

HEMATOLOGY AND SERUM BIOCHEMISTRY PARAMETERS OF NORTH AMERICAN RIVER OTTERS (*LONTRA CANADENSIS*)

Maryanne E. Tocidlowski, D.V.M., Lucy H. Spelman, D.V.M., Perry W. Sumner, M.S., and Michael K. Stoskopf, D.V.M., Ph.D.

Abstract: Blood samples were obtained from 155 North American river otters (*Lontra canadensis*; 94 adult males, 38 adult females, 10 juvenile males, and 13 juvenile females) to establish baseline hematology and from 50 adult river otters (40 males and 10 females) for baseline serum biochemistry parameters for the species. The otters were live-trapped from eastern North Carolina (USA) during a 4-yr period. Data for 14 routine hematologic parameters and 22 serum chemistry assays showed significant differences in total leukocyte count and absolute neutrophil and monocyte numbers for adults versus juveniles, red blood cell counts and hemoglobin between adult and juvenile males, and calcium and alkaline phosphatase values for adult males between years of the study and an increase in leukocyte counts and absolute neutrophils with increased degree of trap injury sustained.

Key words: Biochemistry, clinical pathology, hematology, *Lontra canadensis*, mustelid, river otter, trap injury.

INTRODUCTION

Translocated wildlife may transmit diseases into new locations, reducing translocation success rate and influencing native wildlife populations.¹ Animals scheduled for translocation should have medical evaluations that include a physical examination, clinical pathology assessment, and disease screening, and any clinical illness or wound should be managed.¹¹ Clinical pathology baseline values help define population health and nutritional status and aid in the identification of infectious or non-infectious diseases. These values may change with season,¹² nutritional state,⁹ reproductive status, and capture method.¹⁰ Previous studies of river otter clinical pathology have been small in scale and were conducted under a variety of environmental and husbandry conditions.^{1,2,5–7,9,11}

This study established baseline hematology for 155 live-trapped North American river otters (*Lontra canadensis*; 94 adult males, 38 adult females, 10 juvenile males, and 13 juvenile females) during each December–February between 1991 and 1994 and 1995 and 1996 and baseline serum chemistry parameters from 50 of the adults (40 males and 10 females) from the same population during the same

months in the two study years of 1991–1992 and 1995–1996.

MATERIALS AND METHODS

Animals and husbandry

The otters were live-trapped for the North Carolina Wildlife Resources Commission Otter Restoration/Translocation Project (Raleigh, North Carolina, USA) by wildlife biologists and cooperating local trappers with various sized standard and modified leghold traps in compliance with recommendations by the Commission's Institutional Animal Care and Use Committee. The animals originated from 10 North Carolina counties.

Otters were housed alone or in groups of two in 0.5- × 1.0- × 0.5-m, vinyl-coated welded wire cages kept in a covered open air shelter. They were fed a variety of fresh or frozen fish twice daily with drinking water provided ad lib. All otters received a 10-day course of trimethoprim sulfadiazine (Di-Trim, Syntex Animal Health, West Des Moines, Iowa 50265, USA; 30 mg/kg p.o. s.i.d.) in fish once they started to eat, usually within 3 days after arrival. The otters were physically examined and had blood and fecal samples collected and wounds treated between 4 and 26 days (median 7 days) after retrieval from the trap and arrival at the holding facility (time of capture).

All of the otters sustained trap injuries to one limb, either minor lacerations (12%, including puncture wounds, missing claws, swelling of the paw), closed luxations of one or more digits (32%), open or compound luxations of one or more digits (41%), or open luxations with exposure or fracture of bones of the digits (15%). Wounds were treated conservatively by cleaning with dilute betadine solution, debridement, and minor suturing where appropriate.

From the Environmental Medicine Consortium and Department of Clinical Sciences, North Carolina State University, College of Veterinary Medicine, 4700 Hillsborough Street, Raleigh, North Carolina 27606, USA (Tocidlowski, Spelman, Stoskopf); the North Carolina Wildlife Resources Commission, 512 North Salisbury Street, Archdale Building, Raleigh, North Carolina 27604, USA (Sumner). Present addresses: Houston Zoological Gardens, 1513 North MacGregor Street, Houston, Texas 77030, USA (Tocidlowski); and the Department of Animal Health, National Zoological Park, 3001 Connecticut Avenue, NW, Washington, D.C. 20008, USA (Spelman).

