus*, transmit *Babesia canis* in dogs, leading to fever, anemia, and thrombocytopenia. Intraerythrocytic piroplasms are visible in blood smears, and PCR confirms the diagnosis. Symptoms include hemolytic anemia and jaundice, requiring differentiation from ehrlichiosis

(*Ehrlichia canis*, with morulae in leukocytes) or immune-mediated anemia (via Coombs test).

Ehrlichiosis and Anaplasmosis: *Ehrlichia canis* causes monocytic ehrlichiosis in dogs, characterized by fever and bleeding, while *Anaplasma platys* leads to cyclic thrombocytopenia. Diagnosis involves blood smears and PCR.

Mites: *Sarcoptes scabiei* in dogs and *Notoedres cati* in cats cause mange, with intense itching and crusty lesions. Differential diagnosis from demodicosis (*Demodex canis*, follicle-dwelling mites) or dermatitis relies on skin scrapings.

Parasitic Diseases in Livestock: Threats to Farm Productivity

Livestock, including cattle, sheep, goats, pigs, and horses, face parasitic threats that significantly impact farm productivity by reducing growth, milk production, and reproductive success. Accurate differential diagnosis, considering regional and management factors, is essential for maintaining herd health and economic sustainability.

Helminth Infections: Worms That Drain Resources

Liver flukes such as *Fasciola gigantica*, affect ruminants by infecting snails as intermediate hosts and releasing metacercariae onto grass. Juveniles migrate through the liver, causing damage and symptoms like weight loss, anemia, and bottle jaw (submandibular edema). Chronic cases result in diarrhoea and reduced milk or wool production. Differential diagnosis includes ruling out haemonchosis (*Haemonchus contortus*, identified via faecal egg counts) or bacterial hepatitis (*Clostridium*, confirmed by culture). Faecal sedimentation detects characteristic trematode eggs, and ultrasonography reveals dilated bile ducts. *Dicrocoelium dendriticum* (lancet fluke), transmitted via ants, causes milder bile duct thickening, with smaller eggs aiding differentiation. Rumen flukes (*Paramphistomum*) cause diarrhoea in ruminants during their immature stages. The *Haemonchus contortus* (barber pole worm) in sheep and goats is a blood-sucking nematode causing anemia, weakness, edema, and sudden death. The infective L3 larvae are ingested from pasture. Differential diagnosis includes fasciolosis (liver involvement) or coccidiosis (oocysts in faeces). The FAMACHA scoring assesses anemia, and faecal egg counts confirm infection. In pigs, *Ascaris suum* larvae cause liver “milk spots” and pneumonia, with coughing

and unthriftiness as symptoms. Patent infections show eggs in faeces, distinguished from bacterial pneumonia (*Actinobacillus*, no eggs). In foals, *Parascaris equorum* can cause intestinal blockages, leading to colic and poor growth, with worms detectable via ultrasonography.

Lungworm (*Dictyocaulus viviparus*) in cattle causes verminous pneumonia and coughing, with larvae detected in feces via the Baermann technique. Differential diagnosis includes infectious bovine rhinotracheitis (BHV-1, confirmed by PCR). In sheep, *Oesophagostomum* causes nodular gut lesions and diarrhoea.

Protozoal Parasites: Microscopic Devastators

Coccidiosis (*Eimeria* spp.) affects young ruminants, pigs, and horses, with oocysts damaging the gut lining, causing bloody diarrhoea and dehydration. Differential diagnosis includes salmonellosis (*Salmonella*, confirmed by culture). Faecal oocyst counts confirm infection.

Toxoplasma gondii causes abortion in sheep and goats, with cats shedding oocysts. Symptoms include fetal mummification and stillbirths, diagnosed via serology and histopathology. *Neospora caninum* in cattle causes abortion storms, with dogs as definitive hosts. Differential diagnosis from brucellosis (*Brucella*, confirmed by culture) is necessary.

