Methodologies for Wolf-Livestock Depredation Investigations in California

Introduction

This document outlines California Department of Fish and Wildlife's (CDFW) methodologies for documentation and data collection during investigations of suspected wolf-livestock depredations. Consistent with the CDFW Scientific Integrity Policy, the techniques identified in this guidance document are intended to maintain professional scientific standards for data objectivity, rigor, interpretation, reporting and transparency. These methodologies will be adapted as the best available science related to depredation investigations evolves. CDFW and other staff should read and be familiar with this document prior to beginning an investigation so that sufficient data and evidence are collected and documented to support evidence-based livestock loss determinations.

Determination Categories

Prior to field assessments, it is important for all investigators to consider each determination category and collect sufficient evidence to allow the appropriate determination to be made. (Considerations for Classification of Reported Wolf Depredation Incidents). While personnel conducting the field investigation should include their recommended determation on the field form, CDFW wolf program staff will make the final determination based on the evidence provided by the investigator.

Types of Evidence

A determination of "Confirmed" or "Probable" wolf depredation requires documentation of physical evidence that an animal was injured or killed, or probably injured or killed, by a wolf or wolves. Such evidence is typically premortem wounds on an injured animal or carcass that are consistent with wolf attack, or an attack and/or kill scene consistent with wolf attack. Such evidence should be documented with clear descriptions and photographs. While evidence of the presence of wolves (tracks, scat, sightings, GPS collar data) may be used to support an investigation determination, because wolves often find and feed on livestock carcasses, there must be physical evidence of an attack at the scene or on the animal to justify confirmed or probable wolf depredation. Genetic evidence collected during the investigation may be used to support other physical evidence, especially in cases of injured livestock.

Wolf Depredations

Predators typically kill livestock in specific ways that help the investigator determine what species was responsible. The size, location, and number of bite/claw marks and extent of underlying trauma can be used to help differentiate between predators. While only a brief overview, Table 1 illustrates typical characteristics of livestock attacks by several large mammals in California. It is also important to remember that body size and condition of livestock, as well as other factors, influence vulnerability to different predators and can influence modes of attack and what a depredation event looks like.

Investigation Form

CDFW's current Lifestock Loss Investigation Form should be completed for each animal investigated. The form can be completed using an online tool or a printable form. All relevant fields should be completed. Descriptions should include sufficient detail that a reviewer who was not present at the investigation can follow and understand how the investigator arrived at the investigator's recommended determination. For this reason, descriptions of wounds used to make a determination must be specific enough to differentiate between potentially responsible predators or other causes of injury or death. All wound photos should include a ruler to clearly demonstrate size of bite marks and extent of trauma to the reviewer. Estimation of time of death is important, especially when evaluated in the context of GPS wolf collar locations at or near the carcass. When estimating time of injury or death, utilize assessments such as fly larval stage (Figure 1), level of decomposition, healing, and carcass temperature.

Photographs

- Scene. Pictures of the general site and the chase/kill scene (if present) are important for documenting which species were present at the time of the reported event. Photograph any tracks and scat, and any diagnostic feeding behavior of particular predators. Include a ruler in photos of tracks and scat. Be careful not to confuse a feeding scene for a chase or kill scene.
- Entire carcass or injured animal. Before moving the carcass and beginning the physical examination, take photographs of the animal and immediate surroundings (even if no wounds are present). These photographs are important to show the position of the animal and amount of feeding and/or scavenging that has occurred. Photographing areas typically attacked by wolves is important even if there are no obvious wounds. These photographs would be potential evidence for a "Non-Wolf Depredation" or "Non-Depredation" determination.
- All wounds used in determination. For each wound, include photos of the outside of hide, inside of hide, and depth of trauma. Shave the outside of the hide first, if possible, to get a clear view of the size, number, and orientation of tooth marks. Additionally, for each area of interest you should first take a photo from farther away to show where on the body the evidence is, then a close up to show details of the wound. Include a ruler in the photos to document the depth and size of wounds.
- Estimated time of injury/death. Photograph features such as fly larvae or decomposition that help document estimated time of death. Photos of fly larvae should include a ruler to document stage of development.