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Schalm's Veterinary Hematology Marjory B. Brooks, Kendal E. Harr, Davis M. Seelig, K. Jane Wardrop, Douglas J. Weiss, 2022-02-24 SCHALM'S VETERINARY HEMATOLOGY An updated guide to veterinary hematology with expanded coverage on a variety of topics The revised seventh edition of Schalm's Veterinary Hematology is updated to provide a comprehensive review of all topics related to disorders of the blood in animals Designed as a gold standard reference this text covers a wide range of species in both confined and free range populations reflects the most recent trends in hematology diagnostics and discusses recent advances in traditional techniques Edited and written by an international team of experts in the field the book represents an accessible yet in depth resource for information on veterinary hematology The new edition includes a hemolymphatic tissue section that covers current understanding of basic science and the species specific hematology section is further expanded from previous editions New chapters address emerging topics in hematology and existing chapters have been revised and rearranged to improve readability and simplify access to the material This seventh edition Updates the most complete reference on veterinary hematology across species Contains a new section on basic biology of hemolymphatic tissues Expands coverage of species specific hematology Presents new and emerging topics in blood disorders and diagnostic techniques Features a reorganized contents list for an integrated easy to use reference Written for veterinary clinical pathologists and residents diagnostic laboratory staff internists and specialists Schalm's Veterinary Hematology is the most comprehensive and up to date reference on the topic

Analysis of Parameters Used to Evaluate the Health of Recently Captured North American River Otters (*Lontra Canadensis*) Involved in a Population Restoration Project Kevin Ross Kimber, 1998

Medical Management of Wildlife Species Sonia M. Hernandez, Heather W. Barron, Erica A. Miller, Roberto F. Aguilar, Michael J. Yabsley, 2019-10-11 This book offers an all encompassing resource for reliable information on the medical management of wild birds mammals amphibians and turtles Focusing on the medical information relevant to the wildlife setting it covers triage emergency care and other key considerations in handling diagnosing and treating wild animals The book's population based approach encourages practitioners to understand individual animal care within the broader context Medical Management of Wildlife Species A Guide for Practitioners begins with a brief summary of natural history and introductory chapters address general topics such as pre release conditioning post release monitoring and legal issues associated with handling wildlife species Species specific chapters provide practical information on medical management including the most prevalent concerns for each species and the epidemiology of infectious diseases Provides a complete reference to handling diagnosing and treating wild species Covers the full range of North American wildlife Includes concepts that can be applied to species globally Emphasizes information relevant to the wildlife setting Focuses on individual medicine firmly grounded within population medicine for a broader approach Targeted at wildlife veterinarians veterinary clinicians that will be presented with wildlife veterinary

technicians and wildlife rehabilitators *Medical Management of Wildlife Species* is a must have addition to the bookshelf of wildlife veterinarians and any veterinarian seeing occasional wild animals as well as wildlife biologists and researchers

Reintroduction Biology John G. Ewen, Doug P. Armstrong, Kevin A. Parker, Philip J. Seddon, 2012-01-30 This book aims to further advance the field of reintroduction biology beyond the considerable progress made since the formation of the IUCN SSC Reintroduction Specialist Group Using an issue based framework that purposely avoids a structure based on case studies the book's central theme is advocating a strategic approach to reintroduction where all actions are guided by explicit theoretical frameworks based on clearly defined objectives Issues covered include husbandry and intensive management monitoring and genetic and health management Although taxonomically neutral there is a recognised dominance of bird and mammal studies that reflects the published research in this field The structure and content are designed for use by people wanting to bridge the research management gap such as conservation managers wanting to expand their thinking about reintroduction related decisions or researchers who seek to make useful applied contributions to reintroduction Index