Tick-borne *Babesia* species (*B. bovis*, *B. bigemina* in cattle; *B. caballi*, *Theileria equi* in horses; *B. ovis*, *B. motasi* in sheep/goats; *B. traubmanni* in pigs) cause fever, also hemoglobinuria, and neurological signs in some species. Differential diagnosis from anaplasmosis (*Anaplasma*, distinguished by Giemsa stains) relies on blood smears showing piroplasms and PCR. *Theileria annulata* in cattle causes lymph node swelling and fever, with schizonts in lymphocytes.

Trypanosoma evansi, transmitted by biting flies, causes anemia, edema, and chronic wasting in cattle and horses. Differential diagnosis from malnutrition involves blood films to detect trypanosomes.

Cryptosporidium parvum in calves causes diarrhoea, with acid-fast oocysts in faeces. *Giardia duodenalis* in young livestock leads to malabsorption and diarrhoea, diagnosed via faecal examination.

Diagnostic Methods: Tools for Unraveling Parasites

Diagnosing parasitic diseases in animals requires a multifaceted approach that integrates both traditional and modern techniques, customized to the specific animal species, the suspected parasite, and the clinical or field setting. This process is essential for accurate identification, effective treatment, and prevention of transmission, including zoonotic risks. Veterinarians and researchers employ a variety of methods, each with its strengths and limitations, to detect parasites at different life stages and in various host tissues. The choice of diagnostic tool often depends on factors such as the availability of equipment, the urgency of diagnosis, and the potential for mixed infections, which can complicate interpretation.

Faecal Examination Techniques: It remains a cornerstone of parasitic diagnosis, particularly for gastrointestinal and some respiratory parasites. Faecal flotation is a widely used method that involves mixing faecal samples with high-density solutions, such as salt or sugar, to allow parasite eggs or oocysts to float to the surface for microscopic identification. This technique is highly effective for detecting common nematodes like *Toxocara* species (roundworms) and *Ancylostoma* species (hookworms), as well as protozoal oocysts from *Eimeria* species causing coccidiosis. The simplicity and low cost of faecal flotation make it accessible in both clinical and field settings, though it may miss heavy eggs or low-burden infections.

For parasites with denser eggs, such as trematodes, faecal sedimentation is preferred. This method allows heavier eggs to settle at the bottom of a container after suspension in water or a low-density solution, facilitating their detection under a microscope. It is particularly useful for identifying fluke eggs, such as those of *Fasciola* species (liver flukes), which do not float well in flotation solutions. Sedimentation provides a complementary approach to flotation, ensuring comprehensive detection in cases where multiple parasite types may be present.

The Baermann technique is specialized for isolating motile larvae, especially from lungworms. It involves suspending faecal material in warm water over a funnel with a sieve, allowing larvae to migrate downward into a collection tube for microscopic examination. This method is effective for detecting larvae of *Dictyocaulus viviparus* in cattle and

Aelurostrongylus abstrusus in cats, offering high sensitivity for respiratory parasites that might not be evident through egg detection alone.

Blood-Based Diagnostics: Blood analysis plays a crucial role in diagnosing systemic and vector-borne parasitic infections. Direct blood smears, stained with Giemsa or similar dyes, enable the visualization of intraerythrocytic parasites like piroplasms of *Babesia* species, which appear as pear-shaped organisms causing babesiosis. Similarly, trypanosomes (*Trypanosoma* species) can be identified as extracellular flagellates in fresh blood films, while schizonts of *Theileria* species are detectable within lymphocytes or monocytes. These microscopic methods are rapid and cost-effective but require skilled interpretation and may miss low-parasitemia cases.

Serological tests help identify exposure to parasites by detecting antibodies in the animal's blood. Commonly used methods include ELISA (enzyme-linked immunosorbent assay) and indirect fluorescent antibody tests, especially for parasites like *Toxoplasma gondii*, *Neospora caninum*, and *Dirofilaria immitis* (heartworm). ELISA can also detect parasite antigens, which indicates an active infection, such as *Giardia* antigens in feces or *Dirofilaria* antigens in blood. These tests provide quick results and are useful for diagnosing infections in individual animals or screening entire herds. However, they may not always differentiate between current and past infections, so additional diagnostic methods may be needed.