Cautions

- Be careful not to confuse postmortem conditions for premortem hemorrhage. When an animal dies, gravity causes blood to sink to the lower parts of the body (lividity), which can look like bruising. Additionally, as decomposition advances, blood vessels burst (postmortem hemorrhaging) and muscle tissues break down. Decomposition begins within the abdomonial cavity and heat and gasses will cause adjacent tissues along the neck and groin to decompose faster than surrounding tissues. Premortem hemorrhage from bites, especially on fresh

carcasses, is generally visible on the underside of the hide and on the surface of adjacent muscle tissue.

- Documenting wounds on an injured animal is particularly difficult, and it is important for the investigor to advise the owner that the animal must be sufficiently restrained to allow thorough examination and documentation of wounds.
- If unable to respond to an investigation request until the following day, encourage the reporting party to cover the carcass with a tarp to prevent scavengers from removing more evidence. The tarp should be weighed down with rocks or logs to prevent access.
- Make sure that your camera is set to take high resolution photographs and is on macro setting to avoid blur. Try to set up shots so that the image is not washed out by improper lighting. Include a ruler in photographs of wounds and fly larvae.

Genetic Evidence

Genetic evidence (for consistency) in depredation investigations can be extremely helpful, but is not a substitute for a thorough investigation of the carcass or injured animal. Genetic evidence may be most useful for injured animals where phyiscal evidence is often limited to the bite or attack wounds on the animal itself. Collection of potential salvia around bite marks can be done using a sterile swab (if neccessary, a clean Q-tip or wad of toilet paper has been successful). In the case of injured animals, the confirmed presence of wolf DNA is almost always cause for confirmation. Appendix 1 includes detailed genetic sample collection protocols.

Wolf DNA on carcasses can confirm wolf presence, but by itself cannot confirm depredation because wolves often scavenge carcasses. As indicated above, additional physical evidence is necessary to verify a wolf attack. Scat, hair, and urine found near a carcass can also be collected and used to genetically confirm wolf presence at a site.

Investigations can sometimes result in the detection and confirmation of wolves in new and/or emerging areas of wolf activity. Genetic samples from such investigations provide an excellent opportunity for CDFW to identify the individual(s) present and potentially assign responsibility of an event to a specific wolf or group of wolves. For investigations occuring in areas of new or unknown wolf activity, CDFW requests the collection of potential wolf genetic samples whenever possible.

Investigation Form Submission

Please notifiy appropriate CDFW staff immediately upon completion of investigations. Submit the investigation form and photographs as soon as possible, preferably within 48 hours of conducting the investigation. Investigation materials not submitted via the online investigation form can be emailed to WolfProgram@wildlife.ca.gov or appropriate regional wolf staff (see CDFW contact list below).

Final Considerations

Depredation investigations can be stressful events with lots of distractions. However, it is very important that an investigator collects clear and thorough photographic evidence. These photographs are the principal part of an investigation and allow CDFW make evidence-based determinations. Because photographs are so important, it may be helpful to have a second person at investigations to be the lead for taking photographs while the primary investigator is conducting the examination. CDFW may also be able to provide examination gloves, rulers, and a dedicated camera to investigators.

