Management Practices and Foot-and-Mouth Disease (FMD) Exposure Risks for Sheep and Cattle Grazing Federal Public Lands

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Purpose

This summary aims to give decision makers managing a foot-and-mouth disease (FMD) outbreak an understanding of the management practices, capabilities, and limitations of ranchers with cattle and sheep grazing federal public lands in the United States. Management practices are described based on interviews of six cattle and sheep ranchers whose livestock graze federal public lands. FMD exposure risks for grazing animals are also described, and this information was based on published literature and interviews with FMD research scientists from USDA Agricultural Research Service and the Pirbright Laboratory in the United Kingdom. This summary provides additional details to support the guidance document, *Movement Decision Criteria for Industry and Regulatory Officials Managing Cattle and Sheep Grazing Federal Public Lands during a Foot-and-Mouth Disease (FMD) Outbreak, 2024* available at https://securesheepwool.org/Assets/Grazing-Fed-Public-Lands-Movement-Decision-Criteria-Guidance-FMD.pdf. This summary complements the guidance available in the Secure Sheep and Wool Supply (SSWS) Plan (www.securesheepwool.org) and Secure Beef Supply (SBS) Plan for Continuity of Business (www.securebeef.org).

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SSWS SECURE SHEEP AND WOOL SUPPLY
www.securesheepwool.org

SBS SECURE BEEF SUPPLY
www.securebeef.org

Introduction

In the event of an FMD outbreak, sheep and cattle owners face unique challenges to mitigate disease exposure risks on public land allotments. When FMD is diagnosed, Control Areas will be established around infected premises and movement restrictions will be implemented. Movement into, within, or out of a Control Area will require a permit and be based on risk. When Control Areas encompass part or all of a public land allotment, in one or more states, there are unique challenges for sheep and cattle owners to mitigate disease exposure risks. There are certain times of year when animals must be moved onto or off public lands based on weather changes, forage availability, management needs (breeding, lambing, calving), natural disasters (fires, flooding), and other factors outside the control of the livestock owners (e.g., exposure to FMD susceptible wildlife). Likewise, controlling access, separation of flocks/herds, or movement off the public lands are out of the individual producer's control in an outbreak. They must work through the state and/or federal land management agency(ies) in addition to the state and federal regulatory officials managing the outbreak to put protection in place for their livestock.

FMD Exposure Risks for Sheep and Cattle Grazing Public Lands

Foot-and-mouth disease virus (FMDV) causes fever, lameness and vesicles on the feet, muzzle, tongue, and teats of cloven-hooved animals (two-toed) animals including cattle, sheep, pigs, goats, and cervids. FMD is not a public health or food safety concern. FMD is considered the most important disease limiting worldwide trade of animals and their products due to it being a highly contagious animal disease resulting in devastating economic impacts.

"It is generally accepted that FMDV spreads predominantly by direct or indirect contact with infected animals, their secretions or contaminated food products. It is also known that under certain circumstances, the virus travels over extensive distances to cause incursions at previously virus-free premises. Although airborne dissemination of infectious aerosols is often implicated, the contributory roles of humans (fomites), wildlife and waterborne spread are often not easily discerned."[1]
FMDV is shed by infected cloven-hooved animals in their feces, urine, breath, milk, and semen. Cattle and sheep grazing public lands can be exposed through:

- Direct contact with an infected animal,
- Oral consumption of contaminated feed,
- Aerosol when the virus is breathed in,
- Indirect contact with contaminated fomites like water troughs, feed bunks, corrals, equipment, vehicles, clothing, and footwear and mechanical vectors like coyotes, wolves, raccoons, rats, other scavengers that can carry infected carcass parts to other locations

The survivability of FMDV in water was discussed with the FMD experts given the distribution systems that are used on some public lands. Nothing definitive was identified in published literature. The FMD experts felt that exposure may occur through shared equipment (troughs, tanks) and the environment around the watering areas in an outbreak. Watering areas that have known infected animals will be contaminated. A study done in Nepal looked at the detection of FMD RNA in environmental samples, one of which was water troughs at a live goat market. The researchers were able to detect it and concluded that this sampling method may have potential to be used as a non-invasive surveillance tool in areas where animals congregate (Colenutt et. al, 2021).[2]

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[1] Arzt J. et al, The Pathogenesis of Foot-and-Mouth Disease I: Viral Pathways in Cattle, *Transboundary and Emerging Diseases;* 2011 Aug;58(4):291-304. https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1865-1682.2011.01204.x

[2] Colenutt C., et al. Environmental sampling for the detection of foot-and-mouth disease virus and peste des petits ruminants virus in a live goat market, Nepal. *Transboundary and Emerging Diseases*, 2021;1-6. https://onlinelibrary.wiley.com/doi/epdf/10.1111/tbed.14257

Disinfection is the standard practice to eliminate FMDV from fomites and the environment. However, this becomes impractical on vast expanses of public lands with miles of water pipelines, wooden corrals, and fencing. A fallow period after infected animals have been removed or leave the area can help decrease the infectious burden; it may not completely eliminate the virus. Environmental and climatic conditions (hot and dry) can aid virus inactivation. Infected cattle can shed more virus than sheep so fallow periods may need to be longer on ground where infected cattle grazed.

