WILDLIFE DECOMPOSITION ANALYSIS FOR TIME OF DEATH ESTIMATES

Plus Forensic Entomology Basics

--- INCOMPLETE ---

EXCERPTS FROM 19 PAGE MANUAL

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Photo: C. Gonder

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Plus Forensic Entomology Basics

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Wildlife Field Forensics
Self-Published
2008

Training, consulting and PowerPoint presentations are available

DEDICATION

I dedicate these efforts to my son Don and his family, to Arrow and the memory of Hope – my four legged companions, and to wildlife officers everywhere who are vital to wildlife populations.

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INTRODUCTION

An issue when investigating poaching of many wildlife species is the discovery of carcasses in advanced stages of decomposition with little information about time of death (TOD). Documenting decomposition changes over time can provide markers for wildlife law enforcement officers to utilize for TOD estimates. For this study, decomposition data has been collected from eight gray wolves, four mountain lions, two black bears, and one whitetail deer.

University of Montana's Lubrecht Experimental Forest
Carcass sites were established in a secure area of Lubrecht Forest, and were protected by four electrified exclosures. The sites were on nearly level knolls at approximately 4,300 feet elevation. Tree canopy for that area is 30-40%. Habitat type is second growth Ponderosa Pine with Douglas Fir understory. The area within the exclosures was covered primarily with pine grass and interspersed with small shrubs and forbs.

Seasonal variation for one carnivore species (data available for each subject)
Due to their availability, wolves provided seasonal variation for one species. Two yearling females were placed 19 June 2006 (summer). The weather remained hot and dry for most of that summer. Within two weeks of placement their hides were nearly mummified, with little underlying tissue. Two adult females were placed 15 September 2006 (fall). While temperatures remained warm, there was slightly more precipitation. This resulted in delayed carcass drying. The summer and fall wolves were well preserved during early decomposition due to mummification. Two adult males were placed 1 December 2006 (winter), and remained static for several months, with hide drying occurring during the static periods. An adult male and female were placed 4 April 2007 (spring) with increased amounts of moisture in the form of rainfall and higher relative humidity, compared to the other seasons. Those spring wolves reached remains stage by April 2008, and were the only subjects in this study to reach that stage as of 19 June 2008. They exhibited decomposition characteristics not observed in the wolves placed during the three previous seasons, such as significant amounts of exposed skeleton starting in the active decay stage. Higher overall moisture resulted in delayed carcass drying which promoted an increase in insect activity while the hide was pliant. As of June 2008, all wolves placed summer, fall and winter seasons were at dry stage with significant amounts of mummified hide remaining. (A three year old black bear was placed the same date as the fall wolves and was also at dry stage as of June 2008.)

Multiple species to illustrate freeze/thaw cycles (data available for each subject)
One cub-of-the-year black bear was placed on bare ground on 28 October 2006. The carcass had been frozen but was fully thawed at the time of placement. That fall the bear had undergone numerous freeze/thaw cycles, and remained static after snowmelt the following spring for well over one month. Three lion kittens and one whitetail deer were placed on bare ground 22 November 2006 during an active snow storm and were well covered the following day. They remained snow-covered until the following spring. The small lions were possibly insulated from freezing until after early spring snowmelt. Two adult male wolves were placed on top of the snow 1 December 2006 and remained frozen until the following spring. One adult male lion was placed 11 January 2007 on snow and it, too, remained frozen until spring.

DECOMPOSITION STAGE SUMMARY

Decomposition stages: Fresh, Bloat, Active Decay, Advanced Decay, Dry, and Remains
Durations are temperature dependent, with characteristic insect succession for each stage.
Stage descriptions accompany photographs for wolf 2 (W 2).

NOTE: Animals were not euthanized for this project, but were management removals, road killed with minimal head trauma, and inadvertent snare capture. Placement condition information is available.

The following were stages reached as of 19 June 2008, with placement dates noted. Winter carcasses were placed on top of snow. A few carcasses will remain in place for another year.

Wolves (photos for W 2 and W 8 are included; photos for remainder are available)
W 1 and W 2 – 19 June 2006; dry stage/mummified. Progressed through predictable stages (summer: hot/dry)
W 3 and W 4 – 15 September 2006; dry stage /mummified. Progressed through predictable stages (fall: warm to cool)
W 5 and W 6 – 1 December 2006; dry stage/mummified. Placed on top of snow and remained frozen throughout winter. Did not progress through predictable stages due to extended static periods (winter: predominantly freezing with snow cover on ground November to March)
W 7 and W 8 – 4 April 2007; Remains stage. Remained fresh until 24 April with signs of early bloat. Did not progress through predictable stages due to extended static periods (spring: mix of freezing day/night temps; warm or cool days/freezing night temps; warm days/cool nights)
Significant amount of hide and fur remain; hide mummified: W 1 – W 6
Significant amount of skeleton exposed; remaining hide mummified: W 7 and W 8

Black bears (photos included)
BB 1 – 15 September 2006; dry stage/mummified. Progressed through predictable stages
BB 2 – 28 October 2006; dry stage/mummified. Placed on bare ground, and freeze/thaw temps until snowfall. Snow covered and at times partially exposed during winter. Carcass possibly remained frozen until snow-free. Did not progress through predictable stages due to extended static periods

Mountain lions (photos for L 4 included; photos for remainder available)
L 1, L 2 and L 3 – 22 November 2006; dry stage/mummified. Placed on bare ground but snowed that same day and were covered by the next day. Remained under at least 4 inches of snow the entire winter and it is believed they did not freeze, but were insulated by snow cover and subnivian space. Did not progress through predictable stages due to static periods
L 4 – 11 January 2007; dry stage/mummified. Placed on top of snow and remained frozen throughout winter. Did not progress through predictable stages due to static periods

Whitetail deer (photos included)
WT 1 – 22 November 2006; dry stage/mummified. Placed on bare ground. Did not become immediately snow covered due to carcass size and froze shortly after placement. Possibly remained frozen throughout winter due to partial exposure at times. Did not progress through predictable stages due to static periods

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Decomposition stages for W 2

Summer

DURATIONS: Day one counts as one
Placed 19 June 2006
19 - 21 June; 3 days fresh
1. Fresh. First stage after death; lasts until bloat begins. Blow flies are usually the first insects and may be present within minutes of death. House and flesh flies may be present. Predatory beetles may be feeding on fly eggs and maggots

All decomposition photos: C. Gonder

FORENSIC ENTOMOLOGY PRIMER (THE BARE BONES BASIC)

Insects collected from carcasses and processed by C. Gonder were analyzed at Montana State University in a separate but concurrent study conducted by Gregory Johnson, PhD. Dr. Johnson is compiling a forensic entomology data base specific to wildlife.

NOTE: 1. Maggots are fly larvae. 2. This easy to use web site is a good reference for color photos: http://bugguide.net
3. Carcasses were not disturbed (moved or lifted) for insect collections.

Blow fly development – temperature dependent; *temperature history is crucial for analysis*

- Eggs at and in body openings can be laid within minutes of death (mouth, ears, nasal passages, anus, wounds; *eggs/maggots are good indicators for bullet entrance/exit if observed on torso*).
- Three stages of larval development: First, second and third instar
- Blow fly larvae: Tiny maggots – first instar; large maggots – third instar
- Maggots cease feeding towards end of third instar and will migrate to pupate*
- Pupae location examples: Summer wolves, a few to several feet from carcasses. Fall carcasses, massed against, near or under carcasses. Some clusters above ground, some under soil surface, or under duff/leaves/carcass. Temperature example of pupae cluster next to carcass on 10/07/06: pupae cluster 93.8 F; ambient 53.3 F
- Pupae: Large rat dropping sized, dark reddish/burgundy color, brown to tan. Adult flies emerge from pupae cases. Look for both closed and open cases.

*Presence of blood in crop indicates feeding; no blood indicates pre-pupal phase

Fly life cycle

Length of durations is determined by temperature.
Durations noted below for the black blow fly were lab generated at *71.6 degrees F.** Maggots pass through three stages of development before pupating.

Starting above adult fly, clockwise:

- Eggs – 20 hours
- First instar – 25 hours
- Second instar – 25 hours
- Third instar – 150 hours
- Pupae – 116.5 hours

*Greenberg, Bernard. 1991. "*Flies as Forensic Indicators*",
J. of Medical Entomology, 28(5):565-577

Life cycle photo: Science Buddies web site

Third instar maggots
Tapered end – mouthparts/anterior
Blunt end – posterior

Third instar photos: Tim Huntington,
University of Nebraska – above and right

Spiracles (breathing apparatus) on posterior end indicating third instar

Maggot masses generate metabolic heat and can raise carcass internal temperature well above 50 degrees F even with below freezing ambient temperatures (observed by C. Gonder).