Molecular Techniques: Polymerase chain reaction (PCR) represents a powerful molecular tool that amplifies parasite-specific DNA or RNA, allowing for precise identification even in low-burden or early-stage infections. The PCR is particularly pinpointing species like *Leishmania*, *Giardia duodenalis*, or various *Babesia* strains, offering high sensitivity and specificity. It is invaluable in research and diagnostic labs for confirming ambiguous cases or differentiating closely related parasites, though it requires specialized equipment and expertise.

Advanced Imaging Techniques: Ultrasonography provides non-invasive visualization of parasitic structures within the body. It can detect adult heartworms (*Dirofilaria immitis*) as characteristic "train track" patterns in the pulmonary arteries of dogs, or bile duct thickening and dilation due to *Fasciola* infections in ruminants. In cats,

ultrasonography is useful for identifying heartworm-associated respiratory disease (HARD), while in sheep, it offers high sensitivity for detecting cystic echinococcosis caused by *Echinococcus granulosus*. This imaging modality aids in assessing the extent of organ damage and guiding treatment decisions.

Post-Mortem Examination: Necropsy, or post-mortem examination, offers definitive diagnosis by directly observing parasites in tissues. It reveals gross lesions such as intestinal nodules from *Oesophagostomum* species, adult flukes (*Fasciola*) in the liver, or muscle cysts from *Trichinella spiralis* in pigs. This method is essential for confirming diagnoses in deceased animals, investigating outbreaks, and understanding parasite pathology, though it is inherently retrospective.

Point-of-Care Methods: Rapid point-of-care kits, such as lateral flow assays, enable quick diagnosis in clinical settings. These are particularly useful for heartworm in dogs, delivering results within minutes from a blood sample, facilitating immediate treatment decisions.

Challenges in Parasites Diseases Diagnosis

Despite the array of diagnostic tools available, several challenges persist in accurately identifying parasitic infections. Sensitivity can vary significantly depending on the parasite's life stage; for example, prepatent periods may yield false negatives in fecal exams. Mixed infections, common in livestock and companion animals, often require multiple complementary tests to unravel the full picture. Young animals, with immature immune systems, or those with low parasite burdens, pose additional difficulties, as clinical signs may be subtle and diagnostic yields low. Addressing these challenges involves integrating clinical history, epidemiological data, and a battery of tests to achieve reliable diagnoses and effective parasite control.

Challenges in Differential Diagnosis: Navigating the Complexities

Parasitic diseases in animals often present significant diagnostic challenges due to the substantial overlap in clinical symptoms with other conditions, making accurate identification difficult without thorough investigation. For instance, anemia in cattle can arise from multiple sources, such as infection with *Babesia bigemina*, which causes haemolytic anemia through tick-borne transmission, or from gastrointestinal nematodes like *Haemonchus contortus*, known as the barber pole worm, that suck

blood from the abomasum. Alternatively, it could stem from nutritional deficiencies, such as iron or cobalt shortages in the diet. To differentiate these, veterinarians must employ a combination of diagnostic tools, including blood smears to visualize intraerythrocytic piroplasms indicative of babesiosis, faecal egg counts to quantify nematode burdens, and a detailed dietary history to assess for malnutrition. This multifaceted approach ensures that the underlying cause is pinpointed, preventing inappropriate treatments that could exacerbate the issue.

Similarly, diarrhoea in puppies can be attributed to various parasitic or viral agents, complicating the diagnostic process. It might result from protozoal infections like *Giardia duodenalis*, which causes malabsorption and watery stools, or *Cystoisospora* species, previously known as *Isospora*, leading to bloody diarrhoea through invasion of intestinal cells. However, it could also indicate a viral infection such as parvovirus, which is highly contagious and often fatal if untreated. Differential diagnosis in these cases requires specific tests, including antigen detection kits for parvovirus and fecal flotation techniques to identify protozoal cysts or oocysts. By integrating clinical signs, such as the presence of blood or the animal's age and vaccination status, with laboratory results, veterinarians can avoid misdiagnosis and implement targeted therapies.