Minimizing FMDV exposures to cattle and sheep would follow similar approaches. It should be noted that cattle have a much longer duration (up to 4 years) of carrying the FMD virus as a reservoir compared to sheep (up to 1 year). This will factor into how animals should be managed in the long term.

Exposure to Wild and Feral Animals

In addition to cattle and sheep, FMD has been reported in cloven-hooved wild and feral animals. The World Organization for Animal Health (WOAH) defines wild animals as "having a phenotype unaffected by human selection and lives independently without requiring human supervision or control" and feral animals as "a domesticated species that lives without requiring human supervision or control"[3]. Feral pigs are of particular concern for their potential to spread FMD in the U.S. Various computer models have explored their role in FMD spread. It should be assumed if feral pigs share areas with domestic livestock, they may play a role in the transmission of FMDV.

Worldwide, more than 100 different wildlife, domestic, and laboratory animal species have been described in published literature as naturally or experimentally infected but not all are naturally susceptible to, or capable of spreading, FMDV.[4] There are variations in how FMD presents in wildlife, and it depends on the animal species and the serotype of FMDV circulating.

In 2013, researchers published a list of wildlife in North America that have been experimentally infected and may be capable of transmitting FMDV to cattle grazing public lands in the U.S. (Weaver et al. 2014). This publication did not list potential wildlife transmission to sheep, although the FMD experts interviewed as part of guidance development shared that the exposure risks are similar.

- American Bison (*Bison bison*) – also naturally infected
- Elk (*Cervus elaphus nelsonii*)
- Mule deer (*Odocoileus hemionus*)
- Pronghorn antelope (*Anilocapra americana*)
- White-tailed deer (*Odocoileus virginianus*) – also naturally infected
- Feral pigs (*Sus scrofa*) – also naturally infected

While not specifically identified in the literature review supporting development of this guidance, for the purposes of this discussion, wild sheep (genus *Ovis*) and wild goats (genus *Oreamnos*) will be considered FMD-susceptible species.

The 2013 Weaver et. al publication included a few species found on U.S. public lands that have published reports of natural FMDV infections in zoos outside of North America including:

- Brown bears (*Ursus arctos*)
- Grizzly bears (*Ursus arctos horribilis*)

[3] World Organization for Animal Health, Terrestrial Animal Health Code, 2022 at: https://www.oie.int/fileadmin/Home/eng/Health_standards/tahc/current/glossaire.pdf

[4] Weaver G.V, et. al. Foot and mouth disease: A look from the wild side. *J of Wildlife Diseases*, 2013; 49(4):759-785

Surveillance in wildlife, particularly where they intersect with domestic livestock, has been part of the response strategy in other countries. It has been suggested that countries, other than sub-Saharan Africa, that focus on controlling FMD in domestic livestock can protect livestock and wildlife without direct or interventional activities with wildlife. Feral pigs may require direct and interventional control strategies to mitigate their transmission potential.

In 2015, the World Organization for Animal Health published guidelines for wildlife disease surveillance (Source: WOAH. Guidelines for Wildlife Disease Surveillance: An Overview, 2015 available at: https://www.woah.org/app/uploads/2021/03/oie-guidance-wildlife-surveillance-feb2015.pdf). A 2022 publication by USDA researchers describes adaptive risk-based targeted surveillance (Source: Miller, R.S., et.al. Adaptive risk-based targeted surveillance for foreign animal diseases at the wildlife-livestock interface. *Transboundary and Emerging Diseases*, 2022:1–12. https://doi.org/10.1111/tbed.14576). Both provide the guidance necessary to prioritize FAD surveillance in wild animals in a Control Area.

Management Practices for Sheep and Cattle Grazing Public Lands

Based on how FMDV can spread, the interviews focused on management practices surrounding animal movements and contact, vehicles/equipment, and people movement. Other topics that contribute to the management strategies discussion include traceability/record keeping, animal health monitoring, and communicating with public lands agencies.