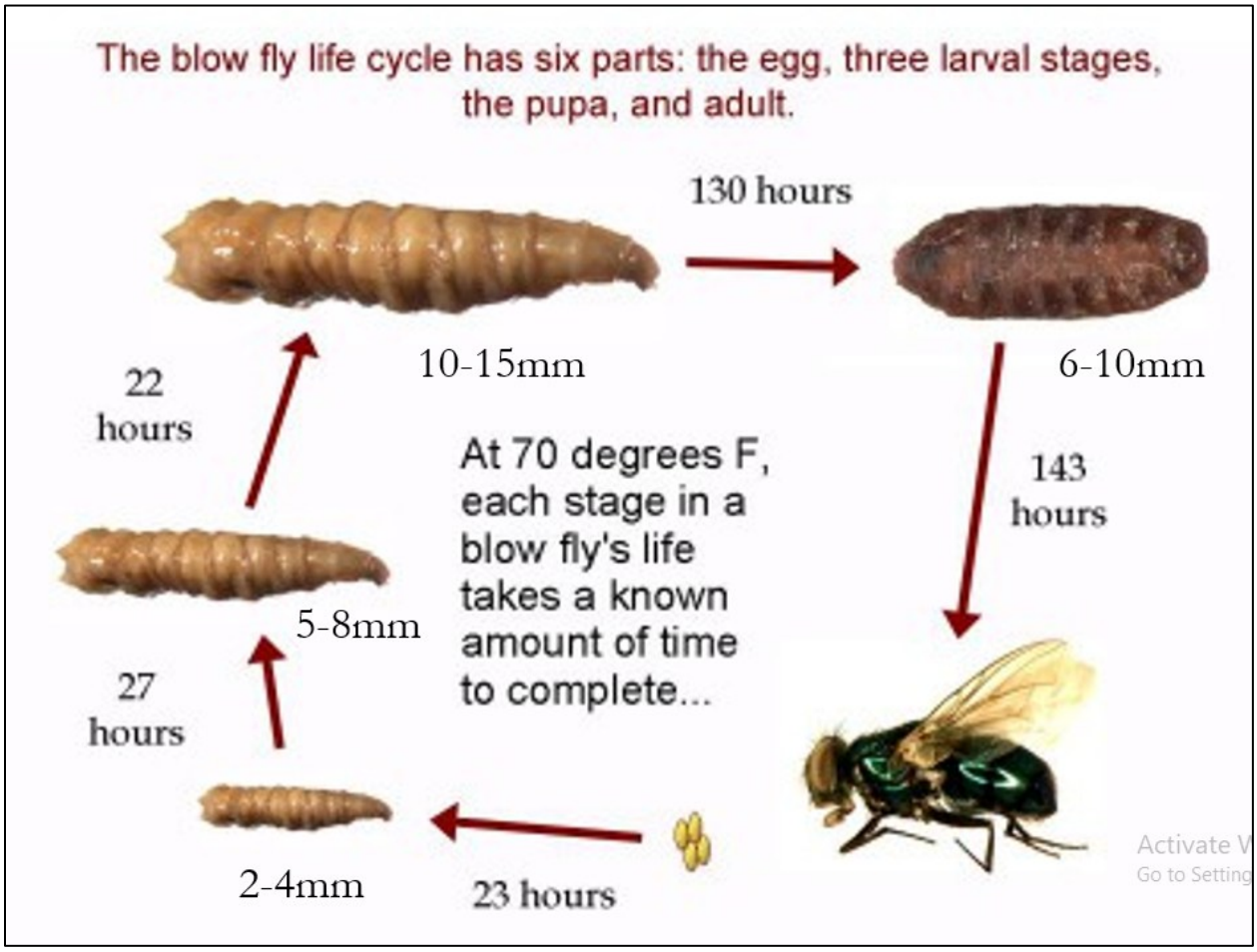
Additional Investigation Resources:

- Methods of Investigating Predation of Livestock (agdex 684-14) (gov.ab.ca)
- Livestock Injury and Mortality Investigations WDFW.pdf (wa.gov)

Table 1. Characteristics of depredation by large mammals in California.

