Pest Management Strategic Plan
for
Rangeland Beef
in
Alaska, Colorado, Idaho, Montana, Nebraska, New Mexico, Utah, Washington, and Wyoming

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SUMMARY OF CRITICAL NEEDS

The following Research, Regulatory, and Educational Priorities were found by industry representatives to be the most critical in rangeland beef cattle production in Alaska, Colorado, Idaho, Montana, Nebraska, New Mexico, Utah, Washington, and Wyoming

Research Priorities

1) Develop an integrated pest management program for rangeland beef production.

2) Develop novel chemical controls for resistant insect pests (e.g., horn fly and lice), monitor resistance levels to insecticides, and develop strategies to prevent resistance.

3) Develop novel chemical insecticide controls, repellents, and application technology (including topical applications) that are effective and fast-acting for management of adult biting flies (e.g., mosquitoes and black flies).

4) Develop an integrated program for external parasites (e.g., lice), that considers internal pest control, emphasizes season-long control, employs new chemistries (e.g., alternatives to avermectins), and reduces the likelihood of resistance.

5) Conduct biological studies of arthropod pests (e.g., black flies) to develop and implement appropriate management.

6) Determine distribution, importance, seasonal abundance, and management implications of both stable fly and face fly in the western states.

7) Evaluate the impact of chemical controls and repellents on non-target organisms.

8) Identify and study the biology of beneficial arthopods (e.g., dung beetles) as tools for pasture improvement, nutrient cycling, and management of rangeland arthropod pests (e.g., horn fly).

9) Integrate chemical treatments for both external and internal pest controls.

10) Address loss of research faculty at western land-grant universities.

Regulatory Priorities

1) Maintain registration of chemical controls with alternative modes of action and formulations.

2) Retain a variety of chemical pesticide classes for resistance management.

3) Add local pests (e.g., black flies, mosquitoes, and biting midges) to insecticide labels such as diazinon and zeta-cypermethrin (Python) where effective.

4) Once new chemical controls and application methods are identified, expedite registration.

5) Maintain registration for effective pesticides, including effective application methods and timing options for pests of rangeland beef cattle including face fly and cattle lice.

6) Maintain or reinstate the use of diazinon, coumaphos (Co-Rad), and pirimiphos-methyl for horn fly control.

7) Facilitate shipping of cattle into blue-tongue-free areas such as Canada (concern for export states).

Educational Priorities

1) Develop and deliver integrated pest management programs that are compatible with regional best management practices and emphasize management for profitability.

2) Recognize regional sources of experience and expertise, then find and secure funding to share this knowledge with other states/regions.

3) Provide a regional information delivery system for extension and producers.

4) Identify training opportunities for extension specialists and agents in cattle pest management.

5) Educate producers about livestock insect pest identification, life cycle, and management (e.g., face fly and others).

6) Provide training on the optimal timing of pest management measures.

INTRODUCTION

In a proactive effort to identify pest management priorities and lay a foundation for future strategies, ranchers, industry representatives, and university specialists from Alaska, Colorado, Idaho, Montana, Nebraska, New Mexico, Utah, Washington, and Wyoming formed a work group and assembled the following document. Members of the group met for two days in June, 2005 in Bozeman, Montana, where they discussed the implications of the Food Quality Protection Act (FQPA) for rangeland beef production in terms of possible pesticide regulatory actions. At the workshop, they drafted a document containing critical research, regulatory, and education needs, individual pest descriptions, and management implications, activity timetables, and efficacy ratings of various management tools against specific pests. The resulting document was reviewed by the work group, including members not present at the meeting. The final result is this comprehensive document addressing pest-specific critical needs for the rangeland beef industry in the western United States.

The Environmental Protection Agency (EPA) is now engaged in the process of re-registering pesticides under the requirements of the FQPA. EPA is examining dietary, ecological, residential, and occupational risks posed by certain pesticides. EPA's regulatory focus on the organophosphate (OP), carbamate, and B2 carcinogen pesticides has created uncertainty as to the future availability of these products. At some point, EPA may propose to modify or cancel some or all uses of these chemicals on rangeland beef production. The regulatory studies that EPA requires registrants to complete may result in some companies voluntarily canceling certain registrations for rangeland beef production.

The Endangered Species Act (ESA) mandates that Federal agencies such as EPA consult with the National Oceanic and Atmospheric Administration (NOAA-Fisheries) if that agency takes an action that may affect threatened or endangered species. Lawsuits have been filed against EPA stating that they failed to complete this consultation process. Threatened and endangered species are located throughout rangeland beef production regions and there are likely to be future EPA decisions that affect pesticide application near endangered species habitat.

The total effects of ESA implementation and FQPA re-registration are yet to be determined. Clearly, however, new pest management strategies and resistance management tactics are needed by the rangeland beef industry.

The document begins by identifying the geographic regions covered in the document, followed by discussion of critical production aspects of rangeland beef production. The remainder of the document is an analysis of pest issues during the production of rangeland beef, organized by pest. Key control measures and their alternatives (current and potential) are discussed. Identification of subregions was discussed and differences between production regions represented are discussed where appropriate.

The use of trade names in this document does not imply endorsement by the work group or any of the organizations represented. Trade names are used as an aid in identifying various products.

Production Regions

Rangeland beef is produced throughout the western United States. This document represents ranchers in Alaska, Colorado, Idaho, Montana, western Nebraska, New Mexico, Utah, Washington, and Wyoming. Within these states, the production areas can be broken down into the following production regions:

- Northern Region: Alaska, northern Colorado (north of Arkansas and Colorado rivers), Idaho, Montana, western Nebraska, northern Utah (north Provo), Washington, and Wyoming.
- Southern Region: southern Colorado (south of Arkansas rivers Colorado rivers), New Mexico, and southern Utah (south of Provo).

Production statistics for the various states can be seen on the tables on the following page.

The focus of this Strategic Plan is restricted to rangeland and pasture-produced beef cattle as opposed to dairy cattle or beef cattle reared in feedlot/confinement situations. While some pest issues are common between rangeland and confinement systems, those issues specific to confinement/crowding will not be included in this document.

Note that while dairy cow management is not included in this Strategic Plan per se, the dairy industry in the western states has implications for rangeland beef production. Older dairy animals go into beef stream when their productive life in the dairy industry is over. Also culled heifer and most bull calves not used for replacement in the dairy operation go into the beef production stream.

The pests addressed in this document include direct insect pests on the animal, internal and external parasites, and disease vectors. Plants impacting rangeland beef cattle production will be covered briefly in the Weeds and Toxic Plants section, with an emphasis on plants species that directly impact the well being of rangeland beef cattle. General weed control in rangeland will not be discussed in this document.

Production Statistics

Beef cattle production statistics for selected states.
Includes states not represented in this PMSP for comparison and perspective.

Geographic Area	Total Operations w/ Beef Cattle	Total Cattle and Calves	Total Operations w/ Cows and Heifers that Calved	Total Value Cattle and Calf Sales ($1,000)	Total Number Cattle and Calves Sales
Colorado	10,801	1,362,219	10,801	708,072	930,352
Idaho	7,902	994,658	7,902	442,210	636,309
Kansas	27,616	3,244,636	27,616	1,290,926	1,829,623
Montana	11,821	2,285,630	11,821	895,832	1,360,235
Nebraska	20,991	4,156,798	20,991	2,306,535	3,076,162
Nevada	1,218	394,046	1,218	178,571	261,942
New Mexico	6,200	1,500,000	6,200	490,893	1,097,340
North Dakota	10,691	1,736,438	10,691	538,008	839,132
South Dakota	15,515	3,204,482	15,515	1,276,279	1,784,757
Utah	5,055	628,574	5,055	251,076	318,600
Washington	9,128	1,100,181	9,927	709,585	1,081,584
Wyoming	4,590	1,182,163	4,590	495,234	674,893

Geographic Area	Farms Selling Calves	Acres Pastureland	Total Number Cows and Heifers that Calved	Rank in US - Total Number Cows and Heifers that Calved	Percent Cows and Heifers that Calved in US
Colorado	5,211	19,139,204	730,052	17	2.2
Idaho	2,215	5,266,718	534,712	23	1.5
Kansas	11,914	17,905,467	1,562,249	6	4.6
Montana	3,628	39,967,394	1,505,191	7	4.5
Nebraska	7,630	23,822,278	1,927,190	4	5.7
Nevada	595	5,288,625	250,728	31	0.7
New Mexico	3,836	39,957,776	790,000	18	1.9
North Dakota	3,384	12,270,083	996,977	12	2.9
South Dakota	5,072	24,377,922	1,721,642	5	5.1
Utah	2,204	9,610,112	364,150	28	1.0
Wyoming	2,061	31,153,855	735,075	16	2.2

Production Issues

All range cattle are normally infected with various species of parasites, including arthropods, worms, and protozoa. Economic estimates in the early 1990s attributed an approximate yearly loss of $600 million to gastrointestinal and pulmonary nematode parasites in beef and dairy cattle, out of a $100 billion per year business in the United States. Approximately $400 million of the $600 million loss occurred in the beef industry, mainly in rangeland beef production. The current estimated loss per animal, including beef and dairy cattle, is between $10 and $20 per animal, when production losses and treatment costs are factored in, according to recent estimates by Dr. Louis Gasbarre, research scientist with the Agricultural Research Service in Beltsville, Maryland. Rangeland beef cattle, considered alone, would be at or above the high end of the scale, because of limited accessibility for diagnostic procedures and treatment. Among rangeland cattle, parasite burdens are usually much lower for those animals on arid range than for those with access to wet meadows or irrigated forage.

Annual or semi-annual worming with an avermectin-type anthelmenthic is considered a desirable husbandry practice. Frequency of treatment depends on local environmental circumstances. Treatment of the breeding herd following fall weaning is often the most cost effective application. A second treatment at the time spring branding is a viable practice in some environments. Producers backgrounding their own calves typically worm calves at weaning.

The beef cattle industry is quite dependent upon the avermectin class of chemicals for a broad range of external and internal pest control. While these treatments can be extremely effective and their registrations should be maintained, new products from different pesticides classes must be developed and registered for resistance management.