Allotments and Pastures on Federal Public Lands

The sheer size and diversity of federal public land allotments varies from a few acres to hundreds of thousands of acres, from desert areas to forests to mountains. Allotments and pastures may or may not have boundary/perimeter fencing. Water sources vary from natural springs and rivers to miles of pipeline bringing it to troughs. In some cases, water is hauled in by ranchers. Water sources attract wildlife and indirect contact occurs with antelope, elk, deer, and others.

Animal Movements and Contact

The ranchers interviewed use a combination of deeded land (referred to as the base property), leased private lands, and federal public lands to feed their animals throughout the year. The grazing season for most public land permits is for 9 months or less. There are very few 12-month permitted uses available from U.S. Forest Service (USFS) and Bureau of Land Management (BLM). These tend to be in the southwest U.S. The BLM also has some 12-month permitted uses in other parts of the Western U.S. where allotments are small and used in conjunction with private lands. Method of movement from the base property to public lands vary depending on the type of adjoining land (deeded, private, state land, public lands), distance to public lands, accessibility via road/trails, time of year, and availability of hired transportation options. Spring turn-out dates vary by location and BLM may be as early as April 15 and USFS may be as early as May 15. End of summer grazing is defined by the permitting agency, and it varies by region. It may range from October 1 to 31. Winter grazing usually begins November 1. See "agency" document for more details.

Those that trail animals (up to 200 miles/year for sheep) may share trails with other livestock, not simultaneously but before or after cattle or sheep from other herds/flocks. One rancher gave the example of an hourglass. The lowlands are wide and to get to/from the high lands/mountains, the animals are funneled through a common trail system. Another referred to this as the "cherry stem". Ranchers stated a single trail to public lands may be 4 miles up to 65 miles from the ranch. It should be assumed that these stock driveways will be shared with animals coming from areas outside of a 6.2 mile/10km area from the ranch (this is the minimum recommended size of a Control Area in an FMD outbreak).

Those that transport using semi-trailers or fifth-wheel trailers may travel more than 150 miles from the base property to the grazing allotments. Livestock trucks vary from being solely owned by the rancher to hired transporters. The interviewed ranchers with their own trailers primarily haul their own animals; they do not commonly haul animals for other ranchers. Occasionally, at the end of a grazing season, they may transport a "straggler" that has gotten in with their livestock (more common with cattle than sheep per interviewees). The hired transporters use equipment that may haul sheep or cattle owned by other ranchers with unknown clean out procedures between loads. Truck washouts are not commonly found in the areas around federal public lands.

It takes experienced drivers to travel mountain and two track roads safely. Trucking will be a limiting factor if livestock need to leave public lands with some urgency (wildfire, FMD outbreak). Getting to/leaving some of the public land grazing allotments requires some trailing due to road conditions/access to certain areas. During an outbreak, coordinating the volume of traffic will be needed to ensure the limited and often narrow roadways are not overwhelmed by responders, equipment, and livestock transportation.

Off-loading sheep and cattle at the allotment may involve use of corrals and pens that are shared, not simultaneously, but before or after cattle or sheep from other herds/flocks going onto nearby allotments. Coordinating corral use is based on producer-to-producer communication. Each rancher has a given timeframe, often up to 2-weeks, to move in/out. In some situations, the pens would only be used by one rancher's animals given the permit for use of the public lands. It should be noted that recreational pack and saddle stock may use the facilities. The corral/pen infrastructure is largely wooden (ramps, chutes, fencing). Some locations have permanent water sources; others do not, and the rancher must haul water in.

Multiple permittees may be on an allotment (commingled herds/flocks are not uncommon). Some permittees may trail across another permittee's allotment to access their own allotment. For instance, sheep trailing across cattle allotments or vice versa. Some lands have common fence lines with shared water troughs. Other lands are separated with an empty unit between BLM/USFS and deeded lands. When hauling water to animals on desert lands, water is pulled from a common spring (commingling of vehicles, not animals) and delivered to troughs that are not shared between flocks/herds. In the fall during round-up, stragglers/remnants may be from different permittees and may be put in a pen for various cattle owners to retrieve. Ranchers also shared they may transport neighbor's livestock with their livestock if picking up stragglers/remnants.

The concept of empty units or pastures as buffers between livestock owned by different ranchers was discussed. This is highly variable depending on the time of year, available forage, water access, and whether there are fences separating different units in an allotment. Most grazing allotments have a pasture rotation system (systems like rest-rotation, deferred rotation, etc.). The system is analyzed in an environmental assessment and the pasture rotations are prescribed in the Allotment Management Plan (AMP). The pasture rotation can be modified sometimes if monitoring or management issues need to be addressed, as long as the overall system is maintained such as providing rest or deferment across the allotment. Empty units or pastures would require coordination with neighboring herds/flocks and the agency that oversees the permits for land use.