Prepatent periods pose another major hurdle in diagnosing parasitic infections, as they can lead to false-negative results in standard tests. During this phase, which varies by parasite, typically 3-4 weeks for nematodes like *Toxocara* eggs, larvae, or antigens are not yet detectable in feces or blood, even though the animal may exhibit symptoms. This delay necessitates repeated testing or the use of alternative methods, such as serology for antibody detection, to confirm infection. In practice, this means that initial negative results must be interpreted cautiously, especially in young or recently exposed animals, to prevent overlooking early-stage infections that could worsen over time.

Mixed infections further complicate differential diagnosis, as multiple parasites can coexist and produce compounded or atypical symptoms. For example, in dogs, concurrent infections with *Toxocara canis* (roundworms) and *Giardia duodenalis* can lead to severe

gastrointestinal distress, including diarrhoea and malnutrition, that might not respond to treatment targeting only one pathogen. Comprehensive testing protocols, including faecal flotation for worm eggs, antigen ELISAs for protozoa, and possibly PCR for molecular confirmation, are essential to identify all contributing parasites. This holistic approach ensures that treatment regimens address the full spectrum of infections, improving outcomes and reducing the risk of recurrence.

Anthelmintic resistance adds yet another layer of complexity, particularly in livestock parasites like *Haemonchus contortus* in sheep and goats. When worms develop resistance to common dewormers, infections persist despite treatment, mimicking ongoing or new infestations. This can lead to confusion in assessing treatment efficacy and requires faecal egg count reduction tests (FECRT) to evaluate drug performance. In regions where resistance is prevalent, veterinarians must rotate anthelmintic classes or integrate non-chemical strategies, such as targeted selective treatment based on FAMACHA anemia scoring, to manage infections effectively.

Zoonotic risks associated with parasitic diseases heighten the urgency of accurate diagnosis, as they can directly impact human health. For instance, *Toxoplasma gondii* in cats, which shed oocysts in faeces, poses a severe threat to pregnant women, potentially causing congenital toxoplasmosis in fetuses. Similarly, *Sarcoptes scabiei* mites in dogs can transmit to humans, resulting in scabies with intense itching and skin lesions. Prompt identification through serology for *Toxoplasma* or skin scrapings for mites is crucial, not only for treating the animal but also for advising owners on hygiene practices to prevent human infection.

Environmental factors, such as climate change, are expanding the geographic ranges of vectors, thereby increasing the prevalence and diagnostic challenges of certain parasitic diseases. Warmer temperatures and altered rainfall patterns are allowing ticks like *Ixodes* species to thrive in new areas, spreading *Babesia* infections in dogs and livestock. Likewise, sandflies carrying *Leishmania* parasites are extending their habitats, leading to more cases of leishmaniasis in previously unaffected regions. Veterinarians must stay vigilant, incorporating epidemiological data into diagnostics,

such as travel history or local vector surveillance, to anticipate and confirm these emerging threats.

In resource-poor areas, limited access to laboratory facilities exacerbates diagnostic difficulties, often forcing reliance on clinical signs alone, which can lead to errors. Without tools like microscopes for faecal exams or PCR machines for molecular detection, conditions like coccidiosis in calves or trypanosomiasis in cattle might be misattributed to bacterial infections or malnutrition. This underscores the need for affordable, field-deployable diagnostics, such as rapid antigen tests, and training programs to enhance clinical acumen in underserved regions.

A practical case illustrates these challenges: a dog presenting with chronic itching could be suffering from sarcoptic mange caused by *Sarcoptes scabiei* mites or from environmental allergies. Initial symptoms like pruritus and hair loss overlap significantly, but deep skin scrapings under microscopy reveal the mites, confirming mange and avoiding the misdiagnosis of allergies, which would require different management, such as hypoallergenic diets or immunotherapy.

Conclusion

Unraveling parasitic diseases in domestic animals through differential diagnosis is both science and art, requiring keen observation and advanced tools to protect pets and livestock. The accurate identification transforms outcomes, saving lives and livelihoods. Pet owners and farmers must stay vigilant, seeking veterinary care early and embracing prevention. As diagnostics advance microscopes to AI the fight against these invisible foes grows stronger, ensuring healthier animals and stronger human-animal bonds.