

**1996 WILDLIFE DISEASE ASSOCIATION  
CONFERENCE AGENDA**

(All activities held at *UAF Natural Science Building* unless otherwise indicated)

**SUNDAY, JULY 21**

8:30–12:00	Journal of Wildlife Diseases Editorial Board Meeting
12:00–1:00	Lunch for Members of Editorial Board and Council
1:00–5:00	Council Meeting
7:30–10:00	Reception and Registration at <i>UAF Museum</i>

**MONDAY, JULY 22**

7:00–8:00	Continental Breakfast
8:15–8:45	Welcome and Opening Comments
8:45–11:45	Symposium—"Wildlife Diseases and Parasites in the Arctic"
11:45–1:00	Lunch
1:00–2:30	Marine Mammals Session
3:00–4:45	Bighorn Sheep Session
6:00–10:00	Picnic— <i>Chena River State Recreation Site (aka "Chena</i>

**TUESDAY, JULY 23**

	Poster sessions during morning and afternoon coffee breaks
7:00–8:00	Continental Breakfast
8:15–8:30	Opening Remarks
8:30–9:30	Brucellosis Session
10:00–12:00	Student Presentation Competition
12:00–1:15	Lunch and WDA Business Meeting
1:15–4:00	Environmental Contamination Session
4:00–4:45	Endangered Species Session
5:00–6:00	AAWV Meeting
7:00–10:00	WDA Auction

**WEDNESDAY, JULY 24**

7:00–8:00	Continental Breakfast
8:15–8:30	Opening Remarks
8:30–11:15	Deer Session
11:15–11:45	Special Presentations by a Wildlife User and a Wildlife Manager
11:45–1:00	Lunch
1:00–2:45	Terrestrial Mammals Session
3:15–4:30	Chemical Immobilization Session
6:00–10:00	Banquet at <i>Alaskaland</i>

**THURSDAY, JULY 25**

7:00–8:00	Continental Breakfast
8:15–8:30	Opening Remarks

# WDA<sub>ALASKA</sub> '96

8:30–11:30	Bird Session
11:30–12:00	Celebrity Debate—"Are Diseases REALLY Bad for Wildlife??"
12:00–1:00	Lunch
1:00–5:00	General Session
5:00	Adjourn

**PRESENTATION SCHEDULE**

**MONDAY, JULY 22**

8:15–8:45 OPENING REMARKS

**SYMPOSIUM**

*Moderator:* Bill Samuel

8:45–9:15 (1) **THE ECOLOGY OF TULAREMIA IN TAIGA AND TUNDRA IN THE HOLOARCTIC REGION.** CLUFF E HOPLA

9:15–9:45 (2) **"MAKING IT" IN A COLD DRY WORLD: PARASITE SURVIVAL STRATEGIES.** MJ PYBUS

9:45–10:15 BREAK

10:15–10:45 (3) **RANGIFERINE BRUCELLOSIS IN THE ARCTIC.** ROBERT A DIETERICH

10:45–11:15 (4) **ENVIRONMENTAL CHANGES AND POLLUTION IN THE ARCTIC - THE EFFECT ON ARCTIC WILDLIFE.** TORSTEN MÖRNER AND BJARNE CLAUSEN

11:15–11:45 (5) **WILDLIFE DISEASES: IMPLICATIONS FOR RESOURCE HARVESTING AND UTILIZATION IN THE NORTHWEST TERRITORIES, CANADA.** BRETT T ELKIN

11:45–1:00 LUNCH

**MARINE MAMMALS**

*Moderator:* Mark Drew

1:00–1:15 (6) **HERPES-LIKE VIRUS INFECTION IN 54 HARBOR SEALS (PHOCA VITULINA) STRANDED IN CENTRAL CALIFORNIA, 1990-1995.** FMD GULLAND, L LOWENSTINE, D KING, T SPRAKER, AND JM LAPOINTE

1:15–1:30 (7) **EVIDENCE OF BRUCELLOSIS IN PACIFIC HARBOR SEALS (PHOCA VITULINA RICHARDSI) AND CALIFORNIA SEA LIONS (ZALOPHUS CALIFIRNIANUS) FROM PUGET SOUND, WASHINGTON.** DL LAMBOURN, SJ JEFFRIES, PB HALL, PG GEARIN, LM POLZIN, DR EWALT, AND JB PAYEUR

1:30–1:45 (8) **A REPORT OF THE MANATEE EPIZOOTIC OF 1996.** SCOTT D WRIGHT

- 1:45–2:00 (9) LUNGWORMS (META**STRONGYLOIDEA**: PSEUDALIDAE) AND VERMINOUS PNEUMONIA IN BELUGA FROM QUEBEC, CANADA. LENA N MEASURES
- 2:00–2:15 (10) THE SEAL LUNGWORM, OTOSTRONGYLUS CIRCUMLITUS, (META**STRONGYLOIDEA**: CRENOSOMATIDAE) IN CANADIAN PINNIPEDS. LENA N MEASURES, EMMANUELLE BERGERON AND JEAN-FRANCOIS GOSSELIN
- 2:15–2:30 (11) EPIZOOTIOLOGY OF WHALEWORM, ANISAKIS SIMPLEX (NEMATODA: ASCARIDOIDEA) IN THE SAINT LAWRENCE ESTUARY, QUEBEC, CANADA. LENA N MEASURES, REJEAN HAYS AND MANON SIMARD
- 2:30–2:35 5-MINUTE SPECIAL: ALASKA JARGON
- 2:35–3:00 BREAK

**BIGHORN SHEEP**

*Moderator:* Dave Jessup

- 3:00–3:15 (12) BIGHORN SHEEP DIE-OFF IN THE DESERT: POINT EPIDEMIC AT A WATER SOURCE. PAMELA K SWIFT, JOHN WEHAUSEN, HOLLY ERNEST, RANDALL SINGER, ANDY PAULI, AND TONIE ROCKE
- 3:15–3:30 (13) EFFICACY OF A MULTIVALENT PASTEURELLA HAEMOLYTICA TOXOID-BACTERIN IN PROTECTING CAPTIVE BIGHORN SHEEP (OVIS CANADENSIS) FROM CHALLENGE WITH PATHOGENIC PASTEURELLA HAEMOLYTICA. BRITA J KRAABEL, MICHAEL W MILLER, JENNIFER A CONLON, AND HEATHER J McNEIL
- 3:30–3:45 (14) AN ATTEMPT TO CONTROL A BIGHORN SHEEP PNEUMONIA DIE-OFF BY DEPOPULATION OF EXPOSED ANIMALS. WILLIAM J FOREYT, BRIGGS HALL, AND DAVID HUNTER
- 3:45–4:00 (15) REVIEW OF DISEASES ASSOCIATED WITH A DIE-OFF OF BIGHORN SHEEP IN A TRI-STATE AREA SURROUNDING THE SNAKE RIVER. D HUNTER, B FOREYT, K RUDOLPH, AND B HALL
- 4:00–4:15 (16) HELLS CANYON BIGHORN SHEEP 20/20 VISION - DISEASE PERSPECTIVE. D HUNTER AND B FOREYT

- 4:15–4:30 (17) **IMPROVING BIGHORN SHEEP POPULATION PERFORMANCE VIA ANTHELMINTIC TREATMENT: EXPERIMENTAL EVALUATION OF MANAGEMENT ALTERNATIVES.** MW MILLER, J VAYHINGER, SP ROUSH, TE VERRY, AN TORRES, AND VD JURGENS
- 4:30–4:45 (18) **A COMPARISON OF GENETIC VARIATION OF MAJOR HISTOCOMPATIBILITY COMPLEX AND MICROSATELLITE LOCI IN BIGHORN SHEEP.** WALTER M BOYCE, PHILIP W HEDRICK, STEVE KALINOWSKI, NOELLE E MUGGLI-COCKETT, MARIA CECILIA T PENEDO, AND ROB R RAMEY II

**TUESDAY, JULY 23**

POSTER PRESENTATIONS WILL BE SET UP BY TUESDAY MORNING. AUTHORS OF POSTERS WILL BE PRESENT DURING THE TUESDAY MORNING AND TUESDAY AFTERNOON COFFEE BREAKS IN ORDER TO ANSWER QUESTIONS.

**BRUCELLOSIS**

*Moderator:* Tom Thorne

- 8:30–8:45 (19) **EPIDEMIOLOGY AND PATHOGENESIS OF BRUCELLOSIS IN YELLOWSTONE NATIONAL PARK (YNP) BISON (BISON BISON), PRELIMINARY REPORT.** THOMAS J ROFFE, JACK C RHYAN, KEITH AUNE, L MICHAEL PHILO, MICHAEL GILSDORF, STEVE OLSEN, THOMAS GIDLEWSKI, AND DARLA R EWALT
- 8:45–9:00 (20) **SEROLOGY AND INFECTION WITH BRUCELLOSIS IN YELLOWSTONE NATIONAL PARK BISON (BISON BISON).** THOMAS J ROFFE, JACK C RHYAN, KEITH AUNE, L MICHAEL PHILO, DARLA R EWALT
- 9:00–9:15 (21) **ORAL ADMINISTRATION OF A ROUGH DERIVATIVE OF BRUCELLA ABORTUS TO WILD UNGULATES.** PH ELZER, DS DAVIS, WA ROTENBERGER, SD HAGIUS, MB FATEMI, JV WALKER, FM ENRIGHT, GG SCHURIG, AND JD KOPEC
- 9:15–9:30 (22) **EFFICACY OF BRUCELLOSIS VACCINATION OF FREE-RANGING ELK IN THE GREATER YELLOWSTONE AREA: THE FIRST 10 YEARS.** SCOTT SMITH, E TOM THORNE, SANDY ANDERSON-PISTONO, AND TERRY J KREEGER

9:30–9:35 5-MINUTE SPECIAL: WEATHER AND DAY LENGTH

9:35–10:00 BREAK

**STUDENT PAPERS**

*Moderator:* Todd O'Hara

- 10:00–10:15 **(23) A NEW GENUS OF PROTOSTRONGYLID LUNGWORM IN MUSKOXEN, UMINGMAKSTRONGYLUS PALLIKUUKENSIS: EXPERIMENTAL INFECTIONS AND ASPECTS OF LARVAL ECOLOGY.** SUSAN KUTZ, ERIC HOBERG, AND LYDDEN POLLEY
- 10:15–10:30 **(24) ATTEMPTED INFECTION OF MULE DEER (ODOCOILEUS HEMIONUS) WITH MORAXELLA OVIS ISOLATED FROM A MULE DEER WITH KERATOCONJUNCTIVITIS.** SA DUBAY AND ES WILLIAMS
- 10:30–10:45 **(25) SIXTEEN YEARS OF LEAD POISONING IN EAGLES (1980-1995): AN EPIZOOTIOLOGIC VIEW.** JANET L KRAMER
- 10:45–11:00 **(26) DISTRIBUTION OF INTERMEDIATE HOSTS OF MENINGEAL WORM IN RELATION TO MOOSE IN NORTHERN MICHIGAN.** PAMELA J BOPPEL AND WILLIAM M SAMUEL
- 11:00–11:15 **(27) MOUNTAIN LION DNA ANALYSIS: ECOLOGICAL GENETICS AND FORENSICS.** HOLLY ERNEST, WALTER BOYCE, AND MICHAEL SYVANEN
- 11:15–11:30 **(28) THE TEMPORAL EPIDEMIOLOGY OF BLUETONGUE VIRUS IN A BIGHORN SHEEP POPULATION.** RANDALL SINGER, WALTER BOYCE, AND AMY FISHER
- 11:30–11:45 **(29) PATHOLOGIC FINDINGS IN KIT FOXES (VULPES MACROTIS MUTICA) AND DEER MICE (PEROMYSCUS MANICULATUS) INHABITING AN OIL FIELD IN THE SOUTHERN SAN JOAQUIN VALLEY OF CALIFORNIA.** KRISTIN G CHARLTON, DAVID W HIRD, STEVEN M GRIFFEY, JOSEPH G ZINKL, AND LINDA K SPIEGEL
- 11:45–12:00 **(30) NATURAL TRANSMISSION OF UPPER RESPIRATORY TRACT DISEASE: HORIZONTAL, VERTICAL, OR BOTH?** GRACE S McLAUGHLIN, IM SCHUMACHER, DR BROWN, PA KLEIN, MB BROWN, AND ER JACOBSON
- 12:00–1:15 LUNCH AND WDA BUSINESS MEETING

**INVITED SPEAKER - THEO COLBORN**

- 1:15–1:45 **(31) ENDOCRINE DISORDERS IN WILDLIFE ASSOCIATED WITH ENVIRONMENTAL CONTAMINANTS.** THEO COLBORN

ENVIRONMENTAL CONTAMINATION

*Moderator:* Jim Sikarskie

- 1:45–2:00 (32) **ECOLOGICAL RISK ASSESSMENT OF MINING ACTIVITIES IN THE OQUIRRH MOUNTAINS, UTAH.** A FAIRBROTHER, LA KAPUSTKA, RS BENNETT, E DORWARD-KING AND WJ ADAMS
- 2:00–2:15 (33) **UPDATE ON CALIFORNIA'S OILED WILDLIFE CARE NETWORK (OWCN) AND OSPR VETERINARY SERVICES.** DAVID A JESSUP AND JONNA AK MAZET
- 2:15–2:30 (34) **CHANGES IN HEMATOLOGIC AND CLINICAL CHEMISTRY VALUES FOLLOWING PETROLEUM PRODUCT EXPOSURE ON MINK AS A MODEL FOR SEA OTTERS.** JONNA AK MAZET, IAN A GARDNER, DAVID A JESSUP, WALTER M BOYCE, AND LINDA J LOWENSTINE
- 2:30–2:45 (35) **RECOMBINANT CELL BIOASSAY FOR THE DIRECT DETECTION OF POLYCYCLIC AROMATIC HYDROCARBONS IN THE SERUM OF FREE-RANGING BIRDS AND MAMMALS.** MICHAEL ZICCARDI, IAN A GARDNER, WJ ROGERS AND MICHAEL S DENISON
- 2:45–2:50 5-MINUTE SPECIAL: RIVERS, MOUNTAINS, AND GLACIERS - ALASKA GEOGRAPHY
- 2:50–3:15 BREAK

*Moderator:* Anne Fairbrother

- 3:15–3:30 (36) **ALASKA NORTH SLOPE MOOSE: MINERALS, METALS, AND MORTALITY?** TODD O'HARA AND GEOFF CARROLL
- 3:30–3:45 (37) **CADMIUM IN ARCTIC ALASKA WILDLIFE: KIDNEY AND LIVER RESIDUES.** TODD O'HARA AND ANNE FAIRBROTHER
- 3:45–4:00 (38) **CAUSES OF FLOODPLAIN WILDLIFE MORTALITY DOWNSTREAM FROM MINING ACTIVITIES IN THE COEUR D'ALENE RIVER BASIN, NORTHERN IDAHO, 1992-1995.** LYNN H CREEKMORE, DANIEL J AUDET, J CHRISTIAN FRANSON, MILTON R SMITH, LOUIS SILEO, CAROL U METEYER

ENDANGERED SPECIES

- 4:00–4:15 (39) **PLAGUE IN ORALLY EXPOSED BLACK-FOOTED FERRET X SIBERIAN POLECAT HYBRIDS.** ELIZABETH S WILLIAMS, KENNETH MILLS, AMY BOERGER-FIELDS, AND SANDY ANDERSON
- 4:15–4:30 (40) **INTENSIVE MANAGEMENT OF AN ENDANGERED SPECIES: LONG-TERM EFFECTS OF CHEMICAL IMMOBILIZATION AND DEHORNING ON HEALTH AND REPRODUCTION IN A DISCRETE POPULATION OF BLACK RHINOCEROS IN ZIMBABWE.** MICHAEL D KOCK AND MARK W

- ATKINSON  
 4:30–4:45 (41) **PATHOLOGICAL FINDINGS IN FREE-RANGING ZIMBABWEAN BLACK RHINOCEROSSES (DICEROS BICORNIS): A SUMMARY.** ND KOCK, C FOGGIN, AND MD KOCK

**WEDNESDAY, JULY 24**

**DEER**

*Moderator:* Randy Davidson

- 8:30–8:45 (42) **AN EPIZOOTIC OF HEMORRHAGIC DISEASE IN CAPTIVE AND FREE-RANGING WHITE-TAILED DEER IN MISSISSIPPI.** TM O'HARA, HJ JACOBSON, T ENGELKEN, SW JACK, DE STALLKNECHT, AND E HOWERTH
- 8:45–9:00 (43) **LYMPHOCYTE SUBSET ALTERATIONS IN PERIPHERAL BLOOD AND LYMPH NODES OF WHITE-TAILED DEER INFECTED WITH EPIZOOTIC HEMORRHAGIC DISEASE VIRUS.** CHARLOTTE F QUIST, LYNDA C KELLEY, DENISE I BOUNOUS, AND ELIZABETH W HOWERTH
- 9:00–9:15 (44) **CHRONIC WASTING DISEASE IN DEER AND ELK: EPIZOOTIOLOGICAL EVIDENCE OF LATERAL TRANSMISSION.** MW MILLER<sup>1</sup>, MA WILD<sup>1</sup>, ES WILLIAMS<sup>2</sup>, AND ET THORNE<sup>3</sup>
- 9:15–9:30 (45) **BOVINE TUBERCULOSIS IN FREE-RANGING WHITE-TAILED DEER IN MICHIGAN.** STEPHEN M SCHMITT, SCOTT D FITZGERALD, THOMAS M COOLEY, COLEEN BRUNING-FANN, LANG SULLIVAN, DALE BERRY, AND JAMES G SIKARSKIE
- 9:30–9:45 (46) **TUBERCULOSIS IN MICHIGAN WHITE-TAIL DEER (ODOCOILEUS VIRGINIANUS).** JANET B PAYEUR AND JERALD L JARNAGIN
- 9:45–9:50 5-MINUTE SPECIAL: ALASKA'S OIL INDUSTRY

9:50–10:15 BREAK

*Moderator:* Steve Schmitt

- 10:15–10:30 (47) **EVIDENCE OF INFECTION BY A PRESUMABLY NOVEL EHRLICHIA-LIKE ORGANISM AMONG WHITE-TAILED DEER (ODOCOILEUS VIRGINIANUS) AND LONE STAR TICKS (AMBLIOMMA AMERICANUM).** SUSAN E LITTLE, JACQUELINE E DAWSON, CYNTHIA WARNER, J MITCHELL LOCKHART, DAVID E STALLKNECHT, AND WILLIAM R DAVIDSON
- 10:30–10:45 (48) **FACTORS AFFECTING DISTRIBUTION OF MENINGEAL WORM, PARELAPHOSTRONGYLUS TENUIS (NEMATODA), IN MANITOBA AND SASKATCHEWAN (CANADA), AND NORTH DAKOTA (USA).** SHAWN M WASEL, WILLIAM M SAMUEL, AND VINCE



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- CRICHTON
- 10:45–11:00 (49) **PARELAPHOSTRONGYLUS TENUIS ON WASSAW ISLAND, GEORGIA: A RESULT OF WHITE-TAILED DEER TRANSLOCATION.** WILLIAM R DAVIDSON, GARY L DOSTER, RON C FREEMAN
- 11:00–11:15 (50) **NATURALLY OCCURRING EHRlichia CHAFFEENSIS INFECTION AMONG WHITE-TAILED DEER (ODOCOILEUS VIRGINIANUS) AND LONE STAR TICKS (AMBLyOMMA AMERICANUM).** J MITCHELL LOCKHART, SUSAN E LITTLE, DAVID E STALLKNECHT, JACQUELINE E DAWSON, CYNTHIA WARNER, AND WILLIAM R DAVIDSON
- 11:15–11:45 SPECIAL PRESENTATIONS BY A WILDLIFE USER AND A WILDLIFE MANAGER
- 11:45–1:00 LUNCH

## VIRAL DISEASES OF TERRESTRIAL MAMMALS

*Moderator:* Beth Williams

- 1:00–1:15 (51) **THE ROLE OF WILDLIFE IN THE EPIDEMIOLOGY OF RABIES IN KIBWEZI DIVISION, MAKUENI DISTRICT, KENYA.** GITHAIGA J KAMAU, JOHN J McDERMOTT, AND WILLIAM O OGARA
- 1:15–1:30 (52) **SAFETY AND EFFICACY OF AN ATTENUATED RABIES VIRUS VACCINE IN COYOTES.** CE RUPPRECHT, M FEKADU, J SHADDOCK, D SANDERLIN, AND C SCHUMACHER

- 1:30–1:45 (53) **NEW YORK STATE CAPITAL REGION WILDLIFE RABIES VACCINATION: FIRST EVALUATION IN AN ENZOOTIC AREA.** CATHLEEN HANLON, AMY WILLSEY, BRIAN LANIEWICZ, CHARLES RUPPRECHT, CHARLES TRIMARCHI, AND JOHN DEBBIE
- 1:45–2:00 (54) **PREVALENCE OF ANTIBODY TO CANINE PARVOVIRUS-2, INFECTIOUS CANINE HEPATITIS, CANINE DISTEMPER AND RABIES IN GRAY WOLVES (CANIS LUPUS) FROM ALGONQUIN PARK, ONTARIO.** IAN K BARKER, JOHN THEBERGE, P SUZANNE CARMAN, AND ALEXANDER I WANDELER
- 2:00–2:15 (55) **SUSCEPTIBILITY OF PEROMYSCUS MANICULATUS TO INFECTION WITH VESICULAR STOMATITIS VIRUS NEW JERSEY SEROTYPE.** ELIZABETH W HOWERTH, DAVID E STALLKNECHT, AND JUDY MADDOX
- 2:15–2:30 (56) **NEW DISEASES (EUROPEAN BROWN HARE SYNDROME AND PHOCEN MORBILLIVIRUS) IN WELL ESTABLISHED WILDLIFE POPULATIONS.** BJARNE CLAUSEN, ERIK RATTENBORG AND HANS HENRIK DITZ
- 2:30–2:45 (57) **DIFFERENTIAL DETECTION OF MALIGNANT CATARRHAL FEVER VIRUSES IN CAPTIVE EXOTIC RUMINANTS BY POLYMERASE CHAIN REACTION AMPLIFICATION USING PRIMERS DERIVED FROM ALCELAPHINE HERPESVIRUS 1 AND OVINE HERPESVIRUS 2.** STACY M SUTTON, ROBERT B KLIEFORTH, AND WERNER P HEUSCHELE
- 2:45–2:50 5-MINUTE SPECIAL: HUNTING, FISHING, AND TRAPPING
- 2:50–3:15 BREAK