Medicus, 2001 *CRC Handbook of Marine Mammal Medicine* Frances M.D. Gulland, Leslie A. Dierauf, Karyl L. Whitman, 2018-03-20 AAP Prose Award Finalist 2018 19 For three decades this book has been acknowledged as the most respected scientific reference specifically devoted to marine mammal medicine and health Written by approximately 100 contributors who are recognized globally as leaders in their respective fields the *CRC Handbook of Marine Mammal Medicine* Third Edition continues to serve as the essential guide for all practitioners involved with marine mammals including veterinarians technicians biological researchers students managers keepers curators and trainers The 45 chapters provide essential information for the practitioner on pathology infectious diseases medical treatment anesthesia surgery husbandry health assessment species specific medicine medically pertinent anatomy and physiology and global health concerns such as strandings oil spills and entanglements of marine mammals Covers all aspects of marine mammal veterinary practice Written by internationally acknowledged experts Adds new chapters on Ophthalmology Dentistry Ethics Oil Spill Response Health Assessments Whale Entanglement Response Dive Response and Biotoxins Richly illustrated in color throughout the new edition including updated anatomical drawings and extensive photographs of ocular lesions Provides guidance to websites that regularly present updated information and images pertinent to current marine mammal medicine such as imaging and stranding network contacts Discusses ethics and animal welfare The book guides the reader through the veterinary care of cetaceans pinnipeds manatees sea otters and polar bears In addition to summaries of current knowledge chapters provide information on those digital resources and websites which present the latest information as it emerges in the field The *CRC Handbook of Marine Mammal Medicine* Third Edition gives a call to action for scientists to experiment with new endeavors to engage and inspire current and future generations to care for marine mammals and the marine environment and work together to find solutions As the most trusted reference for marine mammal conservation medicine and for marine mammal

medical facilities around the world this book needs to be in your library Camel Clinical Biochemistry and Hematology Bernard Faye, Mohammed Bengoumi, 2018-08-27 This work brings together a wealth of data regarding the reference values and factors of variation in biochemical parameters used by camel veterinarians and scientists to determine these animals nutritional and clinical status It also explores several technical aspects involved in determining these parameters sampling procedures and essential elements in the interpretation of the results Though many texts are available on small and large ruminants much less is known about species confined to the marginal zones of tropical and Mediterranean countries such as camels This book addresses precisely this research gap on the one hand by presenting an extensive review of the literature and on the other by synthesizing the outcomes of the authors numerous previous works In veterinary medicine blood tests to help diagnose diseases in cattle were first proposed nearly a century ago but were mainly developed in the 1960s initially at specialized research or veterinary services laboratories and eventually with the advent of new equipment and the miniaturization of the analyzers finding their way into veterinarians cabinets Beyond their diagnostic value veterinary surgeons and zootechnicians also speculated on the potential use of blood tests to evaluate animals nutritional status Thus a whole range of analyses are now proposed to the stakeholders responsible for animal health Such analyses could help to define a metabolic profile which would offer a valuable decision making tool for experts and researchers alike **Diseases**

of Donkeys and Mules, An Issue of Veterinary Clinics of North America: Equine Practice Ramiro E. Toribio, 2019-11-06 This issue of Veterinary Clinics Equine Practice guest edited by Dr Ramiro Toribio in collaboration with Consulting Editor Dr Thomas Divers is devoted to Diseases of Donkeys and Mules Topics include Endocrine and metabolic disorders of donkeys Gastrointestinal disorders of donkeys and mules Clinical pathology of donkeys Genetics evolution physiology in donkeys mules Nutrition and malnutrition Donkey and mule welfare Dermatological disorders of donkeys mules Anesthesia analgesia and sedation in donkeys mules Dental disorders of donkeys Clinical evaluation and preventative care of the donkey Respiratory disorders of donkeys Donkey and mule behavior Clinical Pharmacology of donkeys Key aspects of donkey and mule reproduction and Foot Care and Practical Farriery for the Donkey Exotic Animal Hematology and Cytology Terry W. Campbell, Krystan R. Grant, 2022-03-29 The newly revised Fifth Edition of Exotic Animal Hematology and Cytology delivers a fully updated new edition of the most complete reference to hematology and cytology in exotic animals The book features high quality images and step by step descriptions of practical techniques Organized by animal class to make it easier to quickly find critical information the authors have included 45 new case studies to highlight the application of the content in a real world setting All major exotic animal groups are covered including mammals birds reptiles amphibians and fish Clinicians seeking a decision making aid for patient workup treatment and prognosis will find what they need in Exotic Animal Hematology and Cytology The book also includes Thorough cellular descriptions unique to mammalian avian herptile and fish species with extensive discussions of blood and bone marrow sample collection and hematologic