Species	Attack/Kill Method	Attack Location	Attack Evidence	Scene	Feeding	Canine Spacing	Tooth Channel Width	Depth of Trauma
Gray Wolf	Chase. Chase can be long. May hunt singly or in groups.	On larger prey, typically attack hindquarters, groin, and/or behind elbow. On smaller prey, may bite neck and across back.	Many bite marks. Wide tooth channels from large, dull teeth. Massive trauma under bite marks.	Messy – parts may be scattered. Feeds in the open.	Starts at anus or flanks. Large bones scattered and often broken.	1.5-2”	0.25”	≥1.5”
Coyote	Chase. Chase can be long. May hunt singly or in groups.	Throat, hindquarters and groin.	Many bite marks. Small punctures from sharp teeth.	Messy – parts may be scattered. Feeds in the open.	Starts feeding at anus or flanks. Can’t break large bones.	1-1.4”	0.125”	≤1.0”
Domestic Dog	Chase. Prey may often be injured rather than killed (due to killing inexperience)	Bites can be anywhere. Often some bites on face.	Many bite marks.	Messy. Often extensive chase and attack area.	Often no feeding or feeding in irregular places like the head.	1.4-2.0”	0.125-0.25”	≤1.0”
Mountain Lion	Ambush. Chase usually short. Kill via suffocation or bite through skull or spine.	Top of neck, throat, head.	Few bite marks. Large puncture holes on head/neck. Sometimes long claw marks.	Often drags or carries prey to secluded location to feed. Buries or covers carcass. Often plucks hair from carcass.	Fastidious. Often enters carcass behind rib cage. Rumen often intact.	1.5-2.25”	0.25”	≥1.5”
Black Bear	Ambush. Chase usually short. Blunt force mauling in addition to bites.	Head, neck, back, sides.	Large puncture holes with torn hide. Massive hemorrhage in areas without associated tooth marks.	Messy. Often matted grass remains at feeding site. May move carcass to covered area to feed. May try to bury carcass.	Peels hide back from carcass. Postmortem claw marks often visible.	1.5-2.5”	0.25”	≥1.5”

Figure 1. Blow fly larval development. Keep in mind that this chart reflects development at a constant 70°F. Colder temperatures will slow development, while warmer temperatures will speed it up. Additionally, there are usually larvae at different stages of development on a carcass, as flies continue to arrive and deposit eggs after the animal dies. Look for the most advanced stage of development to estimate time of death. Often the first places flies will lay eggs on a fresh carcass are in and around the orifices and any open wounds.



Appendix 1. Standard Guidelines for the Collection of Biological Samples for the Gray Wolf Program.

1. WHAT samples to collect (ranked by priority).

I. Scat

- **a.** Collect 1-3 inches from the tapered end of the scat and place in a 50-ml tube containing 90% Ethyl Alcohol (EtOH) as soon as possible. Completely submerse scat in the EtOH and store at room temperature until delivery of sample to the Wildlife Forensics Laboratory (WFL) can be coordinated.
- **b.** If EtOH is not available, then collect entire scat and store it in a **paper bag** in a dry environment with good air flow. Process promptly after returning from the field.
- **c.** HairPlace hair (preferably large guard hairs) with roots in labeled envelope and store at room temperature until delivery of sample can be coordinated.

II. Saliva

- **a.** If wound area has dried (e.g., suspected wolf bite marks on a carcass), moisten a forensic-grade sterile cotton swab (e.g., Cap-Shure) with distilled water and thoroughly swab wound margins, bite marks or clumped hair (potential saliva).
- **b.** Use a new swab for each wound or general area if multiple animals are suspected.
- **c.** Allow swab(s) to air dry completely prior to capping.
- **d.** Place swabs individually in paper envelopes and store at room temperature until transfer to CDFW wolf staff or lab.

III. Urine

- **a.** If found in snow, collect snow in a sealed sterile vial. Keep at stable temperature: if thawed leave it at room temperature, if frozen then keep frozen. Transport with an ice block.
- **b.** If found in other substrate, collect a saturated sample in a vial.

2. WHAT data to collect/document with each sample.

I. Survey123 Recording

- **a.** If possible, use the California Gray Wolf Observations survey through Survey123:

  https://arcg.is/1uiqW10 to record all genetic sampling and wolf related observations.