It is also more common to have herders stay with sheep for long periods of time monitoring and moving them as compared to grazing cattle. Range Riders or Buckaroos may stay in a line cabin or cow camp on or near the cattle grazing allotment.

Traceability/Record Keeping
The ranchers interviewed described various types of records kept for their livestock grazing public lands. Ranchers use both paper and electronic records to know how many animals were moved onto the lands, how many were moved out, movement dates, and losses due to death or depredation. Some ranchers described certain state requirements for collecting brand or ear tag data. Sheep with scrapie ear tags may have a Premises Identification Number (PIN) that is linked to the ranch. In states where brand inspectors need to inspect loads, numbers of head are captured by the load. Sheep herders also keep head count records as they move units and during lambing. Some ranchers calve on the public lands. Counts are also taken during gathering/branding/castrating/tail docking while on the public lands. Both BLM and USFS require Actual Use Reports which provide livestock numbers and use dates, as well as livestock movement through pastures. This is reported at the end of the season, not real-time. Ranchers agreed that at any given time, they would know the number of head on a particular allotment.

Vehicles and Equipment

Public lands are used by ranchers, Wildlife Services, mine employees, wood cutters, oil well workers, hunters, fishers, tribal members, and recreationalists. This discussion focuses on the use of vehicles and equipment by the ranchers. It should not be overlooked that in an outbreak, the traffic by others on shared paths may pose a risk of FMD spread. This is discussed more in the "Movement Decision Criteria" document.

Livestock trucks, trailers, and pickups are used to load/unload animals at the corrals. Once on the grazing allotments, the types of vehicles and equipment varies by the land use. Herders have wagons/campers that they move with a pickup truck with the bands of sheep. Water tender trucks are used to haul tanks on allotments. Using motor vehicles on federal public lands is site-specific. The BLM and USFS only allow use of motorized vehicles if it is not restricted by the travel management plan, land use plan, or by statute. Permission may be granted in an emergency requiring evacuation. Moving livestock across units is typically done with horses and dogs (livestock guardian dogs that remain with the flock and border collies that may return to the ranch) and all-terrain vehicles (ATVs) in winter. There are a few virtual fencing pilot projects underway using Global Positioning System (GPS) technology with receiver collars on cattle with the ability to remotely move the "fence lines", herding cattle across the allotment.

People Movement

Herders that stay with the bands of sheep tend to be the same people that start and end the grazing season. Cattle ranchers stay for a few days at a time during moves but not typically between moves. Range Riders/Buckaroos tend to stay with the cattle for longer periods of time.

Supplies are delivered to the herders by the ranchers or camp tenders. Frequency varies based on location and types of supplies (twice a week to every other week). Some supplies are delivered right to the camp. Often there is a central location, some permanent structures, where supplies are delivered. The herders may use a pickup truck or other vehicle to retrieve supplies. It is assumed horses and pack animals are also used to retrieve supplies. Examples of supplies include groceries, propane, dog food, salt blocks, grain, and certified weed seed free hay or feed. Cattle may also be provided mineral or protein supplements in a drought. These also attract wildlife and should be a consideration in an FMD outbreak.

Animal Health and Disease Monitoring

Herders monitor sheep health and may keep some notes but not daily observations. Cattle may not have people that observe them frequently except during moves, round up, or branding/castrating. Livestock are inspected by the brand inspector when moved across county lines in some states. The FMD experts were asked to discuss the options for monitoring clinical signs during an outbreak in the event herds/bands are within a Control Area. Both agreed that the animals should be gathered and corralled some distance

(terrain and virus strain will contribute to distance recommendation) from the known infected animals. This should also help decrease wildlife interactions. A portion of the herd/band should be examined every 2-3 days for lesions. Cattle shows signs more readily than sheep. However, the only definitive test is through individual animal sampling. A probang sample can detect virus 10 days post infection. Prior to 10 days (when exposure may be suspected but no clinical signs), nasal or oral swab samples tested by rRT-PCR can be used. The use of environmental sampling as described in a publication describing sample collection in a Nepal goat market (Colenutt et al., 2021) may be a consideration in addition to other strategies.

Given the logistics of handling animals to collect samples, especially probang samples (specific instrument placed down the throat requiring proper restraint and training for animal safety and proper collection), determining the need for testing is critical. For instance, if the animals need to move and status must be known prior. If it is part of a foreign animal disease (FAD) investigation due to a known or high risk of exposure or suspect signs were seen, then that changes the surveillance plan. It is no longer for business continuity and no evidence of infection. Now it is an investigation. These are all factors to be considered.