techniques for each group Comprehensive evaluation of the peripheral blood specific to mammals birds herptiles and fish as well as the evaluation of bone marrow Practical discussions of hematology case studies with applications to common real world clinical problems Color atlas of hemic cells of select species for quick and easy reference Extensive examinations of cytodiagnosis and exploration of unique features within mammals birds herptiles and fish as well as cytology case studies and wet mount cases in fish Access to video clips and additional case reports on a companion website Exotic Animal Hematology and Cytology is an essential reference for veterinary clinical pathologists anatomic pathologists clinicians and technicians as well as for veterinary students taking courses involving exotic hematology and cytology Harkness and Wagner's Biology and Medicine of Rabbits and Rodents Patricia V. Turner, Colette L. Wheler, Hugues Beaufrère, Niora Fabian, John E.

Harkness, 2025-08-19 Practical reference on small mammal husbandry and health now with full color clinical photographs throughout The Sixth Edition of Harkness and Wagner's Biology and Medicine of Rabbits and Rodents provides a thorough update to the classic reference on small mammal health and husbandry now with full color clinical photographs throughout Part of ACLAM's series of laboratory animal books the book is a comprehensive practical guide to caring for rabbits guinea pigs hamsters gerbils mice rats and chinchillas Emphasizing biology contemporary husbandry diagnostics and clinical procedures clinical signs and diseases and conditions the book is equally useful in the research companion animal practice or food animal setting New topics for the Sixth Edition include environmental monitoring for rodent health assessments behavioral management considerations for optimizing animal health enhanced pain assessment approaches as well as considerations for creating a welfare friendly small mammal practice The Sixth Edition also updates common therapeutics analgesics anesthetics and blood collection methodology disease biology husbandry diagnostic modalities and references and covers new techniques for creating and modifying genetically engineered rodents Harkness and Wagner's Biology and Medicine of Rabbits and Rodents includes information on General husbandry and disease prevention covering equipment needs factors predisposing to disease and occupational health and safety issues Clinical procedures covering hematology clinical chemistry urinalysis surgery post operative care dentistry ophthalmology and imaging Clinical signs and differential diagnoses covering astroviruses hepatitis E and leporid herpesvirus 4 for rabbits and antimicrobial resistance for commercial rabbits Serologic testing and diagnostic sample submission covering newer methodologies environmental monitoring and considerations for large rodent feeder breeder operations The Sixth Edition of Harkness and Wagner's Biology and Medicine of Rabbits and Rodents is an essential reference for veterinary professionals dealing with small mammal species in research or practice settings as well as veterinary students interested in small animals comparative medicine or laboratory animal medicine **Geriatrics, An Issue of Veterinary Clinics of North America: Exotic Animal Practice, E-Book** Paul Raiti, 2020-09-07 This issue of Veterinary Clinics Exotic Animal Practice guest edited by Dr Paul Raiti is focused on Geriatrics This is one of three issues each year selected by the series consulting editor Dr J rg Mayer Article topics include Geriatric