II. Scat

- **a.** Photograph of scat as found with ruler for scale.
- **b.** Geographic coordinates for the location of the scat (i.e., GPS data)
- **c.** Remainder or all of scat placed in a paper bag.

d. Label envelope/bag containing remainder of scat with: Date, Your Name, Sample # (S#-mmddyy), Lat/Long, and Max width (mm)

e. Photograph co-occurring sign (e.g., tracks), using a ruler for scale - Appendix 1 (Gray Wolf Field Guide)

III. Hair

a. Photograph of hair as found, with ruler for scale

b. GPS location of hair

c. Label envelope containing hair with: Date, Your Name, Sample #, Lat/Long

d. Photographs of co-occurring sign with ruler for scale

e. Documentation of surroundings/context

IV. Saliva

a. Close-up photograph of area swabbed (i.e. bite wounds), with ruler for scale.

b. Zoomed out photograph of area swabbed/carcass with indicator of where close-up photograph was taken.

c. GPS location of site

d. Label sample container with: Date, Your Name, Sample #, Lat/Long

e. Photograph co-occurring sign (including other species), with ruler for scale.

f. Documentation of surroundings and/or context (e.g., carcass species, sign of other predator/scavenger species, habitat attributes)

V. Tracks with no co-occurring sign

a. Photograph each set of tracks, with ruler for scale.

b. GPS location of tracks

c. Document: Date, Your Name, Lat/Long, # Track Sets, Direction (bearing) of tracks

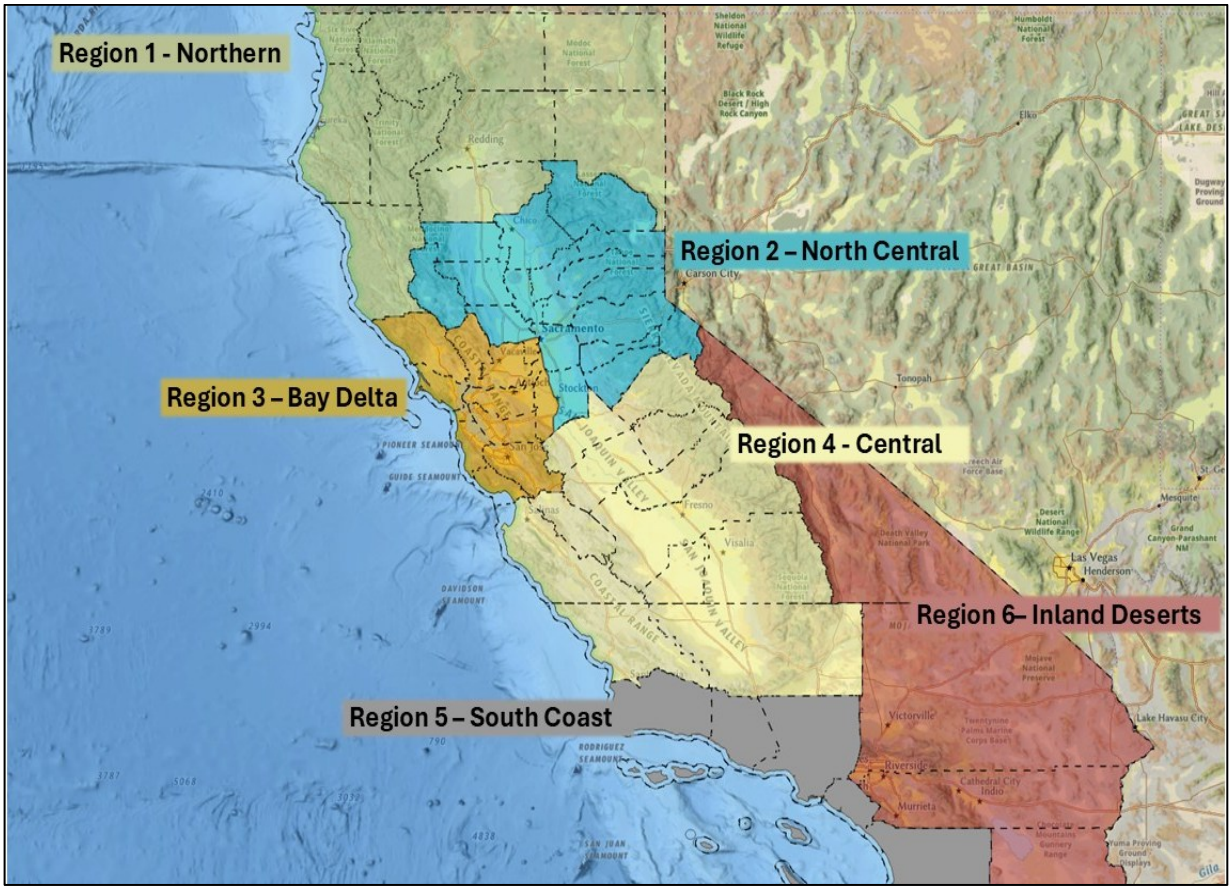
3. WHERE to send samples.