There are some expectations by USFS and BLM for the handling of dead animals on public lands. Carcasses found near watering holes or public access roads need to be moved. The ability to do so depends on the size of the animal (2000-pound bull vs. 50-pound lamb). Some animals may be buried pending the terrain. Some herders will bring in dead lambs or small sheep to haul back to the ranch for disposal. Scavengers, heat, and snow cover all contribute to carcass removal.

This project explored options for livestock with no evidence of infection located in a Control Area to maintain or regain business continuity. Discussing depopulation of infected animals was beyond the focus of this document/project. For information on the management of infected animals, refer to the USDA FMD Response Plan and FAD PReP documents for Depopulation and Disposal available at: https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/emergency-management/em-fmd/ct_fmd

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Appendix A: Definitions of Terms Related to Public Land Grazing

Actual Use: A report on the actual livestock grazing use. Actual use may be expressed in terms of animal unit months or animal months. A record of actual use contains dates and numbers of livestock gathered or moved, notes about partial removals and death losses, and it may also include information about grazing problems involving water or livestock distribution, salting records, or forage conditions.
Allotments: An area of land determined to contain acres suitable for livestock grazing, and where there has been a decision (even if a historical decision) to authorize livestock use and occupancy at present, in

the past, or in the future. An allotment can be comprised of both federal public lands and non-federal lands. Livestock grazing use on an allotment is authorized under some type of grazing permit, commonly a term grazing permit.
Allotment Management Plan (AMP): A documented program developed as an activity plan, consistent with the definition at 43 U.S.C. 1702(k), that focuses on, and contains the necessary instructions for, the management of livestock grazing on specified public lands to meet resource condition, sustained yield, multiple use, economic and other objectives.
Animal-Month (AM): A month's tenure upon range by one animal. Must specify kind and class of animal. Not synonymous with animal-unit month.
Animal Unit (AU): Considered to be one mature cow of about 1,000 pounds, either dry or with calf up to 6 months of age, or their equivalent, consuming about 26 pounds of forage per day on an oven-dry basis. Five sheep or goats are the general equivalent of one cow.
Animal Unit Month (AUM): Amount of forage necessary for the sustenance of one cow or its equivalent for a period of 1 month. The amount of oven-dry forage required by one animal unit for one month based on a forage allowance of 26 pounds per day. Not synonymous with animal-month. The term "AUM" is commonly used in three ways: a) stocking rate, as in "X acres per AUM", b) forage allocations, as in "X AUMs in Allotment A", or c) utilization, as in "X AUMs taken from Pasture B."
Band: A group of approximately 1000 head of ewes (or ewes with lambs) that move together when grazing rangeland
Base Property: Land and/or interests used by permittees and specifically designated by the permittee to qualify for a term grazing permit. Requirements may vary according to specific USFS or BLM definitions.
Camp Tenders: Someone who supervises and coordinates activities of sheep herders that tend bands of sheep on range or pasture and keeps them supplied with food and other necessities. Observes condition of range, water, and animals, and guides when to move to another range.
Grazing Permit and Lease: Any method of administration of an agreement or permit typically considered public lands grazing in any of the following states: Arizona, California, Colorado, Idaho, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming as outlined in U.S. Code Title 43, Public Lands, Chapter 35 (BLM, Federal Land Policy and Management) and the 36 CFR Chapter 2 (USFS National Forest Systems and Grasslands).
Public Lands: For the purposes of this document, public lands refer to federal public lands managed by USFS and BLM. It includes any land or interest in land owned by the United States within several States and administered by the Secretary of the Interior through the Bureau of Land Management and the Secretary of the Department of Agriculture through the Forest Service, that are managed according to a multiple use mandate.
Units: varying sizes of grazing land within an allotment with natural or fenced barriers; sometimes called pastures

Sources:

- U.S. Code Title 43, Public Lands, Chapter 35: Federal Land Policy and Management, Subchapter 1 – General Provisions, Section 1702 Definitions, available at: https://uscode.house.gov/view.xhtml?path=/prelim@title43/chapter35&edition=prelim
- Code of Federal Regulations, Title 43, Chapter II, Subchapter D, Range Management 4100.0-5 Definitions, available at: https://www.ecfr.gov/current/title-43/subtitle-B/chapter-II/subchapter-D/part-4100
- Code of Federal Regulations Title 36, Chapter II, Subpart A, Part 222 (National Forest Systems) and Part 213 (National Grasslands)
- U.S. Forest Service Representative, personal communication, September 2022.
- Rancher, personal communication, June 2022.