Freshwater and Marine fish Geriatric Reptiles and Amphibians Geriatric Psittacines Geriatric raptors Geriatric Rats Mice
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 Hedgehogs End of Life Decisions Palliative Care Hospice and Euthanasia for Exotic Animals and Pathology of Diseases of
 Geriatric Exotic Mammals **Hawkey's Atlas of Wild and Exotic Animal Haematology** Jaime Samour, Mike
 Hart, 2020-11-05 This revised updated and expanded edition of Christine Hawkey's A Colour Atlas of Comparative Veterinary
 Haematology is bursting with high quality images to aid identification of blood cells and haemoparasites in the different
 species commonly seen in private practice and zoological collections It will assist veterinarians in the identification of normal
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 This impressively illustrated comparative haematology atlas is unrivalled in its scope quality and accuracy It is a must have
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 zoological collections and specialists in exotic animal medicine **Schalm's Veterinary Hematology** Douglas J. Weiss, K.
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 comprehensive reference is an essential purchase for veterinary clinical hematologists internists and students Veterinary
Hematology, Clinical Chemistry, and Cytology Mary Anna Thrall, Glade Weiser, Robin W. Allison, Terry W.
 Campbell, 2022-02-02 A clear and concise guide to veterinary laboratory diagnostic techniques and interpretation The newly
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Gastroenterology, An Issue of Veterinary Clinics of North America: Small Animal Practice, E-Book Frederic Gaschen, 2020-11-21 This issue of Veterinary Clinics Small Animal Practice guest edited by Dr Fr d ric P Gaschen focuses on Advances in Gastroenterology Articles in this issue include but are not limited to Esophagitis Gastroprotective therapy Gastric motility disorders in dogs and cats Aerodigestive diseases in dogs Digestive diseases in brachycephalic dogs Acute hemorrhagic diarrhea syndrome in dogs From bench top to clinics How to use new tests to diagnose and treat dogs with chronic enteropathies Differentiating IBD from alimentary lymphoma in cats Canine protein losing enteropathies and systemic complications Impact of GI microbiome changes in canine and feline digestive diseases Dietary and nutritional approaches for the management of chronic enteropathy in dogs and cats Value of probiotics in canine and feline gastroenterology and Fecal microbiota transplantation in the dog Sturkie's Avian Physiology Colin G. Scanes, Sami Dridi, 2021-11-06 Sturkie s Avian Physiology Seventh Edition is the classic comprehensive single volume on the physiology of domestic as well as wild birds This latest edition is thoroughly revised and updated and features several new chapters with entirely new content on such topics as vision sensory taste pain reception evolution and domestication Chapters throughout have been greatly expanded due to the many recent advances in the field This book is written by international experts in different aspects of avian physiology For easy reading and searches this book is structured under a series of themes beginning with genomic studies sensory biology and nervous systems and major organs The chapters then move on to investigate metabolism endocrine physiology reproduction and finally cross cutting themes such as stress and rhythms New chapters on feathers and skin are featured as well Sturkie s Avian Physiology Seventh Edition is an important resource for ornithologists poultry scientists and other researchers in avian studies It is also useful for students in avian or poultry physiology as well as avian veterinarians Stands out as the only single volume devoted to bird physiology Features updates revisions or additions to each chapter Written and edited by international leaders in avian studies **Exotic Animal Laboratory Diagnosis** J. Jill Heatley, Karen E. Russell, 2020-03-24 Exotic Animal Laboratory Diagnosis ist ein praxisorientiertes leserfreundliches Fachbuch mit allem Wissenswerten f r die Durchf hrung diagnostischer Tests bei vielen Exoten Erl utert

detailliert wie Proben entnommen Tests durchgeführt und Laborergebnisse interpretiert werden Bietet Informationen zu jeder Tierart die zum schnellen Nachschlagen einheitlich präsentiert werden Legt den Schwerpunkt auf klinische biochemische Untersuchungen Urinalysen und gängige Diagnoseverfahren die in anderen Publikationen nicht zu finden sind Führt in einem leicht zugänglichen Fachbuch alles Wissenswerte zu Auswahl Durchführung und Anwendung von Testverfahren zusammen Deckt eine Vielzahl von Tierarten ab u a Kleinsäugetiere Primaten Reptilien Wassertiere Wildtiere Laborversuchstiere und Hausvögel

Index Veterinarius, 2007 **Animal Clinical Chemistry** G.O. Evans, 2009-04-01 10 Years of Updates Since First Edition Newcomers to the animal clinical chemistry and toxicology fields quickly find that the same rules of human medicine do not always apply Following in the footsteps of its standard setting first edition Animal Clinical Chemistry A Practical Handbook for Toxicologists and Biomedical Researchers Second Edition

Atlas of Clinical Avian Hematology Phillip Clark, Wayne Boardman, Shane Raidal, 2009-09-08 Atlas of Clinical Avian Hematology is a practical guide to the hematological characteristics of birds Illustrated throughout with many color photographs this rich resource aids interpretation of hematological data and promotes the accurate classification of hematological cells and identification of pathological changes Covering over 100 species of birds the Atlas illustrates the general hematological characteristics of birds the hematological variations encountered between the different Orders of birds and the hematological responses to disease of birds using clinical cases from many species of birds and a range of clinical disorders Describes how to collect and handle blood samples from birds to best preserve the quality of the blood Highly illustrated color guide to the hematological characteristics of birds Case data and images illustrates the avian hematological responses to disease

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