**CHEMICAL IMMOBILIZATION**

*Moderator:* Terry Kreeger

- 3:15–3:30 (58) **FIELD EXPERIENCE WITH ETORPHINE AND CARFENTANIL IMMOBILIZATION OF FREE-RANGING BISON (BISON BISON) IN YELLOWSTONE NATIONAL PARK.** THOMAS J ROFFE, DAVID HUNTER, AND KEITH AUNE
- 3:30–3:45 (59) **THE USE OF PHARMACOLOGICAL AGENTS IN WILDLIFE.** MARK L DREW

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- 3:45–4:00 (60) **FIELD ANESTHESIA AND MONITORING OF HOWLING MONKEYS (ALOUATTA PALLIATA) IN COSTA RICA.** STEPHANIE D SHAW, KENNETH E GLANDER, AND MARK F TEAFORD
- 4:00–4:15 (61) **REVERSIBLE IMMOBILIZATION OF ARCTIC UNGULATES USING MEDETOMIDINE-KETAMINE AND ATIPAMEZOLE.** JON M ARNEMO, AS BLIX, AND T SOVERI
- 4:15–4:30 (62) **CHEMICAL IMMOBILIZATION OF ROTHSCHILD'S GIRAFFE (GIRAFFA CAMELOPARDALIS ROTHSCHILDI) IN LAKE NAKURU NATIONAL PARK AND A REVIEW OF SOME BLOOD PARAMETERS.** JACOB M MWANZIA, JOHN M WAMBUA, DENIS MUDAKHA AND JOHN KANYINGI

**THURSDAY, JULY 25**

## BIRDS

*Moderator:* Tonie Rocke

- 8:30–8:45 (63) **EFFECT OF HOLDING TIME ON COMPLETE BLOOD COUNT VALUES IN HAWAIIAN COMMON AMAKIHI.** J GREGORY MASSEY, HELEN BAKER, KEVEN FLAMMER
- 8:45–9:00 (64) **NECROPSY FINDINGS IN LOONS IN ONTARIO, 1989-1995.** DOUGLAS CAMPBELL, IK BARKER, EM ADDISON, AND A SCHEUHAMMER
- 9:00–9:15 (65) **A MULTIFACTORIAL ETIOLOGIC BASIS FOR WINTER MORTALITY OF COMMON LOONS (GAVIA IMMER) IN FLORIDA COASTAL WATERS.** DONALD J FORRESTER, WILLIAM R DAVIDSON, ROBERT E LANGE, JR, RICHARD K STROUD, AND J CHRISTIAN FRANSON
- 9:15–9:30 (66) **MORBIDITY AND MORTALITY OF RAPTORS IN FLORIDA: A SEVEN YEAR RETROSPECTIVE STUDY.** SHARON L DEEM, SCOTT P TERRELL, AND DONALD J FORRESTER
- 9:30–9:45 (67) **WHOOPING CRANES IN FLORIDA: THE HEALTH OF AN EXPERIMENTALLY RELEASED POPULATION.** MARILYN G SPALDING, STEPHEN A NESBITT, ROBERT C MCLEAN, J MIKE KINSELLA, AND TANIA A CAMES
- 9:45–9:50 5-MINUTE SPECIAL: DOG MUSHING
- 9:50–10:15 BREAK
- Moderator:* Helen Schwantje
- 10:15–10:30 (68) **MYCOPLASMA GALLISEPTICUM IN A CAPTIVE FLOCK OF HOUSE FINCHES: FIELD IMPLICATIONS.** DAVID E STALLKNECHT, M PAGE LUTTRELL, JOHN R FISCHER, AND JOE L CORN
- 10:30–10:45 (69) **REASONABLE OVEREXERTION, A METHOD FOR CAPTURING STEPPE EAGLES (AQUILA NIPALENSIS) IN THE WILD: EVALUATION OF PHYSIOLOGICAL STRESS AND EFFORT RECUPERATION.** STÉPHANE OSTROWSKI, STÉPHANE HÉMON, AND PATRICK PAILLAT
- 10:45–11:00 (70) **BLOOD LEAD CONCENTRATIONS OF SPECTACLED EIDERS NEAR THE KASHUNUK RIVER, YUKON-KUSKOKWIM DELTA, ALASKA.** LYNN H CREEKMORE, J CHRISTIAN FRANSON, MARGARET R PETERSEN, AND MILTON R SMITH
- 11:00–11:15 (71) **NATURAL AND EXPERIMENTAL AVIAN MORTALITY RELATED TO POTASH PROCESSING IN SOUTHEASTERN NEW MEXICO.** FJ DEIN, LA BAETEN, MK MOORE, CU METEYER, MD SAMUEL, AND CW JESKE
- 11:15–11:30 (72) **CALCIUM DEFICIENT RICKETS IN CATTLE EGRETS (BUBULIS IBIS) IN EAST CENTRAL TEXAS.** DAVID N PHALEN,

# WDA<sub>ALASKA</sub> '96

11:30–12:00 MARK L DREW, DAVID L GRAHAM, AND CINDY HOBSON  
CELEBRITY DEBATE—"ARE DISEASES REALLY BAD FOR WILDLIFE??"

12:00–1:00 LUNCH

## GENERAL SESSION

*Moderator:* Mike Miller

- 1:00–1:15 **(73) EVIDENCE FOR COWDRIA RUMINANTIIUM INFECTION IN WILDLIFE SPECIES IN ZIMBABWE.** ND KOCK, F JONGEJAN; AHM VAN VLIET, AND K CHARLTON
- 1:15–1:30 **(74) SEROLOGIC SURVEY FOR INFECTIOUS PATHOGENS IN FREE-RANGING AMERICAN BISON (BISON BISON).** SHARON K TAYLOR, V MICHAEL LANE, DAVID L HUNTER, KENDAL G EYRE, SANDRA KAUFMAN, STEPHEN FRYE, AND MARK R JOHNSON
- 1:30–1:45 **(75) ECOLOGICAL INVESTIGATION OF WILDLIFE DISEASE TRANSMISSION: A CASE STUDY IN FLORIDA.** DONALD F COYNER, MARILYN G SPALDING, AND DONALD J FORRESTER

- 1:45–2:00 (76) ESTIMATING POPULATIONS OF YELLOW GRUB (CLINOSTOMUM MARGINATUM) IN SMALLMOUTH BASS AND CHANNEL CATFISH. JAMES J DALY, JEUREL SINGLETON, BRUCE DEYOUNG, AND JAMES ALMOND
- 2:00–2:15 (77) NEURONAL VACUOLATION (SUSPECT SPONGIFORM ENCEPHALOPATHY) IN RACCOONS (PROCYON LOTOR). AMIR N HAMIR, JERRY R HEIDEL, REBECCA A PICTON, AND CHARLES E RUPPRECHT
- 2:15–2:30 (78) "NAME THAT BILL": A LOOK AT SOME WILDLIFE LEGISLATION INTRODUCED TO THE UNITED STATES SENATE IN THE 104TH CONGRESS. STEPHANIE D SHAW
- 2:30–2:45 (79) INVESTIGATION, CONTROL AND EPIZOOTIOLOGY OF ANTHRAX IN A GEOGRAPHICALLY ISOLATED, FREE-ROAMING BISON POPULATION IN NORTHERN CANADA. C CORMACK GATES, BRETT T ELKIN, AND DANIEL C DRAGON
- 2:45–3:15 BREAK

*Moderator:* Buffy Howerth

- 3:15–3:30 (80) DISEASES AND ANOMALIES OF THE FLORIDA BLACK BEAR. MIKE R DUNBAR
- 3:30–3:45 (81) POTENTIAL VALUE OF IN VITRO ANTIGEN-SPECIFIC IFN-GAMMA ASSAYS FOR THE DIAGNOSIS OF TUBERCULOSIS, BRUCELLOSIS AND INFECTIOUS BOVINE RHINOTRACHEITIS IN BISON HERDS IN BELGIUM. GODFROID JACQUES AND FRANCK BOCLAERT
- 3:45–4:00 (82) PATHOLOGY AND EPIDEMIOLOGY OF OROPHARYNGEAL FIBROPAPILLOMAS IN HAWAIIAN GREEN TURTLES (CHELONIA MYDAS). A ALONSO AGUIRRE, GEORGE H BALAZS, AND TERRY R SPRAKER
- 4:00–4:15 (83) HEALTH STATUS MONITORING OF A COLONY OF TRANSLOCATED GOPHER TORTOISES (GOPHERUS POLYPHEMUS). BONNIE L RAPHAEL, JEFF SPRATT, JOHN L BEHLER, ELLEN S DIERENFELD, ROYCE HAYES, AND BRAD WINN
- 4:15–4:30 (84) TECHNIQUE FOR SURGICAL IMPLANTATION OF TRANSMITTERS IN SNAKES. BONNIE L RAPHAEL, PAUL P CALLE, WILLIAM B KARESH, JESUS RIVAS, AND DWIGHT LAWSON

# WDA<sub>ALASKA</sub> '96

- 4:30–4:45      **(85) A HEALTH MONITORING PROGRAM IN THE WILLOW GROUSE (*LAGOPUS LAGOPUS*).** TORSTEN MÖRNER AND ROLF BRITTAS
- 4:45–5:00      **(86) CHRONIC NECROTIC COLITIS IN MOOSE (*ALCES ALCES*).** DOLORES GAVIER-WIDÉN, CARL HÅRD AF SEGERSTAD, RONNY LINDBERG, AND TORSTEN MÖRNER

**(1) THE ECOLOGY OF TULAREMIA IN TAIGA AND TUNDRA IN THE HOLOARCTIC REGION**

CLUFF E HOPLA, Department of Zoology, University of Oklahoma, Norman, Oklahoma 73019-0235 USA

*Abstract:* The ecology of tularemia organisms (*Francisella tularensis*) within the taiga and tundra biomes of the Nearctic and Palearctic regions (Holarctic) will be presented. The ecology of tularemia organisms in boreal North America (Subarctic and Arctic regions) will be emphasized. While a hare-tick cycle may exist in portions of the taiga, it is not as important as the microtine rodent-water-flea cycle, especially in the tundra. The microtine rodent-water-flea cycle in the tundra is less complicated due to the smaller number of species of animals involved; this cycle can exist in the absence of a tick-lagomorph cycle. A concept that the microtine-flea-water cycle is the primary cycle in taiga and tundra and the more primitive cycle will be discussed.

**(2) "MAKING IT" IN A COLD DRY WORLD: PARASITE SURVIVAL STRATEGIES**

MJ PYBUS, Wildlife Disease Specialist, Alberta Fish and Wildlife



## (3) RANGIFERINE BRUCELLOSIS IN THE ARCTIC

ROBERT A DIETERICH

## (4) ENVIRONMENTAL CHANGES AND POLLUTION IN THE ARCTIC - THE EFFECT ON ARCTIC WILDLIFE

TORSTEN MÖRNER<sup>1</sup> AND BJARNE CLAUSEN<sup>2</sup>

<sup>1</sup>Department of Wildlife, National Veterinary Institute, PO Box 7073, 750 07 Uppsala, Sweden

<sup>2</sup>National Environmental Research Institute, PO Box 358, DK-Roskilde, Denmark

*Abstract:* The arctic environment and climate is to a great extent dominated by the low temperatures all year-round and that only a limited number of plant and animal species and microorganisms can survive under these harsh conditions. A common pattern observed in animal populations in the arctic is also the cyclic fluctuations of animal numbers, with peaks followed by crashes and mass mortality. The arctic ecology is also very vulnerable in that small changes caused by environmental factors or pollution, or introduction of new species or diseases, can lead to dramatic ecological changes within the ecology and animal populations, which have happened in some parts of the arctic. The effects caused by environmental factors or introductions can be either permanent or temporal. Examples of permanent factors related to mans activity are the establishment of human urbanization, mines, factories, oil winning or military activity and testing of military equipment. The local area and environment around most of these activities are normally most affected, but transportation by air can cause pollution in areas far from the pollution site, like in northern Norway where the air pollution originates from a Russian nickel smelter factory many kilometers eastwards. Examples of temporal factors affecting the ecology is human activities such as overfishing, uncontrolled hunting or overgrazing by reindeer or domestic animals. Even if these factors are temporal they can cause long-term disturbances in the arctic which may take decades to repair. The introduction of domestic animals as well as new wild species is always a great risk since these introductions can lead to the entrance of new parasites or other microbes that in many cases have a devastating effect in the resident animal populations with uncontrolled outbreaks of these new diseases.

**(5) WILDLIFE DISEASES: IMPLICATIONS FOR RESOURCE HARVESTING AND UTILIZATION IN THE NORTHWEST TERRITORIES, CANADA**

BRETT T ELKIN, Department of Renewable Resources, Government of the Northwest Territories, 600, 5102-50 Ave, Yellowknife, NWT, Canada X1A 3S8

*Abstract:* A number of enzootic diseases and parasites occur in big game species found in the arctic and subarctic regions of northern Canada. These can have a number of implications for the subsistence, sport and commercial harvesting of wildlife. In the Northwest Territories, the sustainable harvesting of wildlife resources is very important to the economy and lifestyles of northern residents. Subsistence harvesting of "country foods" has important nutritional, social and cultural significance in most communities, where imported alternatives of similar nutritional value are more expensive and not always readily available. The skills and experience acquired by subsistence harvesters are important in recognizing diseases and parasites in wildlife, and their implications for food quality and safety. Hunters generally select against obviously diseased animals in order to avoid condemnation of the carcass and loss of hunting effort. Zoonotic diseases such as brucellosis in caribou can have direct human health implications for resource harvesters, and may influence carcass utilization and harvesting patterns. Nonzoonotic conditions which affect the aesthetic value of a carcass, such as *Taenia krabbei*, can also influence the disposition of a harvested animal. It is important to recognize that both real and perceived changes to the health of wildlife can influence utilization of an individual animal, and possibly influence future harvesting activities. Public education on wildlife diseases and parasites is important, but must take into account the broader health, economic and social consequences of any advice that may influence harvesting or consumption patterns.

## (6) HERPES-LIKE VIRUS INFECTION IN 54 HARBOR SEALS (*PHOCA VITULINA*) STRANDED IN CENTRAL CALIFORNIA, 1990-1995

FMD GULLAND<sup>1</sup>, L LOWENSTINE<sup>2,4</sup>, D KING<sup>1,2</sup>, T SPRAKER<sup>3</sup>, AND JM LAPOINTE<sup>2</sup>

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<sup>4</sup>Zoological Society of San Diego, California 92027 USA

*Abstract:* Intranuclear inclusion bodies typical of herpes virus infection were observed in adrenal cortical cells and hepatocytes of 33% (54/162) of harbor seal (*Phoca vitulina richardsii*) pups examined histopathologically at The Marine Mammal Center, Sausalito, California. Animals died between 0 and 62 days following admission to the center, the majority of cases occurring between mid April and mid May in each year from 1990 to 1995. Prevalence of inclusion bodies did not differ between the sexes (29/96 males, 25/65 females), but was greatest in pups that stranded in Monterey county (24/33, 73%) and lowest in pups that stranded in Humboldt county (1/13, 7.7%). Clinical signs of infection varied from chronic weight loss to sudden death. On post-mortem examination, 19 of the 54 affected pups showed no gross lesions other than adrenocortical atrophy. Histologic examination revealed acute multifocal adrenocortical and hepatic necrosis, with amorphous, smudgy intranuclear inclusions typical of herpes virus infections. Syncytia were sometimes present in the adrenals but not in the liver. The other 35 pups had a variety of lesions including, in decreasing order of frequency, omphalitis, suppurative bronchopneumonia, meningitis, enterocolitis, cutaneous abscesses and septic arthritis. These animals had similar inclusions in adrenal cortical cells and hepatocytes. Transmission electron microscopic examination of adrenal glands with inclusion bodies revealed icosahedral viral particles, about 100 nm in diameter, both with and without outer envelopes. Primary adrenal cell cultures were established from harbor seals, and inoculated with adrenal gland homogenate from animals with inclusion bodies. Cytopathic effect (cell rounding and plaque formation) was observed in the primary cell lines, but could not be transmitted to Vero cell lines.

**(7) EVIDENCE OF BRUCELLOSIS IN PACIFIC HARBOR SEALS (*PHOCA VITULINA RICHARDSI*) AND CALIFORNIA SEA LIONS (*ZALOPHUS CALIFIRNIANUS*) FROM PUGET SOUND, WASHINGTON**

DL LAMBOURN<sup>1</sup>, SJ JEFFRIES<sup>1</sup>, PB HALL<sup>2</sup>, PG GEARIN<sup>3</sup>, LM POLZIN<sup>4</sup>, DR EWALT<sup>5</sup>, AND JB PAYEUR<sup>5</sup>

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<sup>3</sup>National Marine Mammal Laboratory, 7600 Sand Point Way, Seattle, Washington 98115 USA

<sup>4</sup>Washington Department of Agriculture, 3939 Cleveland Ave. SE, Olympia, Washington 98501 USA

<sup>5</sup>National Veterinary Services Laboratories, PO Box 844, Ames, Iowa 50010 USA

*Abstract:* As part of ongoing research activities being conducted by the Washington Department of Fish and Wildlife and National Marine Mammal Laboratory, blood samples were collected from harbor seals and California sea lions during capture and marking operations in the Puget Sound, Washington. Harbor seals were captured at Gertrude Island in southern Puget Sound as part of a long term research effort to monitor their overall status and health. Seals from this site have been screened for various diseases (Leptospirosis, Influenza, and Morbillivirus) in the past. Since 1994, tests have been conducted to screen for evidence of exposure to Brucellosis at this site as well. Serum collected from thirty harbor seals in 1994 were tested for exposure to *Brucella* and resulted in two with positive titres. In 1995 an additional 62 harbor seals were captured and screened for *Brucella*, resulting in 13 animals with positive titres and 7 additional animals with possible exposure. An additional 10 harbor seals recovered from area beaches were also tested and resulted in 3 animals with positive titres. Following their deaths, tissues from two of these seals were subsequently collected and sent to the National Veterinary Services Laboratories for culture. A *Brucella* organism was subsequently isolated from both seals and appears to be similar to a *Brucella* organism isolated from a seal in the United Kingdom. The *Brucella* organism was isolated from the following tissues: lymph nodes (inguinal, supraclavicle, subclavical, and mesenteric), liver, and lung. Disease screening on California sea lions was conducted as part of ongoing capture and marking operations near the Ballard Locks in Seattle. Testing of 50 sea lions captured in 1994 and 1995 showed 4 animals with high positive titres for *Brucella*. One of these animals was found moribund and showed high *Brucella* titres. Attempts at culturing *Brucella* from various tissues from this animal were unsuccessful. At this time, the significance of *Brucella* isolation in Pacific harbor seals and California sea lions from Puget Sound remains unclear. It should be noted, however, that livestock in Washington are considered *Brucella* free and the potential exists in some areas for contact between *Brucella* positive pinnipeds and livestock. Additionally, there is also some risk of *Brucella* transmission to humans due to the large numbers of stranded pinnipeds handled each year in the Northwest. In order to address this issue, continued monitoring of Brucellosis exposure in regional pinniped species has been proposed.

## (8) A REPORT OF THE MANATEE EPIZOOTIC OF 1996

SCOTT D WRIGHT, Department of Environmental Protection, Florida Marine Research Institute, Marine Mammal Pathobiology Laboratory, St. Petersburg, Florida 33711 USA

*Abstract:* Throughout nearly 8 weeks, 155 manatee carcasses were recovered from a 80 nautical mile expanse of the southwest coast of Florida. This event occurred following an extremely cold and persistent winter and in the presence of an extreme Red Tide. Although the event lasted 8 weeks, peak mortality (11 carcasses a day) occurred within the first few weeks. A large portion of the carcasses were in very fresh condition, however, no sick animals were reported during the height of the event. Four sick animal were recovered during the last weeks of the event. Gross findings include: inflammation and congestion of the nasal mucosa, congestion of the meninges and choroid plexus, mildly swollen and congested liver and kidneys, and bilateral diffuse congestion and edema of the lungs. Severe pulmonary lesions included a thick ropery serosanguinous exudate throughout the primary and secondary airways. Microscopically, the major inflammatory response was principally mononuclear and contained within the nasal mucosa. Other lesions include a marked hemosiderosis in the liver, spleen, and kidneys and a mild nonsuppurative leptomeningitis. Carcass condition and microscopic findings suggest a rapid death. An investigation was launched almost immediately and involves over 16 collaborators worldwide. At this writing, no conclusive evidence of a potential etiologic agent(s) has been found.

**(9) LUNGWORMS (METASTRONGYLOIDEA:PSEUDALIDAE) AND VERMINOUS PNEUMONIA IN BELUGA FROM QUEBEC, CANADA**

LENA N MEASURES, Department of Fisheries and Oceans, Maurice Lamontagne Institute, PO Box 1000, Mont-Joli, Quebec, Canada G5H 3Z4

*Abstract:* Lungs from two populations of beluga, *Delphinapterus leucas*, were examined for pseudaliid nematodes using a systematic protocol to estimate worm burdens. Both right and left lungs from the endangered population of the Saint Lawrence estuary beluga were collected from animals (N = 9) stranded during 1993, 1994 and 1995. One lung chosen at random from Arctic beluga (N = 14) from eastern Hudson Bay, Ungava Bay and Hudson Strait, Nunavik, Quebec were collected by Inuit hunters in 1994 and 1995. Principally, two pseudaliid nematodes were found in beluga: a small lungworm, *Halocercus monoceris*, and a large lungworm, *Stenurus arctomarinus*. *Stenurus arctomarinus* was more prevalent (71%) with greater intensities of infection (2-544, mean = 121) in Arctic beluga than in Saint Lawrence beluga (44%, intensities of 4 - 10, mean = 6). In contrast, *Halocercus monoceris* was more prevalent (89%) with greater intensities of infection (9 - 12,561, mean = 3026) in Saint Lawrence beluga than in Arctic beluga (29%, intensities of 4-16, mean = 27). Beluga were first observed infected with either lungworm when they attained a minimum length of 2.0 meters. *Stenurus arctomarinus* was usually found in major airways (bronchi, large bronchioles) while *Halocercus monoceris* was usually found in minor airways (small bronchioles). Histopathological data, available for Saint Lawrence beluga (N = 7) only, indicated that 4 of 7 had verminous pneumonia with at least one having significant lesions contributing to death.

**(10) THE SEAL LUNGWORM, *OTOSTRONGYLUS CIRCUMLITUS*,  
(META**STRONGYLOIDEA**: CRE**NOSOMATIDAE**) IN CANADIAN PINNIPEDS**

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*Abstract:* The lungs and heart from over 650 pinnipeds were examined for the crenosomatid nematode, *Otostrongylus circumlitus*. Seals were collected by hunters, found stranded or collected from the cod fishery bycatch on the Northwest Atlantic and arctic coast of Canada. *Otostrongylus circumlitus* was found in 16 of 308 grey seals (*Halichoerus grypus*), 1 of 17 harbor seals (*Phoca vitulina*), 1 of 4 bearded seals (*Erignathus barbatus*), and 21 of 226 ringed seals (*Phoca hispida*). Harp seals, *Phoca groenlandica*, (N = 100) and one hooded seal, *Cystophora cristata*, were uninfected. Intensity of infection ranged from 1 to 77. The anterior end of worms was attached deep within lung tissue with the body of worms lying in bronchioles and bronchi as far anterior as the tracheal bifurcation. Infections were generally restricted to young-of-the year seals. Prevalence and intensity of infection was significantly related to sternal blubber thickness. Salluit in Arctic Quebec, where almost 50% of young-of-the-year ringed seals were infected, is an ideal enzootic site for further studies on the biology of this lungworm which may affect the recruitment of young seals to the population. Marine invertebrates and fish were exposed to first-stage larvae of *O. circumlitus* from infected seals. Larvae developed and moulted to the third stage within the intestinal wall of fish within 56 days. Fish are thus considered intermediate hosts in the life cycle of this metastrongyloid, although invertebrates may serve as paratenic hosts.

**(11) EPIZOOTIOLOGY OF WHALEWORM, *ANISAKIS SIMPLEX*  
(NEMATODA: ASCARIDOIDEA) IN THE SAINT LAWRENCE ESTUARY,  
QUEBEC, CANADA**

LENA N MEASURES, REJEAN HAYS AND MANON SIMARD, Department of Fisheries and Oceans, Maurice Lamontagne Institute, PO Box 1000, Mont-Joli, Quebec, Canada G5H 3Z4

*Abstract:* Whaleworm, *Anisakis simplex*, occurs principally in the first chamber of the stomach of marine mammals, usually cetaceans, which are the final host. In the Saint Lawrence estuary *A. simplex* has been found in 29 of 39 beluga, 5 of 5 minke whale, 59 of 78 harbor porpoise and 3 of 5 Atlantic white-sided dolphin. One blue whale was uninfected. Other species of cetaceans frequent the estuary on a seasonal basis but have yet to be examined. Marine invertebrates, such as krill (Euphausiacea), and various marine fish such as capelin and herring, which have been implicated as playing a role in the life cycle, were examined from the Saint Lawrence estuary for larval *Anisakis*. Over 560,000 krill (*Thysanoessa raschii* and *Meganyctiphanes norvegica*) were collected and examined for larval *Anisakis* sp. Overall abundance of larval *Anisakis* sp. was  $18.0 \times 10^{-5}$ . All but one larval *Anisakis* sp. were in the third stage and measured 23.4 to 28.5 mm long. Capelin and herring which frequent and spawn in the estuary and form an important component in the diet of various cetaceans were examined for larval *Anisakis* sp. An examination of 100 herring and 100 capelin indicated that almost 100% of herring and 5% of capelin harbored larval *Anisakis* sp. Larval *Anisakis* sp. in fish were in the third stage and were not statistically longer than those from krill nor than those found in the stomach of beluga. These data indicate that invertebrates such as krill are intermediate hosts, fish are transport or paratenic hosts and that fish-eating whales acquire infections of *A. simplex* from infected fish while krill-eating whales acquire infections directly from infected krill. In addition, these data demonstrate that the Saint Lawrence estuary is a suitable enzootic site for further epizootiological studies with *Anisakis simplex*.



## (12) BIGHORN SHEEP DIE-OFF IN THE DESERT: POINT EPIDEMIC AT A WATER SOURCE

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*Abstract:* During a routine telemetry flight of the Mojave Desert in August of 1995 mortality modes were detected in two of twelve radiotelemetered bighorn ewes (*Ovis canadensis*) in the Old Dad Peak area in San Bernardino County, California. A series of field investigations determined that at least 44 bighorn sheep and a raven (*Corvus corax*) had died during the same time period, approximately 3 weeks previously, in the vicinity of the main peak guzzler. One of the water storage tanks of the main peak guzzler was found to be damaged with the hatch lid removed. Thirteen dead bighorn lambs were discovered in this tank. The other two water storage tanks and the drinker were dry. During one field investigation a freshly dead bighorn ewe was discovered and flown by helicopter to Redlands Airport and transported to a nearby diagnostic laboratory for necropsy. The rapidity of the die-off, the involvement of all age groups, and the distribution of the carcasses indicated a common source epizootic and attention was focused on the carrion-contaminated water in the water storage tank. The contaminated water and the bighorn ewe were tested for the presence of pesticides, heavy metals, strychnine, blue-green algae, *Clostridium botulinum* toxin, ethylene glycol, sodium/salts and nitrates/nitrites. Mouse bioassay and enzyme-linked immunosorbent assay (ELISA) were used to detect botulinum toxin type C in fly pupae collected from water storage tank and in blood taken from the bighorn ewe. The following scenerio was produced to reconstruct the disease outbreak. Bighorn lambs fell into the water storage tank and drowned. The decomposing carcasses provided substrate for the proliferation of *C. botulinum* and resultant botulinum toxin. Adult bighorn sheep drinking from the tank ingested toxin-containing maggots or carrion and died shortly thereafter. The difficulty of diagnosing botulism in ruminants will be discussed. This is the first known report of botulism in bighorn sheep.

**(13) EFFICACY OF A MULTIVALENT *PASTEURELLA HAEMOLYTICA* TOXOID-BACTERIN IN PROTECTING CAPTIVE BIGHORN SHEEP (*OVIS CANADENSIS*) FROM CHALLENGE WITH PATHOGENIC *PASTEURELLA HAEMOLYTICA***

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*Abstract:* We examined the efficacy of a multivalent *Pasteurella haemolytica* toxoid-bacterin (A1, A2, T10) in reducing morbidity and mortality in captive bighorn sheep (*Ovis canadensis*) after challenge with pathogenic strain of *P. haemolytica*. Fifteen captive bighorns were divided into three groups based on vaccination status; five animals received one or two doses of vaccine 57 weeks prior to challenge, five animals received one dose of vaccine 10 days prior to challenge, and five animals received no vaccine. All sheep were challenged intratracheally with  $6.3 \times 10^7$  colony forming units (CFUs) of *P. haemolytica* biotype T, serotype 10, ribotype E<sub>CO</sub> ("Alamosa Canyon" isolate). Vaccination reduced mortality rates ( $P = 0.1$ ) and lung pathology ( $P = 0.08$ ) in bighorns vaccinated 10 days prior to challenge, as compared to controls; although mortality rates and lung pathology in bighorns vaccinated 57 weeks prior to challenge did not differ from controls ( $P \geq 0.2$ ), a trend in reduced mortality and pathology was apparent. Cytotoxin neutralizing antibody titers to *P. haemolytica* were elevated at challenge in bighorns vaccinated 10 days previously ( $P = 0.0034$ ), and titers in bighorns from both vaccinated groups were elevated at postmortem  $\leq 7$  days after challenge ( $P \leq 0.0044$ ). In contrast, titers of agglutinating antibody to *P. haemolytica* serotype A1 or T10 capsular antigens did not differ between vaccinated and unvaccinated bighorns ( $P \geq 0.19$ ). Our findings suggest that bighorn mortality caused by pneumonic pasteurellosis can be reduced by vaccination with this multivalent toxoid-bacterin. Further evaluation of this vaccine as a tool in preventing and managing pasteurellosis in wild bighorn sheep appears warranted.

## **(14) AN ATTEMPT TO CONTROL A BIGHORN SHEEP PNEUMONIA DIE-OFF BY DEPOPULATION OF EXPOSED ANIMALS**

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BRIGGS HALL, Department of Fish and Wildlife, 600 Capitol Way North, Olympia, Washington 98501-1091 USA

DAVID HUNTER, Idaho Fish and Game Department, 600 South Walnut, Box 25, Boise, Idaho 83707 USA

*Abstract:* In November 1995, biologists from the Washington Department of Fish and Wildlife documented a pneumonia related die-off of Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*) in Hells Canyon along the Snake River Canyon of southwest Washington. An aerial survey revealed 30 dead sheep in the lower part of the canyon, an area usually inhabited by roughly 125 sheep. Many other sheep were affected, based on the observance of coughing and the inability to run when approached by the helicopter. A contiguous population of approximately 125 sheep, farther up the canyon, but separated by the Grande Rhonde River, appeared to be unaffected. Depopulation of the remaining animals in the lower population was recommended in an attempt to prevent the spread of the pneumonia outbreak to the upper canyon populations in Idaho, Oregon, and Washington. A total of 72 animals were captured by helicopter net gunners. The sheep were treated with antibiotics, vitamins, fluids, and anthelmintics, and were trucked to a research facility in Idaho where treatment for the pneumonia continued. All animals survived the capture and the trip to Idaho. Initial expectations were that the recovered animal might eventually be returned to the canyon. However, 64 of 72 captured animals died from pneumonia. *Pasturella, haemolytica, pasturella multocida* were the primary organisms isolated from most sick and dead sheep, but the origin of the outbreak could not be determined. After depopulation the outbreak spread further up the canyon into Oregon and other herds in Washington.

**(15) REVIEW OF DISEASES ASSOCIATED WITH A DIE-OFF OF BIGHORN SHEEP IN A TRI-STATE AREA SURROUNDING THE SNAKE RIVER**

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B FOREYT, Washington State University, Department of Veterinary Microbiology and Pathology, Pullman, Washington 99164 USA

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B HALL, Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, Washington 98501-1091 USA

*Abstract:* In December 1995, an entire herd of 72 Rocky Mountain Bighorn Sheep (*Ovis canadensis canadensis*) was captured by helicopter net gunning in the Snake River Canyon. These animals were relocated to the Idaho Fish and Game Wildlife Health Laboratory in Caldwell. This endeavor was intended to place a buffer zone between the disease outbreak herd and the "healthy" herds in the canyon. Test results showed the herd of 72 were exposed to many disease agents. The viral agents included: Parainfluenza III, Bluetongue/EHD, Respiratory Syncytial Virus and Contagious Ecthyma. The parasites within the herd included lungworms and psoroptes. The bacterial agents responsible for the pneumonia were from the genus *Pasteurella*. Several species of *Pasteurella* were associated with the deaths of wild bighorn sheep in the canyon and at the Wildlife Health Laboratory. The interrelationship between the pathogenic agents mentioned above is poorly understood. Although the entire herd of 72 was removed from the hill side, observations showed bighorn sheep in the canyon were still dying of pneumonia. Tests are ongoing to determine the association of the N-RAMP (Natural Resistance Associated Macrophage Protein) gene in the animals that survived the die-off. Investigation of possible field treatments in bighorn sheep during a pneumonia outbreak were investigated and will be discussed.

## **(16) HELLS CANYON BIGHORN SHEEP 20/20 VISION - DISEASE PERSPECTIVE**

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B FOREYT, Washington State University, Department of Veterinary Microbiology and Pathology, Pullman, Washington 99164 USA

*Abstract:* Hells Canyon and the Snake River habitats are a vast area and could potentially include 5000 to 15,000 bighorn sheep. At present, a plan addressing the relocation of bighorn sheep to this area is being compiled. This plan would create the largest herd of Rocky Mountain Bighorn Sheep (*Ovis canadensis canadensis*) in the lower 48 states. If this proceeds as scheduled, the relocation would begin in the winter of 1996-1997. The disease entities found within the populations of Snake River Canyon, including Hells Canyon, will be discussed. The need to address the impact of these pathogens on future populations of bighorn sheep within the canyon is mandatory. As populations within the canyon increase in density, the transmission and risk factors of diseases will increase accordingly. Recent data collected from a herd in the canyon revealed many pathogens including Pasteurella, Parainfluenza III virus, lungworm and psoroptes. Many times animals relocated from other areas into a habitat are considered totally interchangeable biological packages or units. Differences in genetic selection between populations should be addressed. Trace minerals tolerances, predators, escape cover, migration patterns and disease exposures should be investigated to assure successful translocations. Ideas will be presented to stimulate interest towards a viable vision for Hells Canyon.

**(17) IMPROVING BIGHORN SHEEP POPULATION PERFORMANCE VIA ANTHELMINTIC TREATMENT: EXPERIMENTAL EVALUATION OF MANAGEMENT ALTERNATIVES**

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*Abstract:* We conducted a 4-year management experiment to examine the effects of alternative lungworm treatment strategies on lamb survival and population performance in four Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*) herds in southcentral Colorado. Herds were managed under each of four alternative lungworm treatment regimes, rotated annually under a randomly-selected schedule: baiting with alfalfa hay and apple pulp treated with fenbendazole (about 3 g/adult ewe) (B/T), baiting with alfalfa hay and apple pulp without fenbendazole (B), placing fenbendazole-treated salt blocks (1.65 g fenbendazole/kg) on winter ranges (T), and withholding bait and fenbendazole (control) (C). We monitored lamb production and survival among radiocollared ewes in each herd from May through October 1991-1995. Mean recruitment rates did not differ among herds ( $P = 0.51$ ) or between years ( $P = 0.80$ ). Mean lamb production ranged from 0.83 (B/T) to 0.95 (B), but did not differ among treatments ( $P \geq 0.23$ ). Mean lamb survival through October ranged from 0.59 (B/T) to 0.81 (T), and was also unaffected by management treatment ( $P \geq 0.15$ ); moreover, baiting combined with fenbendazole administration failed to prevent catastrophic (86%) lamb mortality in one herd. Overall, neither baiting ( $P = 0.45$ ) nor fenbendazole treatment ( $P = 0.62$ ) enhanced lamb recruitment among these four apparently healthy bighorn populations during the 4 years of our study. Our results demonstrate that annual parasite treatment is not prerequisite for lamb survival among southcentral Colorado's wild bighorn populations, and that annual parasite treatment may not prevent catastrophic losses of lamb cohorts among treated herds. Based on these data, we question the need for annual baiting and parasite treatment in the herds studied here and believe such practices need to be reevaluated elsewhere as well.

**(18) A COMPARISON OF GENETIC VARIATION OF MAJOR HISTOCOMPATIBILITY COMPLEX AND MICROSATELLITE LOCI IN BIGHORN SHEEP**

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*Abstract:* We examined genetic variation at five major histocompatibility complex (MHC) and three microsatellite (MS) loci in 235 bighorn sheep from 14 populations. Both types of loci were polymorphic and were in Hardy-Weinberg equilibrium. The pattern of variation at MHC loci was consistent with a history of exposure to infectious diseases while the MS loci did not show such a pattern. Our results contrasted with earlier mitochondrial DNA studies in that we found a substantial amount of genetic variability within and between putative subspecies of bighorn sheep. These results provided insights regarding the potential influence of disease on the geographic structure of bighorn sheep populations and they were useful in formulating recommendations for the conservation and management bighorn sheep.

**(19) EPIDEMIOLOGY AND PATHOGENESIS OF BRUCELLOSIS IN  
YELLOWSTONE NATIONAL PARK (YNP) BISON (*BISON BISON*),  
PRELIMINARY REPORT**

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*Abstract:* Bison of the Greater Yellowstone Area (GYA) are known to be infected with brucellosis (*Brucella abortus*). The agricultural industry views this infection as a threat to the brucellosis-free status (livestock) in Wyoming, Montana and Idaho. While brucellosis transmission among cattle is well understood, there are limited data on the prevalence of infection and considerable debate on the modes of transmission among free-ranging bison of the GYA. We are completing the first of a 5-year project on the epidemiology of brucellosis in YNP free-ranging bison. We have immobilized bison; sampled blood, fluids, and solid tissues using percutaneous biopsy methods; determined pregnancy status; and have applied radiocollars for tracking and relocation. We are repeatedly sampling these free-ranging bison and their 1996 progeny 3 times per year over a 5-year study. The first year has been a pilot study, using 10 adult females, to develop the field methodology and gain preliminary information for the main study of 60 adults and their offspring. This paper will report on our field methods and preliminary findings through July 1996.



**(20) SEROLOGY AND INFECTION WITH BRUCELLOSIS IN YELLOWSTONE NATIONAL PARK BISON (*BISON BISON*)**

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*Abstract:* During the last year we collected complete sets of tissues from 22 Yellowstone National Park (YNP) bison killed as a result of migration out of YNP. Samples from these bison were collected to maximize the opportunity to culture *Brucella abortus* following the research sampling protocol established by the Greater Yellowstone Interagency Brucellosis Committee for bison. We necropsied and sampled 16 seropositive females, 3 seronegative females (and their fetuses) and 3 seropositive males. Culture work is complete for 6 seropositive females and 3 seropositive males. Three of these females and none of the males were culture positive. *Brucella abortus* biovar 1 was isolated from 2 animals and *B.a.* biovar 2 from 1 animal. One of the seropositive, culture positive females had recently aborted and had a retained placenta. Sites of tissue localization of *Brucella* have been similar to cattle. This report will summarize culture and serologic work completed through July 1996.

**(21) ORAL ADMINISTRATION OF A ROUGH DERIVATIVE OF *BRUCELLA ABORTUS* TO WILD UNGULATES**

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*Abstract:* RB51 is a stable rough variant of *Brucella abortus*. It has been associated with limited or no pathogenesis and provides protection against virulent *B. abortus* challenge in experimentally infected mice, cattle, goats, and swine. Domestic ungulates receiving RB51 orally are protected against virulent challenge. Sexually mature, brucellosis negative, male elk were used in this study to determine whether RB51 could be used as an oral vaccine in wild ungulates. The elk were divided into 2 groups, group one received feed pellets with saline poured over them and group two received feed pellets mixed with RB51 resuspended in corn syrup. All of the animals ate at the troughs and the vaccinates received at least  $> 10^{10}$  colony forming units of RB51 orally. All the animals remained negative for *Brucella* using the standard card test. All of the elk were electroejaculated and the semen was collected, examined and cultured. Gross palpation revealed no differences between the controls and the vaccinates; sperm motility and morphology were the same for all of the samples. RB51 was not recovered from the semen of the vaccinates. From data collected from this study and others, RB51 seems to be a likely candidate to administer orally to wild ungulates. An oral vaccination study is currently in progress testing the vaccine efficacy of RB51 to protect pregnant elk against virulent challenge.

**(22) EFFICACY OF BRUCELLOSIS VACCINATION OF FREE-RANGING ELK IN THE GREATER YELLOWSTONE AREA: THE FIRST 10 YEARS**

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*Abstract:* The Greater Yellowstone Area (GYA) contains the largest free-ranging population of elk (*Cervus elaphus nelsoni*) in the world. Some of these elk are infected with *Brucella abortus*, the causative agent of bovine brucellosis. The presence of brucellosis in the GYA creates conflict with a federal goal of eliminating brucellosis from the United States by the year 1998. To decrease the incidence of brucellosis in the GYA, the Wyoming Game and Fish Department has been vaccinating elk concentrated on winter feedgrounds with reduced dose ( $5.6-7.6 \times 10^9$  CFU) *B. abortus* strain 19 vaccine delivered remotely via biobullet. Elk were vaccinated annually since 1985 on the Greys River feedground (GRF) and from 1989-1991 on the National Elk Refuge (NER). Adult elk (> 1 yr) were captured before (GRF and NER; 1971, 1973, 1974) and during (GRF) or after (NER) years of vaccination (1993, 1995, 1996) and tested for *B. abortus* antibodies using standard cattle tests (standard plate agglutination, buffered *Brucella* antigen rapid card, rivanol, and complement fixation) and previously-established criteria for elk. Prior to vaccination, there was no difference in the prevalence of brucellosis between GRF and NER ( $P = 0.20$ ). Compared to prevaccination rates, prevalence of brucellosis decreased both at GRF ( $P = 0.004$ ) and NER ( $P = 0.03$ ). There was no difference in prevalence between GRF and NER during the 1990s ( $P = 0.27$ ). These data suggest that large-scale vaccination can reduce the incidence of brucellosis in free-ranging elk.

**(23) A NEW GENUS OF PROTOSTRONGYLID LUNGWORM IN MUSKOXEN,  
*UMINGMAKSTRONGYLUS PALLIKUUKENSIS*: EXPERIMENTAL  
INFECTIONS AND ASPECTS OF LARVAL ECOLOGY**

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*Abstract:* A new genus and species of protostrongylid lungworm in muskoxen of the Kugluktuk region, Northwest Territories, Canada, has recently been described and named by Hoberg et al. This parasite, *Umingmakstrongylus pallikuukensis*, has a high prevalence, 92.5%, and may be partly responsible for the 50% decline in the muskox population from 1988 to 1994. Studies describing the epidemiology of the parasite are currently underway. The lifecycle of *U. pallikuukensis* has been experimentally completed in captive muskoxen. The gastropod intermediate host *Deroceras reticulatum* was infected with first stage larvae from the feces of naturally infected muskoxen and the third stage larvae recovered from these gastropods were administered orally to 2 captive muskoxen. Prepatent periods observed in the 2 animals were 91 and 95 days. Larval shedding has been continuous for at least 11 months and output of first stage larvae has ranged up to 6000 larvae per gram wet feces. No clinical signs or hematological changes have been observed in the experimentally infected animals, but numerous parasite induced nodules are apparent on radiographic examination. The unusual phenomenon of third stage larval emergence from the experimental gastropod intermediate host, *D. reticulatum*, has been consistently observed in the lab. Emergence begins on day 19 PI, and by day 56 PI up to 95% of the total larval burden in the gastropod has emerged. These free living third stage larvae survive at least 6 months in tap water at 4°C. Emerged third stage larvae have recently been administered orally to a third captive muskox to assess their infectivity for the definitive host. If this emergence and subsequent larval survival and infectivity occurs in the wild it may profoundly affect the parasite's epidemiology. Studies are underway to identify the potential gastropod intermediate hosts in the Arctic and to determine the significance of emergence of third stage larvae from the gastropods. This information is critical in elucidating the mechanisms which determine the parasite's high prevalence in muskoxen and its potential to spread to other geographic regions and muskox populations.

**(STUDENT PAPER)**

**(24) ATTEMPTED INFECTION OF MULE DEER (*ODOCOILEUS HEMIONUS*) WITH *MORAXELLA OVIS* ISOLATED FROM A MULE DEER WITH KERATOCONJUNCTIVITIS**

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Abstract: *Moraxella ovis* was isolated from two free-ranging mule deer and two moose (*Alces alces*) with keratoconjunctivitis during fall and winter 1995. Bacterial identification was based on hemolysin production, morphology, the ability to reduce nitrate and the BIOLOG computerized identification system. An isolate obtained from an affected mule deer in December, 1995 was frozen at  $-70^{\circ}\text{C}$  for three months and then inoculated into the conjunctival sacs of three healthy mule deer fawns. Phosphate buffered saline containing  $6.0 \times 10^8$  colonies per ml was used as the inoculum and 0.5 ml was placed into the left conjunctival sacs with a syringe without a needle. One animal was used as a control and received only phosphate buffered saline. Conjunctival swabs were taken three times before inoculation to insure that *Moraxella* spp. were not present. Swabs were taken five times during the week immediately after inoculation and twice per week for the next three weeks. *Moraxella ovis* was not recovered at any time during the trial and clinical signs of keratoconjunctivitis were not seen. Our findings suggest that *M. ovis* is not a primary pathogen in mule deer.

**(STUDENT PAPER)**

**(25) SIXTEEN YEARS OF LEAD POISONING IN EAGLES (1980-1995): AN  
EPIZOOTIOLOGIC VIEW**

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*Abstract:* A sixteen year (1980-1995) retrospective study was conducted to assess differences in the eagles admitted to The Raptor Center at the University of Minnesota for the years before and after legislation was enacted banning the use of lead shot for hunting waterfowl on federal lands (1991). A total of 869 cases were reviewed from which 138 cases of lead poisoned eagles were evaluated for the following: location found, blood lead level, month of admission, radiographic evidence of lead in the gizzard, and primary cause of admission. The average incidence of lead poisoning in eagles increased after 1991, but average blood levels of lead in the same population decreased. These findings call into question current theories regarding the source of lead and the actual mechanisms by which eagles are poisoned. Lead poisoning is an ongoing problem both regionally and internationally and it is apparent that there are many variables related to this toxicity that have yet to be conclusively defined.

**(STUDENT PAPER)**

**(26) DISTRIBUTION OF INTERMEDIATE HOSTS OF MENINGEAL WORM  
IN RELATION TO MOOSE IN NORTHERN MICHIGAN**

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*Abstract:* A total of 61 moose were reintroduced to northern Michigan in 1985 and 1987. The population has grown to nearly 400 despite the fact that 43% of white-tailed deer (156 examined) are infected with meningeal worm, *Parelaphostrongylus tenuis*. Fatal neurologic disease has occurred in moose, but concentrations of infected intermediate-host gastropods in areas moose do not use regularly could explain why moose numbers continue to increase. Twenty-seven species of terrestrial gastropods were examined for infective-stage larvae in summer 1995; 53 of 6418 (0.8%) were infected. Greatest numbers of infected gastropods were found where deer congregated in winter-yarding areas (19 of 1571, 0.5%) and along roadsides (13 of 690, 1.9%), in contrast to other collection sites (21 of 4157, 0.5%) selected by habitat types. We suggest that some form of temporal-spatial separation of definitive and gastropod hosts is present and critical to the survival of moose. The very long winter, 1995-1996, which resulted in extensive concentration of deer in yarding areas should provide interesting results during the field season in summer 1996.

**(STUDENT PAPER)**

**(27) MOUNTAIN LION DNA ANALYSIS: ECOLOGICAL GENETICS AND FORENSICS**

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*Abstract:* DNA analysis can prove valuable for assessments of mountain lion (*Felis concolor*) population ecology and predator-prey interactions (including those where livestock or humans may be involved). We started a three year study in June 1995 to examine several aspects of individual and population genetic structure of mountain lions in California by the use of molecular markers in blood, tissue, and feces. Techniques to extract and analyze DNA mountain lion feces have been developed. Genetic markers in scat samples are being used to DNA fingerprint individual mountain lions and study patterns of predation in desert bighorn sheep in southern California. The genetic structure of mountain lion populations will be examined by applying statistical methods of intraspecific differentiation to data generated with molecular markers. Fecal and blood or tissue samples were collected from captive animals housed at rehabilitation facilities and from carcasses presented for necropsy. Mountain lion feces was collected from mortality sites of radiocollared bighorn sheep in southern California. DNA was extracted from blood, tissue, and fecal samples and then polymerase chain reaction (PCR) technique was used to amplify gender-specific nuclear loci (ZFX-Y and SRY) and highly polymorphic microsatellite regions. The results of preliminary research will be presented and related to practical applications in conservation biology and forensics.

**(STUDENT PAPER)**



## **(28) THE TEMPORAL EPIDEMIOLOGY OF BLUETONGUE VIRUS IN A BIGHORN SHEEP POPULATION**

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*Abstract:* Bluetongue virus (BTV) is a vector-borne virus capable of causing hemorrhagic disease in ruminants. Virus isolation, diagnostic polymerase chain reaction (PCR), competitive ELISA (c-ELISA), and serum neutralization are four diagnostic tests used to monitor exposure to BTV in animal populations. We evaluated the applicability of these diagnostic tests in assessing the temporal epidemiology of BTV in a population of desert bighorn sheep (*Ovis canadensis*) in New Mexico from 1989 through 1995. Specifically, we studied the relationship between the temporal herd immunity to BTV and a large die-off that occurred in this bighorn sheep population in 1991. In addition, we related the 1995 exposure patterns to BTV in this population of bighorn sheep to those in an adjacent cattle herd. The combination of the c-ELISA and PCR results provided the most useful information concerning the temporal epidemiology of BTV. The herd immunity within the bighorn sheep population increased from 44% in 1989 to 100% in 1992, a period that coincided with the 1991 die-off. The herd immunity in the bighorn declined from 100% in 1993 to 72% in 1995 with no evidence of BTV exposure in the yearling bighorn in 1995. Bluetongue virus was still actively circulating within the cattle herd in 1995 as determined by PCR. The cattle appeared to be exposed to the same serotypes of BTV as the bighorn sheep. Because low levels of herd immunity and high numbers of susceptible animals are key factors in the occurrence of epizootics, this population of bighorn sheep may be at an increased risk for experiencing a BTV epidemic.

**(STUDENT PAPER)**

**(29) PATHOLOGIC FINDINGS IN KIT FOXES (*VULPES MACROTIS MUTICA*) AND DEER MICE (*PEROMYSCUS MANICULATUS*) INHABITING AN OIL FIELD IN THE SOUTHERN SAN JOAQUIN VALLEY OF CALIFORNIA**

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*Abstract:* Oil fields in the southern San Joaquin Valley of California provide important habitat for the endangered San Joaquin kit fox (*Vulpes macrotis mutica*) and several species of threatened or endangered small mammals (*Dipodomys ingens*, *Amмосpermopilus nelsoni*, *Dipodomys nitratoides* sp.). However, little has been done to investigate the potential effects of oil field-related toxins on the animals inhabiting these areas. Between 1992 and 1993 we collected blood samples from ten foxes inhabiting the Midway-Sunset oil field and from 11 foxes inhabiting the undeveloped Lokern Natural Area for hematologic and serum chemistry analysis. We also collected tissue samples from 12 deer mice (*Peromyscus maniculatus*) inhabiting the oil field and from eight deer mice inhabiting the Lokern Natural Area for histologic analysis. A higher proportion of kit foxes from the oil field had polychromatic red blood cells than foxes from the undeveloped Lokern site ( $p = .06$ ). A significantly higher proportion of deer mice from the oil field exhibited adrenocortical vacuolation and extramedullary hematopoieses in their tissues than deer mice inhabiting the Lokern site ( $p = .04$ ). These two histologic lesions occurred concurrently in the majority of affected deer mice, suggesting a common etiology. We concluded that kit foxes and deer mice inhabiting the Midway-Sunset oil field may be exposed to conditions that lead to the development of certain hematologic and histologic changes. The potential detrimental effects of oil field exposure on terrestrial wildlife should be considered in the recovery planning process given the importance of oil fields as habitat for several sensitive species in the southern San Joaquin Valley of California.

**(STUDENT PAPER)**

## **(30) NATURAL TRANSMISSION OF UPPER RESPIRATORY TRACT DISEASE: HORIZONTAL, VERTICAL, OR BOTH?**

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*Abstract:* A pairing study was implemented to investigate the potential for and timing of transmission of *Mycoplasma agassizii* between adult tortoises (horizontal transmission) and from parent to offspring (vertical transmission). Fifteen female-male pairs of gopher tortoises, 5 negative controls and 10 with one member positive for infection with or exposure to *M. agassizii*, were established. At irregular intervals, tortoises were assessed and sampled for culture, PCR, and ELISA. Samples were collected from females and eggs, and assessed by culture, PCR, and/or ELISA, as appropriate. Chorio-allantoic/amniotic fluid was collected from eggs at hatching and processed for culture and PCR. Blood samples were collected from hatchlings by cardiocentesis within 2 weeks of hatching and processed for ELISA. Horizontal transmission was documented by development of clinical signs of URTD in 6 initially uninfected tortoises, with recovery by culture and PCR detection of *M. agassizii* in flushes and seroconversion. No evidence of vertical transmission of mycoplasma was detected by culture or PCR, although the sample size of infected females was small. No eggs or hatchlings from ELISA-negative females had detectable antibody levels. Eggs and/or hatchlings from ELISA-positive females were positive for antibodies.

**(STUDENT PAPER)**

**(31) ENDOCRINE DISORDERS IN WILDLIFE ASSOCIATED WITH ENVIRONMENTAL CONTAMINANTS**

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*Abstract:* Evidence that widespread morbidity and mortality among wildlife populations resulting from exposure to synthetic chemicals led to the gathering in 1991 of a multidisciplinary group of scientists to discuss their research relevant to, "Chemically Induced Alterations in Sexual Development: The Wildlife/Human Connection." By the close of the work session the group was "...certain that a large number of man-made chemicals...have the potential to disrupt the endocrine system of animals, including humans." These chemicals are particularly damaging during the embryonic, fetal, and early postnatal periods because they resemble or interfere with the hormones, neurotransmitters, growth factors, and inhibiting substances that normally control development of the endocrine, immune, nervous, and reproductive systems. Damage during these early stages in most cases is irreversible and may be expressed as changes in function of these vital systems rather than obvious physical changes, e.g., behavior, intelligence, fertility, immune competence. Exquisitely low doses that affect the embryo can have no effect on the mother. All of the above pose difficulties in detecting effects in both wildlife and humans until the effects are expressed at the population level, e.g., reduced reproductive success, wide-scale morbidity, and in the case of some species, extirpation. Since 1991, wildlife experts, ecologists, laboratory-bound toxicologists, endocrinologists, physiologists, chemists, and others working collaboratively have introduced new dimensions to their research strategies in order to compensate for these difficulties. This multidisciplinary approach has revealed more about the extent of geographical distribution and transgenerational exposure to synthetic chemicals systems and strengthens the link between exposure to synthetic chemicals and damage to developing wildlife and humans.

## **(32) ECOLOGICAL RISK ASSESSMENT OF MINING ACTIVITIES IN THE OQUIRRH MOUNTAINS, UTAH**

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*Abstract:* Kennecott Utah Copper (KUC) operates the largest open-pit mine in the world, in the Oquirrh Mountains south of the Great Salt Lake, Utah. Ore processing facilities are located adjacent to shoreline marshes of the lake. We conducted an ecological risk assessment to ascertain whether flora and fauna of the Oquirrh Mountains, the shoreline wetlands, or the Great Salt Lake are being impacted from past or contemporary mining practices. In 1994, we mapped the distribution of metals in soils and vegetation of the 160-mi<sup>2</sup> project area. Proportions of native and late-successional plant species were comparable to other near-by mountain ranges. In 1995 concerns for wildlife food chains were addressed by sampling biota along a gradient of soil concentrations of lead and copper. Multiple regression analyses identified relationships among metal concentrations and ecological effects. There was no evidence that herbivorous wildlife are at risk. Insectivores and their predators are potentially at risk from naturally-occurring selenium in accumulator plants. However, no impairment in wildlife populations was actually detected. Bird use and nesting activity observed during 1995 in KUC-owned wetlands were similar to two near-by waterfowl management areas. Selenium poses risks of reproductive failure to stilts in some locations. Concentrations of metals in Great Salt Lake water and brine shrimp are below toxicity thresholds for shrimp or the birds that feed on them. Ecological effects are more likely to result from uncontrolled water level changes in the wetlands and overgrazing in the mountains and wetlands than from exposure to contaminants.

**(33) UPDATE ON CALIFORNIA'S OILED WILDLIFE CARE NETWORK (OWCN) AND OSPR VETERINARY SERVICES**

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*Abstract:* A network of centers for the care of all species of wildlife that may potentially come in contact with oil has been established in California. Locations include three universities, one marine park, one aquarium, and 16 wildlife rehabilitation centers. New veterinary care centers are being built in San Diego, Los Angeles, Santa Barbara, Santa Cruz, the San Francisco Bay Area and Humboldt Bay. Existing centers are being improved, equipped, trained and supplied. Several permanent and/or part time wildlife veterinary positions may develop around these centers.

The OWCN has been designed to allow its development to augment and form partnerships with existing wildlife research, rehabilitation, and public school and university education programs. A broad coalition including industry, government, scientific researchers, animal welfare groups and educators provide a base of political and community support as well as workers during environmental disasters.

New legislation has added the operations and maintenance of the Oiled Wildlife Care Network (OWCN), in partnership with the UC Davis Wildlife Health Center, and a competitive grants program to support research and technology development to the programs mandate, and has given the program a dedicated source of funding through the year 2003.

The unique sources and methods by which these programs are funded allow their development and implementation without negatively impacting existing wildlife health and conservation efforts.

Research into the effects of oil on wildlife, both at the level of the individual animal and at the population and ecosystem levels are being supported. These developments have allowed OSPR to support the advance degree or post doctoral research of 6 individuals over the last 3 years, that will culminate in 4 PhD degrees. Competitive grants for research and technology development will further expand this. These programs are a model of cooperation between private business, government, and educational institutions and an example of the benefits that a state agency can reap when it fully integrates veterinary care into resource trustee responsibilities.

## **(34) CHANGES IN HEMATOLOGIC AND CLINICAL CHEMISTRY VALUES FOLLOWING PETROLEUM PRODUCT EXPOSURE ON MINK AS A MODEL FOR SEA OTTERS**

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*Abstract:* In order to attribute specific changes in hematologic and clinical chemistry values to petroleum exposure and to identify measurements which might be useful for making management decisions involving the triage and release of sea otters (*Enhydra lutris*) which have been exposed to environmental oil, American mink (*Mustela vison*) were used as a laboratory animal model to study the effects of oil exposure. Mink were either exposed externally on a single occasion to a slick of one of two oils, Alaska North Slope crude oil or bunker C fuel oil, on sea water or via low level contamination of their daily rations from January to June 1994. Blood values which were affected directly by petroleum product exposure in the acute phases of exposure included: red blood cell count, fibrinogen, white blood cell count, neutrophils, lymphocytes, sodium, calcium, creatinine, total protein, alanine transferase, creatine kinase, alkaline phosphatase, gamma glutamyl transferase, and cholesterol. Our results confirm previous reports which attribute increased alanine transferase and alkaline phosphatase and decreased total protein in sea otters which died shortly after presentation to rehabilitation centers after the *Exxon Valdez* oil spill to petroleum exposure. Our data also suggest that aspartate transferase, alkaline phosphatase, gamma glutamyl transferase, lactic dehydrogenase, and cholesterol vary due to a chronic low-level contamination of a food source and that these measurements may also be indicative of a previous acute exposure to environmental oil. Variables which were predictive of exposure and may be valuable in determining exposure status in sea otters presenting to rehabilitation centers were sodium, calcium, creatinine, cholesterol, and lactic dehydrogenase. Blood values which may be useful in predicting which petroleum-exposed sea otters will reproduce in the year following an oil spill include exposure status, creatinine, and lactic dehydrogenase. Evaluation of these measurements should aid wildlife health professionals in making improved decisions regarding sea otter medical treatment, rehabilitation, and release after environmental oil spills.

**(35) RECOMBINANT CELL BIOASSAY FOR THE DIRECT DETECTION OF POLYCYCLIC AROMATIC HYDROCARBONS IN THE SERUM OF FREE-RANGING BIRDS AND MAMMALS**

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*Abstract:* Halogenated and nonhalogenated aromatic hydrocarbons, such as polychlorinated dibenzo-p-dioxins, biphenyls, benzo(a)pyrene and related chemicals have been recognized as significant and widespread environmental pollutants. These chemicals have been demonstrated to cause a variety of effects in both vertebrates and invertebrates, including tumorigenesis, endocrine abnormalities, organ dysfunction and lethality. Currently, although few cost- and time-effective methods are available to differentiate exposure in animals, they are expensive, labor intensive and require large amounts of tissue for analysis. A recombinant cell line which responds to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and related chemicals with the induction of firefly luciferase has been developed as a bioassay for the direct detection of these chemicals in small amounts of serum. Induction of luciferase activity acts both in a time- and dose-dependent manner, can be observed with as little as 25 to 50 µl of TCDD-containing serum, and has an observable detection limit for TCDD of approximately 5 ppt. Due to the small volumes of sample needed for analysis, the relatively small cost for analysis and the rapidity by which samples can be assayed, this bioassay provides an effective avenue for monitoring levels of these chemicals present in endangered species, populations which may or may not be exposed to harmful pollutants (i.e., in an oil spill event) and in organisms where limited amounts of biologic samples are available.



## **(36) ALASKA NORTH SLOPE MOOSE: MINERALS, METALS, AND MORTALITY?**

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*Abstract:* Minerals and heavy metals analysis was conducted on liver, muscle and kidney in Alaska moose of the northern Brooks Range and North Slope associated with the Colville River in response to a declining population and moose found dead in summer 1995. Radionuclides were measured in bone and muscle of found dead moose only. Evidence of potential disease problem partly due to a mineral deficiency is based upon poor calf production or survival, an adult mortality (30-50 animals, summer 1995) event, reports (not confirmed) of hoof lesions (hoof overgrowth), low levels (mean, ppm w.w.) of copper in liver (9.80) and kidney (3.72) of moose sampled in 1995. Mean molybdenum levels for liver was 1.54 ppm w.w. which is considered in the high "normal" range. Eight of the 9 moose sampled had liver Cu levels less than 10 ppm w.w. (< 10 ppm is considered a deficiency). Whether this apparent Cu deficiency is primary or secondary, and what is the significance to the health of individual moose and this apparently stressed population will be investigated and addressed. Cadmium levels are relatively high in kidney (0-21.60 ppm w.w.) and increased with age. Chromium mean levels (ppm, w.w.) in liver, kidney and muscle were 6.38, 4.95, and 6.62, respectively. Chromium in kidney increased with age. Histopathologic and gross evaluation revealed only incidental lesions in hunter killed moose (5).

**(37) CADMIUM IN ARCTIC ALASKA WILDLIFE: KIDNEY AND LIVER RESIDUES**

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*Abstract:* In Arctic Alaska, cadmium (Cd) levels are of concern in kidney and liver of mammals including: bowhead whale, beluga whale, walrus, caribou, moose, and ringed seal. Cd levels in some animals exceed published threshold criteria in kidney for renal dysfunction and other effects (15-200 ppm), tolerance levels for human consumption (liver = 1 ppm, kidney = 3 ppm), and WHO weekly intake limits (500 $\mu$ g Cd/week). An assessment of risk to indigenous people and to wildlife populations will be presented. Cigarette smoking is another major source of Cd to be considered for humans. Bowhead whale kidney and walrus kidney and liver represent major dietary sources of Cd. Followed by ringed seal liver (kidney data not available), beluga whale liver and kidney, moose kidney, and caribou kidney. Small portions of bowhead and walrus kidney (< 10g/week) exceed weekly intake levels as suggested by WHO. Age positively correlates with Cd levels in kidney (bowhead, moose, walrus, and caribou) indicating that avoiding older (larger) animals would reduce exposure. Harvest of wildlife is important to many arctic people for nutritional and cultural survival. Assessing risks associated with contaminants is essential for the well-being of indigenous people and wildlife. The nutritional value of these local resources and the potential inadequate alternatives must be considered and the potential impact anthropogenic sources have on wildlife.

## **(38) CAUSES OF FLOODPLAIN WILDLIFE MORTALITY DOWNSTREAM FROM MINING ACTIVITIES IN THE COEUR D'ALENE RIVER BASIN, NORTHERN IDAHO, 1992-1995**

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*Abstract:* Lead poisoning of waterfowl and raptors caused by the ingestion of spent lead shot has been well documented. Lead poisoning by other sources and in other species of wildlife has been generally less well studied. Since 1976, there have been published reports of lead poisoning in tundra swans (*Cygnus columbianus*) and other waterfowl in the Coeur d'Alene River Basin in Kootenai County, Idaho caused by ingestion of lead released into the environment by historic and recent mining practices. In 1992 an intensive effort to evaluate mortality in wildlife in the Coeur d'Alene Basin was initiated. From 1992 through 1995, 120 of 261 animals found sick or dead were suitable for necropsy and submitted to the National Wildlife Health Center for examination. These animals represented 18 species of birds and three species of mammals, but the predominant submissions were tundra swans (n = 71) and Canada geese (*Branta canadensis*) (n = 13). Lead poisoning caused by ingestion of lead-contaminated sediments was the greatest single cause of sickness or death (n = 68). In addition to emaciation, gross lesions included bile staining and impactions of the upper gastrointestinal tract. Histopathology revealed hepatic hemosiderosis, myocardial necrosis, and renal lead inclusions. Liver lead levels in lead-poisoned animals ranged from 6 to 48 ppm wet weight (Mean 22.7, Median 20.5). Lead levels in ingesta ranged from 6 to 823 ppm wet weight (Mean 197.1, Median 117.4). Other causes of death included trauma (17), emaciation (4), lead poisoning caused by ingestion of lead shot (5), aspergillosis (2), electrocution (1), avian tuberculosis (1), enteritis (1), renal gout (1) and undetermined (20). Twelve carcasses representing four species of birds were submitted from a neighboring drainage uncontaminated by mining wastes. Four of these birds, all with ingested shot, were diagnosed as lead-poisoned. Other causes of mortality included trauma (3), emaciation (1) and undetermined (4).

**(39) PLAGUE IN ORALLY EXPOSED BLACK-FOOTED FERRET X SIBERIAN POLECAT HYBRIDS**

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*Abstract:* Diagnosis of plague in a black-footed ferret (*Mustela nigripes*) most likely contracted by oral exposure prompted us to investigate susceptibility of ferrets to *Yersinia pestis* infection via the oral route. Twelve black-footed ferret x Siberian polecat (*M. eversmanni*) hybrids were used as surrogates for black-footed ferrets. Each ferret was fed a laboratory mouse which had died or been euthanized with clinical signs of plague following intraperitoneal inoculation with *Y. pestis*. Heart blood was collected from each mouse prior to being fed to ferrets to confirm the presence of *Y. pestis* by culture. Clinical signs of depression, anorexia, fever, and photophobia were seen in nine animals starting 2 days postinoculation. Fever exceeded 41.7°C in some animals. Nine ferrets died or were euthanized with plague 3 to 17 days postinoculation, with all but one mortality within 7 days. *Yersinia pestis* was isolated from all affected animals. Necrotizing cervical lymphadenitis and pulmonary edema and hemorrhage were found on gross and microscopic examination. The ferret that lived 17 days with plague had hemagglutinating antibodies; however, the three ferrets that survived oral exposure had no detectable serum antibodies suggesting they did not become infected. The high mortality of hybrid ferrets infected with *Y. pestis* suggests that black-footed ferrets are similarly susceptible. The widespread distribution of plague in prairie dog (*Cynomys* spp.) populations may seriously compromise reintroduction of black-footed ferrets to the wild.

## **(40) INTENSIVE MANAGEMENT OF AN ENDANGERED SPECIES: LONG-TERM EFFECTS OF CHEMICAL IMMOBILIZATION AND DEHORNING ON HEALTH AND REPRODUCTION IN A DISCRETE POPULATION OF BLACK RHINOCEROS IN ZIMBABWE**

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*Abstract:* With current concerns for animal welfare and the effects of various management and research interventions on wild animals there is a need to document the effects (short and long term) of these interventions. Negative effects can range from short- to long-term stress, traumatic lesions, disease introduction or increased susceptibility to existing disease, reduction in reproductive potential and increased susceptibility to, for example, predation. On the other hand, in many instances management and research interventions can result in significantly positive impacts on the health and survival of wild animal populations, aside from valuable behavioral and biological data that may be collected. Ultimately, if these impacts are overwhelmingly negative then it would be inappropriate to continue and alternative methods of capture for marking or collection of biological data, or reducing the incentive for illegal hunting, for example black rhino dehorning, would need to be identified.

In the Sinamatella Intensive Protection Zone (IPZ), Hwange National Park, Zimbabwe, black rhinos (*Diceros bicornis*) were first dehorned in 1992 as part of a conservation management program to reduce the incentive to illegal hunters. Since 1992 this population has had management and research interventions on at least 4 occasions, involving the use of chemical immobilization followed by either dehorning or the attachment of radiocollars. The last such intervention was in December 1995. As part of an adaptive management program considerable data has been collected on this population with regards to morbidity and mortality, reproduction and the long-term effects of repeated chemical immobilization using opioids on black rhino's health and survival.

The population of black rhinos in the Sinamatella IPZ was estimated to be >60 animals in 1992, following operations in 1994 and 1995 the current population is estimated at >65. During the early part of 1993, with severe budgetary cuts within the DNPWLM and, therefore, a severe reduction in law enforcement effort coupled with at least 18 months of horn regrowth over 80 white rhinos and an estimated 8-10 black rhinos specifically from the Sinamatella population were presumed to have been poached. Despite this initial setback in population numbers following the dehorning program (this program has subsequently been a success following improved law enforcement), the total number of black rhinos lost during management interventions is 1 animal (from an estimated population of 60, indirect mortality rate = 1.6%). This 1 mortality occurred 12-24 hours after immobilization and recovery (the animal was estimated to be >35 years old indicating that he was a high risk animal). Greater than 140 individual immobilizations have been carried out on the Sinamatella population since 1992. Despite some black rhinos being immobilized 6 times over a 4-year period there have been no known deaths directly related to chemical immobilization. During this period over 17 calves have been born to the population and confirmed to be alive and well in December 1995.

In addition, related to dehorning there is evidence that this conservation measure reduces the estimated 30%-40% mortality related to interspecific fighting in black rhinos. Based on both biological (blood health evaluation) and body condition scoring coupled with reproductive success, chemical immobilization, dehorning and radiocollaring appear to have had a minimal impact on the long-term survival of this

population. Key factors in reducing the impact include efficient monitoring and, therefore, documentation (both ground and aerial through radiotracking and, the positive identification of all animals in the population through passive implantable transponders, ear notches or spoor patterns), early detection of any health problems and mortalities, and ensuring that management interventions are carried out to the highest professional standards.

## (41) PATHOLOGICAL FINDINGS IN FREE-RANGING ZIMBABWEAN BLACK RHINOCEROSSES (*DICEROS BICORNIS*): A SUMMARY

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*Abstract:* The black rhinoceros (*Diceros bicornis*) is severely threatened with extinction, having dropped from an African population of about 65,000 in 1970, to less than 3000 at present, a decline largely the result of poaching. Zimbabwe maintains a relatively large population of these animals, although many are now managed in large conservancies, having been translocated in the late 1980s and early 1990s. Samples from translocated animals have enabled the establishment of baseline biological parameters and allowed investigation into pathological conditions.

Haemolysis has been a well recognized syndrome in captive black rhinoceroses, and when chronic and/or intermittent is associated with widespread deposition of haemosiderin (haemosiderosis), an insoluble iron product from red blood cell breakdown. Haemosiderosis is not recognized in free-ranging animals, although some animals held in confinement after capture and some translocated from natural habitats to conservancies have developed haemosiderosis months to years after capture. Widespread, marked lymphoid depletion was also usually seen in animals with haemosiderosis. Signs of acute haemolysis were seen in several animals held in creosote-treated bomas after capture.

Coronary artery aneurysms were diagnosed in 2 animals, 1 of which had ruptured and resulted in fatal cardiac tamponade. The exact cause of the lesions is not known, but they appear to be the result of chronic inflammation, possibly of parasitic aetiology. Degenerative arthritis of the coxofemoral joint was found in 1 animal, presumably the result of trauma and resulting instability.

*Streptococcus equisimilis* was isolated from fractured nasal bones, the result of self-inflicted trauma, and from visceral organs and brain in 2 animals. Splenic lymphoid hyperplasia at the time of necropsy indicated ongoing reaction to antigenic stimulation, most likely the result of haematogenously borne *S. equisimilis*, which likely resulted in septicaemia and death.

Fecal samples were collected from 38 immobilized black rhinoceroses in 1988. Eggs from 3 different parasites were recovered consistently, including *Oxyuris* sp., *Anoplocephala* sp., and strongyles. *Gasterophilus* sp. larvae were quite consistently seen attached to the gastric mucosa and occasionally to the oesophageal mucosa as well in animals that were necropsied. The large bowel of 1 emaciated animal was found to be teeming with *Oesophagostomum* sp. Multiple, discrete oesophageal ulcers were found in 2 animals, in the mid oesophageal region. The possibility that they were caused by *Gasterophilus* sp. larvae is suggested by finding them in the upper alimentary tracts of most animals, although they were not found in the animals with ulcers. Information on the use of antehelminthics on these animals was not available, but they have been used in some instances on black rhinoceroses after capture, and it is possible that the ulcers represented old sites of attachment.

Skin lesions have been reported in free-ranging black rhinoceroses in South Africa and Kenya, as well as in Zimbabwe, and are felt to be the result of the filarial nematodes (*Stefanofilaria* spp.) that are present in the

lesions. Transmitting insects harbor the forms which develop into the infective third stage larvae, which are deposited into the skin when the insect feeds. The microfilaria develop in the definitive host and are ingested by the vectors during feeding, thus allowing the cycle to continue. The lesions described in free-ranging rhinoceroses appear to be unrelated to the syndrome described in captive animals.



## (42) AN EPIZOOTIC OF HEMORRHAGIC DISEASE IN CAPTIVE AND FREE-RANGING WHITE-TAILED DEER IN MISSISSIPPI

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*Abstract:* During late summer and early fall 1994, 36 of 114 captive white-tailed deer died as a result of epizootic hemorrhagic disease, type 2 (EHDV-2). Serology indicated that nearly the entire herd was positive for EHDV-2 antibody, 94.4% by agar gel immunodiffusion (AGID) and 100% of these AGID positive deer had titers  $\geq 1:10$  by serum neutralization (SN). All age-classes seroconverted and 88.9% of the EHDV-2 mortality resulted within a 7-week period, starting 19 August 1994. Frequency of postmortem findings included: pulmonary hemorrhage and edema (63.9%), cardiac hemorrhage (50.0%), gastrointestinal hemorrhage (44.4%), oral ulcers (36.1%), splenomegaly (19.4%), lingual hemorrhage/necrosis (13.9%), and hoof lesions (11.1%). Hoof lesions were seen in 21.8% of those surviving the acute phase. In 1994 the most common cause of death was EHDV-2, 36 of 44 diagnoses (81.8%) in the captive herd and 30% in free-ranging deer submitted for necropsy. Hunter-killed free-ranging deer sampled in fall 1994 were positive (34.5%) for antibodies to the EHD viruses by AGID and 95.4% of these had titers  $\geq 1:10$  for EHDV-2 and only 20.7% for EHDV-1, and older deer (> 3.5 years of age) had a higher prevalence of EHDV-1 antibodies.

**(43) LYMPHOCYTE SUBSET ALTERATIONS IN PERIPHERAL BLOOD AND LYMPH NODES OF WHITE-TAILED DEER INFECTED WITH EPIZOOTIC HEMORRHAGIC DISEASE VIRUS**

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*Abstract:* Epizootic hemorrhagic disease virus (EHDV) is one of the orbiviruses that causes hemorrhagic disease, the most important infectious disease complex of white-tailed deer (*Odocoileus virginianus*). During the acute phase of infection, deer often become lymphopenic and have depression of cell-mediated immunity both in vitro and in vivo. The objectives of this study were to determine if alterations in lymphocyte subset populations in peripheral blood or lymph nodes of infected white-tailed deer corresponding to this immune depression. Six white-tailed deer fawns were infected with EHDV serotype 2; six additional fawns served as uninfected controls. At 4, 8, and 12 days post-infection, two infected and two control animals were euthanized. Alterations in lymphocytes subsets including CD6+, CD4+, KL cells, and MHC Class II cells were examined via flow cytometry of peripheral blood every 4 days and in lymph nodes of euthanized deer. Total T-cell and B-cell populations were examined in lymph nodes of euthanized deer via immunohistochemistry. Complete blood counts and lymphocyte proliferation assays were conducted at each sample point. During the acute phase of infection, infected deer had lymphocyte subset alterations in peripheral blood and lymph nodes that coincided with reduced lymphocyte counts and the depressed lymphocyte proliferation in response to mitogens. Similar lymphocyte subset alterations have been seen during the acute phase of infection in the peripheral blood and lymph nodes of bluetongue virus-infected cattle.

## **(44) CHRONIC WASTING DISEASE IN DEER AND ELK: EPIZOOTIOLOGICAL EVIDENCE OF LATERAL TRANSMISSION**

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*Abstract:* Chronic wasting disease (CWD) occurs in captive and free-ranging deer (*Odocoileus* spp.) and elk (*Cervus elaphus nelsoni*) in northcentral Colorado and southeastern Wyoming. Although similar in some respects to other transmissible spongiform encephalopathies of domestic ruminants, CWD appears to differ substantially in the relative importance of lateral transmission in its epizootiology. Among 10 CWD cases observed in captive herds in Colorado since 1986, all 4 elk and 5 of 6 deer cases occurred among maternally-unrelated individuals. For both elk and deer, time intervals between index and subsequent cases in captive herds were consistent with incubation periods observed in experimental infections. From 1981 to 1996, 67 CWD cases were also detected among sympatric populations of free-ranging elk, mule deer (*O. hemionus*), and white-tailed deer (*O. virginianus*) in Colorado and Wyoming; at least 3 distinct elk subpopulations and 4 distinct deer subpopulations yielded cases. In northcentral Colorado, 56 cases were distributed across these 3 species in approximate proportion to their relative abundance in the wild, but cases in mule deer bucks were encountered about 10 times more frequently than expected: although buck:doe ratios were about 1:5 in affected mule deer populations, 28 (61%) of 46 affected mule deer were male. Preliminary results of harvest surveys in Colorado estimated CWD prevalence in wild mule deer at about 0.9% (95% CI 0.2-2.5%) in one affected deer herd; simulation modeling revealed such prevalence rates probably could not be achieved or sustained in a wild deer population in the absence of lateral transmission. Although not conclusive, these rather diverse observations of CWD in captive and free-ranging deer and elk populations provide compelling evidence that lateral transmission is likely an important component of CWD epizootiology. We believe that the implications of these observations warrant consideration in developing strategies for managing chronic wasting disease in captive or wild cervids.

**(45) BOVINE TUBERCULOSIS IN FREE-RANGING WHITE-TAILED DEER IN MICHIGAN**

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*Abstract:* A 4-year-old, male, white-tailed deer (*Odocoileus virginianus*) killed by a hunter during the 1994 firearm season in northeastern Michigan (USA) was cultured positive for *Mycobacterium bovis* in January 1995. While once relatively common in cattle, bovine tuberculosis has historically been a very rare disease in wild deer. In fact, only 8 wild white-tailed or mule deer (*Odocoileus hemionus*) have ever been reported with bovine tuberculosis in North America. The only other time bovine tuberculosis was found in a wild Michigan deer was in 1975, when a hunter killed a 9-year-old doe approximately 13 km from where the 1994 bovine tuberculosis positive deer was harvested. The disease is still a problem for livestock owners in the United States. From January 1991 to December 1995, a total of 27 cattle herds and 31 captive deer and elk herds nationwide were confirmed to be infected with bovine tuberculosis. In response to the 1994 tuberculosis positive deer, a multi-agency cooperative team was formed which consisted of representatives from the Michigan Department of Natural Resources, Michigan Department of Agriculture, Michigan Department of Community Health, Michigan State University, and the United States Department of Agriculture. During fall 1995 and the winter and spring 1996, over 800 hunter and highway killed deer were examined for tuberculosis in an area of 1295-km<sup>2</sup> surrounding the 1994 tuberculosis positive deer. Twenty-six were confirmed positive for *M. bovis* through a combination of gross and histologic lesions, acid-fast staining, mycobacterial isolation, and DNA probe. All positive deer came from a 471-km<sup>2</sup> area of private lands used primarily for hunting. To date, over 2,500 cattle, goats, pigs, and llamas have been tested and found to be negative for bovine tuberculosis in the 1295-km<sup>2</sup> test area. The results of these surveys showed a unique situation whereby bovine tuberculosis was being transmitted from deer to deer and maintained in the deer population without involvement of infected livestock. A statewide survey of highway killed deer from all 83 counties in Michigan began in February 1996. To date, tuberculosis has not been found in any deer outside of the 471-km<sup>2</sup> area. Management plans include education, wildlife surveys, testing of livestock, elimination of supplemental feeding of deer and population reduction of deer by way of the hunting season.

## **(46) TUBERCULOSIS IN MICHIGAN WHITE-TAIL DEER (*ODOCOILEUS VIRGINIANUS*)**

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*Abstract.* Reports of *Mycobacterium bovis* in free-ranging deer are uncommon. Previous diagnoses were from isolated cases involving individual deer and were easily explained as contact with infected cattle or captive elk.

In November 1994, *M. bovis* was isolated from a hunter-killed, white-tail buck near Alpena, Michigan. Because of this and a 1993 isolate from a dairy cow from Mount Pleasant, Michigan, a four-county survey was initiated in the fall of 1995. Also, in 1975, a female white-tail deer was confirmed to be infected with *M. bovis* by the Michigan State University. It was killed about 10 miles from where the infected buck was killed in 1994.

Since November 1995, the National Veterinary Services Laboratories (NVSL), in cooperation with the Michigan State University, and the Michigan Departments of Public Health (MDPH), Natural Resources, and Agriculture, has examined tissues from 678 white-tail deer as part of state-wide survey. Forty-two deer samples with gross tuberculous lesions were cultured separately, and 636 samples with no gross lesions were cultured in 33 different pools. As of May 10, 1996, 18 isolations of *M. bovis* have been made at the NVSL. Two of the isolations were from pooled samples. Five deer were compatible for tuberculosis on histopathology, but no isolation of *M. bovis* was made. Culture results are still pending on approximately 200 deer samples.

Fatty acid analysis of the Michigan deer isolates and a bovine heifer isolate from Wisconsin, which may have originated from a herd from Hubbard Lake, Michigan, appear to be the same strain of *M. bovis*. Restriction fragment length polymorphism analysis was performed by the MDPH on isolates from the index deer (1994), the Wisconsin heifer, and a captive elk from Michigan. They concluded that the index deer (1994) and the Wisconsin heifer isolates had identical IS6110 and TBN12 patterns, indicating that they were the same strain of *M. bovis*. The elk isolate had different IS6110 and TBN12 patterns.

The following theories are being considered:

- 1 *Mycobacterium bovis* has been present in white-tail deer in this area for at least 20 years.
- 2 *Mycobacterium bovis* has been present in cattle from this area on occasion.
- 3 Transmission between cattle and deer has occurred.

It was assumed that bovine tuberculosis could not be maintained in wild deer populations. Hopefully, the occurrence of tuberculosis in wild white-tail deer in Michigan can be eliminated by cessation of artificial feeding and population reduction.

**(47) EVIDENCE OF INFECTION BY A PRESUMABLY NOVEL *EHRlichia*-LIKE ORGANISM AMONG WHITE-TAILED DEER (*ODOCOILEUS VIRGINIANUS*) AND LONE STAR TICKS (*AMBLIOMMA AMERICANUM*)**

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*Abstract:* Nested polymerase chain reaction (PCR), restriction fragment length polymorphism (RFLP), and nucleotide sequencing recently were used to identify a novel *Ehrlichia*-like 16SrRNA sequence in the blood of white-tailed deer (*Odocoileus virginianus*) from Georgia and Oklahoma. The nucleotide sequence of this gene fragment differed from all known species of *Ehrlichia* but was most similar (>94% identity) to the genogroup comprised of *E. phagocytophila*, *E. equi*, and the unnamed human granulocytic ehrlichiosis (HGE) agent. Specific primers were constructed and used in PCRs to confirm that this *Ehrlichia*-like sequence occurred in blood, spleen, and lymph nodes of deer from seven populations in Arkansas, Georgia, Missouri, and South Carolina (50 to 100% prevalence) but not in one other population in Georgia or two in West Virginia. This *Ehrlichia*-like sequence also was amplified from 1 of 79 pools of lone star ticks (*Amblyomma americanum*) collected from vegetation at a site in Georgia inhabited by PCR positive deer. The presence of this *Ehrlichia*-like sequence in deer was associated ( $P < 0.001$ ) both with *E. chaffeensis*-reactive antibodies detected by indirect immunofluorescence and with lone star tick infestations. The above findings confirm that this novel *Ehrlichia*-like organism is widespread and common in white-tailed deer and suggest that lone star ticks may serve as its vector. A described primer designated GE9f, constructed to amplify DNA from the HGE agent and other granulocytotropic ehrlichiae in the *E. phagocytophila* genogroup (Chen et al. 1994), also amplified the deer *Ehrlichia*-like sequence. The possibility of serologic cross-reactions and nonspecific PCR products arising from the deer *Ehrlichia*-like organism should be considered when investigating the natural history of the known causative agents of human ehrlichiosis.

**(48) FACTORS AFFECTING DISTRIBUTION OF MENINGEAL WORM, *PARELAPHOSTRONGYLUS TENUIS* (NEMATODA), IN MANITOBA AND SASKATCHEWAN (CANADA), AND NORTH DAKOTA (USA)**

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*Abstract:* Prevalence of adult meningeal worm in white-tailed deer from Saskatchewan, Manitoba and North Dakota (USA) was < 1, 18.6 and 8.4%, respectively (1902 deer examined). Presence was positively correlated with deer density and precipitation during frost-free periods, and negatively correlated with winter and spring temperature. Landscapes with less than 75%, and greater than 50%, forest cover were most likely to have *P. tenuis*-infected deer. Gastropod intermediate hosts were most abundant and broadly distributed in regions of the study area with the highest reported prevalences. The westernmost limit of *P. tenuis* is likely restricted by low rainfall, low white-tailed deer density and limited abundance and distribution of terrestrial gastropods. Although the influence of temperature on distribution of meningeal worm remains unclear, we propose that high temperatures in the grassland biome limit parasite distribution by restricting abundance of gastropod intermediate hosts, and cooler temperatures associated with the northern boreal mixedwood forest limit distribution by retarding gastropod activity and development of *P. tenuis* larvae in the gastropod host.

**(49) PARELAPHOSTRONGYLUS TENUIS ON WASSAW ISLAND, GEORGIA:  
A RESULT OF WHITE-TAILED DEER TRANSLOCATION**

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*Abstract:* Meningeal worms (*Parelaphostrongylus tenuis*) were found in each of five white-tailed deer (*Odocoileus virginianus*) examined from Wassaw Island, Chatham County, Georgia in September, 1993. The discovery of *P. tenuis* on Wassaw Island represents the first reported occurrence of the parasite on a southeastern barrier island and extends its geographic distribution approximately 140 km beyond the nearest known infected mainland deer population. An anecdotal account indicates that six white-tailed deer were imported from Pennsylvania and released on Wassaw Island in 1905 or shortly thereafter. Based on its absence elsewhere along the southeastern coast from North Carolina to Louisiana and its high prevalence in Pennsylvania, the enzootic focus of *P. tenuis* on Wassaw Island was attributed to translocation of infected deer. These findings lend credence to concerns that *P. tenuis* can be spread by relocation of even a small number infected cervids and that this can occur in ecologic settings previously considered inhospitable for survival of the parasite.



**(50) NATURALLY OCCURRING *EHRlichia CHAFFEENSIS* INFECTION AMONG WHITE-TAILED DEER (*ODOCOILEUS VIRGINIANUS*) AND LONE STAR TICKS (*AMBLYOMMA AMERICANUM*)**

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*Abstract:* The roles of white-tailed deer (*Odocoileus virginianus*) and lone star ticks (*Amblyomma americanum*) in the epizootiology of *Ehrlichia chaffeensis* were investigated using in vitro culture, molecular techniques (PCR, RFLP, and DNA sequencing), and serologic testing. Two isolates of *E. chaffeensis* were obtained in DH82 canine macrophage cells from blood or lymph node of wild deer from Clarke and Chatham Counties, Georgia, respectively. A nested PCR protocol incorporating *E. chaffeensis*-specific primers detected *E. chaffeensis* DNA in the blood, spleen, or lymph nodes from 23 of 73 (31.5%) wild deer from Georgia, South Carolina, and Missouri but not in 28 deer from Arkansas or West Virginia. The two isolates and five PCR products from deer in Georgia and South Carolina had RFLP patterns and 16SrRNA nucleotide sequences identical to that of a human *E. chaffeensis* isolate. This is the first culture and molecular genetic confirmation of naturally-occurring *E. chaffeensis* infection among wild white-tailed deer. PCR, RFLP, and DNA sequencing also were used to confirm *E. chaffeensis* infection in at least 3.5% of 452 adult lone star ticks collected from vegetation at the Clarke County site. Indirect fluorescent antibody testing disclosed high prevalences of *E. chaffeensis*-reactive antibodies in 9 deer populations with lone star tick infestations but no antibodies in 3 populations where no ticks were found. These data support the concept that white-tailed deer and lone star ticks serve as reservoir hosts and vectors for *E. chaffeensis* in nature; however, a more complex epizootiology involving other species of animals or ticks should not be discounted based on currently available data.

**(51) THE ROLE OF WILDLIFE IN THE EPIDEMIOLOGY OF RABIES IN KIBWEZI DIVISION, MAKUENI DISTRICT, KENYA**

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*Abstract:* Brain samples were collected from animals killed by vehicles along a 20-km section of the Mombasa - Nairobi highway from Mbuinza to Machinery townships and tested for rabies using fluorescent antibody technique (FAT). This was done for a period of 8 months between October 1994 and May 1995. A total of 185 carcasses were counted and brain samples were collected from 81 of them. Five (6.2%) of the samples tested positive under FAT. Of the 5 which tested positive, 1 (one) was from a genet (*Genetta genetta*), 1 (one) was from a mongoose (*Herpestes spp*) and 1 (one) was from a wild animal of unknown species. The other 2 were from a goat (*Caprine*) and a domestic cat (*Felis catus*). Two-hundred households from 4 sublocations through which the highway runs were randomly selected and a questionnaire administered to identify the species of wildlife encountered, the frequency, the time of day or night and the season encountered. Encounters with wild animals exhibiting abnormal behavior was also recorded as well as the frequency of fights between the wild animals and the domestic dogs. The bush squirrel (*Paraxerus spp.*), the genet (*Genetta genetta*), the common mongoose (*Herpestes spp.*) and the white tailed mongoose (*Ischeumia albicauda*) were the species of animals most frequently encountered. The African civet (*Civetta civetta*) was less frequently encountered while the larger carnivores like the hyaena (*Crocuta crocuta*), lion (*Panthera leo*) and leopard (*Panthera pardus*) occasionally entered the area from the neighboring game parks. The white tailed mongoose (*Ischeumia albicauda*) was the most common species of wildlife which showed aggressive behavior towards people and fought with the domestic dogs. An active community based rabies surveillance project was carried out concomitantly in the same area. Fifty-seven brain samples were tested for rabies using FAT. Twenty-two of them tested positive, 20 of them from domestic dogs, 1 (one) from a cat and 1 (one) from a goat.

Rabies has remained endemic in this area since the early 1970s when the disease was well controlled in the rest of the country. The role of wildlife in its maintenance and transmission has never been investigated. This study shows that small wild carnivores come into frequent contact with the domestic dog population in which the disease is endemic. Collection of brain samples from carcasses of animals killed by vehicles has not been a common practice in this Kenya and it should be used to overcome the difficulty of retrieving samples from wildlife populations and to further investigate the role wildlife are playing in the epidemiology of the disease.

## (52) SAFETY AND EFFICACY OF AN ATTENUATED RABIES VIRUS VACCINE IN COYOTES

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*Abstract:* Coyote rabies has emerged as a significant public health problem in the United States, calling for novel adjunct methods of disease control. To this end, a preliminary laboratory dose-response experiment was conducted to compare the safety and efficacy of a single 1 ml dose of the SAG-2 attenuated rabies virus vaccine, containing  $10^9$  or  $10^8$  TCID<sub>50</sub>, administered orally sans bait in 10 sedated healthy, wild-caught adult coyotes from Georgia versus 5 control animals. Coyotes were observed daily for 1 month and no detectable adverse signs were associated with vaccination. During this period a ~5-ml blood specimen was taken following sedation to determine specific rabies virus neutralizing antibody (VNA) titers by the RFFIT on days 0, 14, and 28. By day 14, only vaccinated coyotes developed VNA > 1/5, with the exception of a single individual (G04) in the  $10^8$  TCID<sub>50</sub> group. At 1 month post-immunization, coyotes were challenged in the masseter muscle with 0.5 ml ( $10^{5.3}$  MICLD<sub>50</sub>) of coyote street rabies virus; blood specimens were also collected one week after challenge. With the exception of the single animal (G04) that never developed a detectable rabies VNA titer, all other vaccinated animals demonstrated the rapid induction of an anamnestic VNA response by 7 days post-challenge. All coyotes were observed for a minimum of 90 days after challenge. Coyotes that displayed definitive signs of the disease were euthanized by IV barbiturate overdose, necropsied and selected tissue specimens (e.g., brain) were tested for the presence of viral antigen by a direct immunofluorescent antibody assay performed upon frozen tissue sections. Animal G04 was the only vaccinated coyote that succumbed to rabies challenge and was IFA positive for rabies antigen from brain tissue collected at necropsy. All other vaccinated coyotes were IFA negative for rabies antigen at the time of euthanasia when the study was concluded.

**(53) NEW YORK STATE CAPITAL REGION WILDLIFE RABIES  
VACCINATION: FIRST EVALUATION IN AN ENZOOTIC AREA**

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*Abstract:* The first evaluation of the effect of wildlife vaccination in an enzootic area of raccoon rabies was initiated in October 1994. The overall objective is to assess the effect of oral vaccination upon the intensity of rabies in an enzootic area and to compare two different vaccine containers encompassed in the same fishmeal bait matrix. During autumn 1994, cylindrical fishmeal polymer (FMP) baits with wax ampule vaccine containers were distributed in the 300 sq km Albany County site. Due to delays in bait availability, only 4,400 of the planned 30,000 rectangular FMP baits containing sachet vaccine chambers were available to bait a 50 sq km portion of the proposed 300 sq km site in Rensselaer County. In spring 1995, the entire 600 sq km site was baited at a density of 100/sq km. In autumn 1995 and spring 1996, approximately 45,000 baits were distributed at a lower bait density of 75/sq km. To date, serological results from live-trapped raccoons indicate that 49% (61/125) of raccoons in the Albany County vaccination area and 31% (26/84) of raccoons in the Rensselaer County site have rabies virus neutralizing antibodies. During 1995, there were 22 (of 62 tested) and 31 (of 55 tested) rabid raccoons in the unbaited portions of Albany and Rensselaer Counties, respectively. In the vaccinated areas, cases were limited to three rabid raccoons of 41 tested from the Albany County site and one case among 19 rabies-suspect raccoons from the Rensselaer County site; all occurring within 3 km of the edge and five to six months following autumn and spring bait campaigns. A statistically significant reduction in cases has been demonstrated; rabies has been effectively suppressed in the vaccination area.

## **(54) PREVALENCE OF ANTIBODY TO CANINE PARVOVIRUS-2, INFECTIOUS CANINE HEPATITIS, CANINE DISTEMPER AND RABIES IN GRAY WOLVES (*CANIS LUPUS*) FROM ALGONQUIN PARK, ONTARIO**

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*Abstract:* Sera from gray wolves live-trapped in Algonquin Park, Ontario were examined for antibody to Canine Parvovirus-2 (CPV-2) by hemagglutination inhibition (HI); Infectious Canine Hepatitis (ICH) and Canine Distemper (CD) by virus neutralization (VN); and to Rabies by competitive ELISA, blocking ELISA and a neutralization test, the results of which were integrated subjectively as a "positive" or "negative" status. Prevalence of exposure to CPV-2 (HI titer  $\geq 64$ ) was: 1989-5/9; 1990-8/10; 1991-10/10; 1992-15/17 (overall 38/46). Prevalence of exposure to ICH (VN titre  $\geq 64$ ) was: 1989-7/9; 1990-6/10; 1991-8/10; 1992-14/17 (overall-35/46). The prevalence and distribution of seroreactivity to CPV-2 and ICH suggested widespread, common and early exposure, with 7/8 pups positive for CPV-2 and 4/8 pups positive for ICH. Prevalence of exposure to CD (VN titer  $\geq 96$ ) was: 1989-5/9; 1990-2/10; 1991-2/10; 1992-3/17 (overall-12/26). The pattern of seroreactivity to CD suggested that an epizootic had occurred in 1989, when exposure was common (5/7) and titres were high (384-1536) in wolves from 3/6 packs sampled that year. In contrast, over the 3-year period 1990-1992, most titres were low, suggestive of decline in convalescence (only 2/7 animals had a titre  $> 192$ ), and prevalence of antibody was higher (5/15) in wolves from the 3 packs in which wolves with CD titres were observed in 1989, versus 2/21 in the other 8 packs sampled over this period. One wolf sampled in 1990 and 1991 retained a CD titre of 192, and a stable CPV-2 titre (128/256) over the 10-month interval, though the ICH titre dropped (1024-128). Rabies exposure was not evident in 18 animals examined in 1989-1990, while in 1991-1992, 5/25 animals, including 2/5 pups, were considered rabies "positive." A fox rabies epizootic occurred in the Algonquin region in summer 1990 and winter 1990-1991, during which period 6 wolves from the study are believed to have died of rabies. However the magnitude of the neutralization reactions was not consistent with survival of clinical rabies. They may have resulted from consumption of oral rabies vaccine baits which were air dropped in eastern Algonquin Park in 1991-1992.

**(55) SUSCEPTIBILITY OF *PEROMYSCUS MANICULATUS* TO INFECTION WITH VESICULAR STOMATITIS VIRUS NEW JERSEY SEROTYPE**

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*Abstract:* Vesicular stomatitis virus New Jersey serotype (VSV-NJ) causes disease in horses, domestic ruminants, and swine. Although VSV-NJ is probably transmitted by both insect vectors and via contact, other aspects of the epizootiology of VSV-NJ are not well defined. What role, if any, small mammals play in the maintenance of VSV-NJ is unknown. This study evaluated the susceptibility of *Peromyscus maniculatus* to infection with a sand fly isolate of VSV-NJ. Weanling and adult mice were inoculated with VSV-NJ via intradermal (ID) injection or intranasal (IN) instillation and housed with uninfected mice as contact controls. After 19 days, seropositive weanling and adult mice were challenged with the same virus via IN instillation; seronegative mice were also inoculated and served as controls. Viremia was not detected in either weanlings or adults inoculated ID, but viremia was detected in both seronegative and seropositive adult and weanling mice following IN inoculation. Only weanlings died following ID inoculation, but both seronegative and seropositive weanlings and adults died following IN instillation. Both weanling and adult mice seroconverted to VSV-NJ following ID and IN inoculation. There was no evidence of contact transmission. Mice that died had meningoencephalomyelitis and myocarditis. Results of this study indicate that both adult and weanling mice are extremely susceptible to VSV-NJ, particularly when inoculated IN, and may serve as a source of virus for blood-sucking insect vectors.

## **(56) NEW DISEASES (EUROPEAN BROWN HARE SYNDROME AND PHOCEN MORBILLIVIRUS) IN WELL ESTABLISHED WILDLIFE POPULATIONS**

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*Abstract:* The possible impact from disease on wildlife populations is often discussed, especially when diseases new to the populations are introduced. In Denmark the population of hares (*Lepus europaeicus*) has been decreasing since the change of agriculture in the 1960s, while the population of Harbor Seals (*Phoca vitulina*) has increased since 1976, when protection and game reserves were established. From 1981 the virus infection EBHS has caused mortality among hares all over Denmark, while the phocine morbillivirus in 1988 killed approximately 60% of the Harbor Seals in Danish waters. None of the diseases have previously been recorded in Denmark. Even the appearance of both diseases looked very dramatic, the EBHS, judging from the bag record does not seem to have influence on the decreasing hare population, and the seal epizootic only caused a short delay in the fast growing seal population.

**(57) DIFFERENTIAL DETECTION OF MALIGNANT CATARRHAL FEVER VIRUSES IN CAPTIVE EXOTIC RUMINANTS BY POLYMERASE CHAIN REACTION AMPLIFICATION USING PRIMERS DERIVED FROM ALCELAPHINE HERPESVIRUS 1 AND OVINE HERPESVIRUS 2**

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*Abstract:* Polymerase chain reaction (PCR) assays have been developed to detect animals latently infected with alcelaphine herpesvirus 1 (AHV-1) and ovine herpesvirus 2 (OHV-2), two known agents of malignant catarrhal fever. Previously, we described two PCR assays derived from AHV-1 strain WC11, one of which also amplifies DNA from the less pathogenic alcelaphine herpesvirus 2 (AHV-2) of topi and hartebeest (*Damaliscus* spp. and *Alcelaphus* spp.). Buffy-coat DNA specimens from a broad range of captive exotic ruminants were tested in all three PCR assays (two derived from AHV-1 and one for OHV-2) to determine the prevalence of latent infections. The OHV-2 sequence was not detected in specimens from any of the animals tested to date, including several species of sheep and goats. However, some sheep and goats were positive by one or both of the AHV-1-derived assays. Among wildebeest, the largest group of tested animals, most specimens produced positive results in one, and usually both, of the AHV-1-derived assays. Among other ruminants, where the AHV-1-derived assays often do not agree, positive results are usually seen in the less specific assay that amplifies both AHV-1 and AHV-2 DNA, except among sheep and goats. The available evidence continues to suggest the existence of ruminant gammaherpesviruses other than those previously described in the literature, while overall prevalence of infection is sufficiently high to justify continued surveillance even in the absence of clinical disease.



**(58) FIELD EXPERIENCE WITH ETORPHINE AND CARFENTANIL  
IMMOBILIZATION OF FREE-RANGING BISON (*BISON BISON*) IN  
YELLOWSTONE NATIONAL PARK**

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*Abstract:* Twenty-two immobilizations, comprised of 16 different animals, were conducted on free-ranging adult bison using etorphine hydrochloride (n = 12) and carfentanil citrate (n = 10) combined with xylazine delivered IM via Pneu-dart. Antagonists consisted of naltrexone (450-500 mg, IV, IM, SC) and yohimbine (carfentanil/xylazine immobilizations only; 50 to 100 mg per bison, IV). Six females were immobilized twice, once with each drug regimen. Mean etorphine dose was 8.83 mg combined with 200 mg xylazine per adult female bison (est weight 410-550 kg). One animal failed to immobilize, was tracked 3 miles and found dead the next day. A second animal immobilized and antagonized normally but was found dead 3 days later. Six animals were inadequately immobilized and 200 mg ketamine was added during field procedures. Carfentanil was given at an average dose of 3.6 mg (8 cows) and 4.4 mg (2 bulls) combined with an average xylazine dose of 84 mg and 90 mg, respectively. Mean induction, down and recovery times for the two anesthesia protocols will be compared. All bison have been repeatedly relocated at least 8 weeks post-immobilization. Renarcotization was not observed. The two mortalities may have been related to etorphine renarcotization or xylazine dose. The carfentanil protocol provided a more predictable induction and stable immobilization while the etorphine required additional anesthesia and a less stable immobilization.

**(59) THE USE OF PHARMACOLOGICAL AGENTS IN WILDLIFE**

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*Abstract:* The use of various pharmacologic and biological agents in wildlife is widespread. The usage of and the conditions of use of many drugs will be significantly altered beginning in January 1997 based on the Animal Medicinal Drug Use Clarification Act of 1994. This act is an amendment to the Federal Food, Drug, and Cosmetic Act (21 USC 360b(a)) and deals specifically with the use of drugs in nonapproved species, the use of nonapproved drugs, and the extra-label use of drugs in approved and nonapproved species. Under the provisions of this act, as well as supporting regulatory changes within the Food and Drug Administration, it will be illegal to use either prescription drugs for labeled uses or over-the-counter drugs for extra-label uses unless those drugs are prescribed or dispensed by a veterinarian in the presence of a valid veterinarian-client-patient relationship. In addition, the FDA has recently modified its labeling requirements for drugs dispensed or prescribed for extra-label purposes. The provisions of the act, its potential effects on individuals working with wildlife, and compliance information will be discussed.

## (60) FIELD ANESTHESIA AND MONITORING OF HOWLING MONKEYS (*ALOUATTA PALLIATA*) IN COSTA RICA

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*Abstract:* This study is a comparison between the effects of the capture dose used for wild mantled howling monkeys (*Alouatta palliata*) and the much lower redose given to the same captured animals when additional anesthesia was necessary to complete data collection. Forty-six howling monkeys (33 females, 13 males) from Hacienda La Pacifica and Santa Rosa National Park, Costa Rica, were immobilized using tiletamine/zolazepam (Telazol) anesthesia during a 10-day period in February 1995. All were initially dart immobilized except one juvenile who was anesthetized with a needle and syringe.

All animals from the La Pacifica site were transported to a base camp 5-10 minutes away for the collection of morphometric data and dental impressions as part of concurrent studies. Twenty-nine animals were redosed 1-3 hours later via needle and syringe at our base camp as needed to complete these data collections. All animals received atropine sulfate intramuscularly at 0.02 mg/kg to reduce salivation and bronchial secretions. All had heart rate (HR) and respiratory rate (RR) measured every 5 minutes and temperature every 15 minutes upon capture until awake and moving. Relative arterial hemoglobin saturation (SaO<sub>2</sub>) was estimated, (SpO<sub>2</sub>), using a Nellcor N-10 pulse oximeter. Various pulse oximeter probe sites were tried using a small clip-on probe with only the popliteal fossa giving consistent readings. If pulse oximeter data were not collected using the popliteal fossa site within 30 minutes of receiving Telazol, the individual's data was not used for statistical purposes. This usually occurred due to multiple animals being captured at once and only one monitor available, or the individual was too awake to collect the data. Of the 46 monkeys captured with Telazol, 23 had usable data. Of the 29 individuals that were redosed, 18 had usable data. Some monkeys had data that was usable from both the capture and redose procedures. Their weights ranged from 2.0 kg to 5.6 kg with a mean of 4.0 kg.

The Telazol capture dose was 150-200 mg resulting in a mean maximum dose of 40 mg/kg. The mean SpO<sub>2</sub> for the capture group was 90% with mean HR = 135 and RR = 22. The mean redose amount of Telazol was 4 mg/kg intramuscularly. The mean SpO<sub>2</sub> for the redose group was 92% with mean HR = 158 and RR = 27. Undesired side effects of Telazol were apnea, bradypnea, and oxygen desaturation. Twelve of the animals in the study were given doxapram HCL (Dopram) intramuscularly at 0.75-2.0 mg/kg due to clinical signs of respiratory depression or a decreasing trend in SaO<sub>2</sub>. There were no mortalities.

**(61) REVERSIBLE IMMOBILIZATION OF ARCTIC UNGULATES USING MEDETOMIDINE-KETAMINE AND ATIPAMEZOLE**

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*Abstract:* Medetomidine (MED), ketamine (KET) and atipamezole (ATI) were evaluated for reversible immobilization of muskoxen (*Ovibos moschatus*), reindeer (*Rangifer tarandus tarandus*) and moose (*Alces alces*). Nine semi-captive muskoxen (3 males, 6 females; 2-6 years of age; 150-250 kg estimated body weight) were darted from ground in May-June 1995 with initial doses of 10 mg MED + 133 mg KET per 100 kg. Mean (SD) (range) time from darting to recumbency (induction time) was 4.6 (1.9) (3.0-8.7) min. Five animals required manual restraint and/or additional dosing. Initial doses of 12-14 mg MED + 60-100 mg KET were used to dart 17 adult free-ranging reindeer (6 males, 11 females; 50-75 kg) from helicopter in November 1995 in Norway. Mean induction time for 16 animals immobilized after one darting was 8.4 (5.0) (1.0-18.5) min. Initial doses of 30 mg MED + 400 mg KET for calves (n = 12) and 40-50 mg MED + 600 mg KET for adults (26 males, 23 females) were used to dart free-ranging moose from helicopter in March 1993-1995 in Finland. Mean induction times for animals immobilized after one darting were 4.2 (1.7) (2.0-7.0) min. for calves (n = 12) and 6.1 (2.1) (3.0-12.0) min. for adults (n = 33). In all three species, complete reversals were achieved with intramuscular administration of ATI at 5 times the dose of MED.