I. Notify either the regional wolf specialist or the state wolf coordinator (contacts below) to coordinate sample submission

II. If samples are properly processed and stored, they may be delivered in batches versus individual samples.

Appendix 2. CDFW and USDA Wildlife Services Contact Information

CDFW Regions:



CDFW Contact List for wolf management and conflict

Regions With Current Wolf Presence and Headquarters *

Region 1 – Northern *(Del Norte, Humboldt, Lassen, Mendocino, Modoc, Shasta, Siskiyou Tehama, Trinity)*	
Nathan Libal, Wolf Specialist (R1/R2) Email: Nathan.Libal@wildlife.ca.gov Phone: 530-260-3118	John Perrine, Wildlife Supervisor Email: John.Perrine@wildlife.ca.gov Phone: 530-227-1093
Jeff Stoddard, Environmental Program Manager Email: Jeffrey.Stoddard@wildlife.ca.gov Phone: 530-768-7146	

Region 2 – North Central *(Alpine, Amador, Butte, Calaveras, Colusa, El Dorado, Glenn, Lake, Nevada, Placer, Plumas, Sacramento, San Joaquin, Sierra, Sutter, Yolo, Yuba)*	
Nathan Libal, Wolf Specialist (R1/R2) Email: Nathan.Libal@wildlife.ca.gov Phone: 530-260-3118	Libby Ehlers, Sierra/Plumas & R2 Wolf Lead Email: Elizabeth.Ehlers@wildlife.ca.gov Phone: 916-336-2107
Ryan Leahy, HWC Supervisor Email: Ryan.Leahy@wildlife.ca.gov Phone: 916-809-3512	

Region 4 – Central *(Fresno, Kern, Kings, Madera, Mariposa, Merced, Monterey, San Benito, San Luis Obispo, Stanislaus, Tulare, Tuolumne)*	
Chris DeTar, Wolf & Conflict Biologist (R4) Email: Christopher.Detar@wildlife.ca.gov Phone: 559-580-3207	Nathan Graveline, Wildlife Supervisor Email: Nathan.Graveline@wildlife.ca.gov Phone: 559-243-4005
David Hacker, Environmental Program Manager Email: David.Hacker@wildlife.ca.gov Phone: 559-417-2976	Sofia Cortes, Conflict Specialist Email: Sofia.Cortes@wildlife.ca.gov Phone: 559-580-3207

Wolf Program – Wildlife Branch, Sacramento *Statewide*	
Axel Hunnicutt - Wolf Program Coordinator Email: Axel.Hunnicutt@wildlife.ca.gov Phone: 916-628-3543	Jason Lombardi - Large Carnivore Coordinator Email: Jason.Lombardi@wildlife.ca.gov Phone: 916-838-2068
Ari Sarchi Email: Arianna.Sarchi-Flood@wildlife.ca.gov Phione: 916-214-9865	
Pete Figura - Wildlife Diversity Program EPM Email: Pete.Figura@wildlife.ca.gov	Vicky Monroe - Conflict Programs Coordinator Email: Victoria.Monroe@wildlife.ca.gov

* *For wolf-livestock investigations in other CDFW regions (Region 3 - Bay Delta, Region 5 - South Coast, and Region 6 - Inland Deserts), please contact the statewide Wolf Program Coordinator listed above.*

USDA Wildlife Services Districts Map and Contacts: