

**Expanding the Use of Time of Death
Determination Parameters to Carnivores**
A Two Part Project



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University of Montana Master's of Interdisciplinary Studies
MIS: Criminology and Forensic Anthropology/Wildlife

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Expanding the Use of Time of Death Determination Parameters to Carnivores: A Two Part Project

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PURPOSE

Determining time of death (TOD) during the first 24 hours postmortem is a technique long used for traditional game species such as deer and elk. In poaching investigations TOD is crucial as court accepted evidence with applicability in two situations:

1. Determine if that animal was taken by a hunter during legal hunting hours
2. Fix the TOD with a point in time matching the presence of a suspect at an illegal take scene

And TOD is often more readily determined at the scene, rather than in a lab.^{1, 2}

An issue when investigating poaching of many federally protected species such as grizzly bears and wolves is the discovery of carcasses in advanced stages of decomposition with little information about time since death.³

Investigators have long understood the importance of TOD determinations, both short term or during the initial hours postmortem, and long term by understanding the various stages of decomposition. This endeavor will explore both via a two part project focusing on carnivores. The practical research involved in this project will provide baseline data on long term decomposition (Part One) as well as short term postmortem changes (Part Two) in order to develop standards for use in the field by federal and state wildlife law enforcement officials. While decomposition stage descriptions will form the bulk of the thesis for this project, development of a network of state and provincial agency personnel to document changes during the initial 24 hours postmortem will over time provide data that will result in establishment of standards for carnivores similar to those long in use for ungulates.

An additional component is organization of wildlife field investigation seminars. Target participants are state and federal wildlife law enforcement officials. Presenters and instructors are agency officials well experienced in field investigations. Topics cover a variety of field techniques.

SIGNIFICANCE

As a law enforcement officer with the US Fish and Wildlife Service (FWS), C. Gonder was a field investigator of several poached deer and elk with antlers or heads removed and the remainder of the carcasses found in advanced stages of decomposition. Those investigations helped to demonstrate a need to Gonder for this type research. Project endorsement further attests to the project's worthiness and includes:

- Tim Eicher, FWS Special Agent: Carleen's project represents "cutting edge research in wildlife enforcement, with direct applications to field investigations and is supported by US FWS Office of Law Enforcement."
- Bonnie Yates, FWS National Fish and Wildlife Forensics Lab's senior mammalogist/osteologist: "I am busting with pride at your progress...Your project is top notch. I am keenly interested in your progress."
- Karen Rudolph, Idaho Fish and Game forensic lab specialist: "What a treat to have a Master's project that will truly provide immediate and hands on (applied) benefits."

Data from this project will be published in A Guide to Time of Death in Selected Wildlife Species (D. Oates, 1984) and Wildlife Forensic Field Manual produced by the Association of Midwest Fish and Game Law Enforcement Officers, which is the non-profit fiscal agent for the project and assures its contribution to wildlife law enforcement.



METHODOLOGY

Part One: Long term decomposition

Long term decomposition will be monitored at a secure site until various pre-selected carcasses have reached the “remains” (skeletal) stage. Data collection will occur at a minimum of once daily at the onset, with increased or decreased frequency to be determined by level of insect and other notable activity.

Criteria to be included:

- Insects, to be analyzed at Montana State University in a separate but concurrent study via Greg Johnson, PhD., wildlife/livestock entomologist
- Weather, general plus micro-climate (*carcass, soil and ambient air temperatures, etc*)
- Desiccation (*fresh, intermediate, dry, mummified*)
- Odor (*normal, faint, mild, moderate, strong, moderate, mild, faint, none*)
- Disarticulation (*sequence, if observable*)
- General appearance, including scavenging effects
- Rate or duration of various processes and stages (*stages: fresh, bloat, active decay, advanced decay, dry, remains*)
- Extensive photo documentation through all stages

Part Two: Initial postmortem interval

During the first 24 hours postmortem, carcasses undergo a number of measurable physiological changes that include:

- Loss of body heat (*measured by thermometers inserted into the carcass thigh*)
- Muscular response to electrical stimuli (*measuring response*)*
- Rigor mortis (*measured by flexing joints*)
- Physiological changes in the eye (*pupil constriction measured and photographed*)

***Taser International has donated two units to test suitability for providing electrical response.**

Data on the immediate postmortem period will be acquired via one of the following:

- C. Gonder will gather TOD data at an agency management action site for a 24 hour period postmortem
- By establishing a network of people with various state and provincial agencies, personnel will gather TOD data at a management action for one-time data collection; not the full 24 hours

PROJECT SUMMARY: CURRENT CARCASSES FOR DECOMPOSITION

On 19 June 2006, two wolves were placed for decomposition in an electrified enclosure. Their decomposition stage is dry and preserved due to mummification. On 15 Sept. two wolves and a black bear were placed in a second enclosure and their current stage is dry and mummified. A black bear was placed 28 Oct. and is at the advanced decay stage. Three mountain lions and a whitetail deer were placed 22 Nov. and are at the advanced decay stage. Two wolves were placed 1 Dec and another lion on 11 Jan. 2007 and are at the dry stage. Two wolves were placed 4 April and are in advanced decay. Though the focus of this project is on carnivores, the addition of the deer sets the stage for long term wildlife decomposition study. A number of agency people involved are eager for this project to continue beyond the Master's thesis. A long term project provides for both the introduction of additional variables and focus on criteria now being discovered that needs further study.

CURRENT NOTABLE DECOMPOSITION VARIABLES

Seasonal variation for one carnivore species (thesis focus)

Due to their availability, wolves will provide seasonal variation for one species. Two yearling females were placed mid June (summer). The weather remained hot and dry for most of the summer. Within two weeks of placement their hides were nearly mummified, with little underlying tissue. Two adult females were placed mid September (fall). While temperatures remained warm, there was slightly more precipitation. This resulted in delayed carcass drying. They are now at the dry stage. The summer and fall wolves are well preserved due to mummification. Two adult males were placed early December (winter), and remained static for several months. They are now at the dry stage. Two wolves were placed in April (spring) with moderate amounts of moisture in the form of rainfall and slightly higher overall humidity, compared to the other 3 seasons. While the spring wolves are currently in the advanced decay stage, they are exhibiting decomposition characteristics not observed in the wolves placed in the three previous seasons, such as significant amounts of exposed skeleton.

Multiple carnivore species to illustrate freeze/thaw cycles

One cub-of-the-year black bear was placed on bare ground on 28 October. The carcass had been frozen but was fully thawed at the time of placement. Last fall it had undergone numerous freeze/thaw cycles, and remained static after snowmelt this spring for well over one month. Three fresh (unfrozen) yearling lions and one whitetail deer were placed on bare ground 22 November during an active snow storm and were fully covered the following day. They remained snow-covered until spring. The yearling lions were possibly insulated from freezing until after snowmelt. Two frozen adult male wolves were placed on snow 1 December and remained frozen until spring. One frozen adult male lion was placed 11 January on top of snow and it, too, remained frozen until spring.

WILDLIFE FIELD INVESTIGATION SEMINAR

Created and organized by C. Gonder, a wildlife field forensics seminar was held 30 May – 1 June 2007 at a conference facility near the current decomposition project site. There were 58 attendees which included law enforcement officials from 7 state and 2 federal agencies. Presentations by ten agency and university instructors included firearms and bullet matching, forensic entomology, time of death determinations including decomposition stages and decomposition site visit, forensic geology, wildlife forensic pathology, tooth cementum aging for law enforcement purposes, basic field forensic techniques, use of GPS for evidentiary purposes, technology in solving wildlife crimes, and relevant case histories from state and federal wildlife poaching cases. There have been numerous requests from agency training supervisors to hold similar seminars at least yearly.

FUTURE PLANS

Discussions about the time of death/decomposition project now include strategies to keep it going long into the future. C. Gonder will be writing proposals to submit to interested agencies and funding entities. The objective is to provide a permanent location for decomposition which would allow for an expanded site area and introduction of the numerous variables encountered in natural settings and poaching situations. Included in this endeavor will be continued data collection from involved state and provincial wildlife agencies to expand the data base for the initial 24-48 hours postmortem, and organization of wildlife field investigation seminars.

GRADUATE COMMITTEE MEMBERS

- **Faculty members**
 - Dan Doyle, Ph.D.; Criminology/Sociology; committee chair; University of Montana; actively involved in community law enforcement research (including US Forest Service law enforcement)
 - Ashley McKeown, Ph.D.; Anthropology; forensic specialist; University of Montana; several years experience conducting research at a University of Tennessee facility dedicated to the study of human decomposition
 - Greg Johnson, Ph.D.; Wildlife Entomology; department head; Montana State University; Montana wildlife entomology expert involved in West Nile Virus research
- **Non-faculty members**
 - David Oates, M.S.; head of Nebraska wildlife lab; key developer of TOD standards currently in use; court expert witness for TOD; assisted in producing the *Wildlife Forensic Field Manual*; published *A Guide to Time Of Death in Selected Wildlife Species*
 - Tim Eicher, M.S.; US FWS Special Agent; has taught wildlife crime scene investigation in Botswana, Tanzania, Ukraine and Canada; well-experienced in grizzly bear and wolf investigations with great success in federal wildlife prosecutions
 - James Jonkel, Montana Fish, Wildlife and Parks bear biologist and wildlife conflict specialist; several years experience and considered expert in his field

FUNDING, EQUIPMENT AND ASSISTANCE

Funding was awarded to the project by the Association of Midwest Fish and Game Law Enforcement Officers. The total award was \$5000 and disbursed quarterly (July 2006 – July 2007). The Wyoming Game Wardens Association awarded \$500 in March 2007. MT Fish, Wildlife and Parks (FWP), via bear management specialist Jamie Jonkel, loaned the use of the electrified pen (site/pen 1) and solar energizer. The owners and operators of Grizzly Fence in Missoula, MT have loaned the use of twelve 12'x6' portable chain link panels for the duration of the project (site/pen 2). Monetary value is \$432.00. MT Department of Natural Resources and Conservation State Forester Bob Harrington loaned the use of a belt weather kit, and Ward McCaughey with the US Forest Service UM research facility loaned the use of a rain gauge and various thermometers. Tim Eicher, FWS Special Agent, donated a 220 pound capacity hanging scale, ropes and pulleys, as well as time, effort and encouragement at the site. Greg Johnson, PhD, has completely outfitted a wet lab for this project, provided all entomological equipment which includes a 15 cubic foot capacity freezer, refrigerator and microscope, and given time, effort and encouragement at the site. Mike Jimenez, the US FWS Wyoming wolf coordinator and Jim Pehringer of US Wildlife Services assisted with procurement of wolves from Wyoming. Steve Nadeau, state carnivore biologist and Jason Husseman, wolf specialist, both with Idaho Fish and Game assisted with procurement of wolves from Idaho. Carolyn Sime, state wolf coordinator, and Mark Atkinson, DVM/wildlife veterinarian, both with MT FWP assisted with procurement of wolves and the adult lion from Montana. Jay Kolbe, MT FWP Blackfoot area biologist assisted with procurement of the yearling lions and whitetail deer. Taser International has donated two Taser units to test their suitability for use in providing electrical stimulus to muscles for time of death determinations. Frank Maus and his forestry staff at UM's Lubrecht Experimental Forest have continually assisted and deserve special acknowledgement.

A number of individuals have helped with material support and other assistance:

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FUNDING AGENT

The Association of Midwest Fish and Game Law Enforcement Officers is the non-profit (501c3) fiscal agent for this project.

¹ Oates, D.W., J.L. Coggin, F.E. Hartman and G.I. Hoilien. 1984. *A Guide to Time of Death in Selected Wildlife Species*. Nebraska Technical Series No 14. Nebraska Game and Parks Commission.

² Stroud, DVM, R.D. Unknown date. *Wildlife Field Forensic Techniques*. US Fish and Wildlife Service National Fish and Wildlife Forensics Lab.

³ Eicher, T. and J. Kropp. 2005. Personal communication on separate occasions. Autumn 2005.

Considerations for future decomposition/time of death wildlife research/Draft

- Soil pH: leakage from carcasses and possible interaction w/soil; with decomposition stages, different fluids assoc with each. Can they chemically be used for TOD determinations?
- Desiccation parameters (ear stiffness, tooth cracking, nose/foot/toe pad pliability; dryness of hide; receding gums/mark on teeth)
- Allowing avian and large mammal scavenging
- Insects
 - Pitfall insect trap collection in winter under snow cover
 - Regional/seasonal duration study for fly larvae development*
- Carcasses
 - Freeze/thaw/seasonal**
 - Simulate field dressed
 - Skinned
 - Quartered
 - Heads or antlers/skull cap removal
 - Buried/partially buried with ground litter
 - Weight differences
 - Species differences
 - Seasonal/species differences
 - Moist/dry sites
 - Slope/flat
 - Slope aspect (north/south)
 - Open/closed canopy/high and low desert/forest
 - Elevation
 - Opening carcasses sequentially during decomposition to note internal activity (insects, organs, etc)
 - Document changes in looseness of skin over connective tissue/fascia/bone (fresh, etc)
- Teeth
 - Cracking sequence
 - Pink color fading sequence
 - If any tooth loss, sequence
- Temps
 - Soil and carcass surface
 - Carcass abdomens on fresh, not carcasses that have been frozen first
 - Way to detect temp of air space both between carcass and soil, and snow undersurface**
- More species, including
 - All ungulates
 - Birds of prey
 - Grizzlies

** I found substantial delay in larvae (maggot) development as temperatures cooled, later in the fall. This indicates that the standards now used for investigations using maggots in time of death determinations has limitations in this region and climate, especially early spring and late fall. Greg Johnson's duration study idea can possibly be done in various regions (east/west MT, Wyoming, north/central/south ID)*

*** I observed 3 carcasses placed late fall that were snow covered by the following day of placement and remained snow covered until spring. It appears these carcasses did not freeze, and they exhibit decomposition differences from overwinter carcasses that were placed on top of snow and remained frozen throughout the winter. It is known that the subnivalian space (area between ground and snow) has characteristics that differ from above snow surface conditions (temperature, etc), and that snow acts as an insulating layer.*

From the on-line version of The New York Times

December 9, 2006

Poachers in West Hunt Big Antlers to Feed Big Egos

By [RANDAL C. ARCHIBOLD](#)

ELY, Nev., Dec. 3 — A bighorn sheep lay in a field not far from here, its head missing. In nearby Elko, three elk and five deer died from gunshot wounds, their carcasses rotting in the hills. And in the distant mountains, game wardens searched for another elk that a tipster said had been killed by illegal hunters apparently just for the thrill of it.

The reports keep coming in — elk, deer, antelope, bighorn sheep and other big-game animals — killed in a wave of poaching that has alarmed state and federal wildlife officials in [Nevada](#) and several other Western states.

The authorities said they are seeing more organized rings of poachers and unlicensed guides chasing the biggest elk and mule deer, with the largest antler array, sometimes trading them on Internet auction sites or submitting pictures to glossy hunting magazines that prominently feature big kills.

“There is almost a fixation on possessing or obtaining trophy-class animals,” said Jim Kropp, the wildlife law enforcement chief for Montana, which this fall began a new public awareness campaign about poaching called Enough is Enough. “People,” he added, “will go to any length to have these things in their possession. It’s big antlers and big egos.”

The federal government does not keep national statistics on poaching incidents, but wildlife law enforcement officials in several states, mainly those with large populations of elk, mule deer and other animals prized for their impressive antlers or girth, have raised concerns about the rash of complaints and the big money that seems increasingly a factor in the cases they investigate.

The officials said tight regulations on where and what can be hunted at various times of year, part of an effort to manage the size of big-game herds, had motivated some shooting out of season or on restricted land.

The [National Park Service](#) wrote in a budget statement last year that poaching had contributed to the decline of 29 species of wildlife in the 390 parks and other sites it oversees.

An interstate compact set up 15 years ago in a few Western states to track and punish violators of hunting laws across state lines has grown to 24 states nationally, including New York this year. Big-game crimes, mostly related to poaching, accounted for 42 percent of the violations to the compact last year.

“We treat these as essentially homicides,” said Lt. Jerry Smith, a Nevada supervising game warden. “But it is such a secretive crime. We have no witnesses to work with, just the bodies, when we find them.”

A decade ago, Nevada tallied 50 or so animals poached or killed out of season and by hunters without permits. Last year, 70 such animals were found, the highest number ever; so far this year the tally is 65, and with a few weeks of the biggest hunting left, Nevada officials said the number could surpass last year’s.

And game wardens here suggest that far more animals may have been killed than they have found; they calculate that they find 1 percent to 5 percent of poached animals.

Poaching is not Nevada’s problem alone.

This year, Montana and federal investigators seized 30 elk heads and prosecuted 22 people in a poaching ring who drew fines and the ring leader, Danny McDonald of Gardiner, Mont., a year in federal prison.

They had illegally led out-of-state hunters to trophy bull elks leaving Yellowstone National Park.

In Idaho, Ed Mitchell, a spokesman for the Department of Fish and Game, said poaching cases in the state had remained steady in recent years, but the crimes increasingly are carried out by people in the black market for antlers and heads, which can fetch tens of thousands of dollars.

“Legitimate hunters don’t find it entirely understandable, but some people will pay to have some critter on their wall they can claim they have shot,” Mr. Mitchell said. “Hunters find that completely out of the realm of understanding.”

In part to better understand the scope of the problem, the Association of Fish and Wildlife Agencies is developing a database that will include closer tracking of the number and nature of poaching incidents nationwide.

In Nevada, officials said they suspect the strict regulation that has allowed the elk and deer population to flourish may also be driving up poaching. People who covet antlers as decorations or to sell on the market do not want to wait the decade or more it can take to get a tag, or permit, to hunt a single big elk or deer.

This year, 25,893 people requested an elk tag, but only 2,254 were issued, to the dismay of some hunter groups that have pushed for more tags. On average, the department receives 15 applicants for every bull elk tag.

Like other states, Nevada has a sparse staff of field game wardens who cover vast swaths of territory, making it easier for poachers to get away with their crimes. Often, poached animals are not found until hunters deep in the backcountry come across something suspicious, said Rob Buonamici, the law enforcement chief for the Nevada Department of Wildlife.

But several of the finds in the past couple of years have been close to growing, populated areas, leading him to suspect the culprits may have been newcomers taking advantage of easy targets close to home.

The rise in poaching here has come as Nevada has managed to increase its elk and mule deer population greatly in recent years, and officials fear poaching will set back those efforts.

“Wildlife belongs to everybody,” said Mr. Buonamici of the Nevada Wildlife Department. “If not for what the departments of fish and wildlife do and the sportsmen support through the fees they pay, the little old lady in L.A. would never be able to see a wildlife documentary because there would be no wildlife left.”

Poaching also angers licensed hunters because it depletes the pool of animals they can potentially bag; by law they must carry away all the edible portions of their kill, which typically fill a freezer and provide steaks, burgers, jerky and the like for more than a year.

“I don’t understand why they just go out there, kill it and leave it,” said Lazo Pavlakis, 76, shaking his head as he stood triumphant over a bull elk he legally killed on the first day of an elk hunt here, 200 miles north of Las Vegas. He had waited 18 years for a permit, issued by annual lottery, to shoot a single elk, which he planned to consume with his grandsons.

“This is about once in a lifetime for me, so no, I don’t appreciate hearing about elks killed and left out there,” he said.

Up against the poachers are wardens like Joe Maslach, a 17-year veteran of the Nevada Wildlife Department and a devoted hunter himself.

On one recent tour, Mr. Maslach put 300 miles on his department-issued pickup truck, checking the documentation of hunters, making sure that legally set traps complied with regulations and responding to a call from a tipster of poached chukars, a popular game bird.

Discovering 26 of the birds shot dead and tucked into bushes, Mr. Maslach grew disgusted as he worked what in effect was a crime scene, photographing the position of the birds, measuring tracks and taking the birds' internal temperature to estimate when they were killed.

"These are the kind of guys you would like to take to jail," he said, stuffing the birds, frozen stiff in the 20-degree chill, into a bag.

But it was also clear hunters were not accustomed to seeing Mr. Maslach or other wardens. Several said they had never had their hunting documents checked or not for years.

In 35 years of hunting in Nevada, Fred Perdomo, who was legally tracking an elk this weekend, said he had encountered a game warden only twice — 12 years ago and on this trip.

"I heard about the poachings and could not believe it," he said. "It just doesn't make much sense."

Mr. Maslach checked his papers, and then Mr. Perdomo set off toward a stand of trees where an elk waited.