**(62) CHEMICAL IMMOBILIZATION OF ROTHSCHILD'S GIRAFFE  
(*GIRAFFA CAMELOPARDALIS ROTHSCHILDI*) IN LAKE NAKURU NATIONAL  
PARK AND A REVIEW OF SOME BLOOD PARAMETERS**

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*Abstract:* A total of twelve (12) subadult Rothschild's giraffes (4 males, 8 females) were immobilized in October 1995 for translocation from Lake Nakuru National Park to reduce the debarking pressure on Acacia trees (*Acacia xanthoploea*).

Etorphine (M99) mixed with a standard dose of 1500 i.u hyaluronidase was used to immobilize the free ranging Rothschild's giraffe (*Giraffa camelopardalis Rothschildi*).

The mean dose (mg)  $\pm$  standard error of mean (SEM) of Etorphine (M99) used was  $10.23 \pm 0.60$ . The induction was fairly smooth with complete recumbency times(minutes) in most cases without the assistance of ropes of Mean  $\pm$  (SEM) of  $12.67 \pm 2.21$ .

Immobilization was characterized by fairly good muscle relaxation, normal rectal temperatures and stable respiratory rates. Differences observed in haematologic and serum chemistry values between these giraffes and those recorded in other normal free ranging and captive subspecies of the Genera Giraffa can be associated with capture stress. From the blood biochemistry there was no evidence to suggest the debarking of acacia trees by the giraffes was related to phosphorus deficiency however this needs further investigation. All immobilization were reversed with diprenorphine at 3 X the M99 dose and led to standing recovery in mean times (minutes)  $\pm$  (SEM) of  $6.58 \pm 0.66$ . Eight (8) animals were translocated successfully, three (3) animals released after being classified as stressed and one (1) animal died.

**(63) EFFECT OF HOLDING TIME ON COMPLETE BLOOD COUNT VALUES IN HAWAIIAN COMMON AMAKIHI**

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*Abstract:* To evaluate how holding time affects complete blood count (CBC) values, wild Common Amakihi (*Loxops virens*) from the Pu`uwa`awa`a area on the island of Hawaii were captured using mist nets. Each bird was randomly assigned to one of three groups: 1, bled within five minutes of capture (5M, n = 27); 2, held in a quiet area for 45 minutes then bled (45Q, n = 32); or 3, bled after holding for 45 minutes in proximity to the banding station with banding and processing done 15 minutes after capture (45S, n = 32). Blood smears were made immediately after samples were collected. Complete blood counts were determined using the eosinophil unopette method. Total white blood cell counts varied significantly between the three groups (mean values were, 45Q = 13,961; 5M = 10, 519; 45S = 8,836). Lymphocyte counts were significantly different between the three groups (mean values were, 45Q = 9,804; 5M = 7,791; 45S = 6,052). The percentage of lymphocytes varied significantly between the three groups (mean values were, 5M = 73.6%; 45Q = 68.6%; 45S = 64.8%). Although the percentage of heterophils did not differ significantly, the trend was the reverse of lymphocyte percentages (45S = 9%; 45Q = 8.8%, 5M = 6.2%). The heterophil to lymphocyte ratio did not vary significantly between groups. The common mean ratio was 0.134 (s.d. = 0.137, n = 91). Numbers of heterophils and lymphocytes showed a significant positive correlation ( $r = 0.339$ ,  $P = 0.001$ ,  $n = 91$ ). From this study it was determined that the handling protocol affects both the number and distribution of white blood cells in Common Amakihi. Assuming the 5M group represents nearly normal CBC values, the birds which were manipulated the most prior to bleeding (45S) showed the greatest deviation from normal.

## (64) NECROPSY FINDINGS IN LOONS IN ONTARIO, 1989-1995

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*Abstract:* Necropsy results from 68 loons found dead or in moribund condition in Ontario over the period 1989-1995 are presented. Loons were examined for body condition, cause of death, significant disease conditions, parasite burdens and exposure to lead and mercury. Important causes of death included: trauma due to gunshot or collisions with boats, cars, or power lines (19/68); lead poisoning due to ingestion of lead fishing sinkers (18/68); drowning due to entanglement in fishing nets (7/68); ingestion of fish hooks, fishing line or other foreign bodies (6/68); and infectious diseases, including aspergillosis and enteric parasites (8/68). Tissue lead levels in lead-poisoned birds ranged from 17-270 ppm dry weight (dw) in liver and 28-480 ppm dw in kidney. Total and organic mercury levels in tissue were measured. Total mercury concentrations in kidney ranged from 6.5-341 ppm (dw) and from 7.6-507 ppm dw in liver. Organic mercury fractions were much lower: 2.2-24 ppm dw in kidney and 3.8-25 ppm dw in liver.

**(65) A MULTIFACTORIAL ETIOLOGIC BASIS FOR WINTER MORTALITY OF COMMON LOONS (*GAVIA IMMER*) IN FLORIDA COASTAL WATERS.**

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*Abstract:* The cause of morbidity or mortality was determined for 434 common loons (*Gavia immer*) found on Florida beaches from 1970 through 1994, primarily during the months of December to April. The most common problem was an emaciation syndrome (66%), followed by oiling (18%), aspergillosis (7%), trauma (5%) and miscellaneous disease entities (1%). The cause of death for 3% of the birds was undetermined. A large percentage of the carcasses examined ( $n = 173$ ) was obtained during an epizootic which occurred from January to March of 1983 in which more than 13,000 loons were estimated to have died. The emaciation syndrome, characterized by severe atrophy of pectoral muscles, loss of body fat, and hemorrhagic enteritis, was the primary finding in this epizootic and was postulated to have a complex etiologic basis involving synergistic effects and energy costs of migration, molting and replacement of flight feathers, food resource changes, salt-loading, intestinal parasitism, environmental contaminants, and inclement weather.



**(66) MORBIDITY AND MORTALITY OF RAPTORS IN FLORIDA: A SEVEN YEAR RETROSPECTIVE STUDY**

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*Abstract:* Thirty-two species of raptors are found in Florida; either as permanent residents or as migrants. Information is available on the distribution and biology for many of these species; however, to the authors' knowledge there have been no large-scale epidemiological studies in the literature on the causes of raptor morbidity and mortality in Florida. In this retrospective study we gathered data from 390 medical records, each representing an individual raptor presented to the Wildlife and Zoological Medicine Service at the University of Florida, Veterinary Medicine Teaching Hospital (VMTH) during a seven-year period (1988-1994). The major aim of the study was to determine the most common causes of morbidity and mortality of raptors presented to the VMTH. The data will be analyzed to provide information on the effects of disease (including trauma) on different raptor species.

**(67) WHOOPING CRANES IN FLORIDA: THE HEALTH OF AN EXPERIMENTALLY RELEASED POPULATION**

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*Abstract:* The goal of establishing a breeding nonmigratory population of whooping cranes in Florida has resulted in the release of 101 juvenile birds over the last 4 years. Of these, 59 are alive, 2 disappeared, 1 was returned to captivity because of trauma to the wing, 1 died before release, and 38 died in the field. Bobcat predation has been the primary cause of mortality (89%) and has recently been ameliorated by changing the release sites to more open habitat. Cause of death could not be determined in 3 cases. Diseases of primary concern with regard to establishing a viable population are eastern equine encephalitis and disseminated visceral coccidiosis. Other mortality and disease factors that appear to have less importance are fence entanglement, metal toxicosis, capillarid stomatitis, intestinal parasitism, cyclocoelid airsacculitis and peritonitis, *Salmonella* sp., blood parasitism, and cartilage tumors associated with a virus.

**(68) MYCOPLASMA GALLISEPTICUM IN A CAPTIVE FLOCK OF HOUSE FINCHES: FIELD IMPLICATIONS**

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*Abstract:* *Mycoplasma gallisepticum* (MG) induced conjunctivitis in house finches (*Carpodacus mexicanus*) was first recognized in 1994, and in two years has spread throughout the eastern range of this species. Although pathogenesis has been described, long-term effects on infected birds are unknown. During October 1995, conjunctivitis was detected among 98 seronegative house finches collected and housed for a long-term experimental study. Rather than destroying this flock, we elected to follow the infection through this captive population. As of 12 weeks, most of the birds had developed eye lesions. Birds were severely debilitated and many either died or were euthanized due to their moribund condition. There was very good agreement between clinical observations and serology, culture, and polymerase chain reaction results. MG could be cultured from these birds up to 9 weeks following onset of conjunctivitis. Due to the efficiency of transmission and the severity of clinical disease, the potential for transmission to occur between infected house finches, other wild birds and domestic poultry needs to be evaluated. Although preliminary information suggests that MG has spilled over into other wild species, major problems with existing diagnostic tools are anticipated.

**(69) REASONABLE OVEREXERTION, A METHOD FOR CAPTURING STEPPE EAGLES (*AQUILA NIPALENSIS*) IN THE WILD: EVALUATION OF PHYSIOLOGICAL STRESS AND EFFORT RECUPERATION**

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*Abstract:* The use of a capture-technique based on human induced overexertion was evaluated on 10 steppe eagles (*Aquila nipalensis*). In order to assess the degree of physiological stress and delay of effort recuperation, various blood parameters were monitored at the moment of capture and 1, 24 and 48 hours later. Mean time required to capture an eagle was 4 min 46 sec ( $n = 10$ ,  $SD = 2'25''$ ).

Serum concentrations of creatinine phosphokinase (CPK), which is an indicator of muscle damage and metabolic flux after prolonged and/or strenuous muscular efforts, changed, reaching peak concentrations 24 hours after capture ( $\bar{x} = 1915$  IU/l,  $SD = 1364$  IU/l,  $n = 10$ ).

Only a slight increase in PCV and total protein was observed, indicating moderate extracellular dehydration at the moment of capture. Values of these parameters returned to normal 1 hour later. Hyperkalemia at the moment of capture could be caused by a redistribution of potassium from the intracellular to the extracellular fluid (acidosis), linked to dehydration or to a slight hemolysis. Kaliemia was back to normal 1 hour after capture. Natremia and chloremia did not change.

The flight-induced increase in blood uric acid 16.2 mg/dl ( $n = 10$ ,  $SD = 6.5$  mg/dl) could be attributed to an increase in purine catabolism. A higher uric acid level should not only enhance water conservation, but may also reduce flight-induced hyperthermia as well as acting as an antioxidant defense against oxidative tissue injury. Uric acid levels returned to normal 24 hours after capture. Basic physiological parameters showed polypnea, tachycardia and hyperthermia as a result of capture. Rectal temperature, respiratory and heart rates had returned to normal physiological values 2 hours after capture.

Blood gas analyses revealed a decrease in arterial blood pH to 7.1 ( $n = 7$ ,  $SD = 0.1$ ), in pCO<sub>2</sub> to 11.6 mmHg ( $n = 7$ ,  $SD = 3.1$  mmHg), in HCO<sub>3</sub> to 5.7 mmol/l ( $n = 7$ ,  $SD = 2.3$  mmol/l) and a deficit of base excess to -18.9 mmol/l ( $n = 7$ ,  $SD = 3.6$  mmol/l) at the time of capture. These parameters are diagnostic of a metabolic acidosis. Blood gas values were back to normal 24 hours after capture.

These data indicate that despite using a physiologically stressful capture technique, effort recuperation proved to be efficient within 24 hours.

**(70) BLOOD LEAD CONCENTRATIONS OF SPECTACLED EIDERS NEAR THE KASHUNUK RIVER, YUKON-KUSKOKWIM DELTA, ALASKA**

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*Abstract:* Lead poisoning of the spectacled eider (*Somateria fischeri*), listed as a threatened species by the US Fish and Wildlife Service, was first documented in Alaska in 1992 near the Kashunuk River, Yukon-Kuskokwim Delta. To further monitor lead exposure in this species, 333 blood samples were collected from spectacled eiders in the vicinity of the Kashunuk River from 1993 through 1995. Blood lead concentrations ranged from not detectable (< 0.02 ppm wet weight) to 14.37 ppm wet weight. Blood lead concentrations of  $\geq 0.20$  ppm, commonly accepted as a positive indication of lead shot exposure, were found in 62 (19%) samples. Twenty birds were sampled twice within the same year, once near the end of incubation and again during the brood rearing period about 4 weeks later. Twelve of the 20 birds were negative for lead exposure during incubation but four (33%) of these 12 subsequently had blood lead concentrations of  $\geq 0.2$  ppm wet weight during brood rearing, indicating exposure to lead within the local area. Seventeen individuals were sampled during each of two or more different years. One bird had blood a lead concentration of 0.32 ppm wet weight in June 1994 and 0.91 and 0.46 ppm in June and July 1995, respectively. Blood lead concentrations in two other individuals reflected lead exposure (1.30 and 0.70 ppm wet weight) the first year (1994) but were less than 0.2 ppm the second year (1995).

**(71) NATURAL AND EXPERIMENTAL AVIAN MORTALITY RELATED TO POTASH PROCESSING IN SOUTHEASTERN NEW MEXICO**

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*Abstract:* Avian mortality was observed at several playa lakes in southeastern New Mexico receiving waste water generated by potash processing operations. Necropsy and laboratory findings suggested that salt toxicosis was a possible etiology. In November 1994, mallards (*Anas platyrhynchos*) were placed in experimental pens at Laguna Toston (Lea Co.; 310,000 ppm total ion concentration) and Williams Sink (Eddy Co.; 290,000 ppm) to assess the health effects of water contact and ingestion. Birds in direct contact with water displayed abnormal behavior in three hours, leading to death or euthanasia by 35 hours. Levels of serum sodium and potassium increased throughout the exposure period. Feather structure changes and reduced flight capacities were noted. Changes in eyes and mucosal surfaces were observed on physical exam and necropsy. Brain sodium levels were consistent with a diagnosis of salt intoxication (> 2000 ppm). Birds provided with lake water for drinking, and housed on land, also had elevated serum and brain sodium, but not to toxic levels. No electrolyte changes were seen in control birds housed on land with distilled drinking water. In March and April 1995, dead and sick wild birds were again found around the lakes. Laboratory and post-mortem analyses showed serum and brain sodium levels within the ranges found in the contact and lake drinking water experimental groups.

**(72) CALCIUM DEFICIENT RICKETS IN CATTLE EGRETS (*BUBULIS IBIS*)  
IN EAST CENTRAL TEXAS**

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*Abstract:* In 1994, two colonies of cattle egrets (*Bubulis ibis*) sustained significant mortality in nestling and fledgling birds due to naturally occurring calcium deficiency rickets. Approximately 3500 affected chicks were found on the ground around the colony between June and August 1994, of which approximately 200 were evaluated for clinical disease. Affected birds had severe osteopenia, curving deformities and folding fractures of long bones. Plasma calcium phosphorus levels were normal and normal to high, respectively. Histologic lesions included parathyroid gland hypertrophy, moderate elongation of the epiphyseal proliferating cartilage zone, elongation of the hypertrophic cartilage zone with failure of cartilage cells to degenerate and mineralize, and failure of osteoid mineralization. Gut contents of affected chicks contained predominately grasshoppers and crickets; vertebrate prey items were absent. Grasshoppers and crickets collected from feeding areas of adult egrets were severely deficient in calcium. The lack of adequate calcium in the diet, especially the lack of vertebrate prey, probably lead to the development of rickets in these chicks.

**(73) EVIDENCE FOR *COWDRIA RUMINANTIUM* INFECTION IN WILDLIFE SPECIES IN ZIMBABWE**

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*Abstract:* *Cowdria ruminantium*, an obligate intracellular rickettsial bacterium, causes heartwater, a severe, often fatal disease in domestic ruminants. It is transmitted by species of *Amblyomma* ticks, and has been reported in most African countries south of the Sahara, and on islands off the African mainland and in the Caribbean Sea. It is also considered a potential threat to other parts of the world, given its vector transmission and wide host range. Fatal disease occurs in cattle, sheep, and goats, particularly those of European origin, making *C. ruminantium* a major impediment against the introduction of exotic breeds into Africa for genetic improvement. African wildlife species are normally not affected, although wildlife species are suspected to be important reservoirs for *C. ruminantium*, and also alternative hosts for *Amblyomma* spp. in areas where tick control methods are exercised.

Sera from free-ranging Zimbabwean black (*Diceros bicornis*) and white (*Ceratotherium simum*) rhinoceroses tested positive for antibodies to *Cowdria ruminantium* by monoclonal antibody-mediated competitive enzyme-linked immunosorbent assay. However, as with other serological tests for *C. ruminantium*, the possibility of cross reactions with *Ehrlichia* spp. had to be considered. Polymerase chain reaction (PCR), a more specific assay, capable of detecting sequences of *C. ruminantium* DNA was later developed, and used to test for *C. ruminantium* in blood and bone marrow from Zimbabwean tsessebe (*Damaliscus lunatus*), waterbuck (*Kobus ellipsiprymnus*), impala (*Aepyceros melampus*), and reedbuck (*Redunca arundinum*). A 297 base pair segment of DNA derived from the MAP1 gene was amplified from blood and bone marrow of tsessebe, from blood of waterbuck, and from bone marrow of impala. Results were confirmed by southern blot hybridisation.

The presence of naturally infected, asymptomatic carriers of *C. ruminantium* make translocation of these species into heartwater-free areas risky, especially those which harbor natural vectors. This is of particular concern for Zimbabwe, which translocates wildlife within the country as well as abroad. Further use of the methods developed will be applied to samples from other wildlife species in Zimbabwe, attempting to further define the role of wildlife species in the epidemiology of heartwater. In addition, isolates from wildlife species will be tested for pathogenicity to domestic ruminants.



**(74) SEROLOGIC SURVEY FOR INFECTIOUS PATHOGENS IN FREE-RANGING AMERICAN BISON (*BISON BISON*)**

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*Abstract:* A serologic survey was conducted on 101 free-ranging apparently healthy American bison (*Bison bison*) from Yellowstone National Park, Wyoming USA. No titers were detected for bluetongue virus, bovine leukemia virus, or *Campylobacter fetus* in these 101 bison. Detectable antibodies occurred against *Anaplasma marginale* (8 of 76, 11%), bovine respiratory syncytial virus (31 of 101, 31%), bovine viral diarrhea (31 of 101, 31%), infectious bovine rhinotracheitis (29 of 76, 38%), *Leptospira icterohaemorrhagiae* (4 of 101, 4%), *L. hardjo* (7 of 101, 7%), *L. autumnalis* (1 of 101, 1%), *L. bratislava* (7 of 101, 7%), *L. australis* (1 of 101, 1%), and parainfluenza 3 virus (27 of 75, 36%). The low antibody titers and the lack of any signs of clinical disease or gross lesions are evidence that while previous exposure to some of these infectious organisms may have occurred, none of the free-ranging bison appeared to have active infections.

**(75) ECOLOGICAL INVESTIGATION OF WILDLIFE DISEASE  
TRANSMISSION: A CASE STUDY IN FLORIDA**

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*Abstract:* Infection with the parasitic nematode *Eustrongylides ignotus* is a significant health risk to wading birds (Ciconiformes) in Florida. Piscivorous birds acquire the parasite by eating infected fish. Field surveys were conducted to determine the distribution of enzootic areas and characterize both positive and negative sites. Over 34,000 fishes were examined for parasites, with infected poeciliids having the most widespread distribution. Experimental laboratory studies were initiated to determine which intermediate hosts were most important in the life cycle of *E. ignotus*. The parasite was shown to be capable of parentenic transport by higher trophic level fishes.

**(76) ESTIMATING POPULATIONS OF YELLOW GRUB (*CLINOSTOMUM MARGINATUM*) IN SMALLMOUTH BASS AND CHANNEL CATFISH**

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*Abstract:* Determination of population parameters of most endoparasites is difficult or near impossible without necropsy. Necropsy is not only tedious and time consuming but also results in death of the host. In wildlife and agricultural research it would be more desirable, in many cases, not to destroy a host animal. Reasons for this would be because of the host's economic value, restricted host numbers, or that host removal would adversely effect the ecosystem. We have found a necropsy-less approach that allows estimation of the population parameters of an endoparasitic larval trematode parasite of fish, *Clinostomum marginatum* (yellow grub), in valuable wildlife and commercial resources; the smallmouth bass (*Micropterus dolomeiu*) and the channel catfish (*Ictalurus punctatus*). Regression analysis of the number of yellow grubs in the gill cavity against grub counts from the whole body of the hosts showed highly significant correlations for mean parasite number/host, standard deviation of the mean parasite number, dispersion, and prevalence of infection. With this technique it is possible to do yellow grub population studies directly at the collection locations, examine large numbers of hosts in a short period of time and allow immediate return of the fish to their habitat.

**(77) NEURONAL VACUOLATION (SUSPECT SPONGIFORM ENCEPHALOPATHY) IN RACCOONS (*PROCYON LOTOR*)**

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*Abstract:* One of the histologic hallmarks of scrapie (and related spongiform encephalopathes) is the cytoplasmic vacuolation of neurons. Similar changes have been described in experimental as well as natural cases of rabies in rodents, skunks, foxes, cat, dog, sheep, horse, and cattle. Naturally occurring scrapie-like encephalopathy, however, has not been reported in the raccoon, and only one report of a successful experimental transmission of a similar spongiform disease, transmissible encephalopathy of mink (TME), has been documented in this species. Microscopic vacuolar changes in neuronal perikaryon, suggestive of spongiform encephalopathy was seen in 2 free ranging raccoons (*Procyon lotor*) from different geographical locations (South Carolina and Oregon) in the United States. In both cases, the vacuolated neurons were not accompanied by changes, such as neuronal degeneration of astrocytosis and both were negative for rabies and scrapie-associated antigens by immunohistochemistry.

## **(78) "NAME THAT BILL": A LOOK AT SOME WILDLIFE LEGISLATION INTRODUCED TO THE UNITED STATES SENATE IN THE 104TH CONGRESS**

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*Abstract:* The AVMA Congressional Science Fellowship offers a unique opportunity to gain insight and experience into the inner workings of our Nation's legislative process. This presentation is a small sampling of environmental bills referred to the Committee whose staff I serve on as a Fellow. As of April 30, 1996 there have been 160 bills referred to the Senate Environment and Public Works Committee in the 104th Congress. Of the 160, there are 32 bills which directly address wildlife or wildlife habitat. These bills address aspects of wildlife management, conservation, and disease, such as bills to amend the well-known Endangered Species Act. There are also numerous bills that would indirectly affect wildlife. For example, a bill to amend the Clean Water Act does not address wildlife or its management, but it would affect their habitat. In addition to the Environment and Public Works Committee, there are other bills pending before the Senate Energy and Natural Resources and the Senate Commerce Committees that would affect wildlife. By taking a look at some of the bills that have been introduced and the legislative process that follows, one can gain insight as to how and where in the process the wildlife veterinarian's input is more useful.

**(79) INVESTIGATION, CONTROL AND EPIZOOTIOLOGY OF ANTHRAX IN A GEOGRAPHICALLY ISOLATED, FREE-ROAMING BISON POPULATION IN NORTHERN CANADA**

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*Abstract:* In July 1993 an outbreak of anthrax caused significant mortality in an isolated, free-ranging population of bison (*Bos bison athabasca*) west of Great Slave Lake in the Northwest Territories, Canada. There was no previous record of anthrax in this area. An emergency response was undertaken to reduce the scale of environmental contamination and dissemination of anthrax spores and hence to reduce the likelihood of future outbreaks. One-hundred-seventy-two bison, 3 moose (*Alces alces*), and 3 black bear (*Ursus americanus*) carcasses were found. Visual detection of carcasses was enhanced with the use of an airborne, remote infrared sensing camera mounted externally on a helicopter. Fifty-five percent of the carcasses were located in forested or shrub-covered sites where detection would not have been likely without the thermal imaging equipment. Carcasses were disposed of by incineration and the sites were decontaminated with formaldehyde, which also served to prevent scavenging. The outbreak occurred after a prolonged period of drying between April and mid July 1993 which followed several successive years of flooding of bison habitat. Dragon and Rennie's "spore concentration hypothesis" provides the most conservative explanation for the occurrence of anthrax under the observed conditions.

## (80) DISEASES AND ANOMALIES OF THE FLORIDA BLACK BEAR

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*Abstract:* One hundred sixty-two black bears (*Ursus americanus*) (96 dead, mostly road-killed; 66 live-captured) from Florida were examined from September 1993 through November 1995 for presence of disease and congenital anomalies. Retained testes were found in 11 (15.5%) of 71 male bears; 4 (5.6%) were considered cryptorchid. Other anomalies found included a hair whorl (N = 1), absence of a tail (N = 1), and absence of one kidney (N = 1). Serum samples collected from 66 live-captured bears were seropositive (%) for antibodies against the following: *Toxoplasma gondii* (N = 66, 60%), *Coxiella burnetii* (N = 38, 3%), bluetongue virus (N = 56, 8%), infectious canine hepatitis, Type I (N = 66, 6%), canine distemper virus (N = 66, 8%), canine parvovirus (N = 66, 15%), eastern equine encephalomyelitis (N = 66, 11%), western equine encephalomyelitis (N = 66, 6%), Venezuelan equine encephalomyelitis (N = 66, 3%), and St. Louis encephalomyelitis (N = 66, 17%). All samples were seronegative for *Brucella* sp. (N = 37), *Francisella tularensis* (N = 38), and pseudorabies virus (N = 37). Other diseases found included salmonellosis (N = 1), mild to severe internal parasitism, and infestation with *Demodex ursi* (N = 9), the causative agent of demodectic mange. This was part of a study to assess the health of black bears in Florida conducted by the Florida Game and Fresh Water Fish Commission.

**(81) POTENTIAL VALUE OF IN VITRO ANTIGEN-SPECIFIC IFN-GAMMA ASSAYS FOR THE DIAGNOSIS OF TUBERCULOSIS, BRUCELLOSIS AND INFECTIOUS BOVINE RHINOTRACHEITIS IN BISON HERDS IN BELGIUM**

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*Abstract:* In the different Member States of the European Union, eradication programs for bovine tuberculosis (*Mycobacterium bovis*) and bovine brucellosis (*Brucella abortus*) were initiated in the 1960s, the vast majority of the cattle herds (> 99.5%) being nowadays declared officially free. Infectious Bovine Rhinotracheitis (IBR) control programs are currently under progress. Reintroduction of these diseases from nonconventional sources, i.e., ruminants in zoological parks, farmed cervids or bison (*Bison bison*), made testing programs compulsory for this later species. A practical cost-effective in vitro assessment of the specific cellular mediated immunity (CMI) should overcome, at least partially, the repeated immobilization problems of bison and other inherent limitations linked to the in vivo nature of the skin test for tuberculosis. It could also overcome some of the limitations of serological tests for IBR (maternal antibodies) and brucellosis (false positive serological results). We adapted a commercial IFN-K test (*Mycobacterium tuberculosis* IFN-K test kit® Idexx) developed in Australia (Rothel et al., 1990) in the context of tuberculosis for the diagnosis of IBR (Godfroid et al., 1995) and brucellosis (Weynants et al., 1995) in cattle. The reactivity of IFN-K is species specific in the bovidae Family. Therefore, the test could also be used in bison. In a first stage we detected tuberculosis (confirmed by *M. bovis* isolation) in 3 bison (also skin test positive) in a Zoo, using the IFN-K test kit. In a preliminary field study, we have used the IFN-K assays in a bison herd, in parallel with the classical serological tests (IBR, brucellosis) or skin tests (tuberculosis, brucellosis). On 2 occasions, the 24 and 32 animals tested were classified negative by the different combinations of tests. Our preliminary results suggest that the assessment of the CMI for different infections by the same in vitro cytokine release assay, should be further evaluated in the context of the certification of the absence of different infectious diseases in bison.



**(82) PATHOLOGY AND EPIDEMIOLOGY OF OROPHARYNGEAL FIBROPAPILLOMAS IN HAWAIIAN GREEN TURTLES (*CHELONIA MYDAS*)**

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*Abstract:* Data analyzed between 1991 and 1995 based on 222 green turtles (*Chelonia mydas*) necropsied from different locations in the Hawaiian Islands, demonstrated that over 62% of turtles with fibropapillomatosis (FP) presented growths in the oropharynx and adjacent tissues. Female biased sex ratios were identified in turtles with glottal fibropapillomas. In addition, these turtles were larger in straight carapace length than turtles with FP and turtles free of the disease, demonstrating a more prolonged, severe course of the condition. In addition, during 1991 to 1995, 561 green turtles were captured live in Kaneohe Bay, Island of Oahu. Of these, 42% presented mild to severe FP, and following oral examination, 40% of turtles with FP had oropharyngeal involvement. Complete gross and histopathologic examinations of the oropharynx were performed in five green turtles (*Chelonia mydas*) with FP. The size, appearance, and anatomic site of growths confirmed that these turtles demonstrated total or partial inability to feed and breath. It was concluded that fibropapillomas of the oropharynx were invasive and seriously reduced the capacity of turtles to survive increasing their susceptibility to stranding.

**(83) HEALTH STATUS MONITORING OF A COLONY OF TRANSLOCATED GOPHER TORTOISES (*GOPHERUS POLYPHEMUS*)**

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*Abstract:* Seventy-five gopher tortoises (*Gopherus polyphemus*) were translocated from mainland Georgia to St Catherine's Island in May 1994. After initial capture, the animals underwent physical examination, blood collection, nasal flushing, tick removal, feces collection and marking. Blood samples were processed for hematology, biochemicals, mycoplasma serology, and nutritional determinations. Females were radiographed to verify the presence of eggs, and juveniles were laparoscoped to determine sex. Six of the animals were fitted with radio transmitters attached to the carapace. Animals were released onto mapped areas of the island and subsequently monitored visually and via radio. Representative numbers of animals were recaptured in October and May of the ensuing years and medical procedures were repeated. At the time of translocation 85% of the animals tested were serologically positive for *Mycoplasma agazzii* antibodies, 81% of the adult females had shelled eggs in the coelom, 30% of those sampled were positive for fecal *Cryptosporidea* sp, and all animals were parasitized by ticks (*Amblyoma tuberculatum*).

After 2 years it appears that the animals are maintaining good health and suffered limited effects due to the stress of translocation, parasitism or existing disease. Comparative nutritional, hematologic and biochemical parameters are evaluated as well as fecals, weights and reproductive status. Monitoring will continue in order to determine the long-term success of the translocation.

## (84) TECHNIQUE FOR SURGICAL IMPLANTATION OF TRANSMITTERS IN SNAKES

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*Abstract:* Techniques for placing transmitters in snakes are described in the herpetological literature from 1972 to present. They include feeding waterproofed transmitter packages, forcefully or hidden in prey items, and surgical implantation, intracoelomically or subcutaneously, using general anesthesia with and without local anesthesia or no anesthesia. Surgical implantation of radio telemeters is a relatively straightforward procedure which has been used by the authors in *Crotalus willardi*, *Eunectes murinus*, *Python sebae*, and *Bitis gabonica*. Manual restraint coupled with local anesthesia has provided good immobilization and analgesia in all cases. Venomous species are held using plexiglass tubes and large pythons and anacondas are fairly easily restrained after a tubular mask is taped over their heads. Local analgesia is provided by administering 0.2%-1.0% lidocaine (without epinephrine) in a modified line block, subcutaneously and intramuscularly dorsal and cranial to the anticipated incision site. The ideal site for intracoelomic implantation is caudal to the stomach and gall bladder. The site can be ascertained by counting scales, or by manual palpation of viscera. Sterile technique and instruments are used for the procedures. An incision is made between the lateral scales, one or two rows dorsal to the interface of the lateral and ventral scales. The length of the incision is appropriate to the size of the telemeter. After the skin is incised and blunt dissection used to create a space slightly caudal to the incision in the coelom or subcutaneously for the transmitter, a long hollow rod is burrowed subcutaneously anterior to the incision, at a length equal to the length of the antenna. At the anterior end of the rod, a 0.5 cm incision is made and the antenna is passed into the hollow rod. The rod is then pulled through the anterior incision, leaving the antenna positioned subcutaneously. Closure of the coelom is achieved with 2-0 absorbable suture in an interrupted horizontal mattress pattern. A layer of subcuticular sutures are placed if possible. Skin is closed with simple interrupted sutures of nonabsorbable material in direct apposition. A liquid skin adhesive is applied over the incision sites to make them impervious to water.

The use of anesthesia is essential for humane reasons. Local anesthesia is safer than general anesthesia and requires no significant recovery time post-operatively. Animals can be released within 24 hours and have been observed eating and otherwise performing normal behaviors subsequent to this procedure. No deaths attributable to the surgical procedure or location of the transmitters have occurred to date.

**(85) A HEALTH MONITORING PROGRAM IN THE WILLOW GROUSE  
(LAGOPUS LAGOPUS)**

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*Abstract:* The Willow grouse (*Lagopus lagopus*) which is circumpolar, inhabits treeless low alpine areas and broad forests in the northern half of Sweden. It is a popular game and around 75,000 birds are shot annually in Sweden. The Willow grouse lives a "secret" life on the mountains and very few sick or dead birds have been investigated. To get a better knowledge about the health status, parasites and levels of heavy metals, a health monitoring program was started in 1989. During 7 years 262 birds have been collected in late August/early September at 4 localities in the northern half of Sweden. Birds have been weighed, measured, and necropsied in the field. From each bird blood smears and intestines were sampled for parasitological examination and liver and kidney for chemical analysis. Almost all birds have gastrointestinal parasites (*Ascaridia*, *Hymenolepis*, *Eimeria*). No *Trichostrongylus* worms, known to be a health problem for Scottish grouse (*Lagopus lagopus scoticus*), were found in the Swedish grouse. Some birds had a very high burden of coccidia, which possibly could have an effect on the health status of these birds. Chemical analysis demonstrated some difference in metal burden between the different localities and mean liver levels of lead around 0.50 mg/kg were found with a higher level in birds from the southernmost study area (Idre). The mean cadmium levels in kidney were 7 mg/kg with a highest level of 37 mg/kg. These levels are similar to levels found in grouse in Norway.

## (86) CHRONIC NECROTIC COLITIS IN MOOSE (*ALCES ALCES*)

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*Abstract:* Moose (*Alces alces*) is the most important and popular game species in Sweden and the population comprises 400,000 animals. A chronic wasting disease with enteritis has been seen in around 10% of the approximately 500 moose necropsied at the National Veterinary Institute between 1986-1995. On gross pathology this chronic wasting disease is mainly characterized by a chronic necrotic colitis. Fibrous adhesions of the serosa and visceral peritoneum around the colon spiralis, the cecum, and the small intestine have been observed. The wall of the colon is thickened (up to 10 mm) and firm, with areas of hemorrhage. Pseudomembranes cover necrotic areas in some cases. The intestinal content has a watery consistency. The primary microscopic lesions include complete necrosis of the epithelium and destruction of epithelial mucosal cells in the colon. Hyperemia, hemorrhages, and thrombosis of capillaries, arterioles, and venules were observed in the lamina propria. A severe inflammatory cellular infiltrate consisting mostly of neutrophils and mononuclear cells was also evident. To date, the moose submitted with this condition were middle aged (2 to 5 years old), nonpregnant females with severe emaciation. The animals were found dead, except for 1 that was euthanized due to poor condition and diarrhea. The cause of the intestinal disturbances in these cases remains unknown. Studies are in progress to determine the etiology of this chronic wasting disease.

**(POSTER) -- ISOLATION AND CULTURE TECHNIQUES OF OPHIDIAN VIRUSES**

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*Abstract:* Culture of poikilothermic cell lines varies from the culture of mammalian cell lines. Growth is extremely slow and temperature ranges are greater than mammalian cell lines. Although the cells survive, the ophidian viruses die at normal mammalian cell growth temperature. The CO<sub>2</sub> concentration required by reptilian cells is less than that for mammalian cells. Cultures have been grown on lab benches or non-CO<sub>2</sub>-enhanced incubators for over 1 year. Although media today have been enhanced to meet the growth of many types of cells, reptilian cells prefer the simple Eagle's Basal Medium with minimal additions of antibiotics and antimycotics. We have isolated and cultured several pneumonia-causing ophidian paramyxovirus strains, for which hemagglutination titers have been increased with addition of trypsin to the medium. We are optimizing growth conditions for a retro-like virus associated with boid inclusion body disease of the central nervous system. Additionally, a retro-like virus associated with renal carcinoma in *Bothrops moojeni* has been isolated from splenic cell cultures growing for approximately 8 months.

## **(POSTER) - INCREASING THE POST-HANDLING SURVIVAL OF REINDEER CALVES ON THE SEWARD PENINSULA THROUGH TREATMENT WITH OXYTETRACYCLINE**

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*Abstract:* Every summer, reindeer (*Rangifer tarandus*) on the Seward Peninsula are handled for antler harvest, calf-marking and vaccinations. These handlings are stressful events for reindeer, particularly calves, which are sometimes injured or made more susceptible to disease. Evidence suggests that improved handling management of calves will have a strong positive effect on reindeer populations.

We hypothesize that survival rates of injured or otherwise compromised calves are greater with treatment of LA-200. We have documented the incidence of broken antlers, antlers that are broken off at the skull, infectious keratitis, other infectious diseases, and trauma during the 1995 and 1996 summer handlings of the Larry Davis reindeer herd. We have also documented the number of times each calf is handled during the handling season. We hypothesize that calves that experience multiple handlings experience lower survival rates than calves that are handled once, and that treatment with LA-200 will increase the survival rate of multiply-handled calves. We also hypothesize that treatment with LA-200 is more critical in low-weight calves for improving survival.

All 1995 and 1996 calves received an ear tag and were placed in a control or treatment group on the basis of a random assignment. A dose of 2 cc of LA-200 was administered to the calves of the treatment group. The percentage of 1995 calves that returned as yearlings in 1996 was considered the survival rate of this cohort. Analysis of variance was used to examine the differences in survival rates between the treatment and control groups. Preliminary results from 1995 are presented here.

**(POSTER) - POLYPEPTIDE COMPOSITION AND ENZYMEIMMUNOASSAY FOR ANATID HERPESVIRUS**

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*Abstract:* The incidence of duck plague on the North American Continent appears to be increasing. We have been studying the molecular features of the virus, since knowledge of the molecular biology of the virus may lead to prevention measures. A plaque-purified isolate of the ATCC, viral reagent #684, was grown on duck embryo fibroblasts in a minimum essential medium containing 5% of the normal amount of amino acids and supplemented with uniformly labeled <sup>14</sup>C amino acids (80 μCi/mole, 100 μCi/ml). At harvest, 36-48 hours later, the virus was purified by precipitation with ammonium sulfate, differential centrifugation, and cesium chloride isopycnic banding. The proteins of labeled virus preparations and mock-infected controls were resolved by SDS-polyacrylamide electrophoresis and the masses of the resolved proteins determined. Major bands occurred at masses of 75, 63.5, 48.5, 36, 31.5, and 18.5 kd with a total of 40 bands resolved by the gels. Similarly purified, unlabeled AHV was administered into the foot pads of New Zealand White female rabbits and antisera collected by venipuncture at 5 weeks. Precipitating antibodies were identified by gel diffusion. The NI<sub>80</sub> of sera was found to be about 700 using high titer AHV stocks. A direct ELISA was developed with adherent antigen (virus) tested using iodinated antigen. A dose-response curve indicated that the reaction was sensitive to 16 ng of the virus stock corresponding to 7-13 pfu. This curve was linear between 63 and 1000 ng protein. The assay was limited by the amount of extraneous protein present as sera proteins in media would interfere with the assay. The data is discussed within the context of the other known physical properties of AHV.



## **(POSTER) - THE CHARACTERIZATION OF MANATEE KIDNEY EPITHELIAL CELLS**

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*Abstract:* The Florida manatee (*Trichechus manatus latirostris*) is a herbivorous marine mammal which inhabits the coastal waters of Florida. To gain further insight into disease pathogenesis in manatees, in vitro studies utilizing kidney cells were initiated. Kidney tissue was harvested from a manatee calf less than 12 hours postmortem. Cultured manatee kidney (MK) cells were characterized by morphology, lineage determination, growth rate, seeding efficiency, and serum dependency assays.

MK cells have a polygonal shape and clearly defined edges demarcating an advancing monolayer. A mouse IgG, anti-pan cytokeratin as a primary antibody and a goat, anti-mouse IgG (Fab specific) secondary antibody, conjugated to fluorescein isothiocyanate (FITC), was used to demonstrate cytokeratin expression. A growth curve seeded at  $1 \times 10^2$  cells/ml, revealed a lag time of three days, a logarithmic growth period of 5 days, a population doubling time (PDT) of 48 hours and plateau at day 8 with  $1.68 \times 10^4$  cells/cm<sup>2</sup>. There was a seeding efficiency of 95%-97% by the fifth passage. With reduced or no serum supplementation, cells did not grow well and the cytosol was vacuolated and tenuous. These findings suggests that these cells are almost likely epithelial in origin.

**(POSTER) - PATTERN OF INFESTATION OF *IXODES RICINUS* (ACARI: IXODIDAE) ON ROE DEER IN THE ITALIAN ALPS**

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*Abstract:* The interaction between *Ixodes ricinus* and roe deer (*Capreolus capreolus*) is one of the most important host-parasite associations supporting the epidemiology of Lyme disease in the Italian Alps. The pattern of infestation of ticks on 534 male roe deer harvested in September 1994 in 56 game districts was assessed. Prevalence and abundance of *I. ricinus* were analyzed by a model based on classification and regression trees (CART), using both discrete and continuous variables concerning environmental and host parameters. This model discriminated tree variables which appear to have the greatest effect on the abundance of ticks on roe deer: altitude, host density and host age, with tick abundance decreasing above 1000 m a.s.l. or with roe deer density below 10 head/100 ha and increasing with host age.

**(POSTER) - ECTOPARASITIC MITES OF MINNESOTA RAPTORS**

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*Abstract:* Thirty-two owls, eight eagles, two falcons and 27 hawks, totalling 15 species, were examined for ectoparasitic mites using detergent washes and microscopic examination. Mite populations ranged from zero to 15,000 feather mites and 4,000 quill mites on an individual bird. New species of feather mites (*Kramerella*, *Aetacarus*, and *Hieracolichus*), new genera and species of quill mites (Syringophilidae and *Paralges*), and skin mites (*Harpyrhynchus*) were found, as well as new nasal mite (*Rhinoecius*) and nest mite (*Dermanyssus*) host records.

**(POSTER) - MICROPHthalmIA AND ANTERIOR SEGMENT DYSGENESIS IN WHITE-TAILED DEER FAWNS**

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*Abstract:* Since 1975, the Southeastern Cooperative Wildlife Disease Study has examined 806 white-tailed deer of which 30 (3.72%) had a primary diagnosis of ocular disease. Congenital microphthalmia or anophthalmia was diagnosed in 20 of those ocular cases (66%). Microphthalmic deer often had anterior segment dysgenesis and other associated lesions. Here, a representative case of microphthalmia with anterior chamber dysgenesis is presented. A blind white-tailed deer fawn had bilateral microphthalmia. Grossly, the fawn's corneas were fibrotic, epithelial pigmentation was extensive, and anterior chambers were shallow. Histologically, both eyes had keratin-filled cysts in the anterior chamber, islands of ectopic lacrimal gland tissue and remnants of lens protein incorporated in the iridial stroma, and retinal dysplasia. Of the 20 deer with congenital eye lesions, one deer was truly anophthalmic with no apparent formation of optic chiasm or optic nerve. Complete histologic examinations of ocular tissue were performed on eight of the 19 microphthalmic deer. Anterior segment dysgenesis was found in five of those eight deer. Case submissions were distributed across the Southeast suggesting microphthalmia is not an uncommon lesion in white-tailed deer. Microphthalmia and associated ocular defects in white-tailed deer are probably the result of defects in formation or growth of the optic vesicle during embryogenesis. Bluetongue and bovine viral diarrhea viruses have been reported to cause retinopathies in cattle and sheep in the United States; however, there are no known documented reports of ocular lesions caused by these viruses in white-tailed deer. The etiology of the lesion in deer is unknown but could include viruses, toxins, or genetic disturbances.