Cattle producers are beginning to recognize that approaches to internal and external pest management must be integrated. Internal parasite management is widespread among western producers and there is interaction between the treatments for internal and external livestock pests. Improved knowledge of the interaction between internal and external parasites and treatments for both will be necessary to develop guidelines for producers.

Pest management in livestock obviously presents a logistical challenge when compared to pest management in traditional “crops” in that livestock are ambulatory. When livestock are on open rangeland, this challenge is significantly greater than when the animals are confined to feedlots or even pastures. Pest management tactics requiring any sort of contact between rangeland animals and humans must take place during the times the cattle are rounded up to be “worked” (see Glossary). Range cattle are typically worked twice per year: at/just prior to turnout (to summer pastures) in spring/early summer, and at/just after roundup in late summer/early fall (moving back to winter range/pastures).

In the Northern Region, cattle normally remain on open range designated for summer grazing from turnout (May/June) until early/mid fall (August/September/early October), after which they are placed in fenced range/pasture or on crop aftermath near ranch headquarters until ground forage is depleted. During late fall/winter, supplemental hay/grain is usually provided for maintenance of cows, replacement heifers, bulls, and weaned calves. However, in several states, winter grazing on desert ranges is an important part of the cycle. In this system, cattle are rarely fed supplemental feeds except during calving.

Range cattle in the Southern Region are affected by the same pest species as those in the Northern Region, however timing, severity of infection, and approach to management are often considerably different. In the Southern Region most breeding animals are maintained on similar rangeland or pasture throughout the year. Operations that are integrated with crop production may winter cattle on wheat pasture, alfalfa stubble, corn, or grain sorghum stalks if available. In general, calving occurs in the spring and weaning in the fall. An increasing number of producers are calving in the fall and year-round calving occurs on some operations.

Producers who export cattle to Canada must contend with international regulations. Bovine spongiform encephalopathy (BSE) receives the most media attention and periodically closes shipment of cattle from the United States to Canada entirely. When the border is open, producers must have their export cattle tested for blue tongue disease prior to shipment. Blue tongue is an insect-vectored disease primarily spread by *Culicoides sonorensis,* a biting midge or gnat that is ubiquitous in Montana at sites less than 4,000 feet in elevation, east of the Continental Divide. Although evidence by mosquito trapping is lacking, it is suspected they are present west of the Continental Divide as well. *C. sonorensis* generally have little or no direct impact on cattle. Although the females require a blood meal, the populations of this species are rarely high enough to change cattle behavior. It is thought that three feedings are necessary for the pathogen to complete the extrinsic incubation period in the fly. Therefore, transmission of the BT virus in Montana is likely a rare event because less than 1% of the insects take a third blood meal. This statement is supported by cattle serology that was conducted in 2002 and 2003 on Montana cattle and by the data that indicates that Montana flies are refractory to infection by oral feeding of the virus.

Research and Extension Crisis

A theme that emerged and was reiterated throughout the workshop and during subsequent reviews of this document by the work group was an extreme lack of extension educators available to address the needs of beef cattle producers now and in the future. It is not an exaggeration to say that, due to budget cuts and attrition through to aging and retirement, there is a crisis in extension information availability. Specialists and agents with expertise in veterinary entomology and other aspects of beef cattle pest management and production are few and far between.

For example, the insect-vectored diseases West Nile Virus and vesicular stomatitis are of increasing concern throughout the west. Yet currently, there is only one faculty-level veterinary entomologist in the entire region. Individuals with training and expertise are needed not only to perform applied research, but also to transmit the latest information to county agents, regulatory agencies, commodity groups, and producers. Beyond these two recognized diseases, other vector-borne threats such as Rift Valley fever and African horse sickness have the potential to devastate the U.S. livestock industry if introduced. With global climate change and bioterrorism, introduction and establishment of such diseases is a genuine threat.

WEEDS AND TOXIC PLANTS

Most weeds and toxic/poisonous plants of concern in rangeland cattle production are forbs (broadleaf plants). A weed can be defined as any plant growing where it is not wanted, particularly those with detrimental impacts on the production system. Weeds are often introduced (foreign, non-native) plants and can be invasive to both native and cultivated habitats. Poisonous plants can be either native or foreign; most often they are not invasive.

Weeds affect livestock by reducing production efficiency and causing health problems. They can reduce the available forage by outcompeting it, gradually replacing the higher quality forage plants with less palatable and sometimes toxic plants. Leafy spurge and knapweed have been known to replace more than 90% of the previously existing plants. These two weeds are among the greatest concerns to beef cattle production in the west and biodiversity of native rangelands.

Although herbicides are neither directly nor indirectly applied to livestock, the loss of herbicides for weed control in forages or pastures may have significant implications for beef production. This document does not attempt a thorough discussion of the role of herbicides in pastures, forages, and rangeland. This is the role of current and future crop profiles and PMSPs for those commodities. We present below only a summary of some of the weeds which are the more important causative factors in poor herd health or production efficiency.

Weeds

All weeds reduce forage quality to some extent. By their very nature most weeds grow and mature more quickly than preferred forage species. Although some weeds, such as **pigweeds** *(Amaranthus, Axyris, and Cycloloma* spp.) and **dandelions** (*Taraxacum* spp.) are touted as very palatable forage, their protein content is considerably less than that of a clover or alfalfa stand. Such weeds, when found in great numbers, will reduce the production efficiency of livestock that feed on higher quality forage.

Leafy spurge *(Euphorbia esula)* is a very aggressive weed that is unpalatable to cattle. Native to Eurasia, it is highly invasive in fertile soil including riparian areas and hay fields. It is among the most pervasive weeds across the west and is causing the greatest loss of grazeable forage, taking over pasture and rangeland. It is common to abundant in Colorado, Montana, and Wyoming.

Knapweeds are more common on drier rangeland areas and river/creek beds and gravel bars. Three species in this group, spotted knapweed *(Centaurea stoebe),* Russian knapweed *(Centaurea repens)*, and diffuse knapweed *(Centaurea diffusa),* occupy millions of acres across the west. They are found from the ranges of the far western states throughout the semi-arid region and are locally abundant to dominant in areas of Idaho and western Montana.

A grassy weed of major concern is **cheatgrass** *(Bromus tectorum)*, an annual bromegrass. This plant is palatable forage early in the growth year but quickly dries to poor forage. It is extremely competitive with perennial grasses in the arid areas of Idaho, Utah, and Washington. With the recent drought it has spread in Colorado, Montana, and Wyoming. This invasive plant not only competes with native and introduced forages grazed by beef cattle but is extremely flammable as it dries out and encourages wild fires that suppress native communities.

Thistles including **Canada thistle** *(Cirsium arvense),* **musk thistle** *(Carduus nutans),* **bull thistle** *(Cirsium vulgare),* and other weeds that produce sharp spines or burrs significantly reduce the palatability of available forage and may reduce uptake by injuring the grazing cattle's tongues and mouths.

Other weed species of growing concern include **yellow star thistle** *(Centaurea solstitialis)*, **purple loosestrife** *(Lythrum salicaria)*, and **toadflaxes** *(Linaria* spp.) These species are locally prevalent but not as widespread as the aforementioned weeds.

Toxic Plants

Hundreds of toxic and potentially poisonous plants are present in the west. Toxicity may vary by location, time of year, and certain conditions. A few deserve special mention due to prevalence and consistent toxicity.

More than 80% of annual cattle poisonings can be attributed to **tall larkspur** *(Delphinium barbeyi),* a native plant endemic in moist rangelands, grazable forests, swales, and draws across the west. It is most toxic in the spring to mid-summer, gradually declining in toxicity from bloom to maturity. Tall larkspur is quite palatable at most stages of growth and stockmen have generally managed to reduce poisonings by avoiding areas with large stands early in the grazing season, delaying use of those areas until later in the season when the risk is lower. **Low larkspur** (*D. nuttallianum*) is a cousin to tall larkspur. It is common on ridge tops across the rangeland areas of the west. It is quite toxic to cattle, but is relatively unpalatable.

Locoweed is a name given to a group of approximately 200 species of poisonous plants. The various species are common in many western states and most are readily consumed by range cattle. Management requires knowing the historical risk associated with the infested area and when possible avoiding use of those areas. Locoweed poisoning is generally most prevalent in the spring months before the better quality forages are available. Higher than normal early spring moisture contributes to severity of the problem.

Snakeweed *(Gutierrezia* spp.), also called broom weed, occurs in high populations in New Mexico and Southern Colorado. Millions of acres are infested. In many areas, it is the most serious competitor to desirable grasses and forbs. It is capable of completely replacing grass under the right circumstances. When grazed in sufficient amounts, it

may cause abortion in pregnant cattle. It can be killed by herbicide treatment, but cost is generally prohibitive.

Whorled milkweed *(Asclepias verticillata),* **poison hemlock** *(Asclepias verticillata),* and **water hemlock** *(Cicuta* spp.) are plants that frequently cause livestock losses in meadow and hay land. These plants are common to ditch banks and moist areas that are prevalent at the borders of hay lands across the west. They are native plants and are quite toxic. Producers avoid grazing their cattle in areas with concentrations of these plants until after frost when the plants are less palatable. Whorled milkweed can be treated with herbicide but hemlock is often too dispersed and widespread for herbicide treatment to be effective.

Nitrate poisoning is another plant-related type of livestock poisoning. It is not specific to any one plant, but occurs when plants accumulate nitrates in their leaves and stems. This most often occurs when plants are grown in highly fertile environments such as fertilized cropland or extended livestock concentration areas with accumulated manure. Therefore, it rarely occurs on rangeland. Moisture stress in plants accentuates nitrate accumulation tremendously so this toxicity occurs most prominently during drought or in droughty areas. Freezing temperatures also increase nitrate accumulation.

Partial List of Toxic and/or Invasive Plants

bracken fern *(Pteridium aquilinum)*
bull nettles *(Solanum* spp*.)*
buttercups *(Ranunculus* spp*.)*
cheatgrass *(Bromus tectorum)*, invasive
chokecherry *(Prunus virginiana)*
cocklebur *(Xanthium* spp.*)*
death camas *(Zigadenus* spp*.)*
foxtail *(Alopecurus* spp.), invasive
foxtail barley *(Hordeum jubatum),* invasive
horsetail *(Equisetum arvense)*
jimsonweed *(Datura stramonium)* especially in Southern Region
johnsongrass *(Sorghum* spp.)
knapweed *(Centaurea* spp.), invasive
larkspur *(Delphinium* spp.)
leafy spurge *(Euphorbia esula),* invasive
locoweeds (various)
lupines *(Lupinus* spp.)
mustards *(Brassica* spp.)
nightshades *(Solanum* spp.)
poison hemlock *(Asclepias verticillata)*
rubberweed *(Hymenoxys* spp.)
saltlover *(Halogeton)*
snakeweed *(Gutierrezia* spp.), especially in Southern Region
water hemlock *(Cicuta maculata)*
yellow star thistle *(Centaurea solstitialis)*

ARTHROPOD PESTS

This section begins with a list of chemical controls and related terms. Following this list is a pest-by-pest discussion of the arthropods most prevalent and most detrimental to rangeland beef production in the region. The pest-by-pest section includes information on production impacts (where known), cultural and biological controls (where applicable), and chemical controls. It also includes research, regulatory, and educational priorities established by the work group for each pest.

Active Ingredients, Terms, and Comments

- Amitraz (Taktic) – Used for lice, mite, and tick control, this product is formulated as a spray. It represents a new mode of action, the formamidine insecticide group.
- Anthelminthics – From the term anti-helminthic, where “helminth” means worm, these compounds are dewormers.
- Avermectins – These macrocyclic lactones have broad-spectrum efficacy on both internal and external pests, but have lower mammalian toxicity than some alternatives. Derived from soil microorganisms of the genus *Streptomyces*, they are easy to use via oral, parenteral, or pour-on methods. The avermectins used commercially are ivermectin, abamectin, doramectin, eprinomectin, and selamectin. All have a broad efficacy at low dosage against more than 300 species of nematode and arthropod parasites.
- *Bacillus sphaericus* (VectoLex CG and WDG) – Microbial larvicide used for mosquito control.
- *Bacillus thuringiensis israelensis* (Bti, Aquabac, Teknar, VectoBac, and LarvX) – Microbial larvicide used for mosquito and black fly control.
- Beta-cyfluthrin. See cyfluthrin.
- Chlorpyrifos – Organophosphate used for face fly and horn fly control, formulated in ear tags.
- Coumaphos (Co-Ral) – Not labeled for use on animals younger than three months, this insecticide is formulated as ear tag, spray, dip, ready-to-use dustbags, or emulsifiable compound for back rubber application. As a dip, Co-Ral is used to control ticks in cattle coming across the border. Ear tag and dust applications are employed predominantly for horn and face fly control as well as for lice control. For controlling grubs, this product has largely been replaced with avermectin.
- Cyfluthrin (CyLence, Cutter Gold) – Forumulated as a pour-on (CyLence) and as an ear tag (Cutter Gold), this product’s primary activity is fly (horn and face) and tick control. Two tags per animal/season is maximum rate and calves less than 3 months old are not tagged. There are resistance issues with this insecticide.
- Diazinon (Terminator, Patriot, Optimizer) – Formulated for ear tags, the recommended application rate is two tags per animal/season, however many producers apply only one tag to calves. Good on lice, horn fly, and face fly control; higher concentrations are more effective than lower concentrations.
- Diflubenzuron (Dimilin) – An insect growth regulator (IGR) used as a pour-on for lice and fly control.

- Doramectin (Dectomax) – A broad-spectrum endectocide used for both internal and external pests including cattle lice, grubs, eyeworms, lungworms, mites, and roundworms. While effective, this product is costly for horn fly control. May be applied by injection or as a pour-on, but primarily used as a pour-on. May be used on all sizes and ages of cattle, but commonly used on animals younger than 20 months. The product has a 35-day treatment-to-slaughter interval.
- Endectocide – This term refers to compounds used in the treatment and control of internal (endo-) and external (ecto-) parasites.
- Enterics – This term refers to feed additives benefiting the intestinal tract, of which phenothiozine is the most common.
- Eprinomectin (Eprinex) – Effectiveness and use is similar to doramectin. Costly for horn fly control, not as effective as some alternatives on lice. Not used on calves under 8 weeks of age.
- Ethion (Commando) – Formulated as an ear tag, the application rate is two tags per animal. Not used much for horn fly control, as it is not very effective.
- Fenvalerate (Ectrin) – Formulated as ear tag, application rate is two tags per animal. Used for horn and face flies, but not recommended because of resistance development in horn fly. Has been replaced by permethrin.
- Flucythrinate (Guardian) – A pyrethroid formulated in ear tags for horn fly control. Also formulated as a spray.
- Ivermectin (Ivomec) – Used as an injection or pour-on for cattle grub control, this avermectin has a treatment-to-slaughter interval of 35 to 48 days. Pour-on formulation cannot be applied if rain is expected to wet cattle within six hours after treatment.
- Lambda-cyhalothrin (Saber) – Used as a pour-on for cattle lice, as ear tags for horn fly and face fly.
- Mosquito larvicide oils (Bonide, BVA2, and Golden Bear-1111/GB-1111) – Used for mosquito larvae control. Applied to surface of water.
- Moxidectin (Cydectin) – This endecticide is used for cattle grub and lice management. Formulated as pour-on or injection. No treatment-to-slaughter interval.
- Permethrin (Actroban, Boss, Ectiban, Permectrin) – This pyrethroid insecticide can be used as an ear tag, pour-on, back rubber, or spray. While somewhat effective for horn flies, face flies, and lice, it is not strongly recommended due to resistance concerns. Use rate is two ear tags per animal.
- Phosmet (Del-Phos) – Formulated as a back rubber and spray for horn fly control. Limited availability.
- Pirimiphos-methyl (Dominator, Double Barrel) – Formulated as an ear tag, two tags per animal, for horn fly management. Not used very much, as availability is a problem.
- Pyrethrins – Natural product for fly control. Formulated as a spray.
- Spinosad (Elector) – Pour-on formulation. Good on lice, some efficacy on horn fly.
- Stirofos (Rabon) – Little used in rangeland, this product is more commonly used in feedlot settings. Formulated as a dust, back rubber, and mineral (feed) additive for horn fly and face fly control. Horn fly has exhibited resistance to this active ingredient. Cannot be applied to Brahman cattle or to calves less than six months old and should not be used more frequently than every 10 days.

- Systemic drugs – Any drugs absorbed into, and effective within, most organs of the body, administered by oral, parenteral, and/or pour-on methods.
- Temephos (Abate) – An organophosphate used for mosquito control.
- Tetrachlorvinphos (Rabon, Prozap, Ravap, Sweetlix) – Organophosphate available as a spray, dust, and oral (block) for fly and lice control.
- Zeta-cypermethrin (Python) – Formulated as dust bag and ear tag for control of horn fly and face fly as well as mosquito protection. Two tags per animal are recommended for five-month control. No treatment-to-slaughter interval. Cannot be applied to calves less than three months old. While there are resistance issues with this insecticide, it is better in this regard than some other products.

Horn Fly, *Haematobia irritans*

The horn fly is one of the most important and economically damaging pests of range cattle in the United States. Production losses from this pest are estimated at 10-15 lbs/head on weaning weights of infested calves and stockers. If left untreated, horn fly populations will reach several hundred per animal. Cattle infested at this level will usually bunch, fail to graze properly and expend considerable energy in tail switching, head throwing, and stamping in attempt to dislodge flies.

Two factors drive the local importance and the economics of horn flies in an area: the region (north or south) and the elevation. In the Southern Region, horn flies have a longer period of activity with continuous production of generations than in the Northern Region. Hot, dry weather will exacerbate horn fly problems; cool, wet years are less problematic. In the Southern Region, horn fly populations may reach economic levels in March and require continuous treatment through October, whereas in the Northern Region treatment levels may not be reached until mid-summer or even late summer. At elevations of over 6500 feet, horn fly populations do not surpass economic levels.

Cultural Controls
No known cultural methods reduce horn fly numbers. Rotational grazing systems have been purported to control horn fly populations, but there is little research-based evidence to support this. Economic thresholds could be used in some cases to determine whether treatment was warranted, but as a practical matter herd history must be used in most cases.

Biological Controls
Some predators and pupal parasites reduce horn fly numbers, but not enough to control them. It would not be practical to rear and release these predators or parasites.

Chemical Controls
Chemical insecticide application is the primary tactic for control of horn flies. Application methods include self-treatment via oilers, dustbags, or ear tags as well as spray and pour-on products. Ear tags are often used in rangeland. Since they must be applied when the animals are handled, they are applied preventatively to cows, calves, and

stockers based on the previous year's experience. Insecticide activity on today's ear tags is only about 60 days, however, so this method must be supplemented with dustbags, oilers, or other treatment. Original (pyrethroid) ear tags lasted 5 months but resistance developed.

Sprays and pour-on insecticides will control horn flies for 2 to 3 weeks after application and therefore theoretically could be used when ear tags start to decline in efficacy. In practice, using sprays or pour-ons for seasonal control is not practical for range cattle producers because of the difficulty in rounding up cattle for treatment. The stress of handling the cattle might offset treatment gains.

Rotation of pesticide classes is recommended, but as a practical matter ear tags are generally left on cattle. Cross-resistance between classes has also been detected among products historically used. For example, methoxychlor is an organochlorine insecticide formerly registered for horn fly control that exhibited cross-resistance with permethrin, a pyrethroid. To delay or prevent the development of resistance in horn fly populations, extension entomologists have developed a set of recommendations for using today's ear tags with the newer insecticides:

- Delay tagging animals until horn fly numbers are at an economic level (200+ per animal).
- Rotate insecticides at least yearly, an organophosphate with a pyrethroid.
- Remove tags from the animals when they become ineffective.
- Provide alternate treatment methods when ear tag efficacy declines.
- Treat only animals in a weight-gain mode (i.e., cows with calves and yearlings).
- Remove ear tags at the end of the fly season.

The insecticides recommended for control of horn flies will also control face flies (see *Active Ingredients, Terms, and Comments*, above).

Critical Needs for Horn Fly Management in Rangeland Beef

Research

- Maintain and increase numbers of research faculty that can generate livestock beef management information.
- Investigate rotational grazing systems' impact on horn fly management.
- Research biological systems such as dung beetles as tool for pasture management, nutrient recycling.
- Investigate improved management systems including, chemical, cultural, and biological for horn flies.
- Determine the factors (genetic and environmental) in certain animals that contribute to their apparent resistance or repellency to horn fly.

Regulatory

- Maintain registrations for diazinon and coumaphos.
- Evaluate new chemistries for effectiveness of horn fly control.

- Retain chemical classes for rotation to prevent resistance development.

Education

- Increase numbers of university extension specialists and agents with expertise in veterinary entomology and beef production who can disseminate information to rangeland cattle producers and communicate producers' needs to researchers and regulators.
- Education regulators about horn fly management and its challenges.
- Develop consistent and up-to-date recommendations and information.
- Form public/private partnership for information transfer; include veterinary practitioners, veterinary sales professionals, and county agents.
- Educate producers on importance of planning ahead on choice of controls and active ingredient, as opposed to defaulting to what worked the previous year. Planning should be consistent and mindful of resistance management.
- Involve extension with veterinary continuing education programs and with industry-sponsored education meetings.
- Recognize regional sources of information with experience and expertise.

Face Fly, *Musca autumnalis*

Face fly is important for its role in eye disease transmission. Feeding by face flies injures the tissue around the eyes, which causes tearing and provides an avenue for the entrance of eye pathogens such as *Moraxella bovis*, one of the causative agents of pinkeye.

This pest is purported to be associated with river valleys and drainages. Face fly became a major problem beginning in 1952 when it spread beyond its historic range and, for a time, had significant impacts on cattle production in the West. Over time, and with the reduction in irrigated pastures in the western United States, face flies have decreased in economic significance. Today, face fly is considered to be an occasional problem, with recent flare-ups reported in rangeland in southern Utah and in Washington. Wyoming, New Mexico, and Idaho report no current problems with this pest. In those locations where face flies continue to be problematic, all production stages (cows, calves, stockers) are impacted.

Cultural Controls

None. Various traps have been studied but none are currently in use.

Biological Controls

Nebraska researchers have studied a nematode that destroys female face fly ovaries and a pupal parasite that kills face fly, but neither proved effective enough to be employed for control.

Chemical Controls

The insecticides recommended for control of horn flies will also control face flies (see *Active Ingredients, Terms, and Comments*, above).

Critical Needs for Face Fly Management in Rangeland Beef

Research

- Maintain and increase numbers of research faculty that can generate livestock beef management information.
- Survey distribution of face fly populations, determine management guidelines, and develop recommendations.
- Develop monitoring program including effective traps and trapping systems for face flies.

Regulatory

- Maintain registration for control on ear tags.

Education

- Increase numbers of university extension specialists and agents with expertise in veterinary entomology and beef production who can disseminate information to rangeland cattle producers and communicate producers' needs to researchers and regulators.
- Conduct more extension education on both face flies and horn flies.
- Educate ranchers about fly identification to ensure that management is directed at the right pest.

Stable Fly (*Stomoxys calcitrans*)

Stable flies have historically been pests of confined cattle at dairies or feedlots, but over the past 15 to 20 years they have been noted as pests of range cattle as well. Some blame the emergence of the pest in rangeland on the widespread use of the big, round hay bale, which appears to be a favored breeding site for this fly. Stable fly seems to be expanding in rangeland within the western region. Presently, they are most prevalent in the eastern part of the region.

Stable fly is a very damaging pest, with losses of 0.4 lbs/day typical on infested rangeland cattle. These flies feed primarily on the front legs of cattle, causing cattle to bunch up in an attempt to protect their front legs. Weight losses occur from bunching, which causes (or increases) heat stress and from annoyance behaviors such as tail switching, hoof stamping, and head movement. These behaviors are attempts to dislodge the flies, which expend caloric energy and contribute to animal weight loss.

Cultural Controls

None known other than, perhaps, elimination of big, round bales.

Biological Controls

Considerable research has been conducted on controlling stable flies with parasites. Small wasps (pteromalids) parasitize stable and house fly pupae. While several commercial insectaries sell these species and some researchers claim success with inundative releases, research conducted at feedlots and dairies with confined cattle found that the wasps did not provide adequate control at release rates considerably higher than recommended and that they were more expensive than standard control methods.

Chemical Controls

No controls for stable fly are currently available for rangeland situations. Control of stable flies on range or pasture cattle is difficult. In Nebraska studies, cattle had to be sprayed three times per week to keep stable flies at levels that did not impact grazing steer weight gains.

Critical Needs for Stable Fly Management in Rangeland

Research

- Maintain and increase numbers of research faculty that can generate livestock beef management information.
- Quantify scope of stable fly as an emerging pest in western rangeland and pastures.
- Develop new control measures (biological, cultural, and chemical) and evaluate their effectiveness.
- Determine refugia areas and movement within rangeland.
- Determine impact of large, round bale presence on stable fly populations.
- Develop methods for monitoring stable flies in rangeland. Preference for stock tanks may offer trapping/monitoring program and management solution.
- Develop application methods and technologies for stable fly management.

Regulatory

- Register chemical controls for rangeland cattle to control stable flies.
- Adjust labels as necessary for efficacy on this pest in rangeland production systems.
- Register biological control agents for stable fly management.

Education

- Increase numbers of university extension specialists and agents with expertise in veterinary entomology and beef production who can disseminate information to rangeland cattle producers and communicate producers' needs to researchers and regulators.
- Include stable flies in education/outreach programs.
- Develop consistent and up-to-date recommendations and information.
- Form a public/private partnership for information transfer; include veterinary practitioners, veterinary sales professionals, and county agents.
- Involve extension with veterinary continuing education programs and with industry-sponsored education meetings.

- Recognize regional sources of information with experience and expertise.
- Educate producers about implementation of biological controls for stable fly.

Black Flies, *Simulium* spp.

Black flies, also called buffalo gnats or turkey gnats, occur throughout the intermountain west wherever there is running water. They create serious but localized problems in Alaska, Idaho, New Mexico, Oregon, Washington, and Wyoming. Observations in southern Idaho suggest that adult black flies emerge about every two weeks during the summer and infestations sometimes persist into early fall.

While there are no scientific studies relating numbers of black flies to animal losses, there have been anecdotal reports of livestock deaths from black fly infestations, including asphyxiation of calves from inhaling too many of the flies. The flies, particularly those that feed in the ears, are a definite annoyance to rangeland cattle, leading to evasion behaviors that can impact weight gain and thriftiness. Black flies also vector vesicular stomatitis and nematodes that cause a filarial dermatitis.

Cultural Controls
Cultural control is beyond the capability of an individual landowner, as adult black flies readily disperse several miles from their larval breeding habitats. Long-term suppression ultimately depends on reducing larval populations where they breed—in streams, rivers, irrigation canals, and other running waters—and must be coordinated on a region-wide basis.

Biological Controls
No known biological controls.

Chemical Controls
Chemical control is partially effective against black flies, providing short-term relief from the adult flies' biting, but even multiple applications of insecticides cannot eliminate black fly problems completely. Insecticide sprays to cattle for other livestock insects may provide some reduction in black fly numbers (see *Active Ingredients, Terms, and Comments*, above). Each of the available products has relatively short residual killing action, lasting for several days, and so must be applied repeatedly during the biting season.

When black fly infestations are heavy, insecticide treatment must cover most of the animal's body. Insecticide concentrates or ready-to-use solutions applied around the head, ears, back, tail, and legs can provide relief. Topical, spot-on, treatments with newer pyrethroid insecticides are promising.

Some products listed also can be used to charge back rubbers, but experience in Idaho suggests that back rubbers only are effective at low black fly populations. Forced-used back rubber applicators placed at entrances to water or mineral sources are more

effective than free-use applicators. Sprays applied around corrals, feedlots, and similar livestock premises can aid in black fly control by killing adults as they rest on building surfaces, but this has limited utility in rangeland production.

BTi is used in some areas for larval control. While some users report excellent results, the economic benefit for rangeland producers is not known.

Critical Needs for Black Fly Management in Rangeland Beef

Research

- Maintain and increase numbers of research faculty that can generate livestock beef management information.
- Determine the breeding sites for black flies. Biological studies of the species are needed to determine appropriate control.
- Develop new control measures (biological, cultural, or chemical) and evaluate their effectiveness.
- Determine the efficacy of new insecticide products on black fly; e.g., zeta-cypermethrin (Python) ear tags are being evaluated.
- Quantify economic impact of black fly on rangeland cattle production.
- Study economics of black fly control.
- Investigate biological control systems (including fish species) for control of black flies.
- Determine how horn fly and face fly control programs impact black flies.

Regulatory

- Consider adding black flies to label of ear tag with diazinon (Patriot) if active ingredient is determined to be effective on black flies.
- Expand other labels to include black flies where appropriate (e.g., zeta-cypermethrin (Python) ear tags; spot-applied pyrethroids).
- Link with public health agencies to coordinate controls.

Education

- Increase numbers of university extension specialists and agents with expertise in veterinary entomology and beef production who can disseminate information to rangeland cattle producers and communicate producers' needs to researchers and regulators.
- Awareness and understanding of black fly impacts and controls need to be included in education/outreach programs.
- Develop consistent and up-to-date recommendations and information.
- Develop public/private partnership for information transfer; include veterinary practitioners, veterinary sales professionals, and county agents.
- Involve extension with veterinary continuing education programs and with industry-sponsored education meetings.
- Recognize regional sources of information with experience and expertise.
- Educate producers about biological controls for black fly.
- Enhance delivery of research findings.

- Develop integrated approaches to information transfer.
- Disseminate information on integrated management systems for black fly control.
- Establish livestock entomology work group.
- Educate nonagricultural audiences at the urban/rural interface about insect pests: human annoyance, West Nile Virus.
- Develop regional publications that could be distributed to a wider audience.

Biting Gnats/Midges, *Culicoides* spp.

Culicoides species occur throughout United States below 7,000 ft in elevation. These members of the Ceratopogonidae family go by numerous names including “punkies” and “no-see-ums.” The primary reason for these pests’ importance is that they vector blue tongue virus (see discussion of blue tongue virus and *Culicoides sonorensis* vector in the *Production Issues* section toward the beginning of this document). There is no economic loss data in the literature concerning *Culicoides* except losses due to blue tongue virus.

Blue tongue is a quarantine issue with shipping cattle and semen to Canada and South America. It is also a disease of wildlife therefore a concern in wilderness areas and in rangeland/wilderness adjacency. In livestock, blue tongue virus is a greater problem for sheep than cattle, but cows or heifers not previously exposed to the virus may abort their calves.

The USDA-ARS laboratory in Laramie, Wyoming has conducted research into vaccines against blue tongue virus. There is not much data on the economics of treatment or the timing of control measures.

Cultural Controls
Draining *Culicoides* breeding areas can help control the pests’ spread. Cattle defecating in watering sites can enrich water to the extent that watering sites become breeding areas for *Culicoides*, therefore intensive grazing programs may increase *Culicoides* populations. Moving cattle to new locations may help.

Biological Controls
Lack of data on breeding habitats and biology of *Culicoides* spp. has prevented the exploration of biocontrol agents.

Chemical Controls
Insecticides are generally not used for control of *Culicoides*, but the animal sprays listed for other livestock insects would provide at least some degree of control. (See *Active Ingredients, Terms, and Comments*, above.)

Critical Needs for *Culcoides* Management in Rangeland Beef

Research

- Maintain and increase numbers of research faculty that can generate livestock beef management information.
- Determine the economics and timing of *Culicoides* management.
- Investigate the development of vaccines.
- Investigate the impact of intensive grazing programs on *Culicoides*, especially on populations around watering holes.
- Study impact of water management on *Culicoides* management.
- Determine the geographic distribution of these species.
- Determine whether *Culicoides* impact cattle directly.
- Identify *Culicoides* breeding areas.

Regulatory

- Streamline shipment of cattle into blue-tongue-free areas (Canada and other export markets).
- Maintain current pesticide registrations and add labels where appropriate.

Education

- Increase numbers of university extension specialists and agents with expertise in veterinary entomology and beef production who can disseminate information to rangeland cattle producers and communicate producers' needs to researchers and regulators.
- Develop consistent and up-to-date recommendations and information.
- Develop public/private partnership for information transfer; include veterinary practitioners, veterinary sales professionals, and county agents.
- Involve extension with veterinary continuing education programs and with industry-sponsored education meetings.
- Recognize regional sources of information for shared experience and expertise.
- Deliver research findings.
- Integrate approaches to information transfer.
- Integrate management systems for *Culicoides* control

Mosquitoes, various, incl. *Ochlerotatus* spp., *Aedes* spp., *Culex* spp.

Mosquitoes are nuisance pests that impact cattle weight gain, behavior, and condition in all production stages. Cattle under heavy mosquito attack will bunch and spend time fighting mosquitoes instead of grazing. Weight gain reductions of 0.04 kg/day/steer have been documented with heavy mosquito infestations. Besides contributing directly to cattle decline, mosquitoes are important in disease transmission.

Mosquitoes can reproduce rapidly using transient water resources. They occur everywhere including western rangeland and pastures. There are many species adapted to different environments.

Cultural Controls

Water management is important in mosquito management. Earthen tanks and float-activated watering systems favor mosquito breeding; over-irrigation of meadows will increase mosquito populations. Pasture improvement (e.g., reducing standing water and low spots) reduces mosquito problems. Moving cattle away from mosquito-infested areas, if possible, can help. Placing cattle in shelters in the evening can help, as this is when most mosquito species are the most active, but this of course is impractical in most rangeland situations. Additionally, one of the major mosquito pests of cattle, *Aedes vexans*, is a daytime feeder.

Biological Controls
Some mosquito-feeding fish are efficient, but they are not practical for floodwater mosquitoes and they do not survive winter in northern climates.

Chemical Controls
The bacterium *Bacillus thuringiensis* var. *israelensis* is formulated for mosquito control by several companies. Aerial applications of malathion can be used for adult mosquito control. There are several larvicides that may be used for larval mosquito control. Some ear tags significantly reduce mosquito populations, but handling cattle and timing is not conducive to typical management practices. (See *Active Ingredients, Terms, and Comments*, above.)

Critical Needs for Mosquito Management in Rangeland Beef

Research
- Maintain and increase numbers of research faculty that can generate livestock beef management information.
- Quantify economic impact of mosquito controls on rangeland beef cattle production.
- Identify new products that are effective for adult and larvae control.
- Research placement, timing, and efficacy of new products for mosquito adult and larvae control.

Regulatory
- Maintain current registrations.
- Register new products that are effective for adult and larval control.
- Identify and work with mosquito control districts.

Education
- Increase numbers of university extension specialists and agents with expertise in veterinary entomology and beef production who can disseminate information to rangeland cattle producers and communicate producers' needs to researchers and regulators.
- Provide information on efficient irrigation management: amount and timing.
- Coordinate between public health officials and ranchers to control mosquitoes.
- Manage irrigation canals and ditches.
- Integrate approaches to mosquito management.

- Provide mosquito control education to land managers.
- Improve targeting of mosquito control measures.
- Assist individuals in understanding and utilizing new technologies to control mosquitoes.
- Educate nonagricultural audiences at the urban/rural interface about insect pests: human annoyance, West Nile Virus.

Tabanids/Horse and Deer Flies, various spp.

Tabanid species occur seasonally throughout the region. They have localized impact on cattle production. Adult feeding causes bleeding from feeding cuts that is significant when flies are numerous. Tabanids are aquatic insects, therefore most species must have moist soil for immature stages to develop. The pests spend little time on the animals, so they difficult to control.

Data on the economics of tabanid attacks on cattle are difficult to obtain because of the pests' mobility and lack of a good control method. Cattle under attack will seek water or shade and sometimes run trying to escape the flies. The most serious economic impact on cattle is the transmission of anaplasmosis, a bacterial disease of cattle once classified as a protozoan. Tabanids are also responsible for mechanical vectoring of rickettsial disease.

Cultural Controls
Mowing vegetation around the edges of ponds has been shown to be effective in reducing numbers of at least one tabanid species in South Dakota. Spraying tree lines surrounding pastures has been shown to have some impact in the Southern Region. Use of traps has been investigated with marginal success.

Chemical Controls
Insecticide sprays recommended for control of other livestock insect pests can also provide short-term tabanid control.

Critical Needs for Tabanid Management in Rangeland

Research
- Maintain and increase numbers of research faculty that can generate livestock beef management information.
- Examine new products and new technologies for control.
- Examine repellents for practicality and efficacy.
- Determine benefit of tabanid control.

Regulatory
- None identified.

Education

- Increase numbers of university extension specialists and agents with expertise in veterinary entomology and beef production who can disseminate information to rangeland cattle producers and communicate producers' needs to researchers and regulators.
- Develop consistent and up-to-date recommendations and information.
- Recognize regional sources of information with experience and expertise.
- Deliver research findings.

Cattle Grub, *Hypoderma lineatum, H. bovis*

Cattle grubs (the larvae of heel flies) occur throughout the region but have been well controlled and even eradicated from some local areas. When present, these pests cause cosmetic damage to hides, create an opportunity for secondary infections, and can cause bloating and paralysis in infested cattle. Economic consequences occur because the damaged hides are less marketable and the damaged meat must be trimmed, resulting in dockage.

Heel flies, which have no mouthparts, die after mating and depositing their eggs on the hair of cattle, typically on the animal's legs. When the eggs hatch, the larvae crawl down the hair to the skin, which they penetrate. The common cattle grub *(H. lineatum)* emerges in late February or early March, and the northern grub *(H. bovis)* emerges about a month later.

It is this life stage, the larva or grub stage, when the pest does its damage to cattle. After penetrating the skin, they crawl around subcutaneously, growing and creating various types of damage. The dying grubs release a toxin, which causes swelling at the site of death. When this occurs in the esophageal area, it can cause bloating; when it occurs in the central nerve canal, it can cause partial paralysis in the hindquarters. Grub presence also contributes to reduced wait gain. The most common impact on cattle is when the grubs settle beneath the hide on the back of the animal, where they complete their larval development in cysts known as "warbles." A breathing hole is cut in the skin from inside the warble, which mars the hide and creates an opportunity for secondary infections.

When the larvae are ready to pupate, they emerge through the breathing hole. The pupae fall to the ground, where they seek shelter in clumps of vegetation until they emerge as adults and lay eggs again.

Cultural and Biological Controls
Cultural and biological controls are not employed for this pest.

Chemical Controls
Systemic avermectin insecticides have been very effective in controlling these pests, virtually eradicating them in some localized areas (e.g., the northern cattle grub no

longer occurs in Wyoming). In areas of Nebraska where cattle were not treated for a four-year period, final infestation was about 15%.

The older organophosphate insecticides are still effective against cattle grubs, but have generally been replaced by the broad-spectrum endectocides such as ivermectin (Ivomec).

The timing of treatment for grubs is important. Cattle should be treated as soon after the heel fly season as possible, which varies by region. They should not be treated later than 8 to 12 weeks prior to the grubs' appearance on the animals' backs, which typically begins in early winter. Cattle purchased from ranches usually go through an animal health program and are treated for grubs and lice regardless of whether the original owner treated them or not.

Critical Needs for Cattle Grub Management in Rangeland Beef

Research

- Maintain and increase numbers of research faculty that can generate livestock beef management information.
- Determine chemical, cultural, and biological alternatives to avermectins for grub control.
- Investigate incorporation of endo- and ectoparasites in a control program.

Regulatory

- Maintain current registrations.

Education

- Increase numbers of university extension specialists and agents with expertise in veterinary entomology and beef production who can disseminate information to rangeland cattle producers and communicate producers' needs to researchers and regulators.
- Continue to include cattle grub management in overall rangeland cattle IPM presentations and programs to prevent complacency.
- Maintain consistent and up-to-date recommendations and information.
- Recognize regional sources of information with experience and expertise.
- Deliver research findings.

Cattle Lice, *Damalinia (Bovicola) bovis, Haematopinus eurysternus, Linognathus vituli, Solenopotes capillatus*

There are four species of lice representing both chewing and blood feeders that occur throughout the region and have a significant impact on production. The primary biting species is the cattle biting louse, *Damalinia (Bovicola) bovis.* Blood-sucking lice include the short-nosed cattle louse, *Haematopinus eurysternus;* the long-nosed cattle louse, *Linognathus vituli;* and the little blue cattle louse, *Solenopotes capillatus.* The life cycles

of the species are similar. Eggs (nits) are deposited on hair. Immature lice resemble adults and feed on the animal. The life cycle is usually completed in about a month. Louse reproduction rates and populations decline in the summer and increase in the winter. This, combined with the fact that cattle feed quality is generally lower in the winter and cattle are stressed by cold weather, makes winter the peak time for production impacts due to lice. Winter is an economically difficult time for a severe pest problem as it is difficult for cattle to recover optimum health condition. Over time, healthy cattle develop an immune response to lice infestation.

Lice are spread by animal contact. Some animals have more lice than others; these are termed “chronics” or “carriers.” Younger animals are more susceptible to lice.

Feeding by lice can reduce cattle weight gain (depression of 0.12 lb/day has been recorded) and thriftiness, and can depress the animals’ immune systems, thereby leading to increased incidence of respiratory problems, abortions, and anemia. In addition to impact on beef production, lice can also reduce hide quality, both directly by pitting the hide and indirectly because infested animals will scratch lice-infested sites and will have a rough-appearing haircoat.

Cultural Controls

Generally, when cattle are placed on a high-nutrition ration, the lice populations will decline. Culling carriers (chronic lice-infested cattle) from the herd makes management easier.

Chemical Controls

Lice numbers are reduced when cattle are treated for cattle grubs in the fall. But the fall grub treatment may not be sufficient or at optimum timing to prevent a lice buildup. As with most rangeland cattle pest management operations requiring handling of the animals, treatment occurs when it is convenient (i.e., when the cattle are worked), rather than when timing is optimum. It also tends to be performed regardless of pest populations. In some operations, cattle are treated for lice when they are sold and prior to being shipped to feedlots regardless of demonstrated need. Because many ranchers treat too early, reinfestation can occur later in the winter. While a number of chemicals are registered on and effective against lice and treating again in late fall can in fact prevent build-up of cattle lice, it is simply not practical for most rangeland producers.

Critical Needs for Cattle Lice Management in Rangeland Beef

Research

- Maintain and increase numbers of research faculty that can generate livestock beef management information.
- Survey western lice populations for resistance development and develop resistance management guidelines as needed.
- Compare product efficacies.
- Study the interaction between cattle grub and lice management.
- Investigate biological controls.

- Research new chemistries with alternative modes of action toward developing an integrated pest management system that forestalls resistance development.
- Investigate immune stimulants to enhance resistance.
- Research a product that would provide season-long lice control.

Regulatory

- Maintain registrations so a variety of modes of actions are available.

Education

- Increase numbers of university extension specialists and agents with expertise in veterinary entomology and beef production who can disseminate information to rangeland cattle producers and communicate producers' needs to researchers and regulators.
- Provide information as to treatment alternatives and optimum timing to prevent large populations during winter.
- Stress contagion of lice infestation and the ease of reinfestation of lice by supposedly clean cattle.
- Communicate importance of and tactics for management of chronics in the herd.
- Disseminate information on the economics of lice treatment.
- Stress importance of monitoring for cattle lice.

Mites/Cattle Scabies, *Psoroptes ovis, Sarcoptes scabiei, Chlorioptes bovis, Demodex bovis*

Of the three so-called scabies species impacting western rangeland cattle, psoroptic scabies (*Psoroptes ovis*), sarcoptic scabies (*Sarcoptes scabiei*) and chorioptic scabies (*Chorioptes bovis*), only *P. ovis* causes true scabies. The other species cause mange. *P. ovis* is the most serious pest, requiring reporting and quarantine if present. These mites have been eliminated five times since 1903. Currently they have been virtually eradicated by avermectins. There is no known population of *Psoroptes ovis* in the U.S. today. A fourth mite (*Demodex bovis*), the cattle follicle mite, may also be found in cattle; economic impacts of this pest are unknown.

Symptoms of mites may not be evident except in winter because, like cattle lice, the reproduction rates of mites increase during cool weather and decrease during hot weather. The life cycle is as short as 10 to 12 days during the winter.

Mites spread from animal to animal by contact. The psoroptic scabies mites do not burrow in the skin as do the other species but their feeding causes severe skin irritation and itching. Subsequent rubbing and scratching by the animal further irritates the infested area. Eventually, a scab forms, providing a sheltered and optimum situation for the mite that allows them to increase rapidly. Infested animals become unthrifty and lose hair, which can lead to severe illness and even death during the winter months.

Cultural Control

Aside from reporting and quarantine, no cultural methodologies are employed for these pests.

Chemical Control
Currently controlled by available insecticides, primarily the avermectins ivermectin, doramectin, and eprinomectin.

Critical Needs for Mite Management in Rangeland Beef

Research
- Maintain and increase numbers of research faculty that can generate livestock beef management information.

Regulatory
- Since control depends on one class of chemicals, be alert for control failures.
- Maintain registration of effective compounds.

Education
- Increase numbers of university extension specialists and agents with expertise in veterinary entomology and beef production who can disseminate information to rangeland cattle producers and communicate producers' needs to researchers and regulators.

Ticks, *Dermacentor* spp., *Rhipicephalus sanguineus, Amblyomma americanum, Otobius megnini*

Ticks are not usually numerous enough to be a major economic problem, but there are occasional flare-ups in both the northern and southern portions of the western beef-producing region. They are not a problem in Alaska, but have been reported as problems in other western states including Wyoming, New Mexico, and Nebraska. The major species impacting the western states are the Rocky Mountain wood tick, *Dermacentor andersoni*; American dog tick, *D. variabilis*; brown dog tick, *Rhipicephalus sanguineus*; lone star tick, *Amblyomma americanum*; winter tick, *D. albipictus*; and spinose ear tick, *Otobius megnini.*

Populations of specific ticks depend on climate and region. *D. andersoni, D albipictus*, and *O. megnini*, for example, only occasionally reach pest levels in Wyoming. Some species reach heavy populations in some parts of New Mexico. The lone star tick and the winter tick may be expanding their range. The lone star tick was found in the central sandhills of Nebraska in 2002, and the winter tick in west central Nebraska in 2002, both of which were new county records for those areas.

Tick paralysis of humans can be caused by tick feeding on spinal column or base of the head of cattle, especially on calves. Ticks also vector anaplasmosis.

Cultural Control
No cultural controls are known for ticks. Scouting is not very reliable because populations of ticks are not easily detected by visual inspection; they engorge from feeding and they drop off the animals. Spinose ear tick can be found in the ear by careful examination but not on superficial inspection.

Chemical Control
Ticks are very difficult to control, as they must have direct contact with pesticide. Sprays and dust formulations are primarily used for control. As visual detection is difficult, cattle are often treated if there is a history of infestation.

Critical Needs for Tick Management in Rangeland Beef

Research
- Maintain and increase numbers of research faculty that can generate livestock beef management information.
- Determine the distribution of lone star tick and document its expansion into newer areas.

Regulatory
- Maintain current pesticide registrations for tick control.

Education
- Increase numbers of university extension specialists and agents with expertise in veterinary entomology and beef production who can disseminate information to rangeland cattle producers and communicate producers' needs to researchers and regulators.
- Educate producers on importance of and appropriateness of controls.

INTERNAL PARASITES

Rangeland beef cattle are impacted by internal parasites as well as external arthropod pests. Internal parasites (a.k.a. endoparasites) include protozoa and worms. In this document, we address the worms, both roundworms (nematodes) and flatworms (flukes and tapeworms). Protazoa are not addressed in this document.

The products used to treat internal worm parasites are referred to generally as *anthelmintics*. Some commercial products now available act against some of the internal parasites as well as some external ones. These dual-activity products are referred to as endectocides. They are usually effective against roundworms but not flatworms.

Internal parasites tend to build resistance to chemical controls, so this must be considered when designing and implementing a treatment program.

Roundworms/Nematodes, Trichostrongylids, Ostertagiasis Type I and II

The most prevalent and economically important internal parasites in rangeland beef cattle are a certain group of roundworms that inhabit the abomasum (a portion of the animal's stomach), small intestine, or lungs. They enter the animal's system when a cow eats forage on which the roundworm larvae are present. Of the various types of roundworm parasites infecting cattle, the Trichostrongylidae family is most important for its ability to suppress immunity, depress appetite, stunt growth, and otherwise inhibit development and production of young cattle from birth to about 3 years of age. Older animals normally develop an immunologic standoff with the worms, which allows a low/moderate population of the parasites to persist without seriously harming the adult cattle. The normal population of worms in the adult animals provides a reservoir of infection for calves and yearlings on pasture with the older cows and bulls.

The infestation level of roundworms in adult range cattle is generally low to moderate, while that of pastured cattle may reach very high levels. The level of exposure of range cattle is usually much less than that of pastured cattle.

Calves coming off summer range prior to weaning frequently harbor large populations of adult trichostrongylid worms in the abomasum and small intestine. The adult worms feed on and erode the mucosal lining of the digestive tract, inducing bleeding and fluid loss and inhibiting digestion and absorption of nutrients. The stress of weaning and associated feed change often enhances the detrimental effects of the worms, resulting in sudden deterioration of animal condition including stunting and/or anorexia. Veterinary services may be required. In extreme cases, the combination of worm presence and stress can be fatal.

Yearling animals that have not been dewormed prior to winter feeding in the Northern Region frequently harbor hypobiotic (hibernating) larvae in the gastric glands of the abomasum during cold winter months. The hypobiotic larvae inhibit secretion of

hydrochloric acid, resulting in a significant increase of the pH of the abomasum, thereby preventing production of pepsin necessary for digestion of dietary protein. The species of worm most often responsible for this condition is *Ostertagia ostertagi,* commonly known as the brown stomach worm.

It is difficult to overestimate the prevalence of this nearly ubiquitous pest. Surveys conducted in Wyoming, for example, found every animal was infected with Ostertagiasis.

A significant percentage of infective L3 trichostrongylid larvae are capable of surviving winter exposure under certain range conditions (e.g., a snow layer insulating/protecting the ground from freezing/drying). Bison, elk, and other free-ranging ruminants also harbor some species of trichostrongylid nematodes, with various levels of contamination occurring year-round. The reproductive potential of most trichostrongylids is significant (many adult female worms produce 5,000 to 10,000 eggs per day), making elimination of the worms almost impossible. Even a small population in a segment of a herd of grazing animals has been shown to produce significant contamination of forage and infections of “clean” herdmates in a relatively short period of time.

Cultural Controls

Pasture rotation aids in reducing spread and re-infestation by nematodes. Good control programs that have most effectively reduced/controlled trichostrongylosis have most commonly involved strategic chemical deworming coordinated with pasture rotation schedules.

Maintaining overall calf and cattle health and vigor helps forestall some of the more severe detrimental effects from worm infestation, as healthy cattle are better able to withstand stresses of weaning, cold weather, and dietary changes that exacerbate worm-related health problems.

Monitoring for actual levels of nematode infestation is difficult. Some producers examine feces for nematode eggs, employing floatation solutions of various types. Although this is a good measure of the current rate of pasture/rangeland egg contamination, it does not correlate well with the numbers of adult nematodes in the animal. The recovery of adult nematodes from the digestive tract of cattle at slaughter is accurate, but very labor intensive and expensive. Fecal egg count, while not ideal, is somewhat useful and relatively inexpensive. Evaluation of wormload in a herd should be based on egg counts from a number of young animals in the herd. The young are the best indicators due to their lack of protective immunity to the parasites. Egg counts in excess of 150 eggs per gram of feces indicate significant trichostrongylid infection in young animals.

Chemical Controls

Most of the roundworms that affect cattle are killed by the avermectin group of endectocides. Most of the other groups of compounds that effectively kill arthropods have little or no effect on nematodes and most have no effect on the protozoa or

flatworms. However, because roundworms are very prone to developing resistance to anthelmintics, product classes must be rotated.

As with most pest management, the timing of anthelmintic use is important. Unfortunately, the best time for nematode treatment does not always coincide with the best time to treat for external parasites. Strategic treatment times include:

> **At Weaning.** Deworming of calves prior to, during, or just after weaning significantly enhances utilization of dietary nutrients and prevents stress-related damage and condition loss associated with infections acquired on range.
>
> **Late Fall.** Treatment of yearlings and two-year-old animals late in the fall after grazing becomes minimal allows animals to efficiently utilize supplemental feed and develop at a normal rate. If a producer is treating for lice at the same time, the choice of product will be different than if treating for worms alone.
>
> **Prior to Summer.** Treatment of cows prior to turnout onto summer range/pasture slows the seeding of herbage with infective larvae, thereby delaying, but not completely preventing, infection of the vulnerable calves as they begin to graze.

Treatment programs for nematodes vary, depending on the environment in which the cattle are maintained. For range cattle, deworming of the adult cattle and calves after the grazing season will often be sufficient. Over a few years' time, this single annual treatment will often reduce the level of contamination and exposure on the range to levels that are below the economic threshold. However, producers must be vigilant; if newly weaned calves from the range are placed into a pasture that is heavily contaminated with larval parasites, they can rapidly become heavily infected.

For pastured cattle the treatment for nematodes may need to be repeated more often. With more frequent treatment, strategic planning is even more critical. One strategy is to treat the adult cows when the calves are worked (vaccinated, etc.) in the spring and then move cows and calves to a new pasture. Then 3 to 4 weeks later, depending on the product used, deworm both cows and calves. This strategy is based on the premise that the cattle would have gathered many of the larvae during that 3- to 4-week period and that the larvae could be killed before they began to lay new eggs. But the effectiveness of that strategy depends upon the level of contamination of the subsequent pasture(s). Producers typically consult with a veterinarian knowledgeable about their herd and their local area when planning a program to manage nematodes.

Flatworms (Liver Flukes/Tapeworms) Fascioliasis

Two classes of flatworms infest cattle: liver flukes and tapeworms. Both are distributed widely throughout North America.

Range cattle infected with the common liver fluke *Fasciola hepatica* acquire the worms when grazing in vegetation near bodies of water that provide habitat for snail intermediate hosts. The larval flukes produced in the snail attach to vegetation near the water and remain in an encysted resting stage until ingested by an herbivore. The developing larvae in the liver of a newly infected bovine burrow through the liver tissue for several weeks prior to entering bile ducts, where they mature and live as adult, egg-producing worms for 5 or more years. The liver fluke has been found in cattle and other herbivores across the West, although prevalence data have not been determined. The chronic, cumulative damage caused by the worms in infected cows older than 4 years requires frequent heifer replacement practices.

Cultural Controls

Liver flukes must have a snail present in the environment to complete their life cycle, so they are not a problem on all ranches. But, many of our western ranches utilize the grazing of wet meadow areas during some phase of the production cycle and this can provide exposure to the liver fluke parasite. Elimination of snails or moist areas that favor snails could provide benefit, but this is impractical in most situations.

Chemical Controls

Tapeworms are not impacted by any of the current endectocides. Therefore if they are considered to be of economic importance, they must be treated with anthelmintics specific to tapeworm.

Liver flukes are also not affected by the endectocides. However, Ivomec Plus is a mixture of ivermectin, an endectocide, and clorsulon, a product specific for liver fluke. Clorsulon (available by itself under the trade name Curatrem) has efficacy on both liver flukes and tapeworm adults. The benzimidazole group of anthelmintics is also efficacious against both flukes and tapeworms, however none of the compounds approved for use against liver flukes is considered 100% effective against the larval flukes undergoing development in the liver parenchyma of infected host animals.

Since accurate prevalence data are unknown, treatment/control methods for liver flukes are determined and employed on a case-by-case basis, often through consultation with an experienced veterinary practitioner or extension agents.

Timing of treatment is critical and must be planned into the overall internal and external pest management program. The larval migration stage of liver fluke lasts about 8 to 12 weeks. Curatrem is quite effective against the larval stage of the liver fluke when employed anytime during this migration to the liver. The amount of clorsulon present in Ivomec Plus is too small to be effective against the larval stage, but is effective on the adult stage. To be effective in a program, treatment with this combined product must take place in winter, after mid-December. With this treatment regiment, the rate of contamination of the pastures will be low enough to minimize the economic impact on the calves after a couple of years.

Critical Needs for Internal Parasite Management in Rangeland Beef

Research

- Promote investigation/development of advanced parasite control options designed to maximize calf production, survival, and developmental condition. Immunological, biological, and medicinal advances could minimize the ability of parasitic agents to develop resistance to presently efficacious treatment options.

Regulatory

- Maintain medicinal registrations/use approvals currently in effect to facilitate animal production capability.

Education

- Train/retrain extension agents and large animal veterinarians in basic parasite epidemiology and diagnostics.
- Emphasize the importance of seasonal differences in clinical severity and appropriate diagnostic methods applicable to parasitic worms and protozoa.
- Inform producers about valid visual indications of clinical parasitism, accurate diagnostics, and cost-efficient application of treatment options.

Description and List of Systemic Insecticides

Drug	Arthropods Affected	Worms Affected
Doramectin (Dectomax)	Mites, grubs, sucking lice	Most roundworms*
Eprinomectin (Eprinex)	Horn flies, mites, lice, grubs	Most roundworms*
Ivermectin (Ivomec)	Mites, lice, grubs, hornflies	Most roundworms*
Ivomec-Plus (ivermectin combined with clorsulon)	Mites, lice, grubs	Most roundworms*, flukes, and adult tapeworms
Moxidectin	Mites, lice	Most roundworms*
Benzimidazoles: Albendazole, Fenbendazole, Oxfendazole, others	None	Adult and some larval tapeworms, flukes

** Includes most Trichostrongylids, Ascarids, Hookworms, Whipworms, Pinworms, Filarids and others.*

GLOSSARY

Active Ingredient. That part of a pesticidal commercial product or spray mix which directly causes pesticidal effects, often expressed in percent, weight of toxicant per unit of measure, or pounds per acre (abbr. a.i.).*

Arid. A term applied to regions or climates where lack of sufficient moisture severely limits growth and production of vegetation. The limits of precipitation vary considerablY according to temperature conditions, with an upper annual limit for cool regions of 10 inches or less and for tropical regions as much as 15 to 20 inches.*

Backgrounding (growing). Calves are confined after weaning (usually at the ranch, but sometimes at a feedlot) and conditioned for a feedlot by being vaccinated, implanted, and fed a mixed ration of forage and concentrate (ration designed for growth) for 60 to 150 days, then sent to a feedlot for finishing. Some backgrounding is done on pasture with supplemental feeding.

Breeding Herd. The animals retained for breeding purposes to provide for the perpetuation of the herd or band. Excludes animals being prepared for market.*

Continuous Grazing. The grazing of a specific unit by livestock throughout a year or for that part of the year during which grazing is feasible. The term is not necessarily synonymous with yearlong grazing, since seasonal grazing may be involved. A preferred term is continuous stocking.*

Continuous Stocking. A method of grazing livestock on a specific unit of land where animals have unrestricted and uninterrupted access throughout the time period when grazing is allowed.*

Corral. A small enclosure for handling livestock.*

Cow-calf System. Cows impregnated by artificial insemination (AI) or by mingling with bulls and are normally timed for production of calves in spring (February/March/April), summer (June/July), or fall (August/September/October) seasons. Calves remain with the cow until weaning at seven to eight months old. After weaning, a calf may be (1) backgrounded, sent to a feedlot for finishing, and marketed in 14 months or (2) returned to rangeland or pasture and sold the following fall at about 1.5 years old.

Cropland. Land devoted to the production of cultivated crops. May be used to produce forage crops.*

Deferment. Intentional delaying of grazing to achieve a specific management objective. This strategy provides time for plant reproduction, establishment of new plants, restoration of plant vigor, a return to environmental conditions appropriate for grazing, or the accumulation of forage for later use.*

Deferred Grazing. The deferment of grazing in a non-systematic rotation with other land units. *

Deferred Rotation. Any grazing system that provides for a systematic rotation of the deferment among pastures.*

Desert. Land on which the vegetation is absent or sparse and often shrubby. Characterized by an arid climate.*

Dipping. Immersing animals in specific solutions to control insects or disease.*

Dipping Vat. A trough made of concrete, wood, or metal for holding solutions in which animals are dipped.*

Drenching. Giving a forced oral dose of a specific solution to an animal, usually to control internal parasites.*

Emergency Feeding. Supplying feed to range animals when available forage is insufficient because of heavy storms, fires, or other such emergencies.*

Endectocides. Pest management products with dual activity against endoparasites (anthelminthic) and ectoparasites (acaricide and insecticide).

External Pests/Parasites. Includes blood-feeding flies (horn flies, mosquitoes, biting midges, black flies, stable flies, tabanids), face flies, heel flies, lice, mites, and ticks that are found on the outside of the animal. Cattle grubs are included in this category though part of the life cycle is spent growing and migrating inside of the animal.

Feedlot-finished Beef. Cattle "finished" in a feedlot are fed a high-energy ration for a period of time prior to slaughter. The time required for the cattle to reach slaughter weight is much shorter in the feedlot.

Grass-finished Beef. Calves to be grass-finished are weaned in the fall, maintained during the winter, and returned to grass the following summer, until they reach slaughter weight. These animals are marketed directly from grass-pasture maintenance without backgrounding. Generally not practiced in range states, although it is becoming more common due to specialty market demand.

Grass. Members of the plant family Poaceae.*

Grass Pasture. A fenced or otherwise defined area in which grasses are the primary species. Grass has both foliage and reproduction stages. The foliage stage may be most desirable for grazing and reproductive or seed stage more desirable as hay.

Grassland. Land on which the vegetation is dominated by grasses, grasslike plants, and/or forbs.*

Grazable Forestland. Forestland on which the understory includes plants that can be grazed without detrimental impact. Syn. grazable woodland, forested range, woodland range.*

Grazing Season. (1) The time period during which grazing can normally be practiced each year or portion of each year. (2) On U.S. public lands, an established period for which grazing permits are issued. It may be the whole year or a very short time span, and is normally a function of forage mass and climate. In this context, the vegetative growing season may be only a part of the grazing season.*

Habitat. The natural abode of a plant or animal, including all biotic, climatic, and edaphic factors affecting life.*

Internal Parasites. Includes nematodes (roundworms), trematodes (flukes), cestodes (tapeworms), and protozoa (single-celled organisms) that inhabit specific organ systems in a host animal. Parasites by definition cause a degree of damage, but not necessarily disease or clinical signs, to all infected hosts.

Irrigated Pasture Production System. A fenced or defined area seeded with high-production forage grass or mixed grass/legume species and having the ability to be irrigated, either by flood, sprinkler, or subirrigation. In Wyoming, as an

example, irrigated pasturage will normally support 1.5 animal units per 3-10 acres, depending on herbage species and water application.

Maintaining. Supplying feed to range animals when available forage is insufficient, typically in winter months.

Native Species. A species that is part of the original fauna or flora of the area in question.*

Natural Pasture. (1) A synonym for rangeland. (2) Formerly forested land that has been allowed to revert to native forage species and is managed primarily for production of native plants for grazing.*

Naturalized Species. A species not native to an area but one that has adapted to that area and established a stable or expanding population. Naturalized species do not require artificial inputs for survival and reproduction.*

Noxious Species. A plant species that is undesirable because it conflicts, restricts, or otherwise causes problems to the prevailing management objectives..*

Open Range. (1) Range that has not been fenced into management units. (2) All suitable rangeland of an area upon which grazing is permitted. (3) Untimbered rangeland. (4) Range on which the livestock owner has unlimited access without benefit of land ownership or leasing.*

Organic Production. The National Organic Program (NOP) regulations were developed to ensure that organically labeled products meet consistent national standards (http:// www.ams.usda.gov/nop). Animals for slaughter must be raised under organic management from the last third of gestation. Producers are required to feed livestock agricultural feed products that are 100 percent organic, but may also provide allowed vitamin and mineral supplements. Organically raised animals may not be given hormones to promote growth or antibiotics for any reason. Preventative management practices, including the use of vaccines, may be used to keep animals healthy. Producers are prohibited from withholding treatment from a sick or injured animal: however, animals treated with a prohibited medication may not be sold as organic. All organically raised animals must have access to the outdoors, including access to pasture. They may be temporarily confined only for reasons of health, safety, and the animal's stage of production, or to protect soil or water quality.

Paddock. (1) A grazing area that is a subdivision of a grazing management unit and is enclosed and separated from other areas by a fence or barrier. (2) A relatively small enclosure used as an exercise and saddling area for horses, generally adjacent to stalls or stable.*

Pasture Rotation. Cattle are generally moved to summer pasture when cool season grasses are available, usually in May. They typically remain in summer pastures until October or November and then are moved to winter quarters. They may graze on pasture that was reserved for winter, but usually require some supplement such as hay in order to obtain sufficient energy for good health.

Pasture. (1) A grazing area enclosed and separated from other areas by fencing or other barriers; the management unit for grazing land. (2) Forage plants used as food for grazing animals. (3) Any area devoted to the production of forage, native or introduced, and harvested by grazing. (4) A group of subunits grazed within a rotational grazing system. (5) To feed on pasture, to use as pasture.* In this

document, when we say “pasture” we are typically referring to a fenced area that restrict animals and can be either irrigated or dryland (rainfed); in the west, these generally consist of planted introduced grass species such as brome or wheat grasses.

Pastureland. Grazing lands, planted primarily to introduced or domesticated native forage species, that receive periodic renovation and/or cultural treatments such as tillage, fertilization, mowing, weed control, and irrigation.*

Pesticide. Any chemical agent such as herbicide, fungicide, insecticide used for control of specific organisms.*

Poisonous Plant. A plant containing or producing substances that cause sickness, death, or a deviation from the normal state of health of animals.*

Prescribed Burning. The use of fire as a management tool under specified conditions.*

Producer. While this term can refer to organisms such as green plants that use radiant energy to synthesize organic substances from inorganic materials,* in this document we use the term “producer” to refer to a rancher/owner of cattle.

Ranch. An establishment or firm with specific boundaries together with its lands and improvements, used for the grazing and production of domestic livestock and/or wildlife.*

Rancher. One who owns, leases, or manages a ranch.*

Range States. In the US, generally considered as the seventeen western states excluding Alaska and Hawaii. In these states, the major portion of the land is used for the production of livestock from range.*

Range. Land supporting indigenous vegetation that either is grazed or that has the potential to be grazed, and is managed as a natural ecosystem. Range includes grassland, grazable forestland, and shrubland, and can include pastureland.*

Rangeland Production System. Cows, calves, and bulls (in some systems) are turned out for grazing on open prairie or mountainous habitat in May/June until about August/September, depending on weather and vegetation conditions, and permit agreements with Forest Service, Bureau of Land Management, and/or private landowners. In Wyoming open rangeland will normally support 1.5 animal units per 15-30 acres, depending largely on rainfall.

Rangeland. Usually a non-fenced area that is rainfed and consists of native grassland that has never been plowed for crop production. Livestock on rangeland must be rounded up to be worked.

Ration Grazing. Confining animals to an area of grazing land to provide the daily allowance of forage per animal.*

Replacement Heifers. Heifers are selected at weaning for replacement of cows culled due to increased reproductive failure. These heifers are usually maintained on rangeland before they can be bred as two-year-olds. Replacement heifers may have pelvic measurements taken and only those that equal or exceed the desired pelvic size are retained, but this is not always done.

Revegetation. Establishing or re-establishing desirable plants on areas where desirable plants are absent or of inadequate density, by management alone (natural revegetation) or by seeding or transplanting (artificial revegetation).*

Riparian Community Type. A recurring, classified, defined, and recognizable assemblage of riparian plant species.*

Riparian Ecosystems. (1) Those assemblages of plants, animals, and aquatic communities whose presences can be either directly or indirectly attributed to factors that are water-influenced or related. (2) Interacting system between aquatic and terrestrial organisms and situations identified by soil characteristics, and distinctive vegetation that requires or tolerates free or unbound water.*

Riparian. Referring to or relating to areas adjacent of water or influenced by free water associated with streams or rivers on geologic surfaces occupying the lowest position on a watershed.*

Rotational Grazing. Cattle under this system are moved from one pasture to another in a sequence to expose them to fresh feed and allow for plant regrowth, as opposed to overgrazing. The rotation may be daily, weekly, or even quite long intervals, depending on the range or pasture.

Sacrifice Area. A portion of the range, irrespective of site, that is unavoidably overgrazed to obtain efficient overall use of the management area.*

Sacrifice Site. A range site which is unavoidably overgrazed to obtain efficient overall use of the management area.*

Shrubland. Land on which the vegetation is dominated by shrubs.*

Stocker/Yearling. After weaning, calves are kept over winter on maintenance ration/pasturage, grazed following summer and sent to feedlot at 13-14 months of age or at approximately 1.5-2.0 years of age, depending on management methods.

Summer Range. Range, particularly in the mountainous western states, that is grazed primarily during the summer growing season.*

Supplement. Nutritional additive (e.g., salt, protein, phosphorus) intended to remedy deficiencies of the range diet.*

Supplemental Feeding. Supplying concentrates or harvested feed to correct deficiencies of the range diet. Often erroneously used to mean emergency feeding.*

Surfactant. From the words “surface active agent,” surfactants are substances used in herbicide formulations to modify the surface contact of the product. Properties improved by surfactants may include the herbicide’s ability to: emulsify, spread, wet, stick, disperse, and/or dissolve.*

Swale. A low tract or trough of land, often one that carries water during rainstorms or snowmelts. A marshy, damp lowland.

Toxic Plants Species. A species of plant that may accumulate or produce a substance toxic to animals.*

Trematodes/Flukes. Flatworm parasites of small intestine, lungs, liver, or circulatory system.

Trichostrongylids. A family (Trichostrongylidae) of roundworm parasites that infect the abomasum, small intestine, or lungs of host animals.

Undesirable Species. (1) Species that conflict with or do not contribute to management of objectives. (2) Species that are not readily eaten by animals.*

Vapor Drift. The movement of pesticide vapors from the area of application.*

Variable Stocking. The practice of allowing a variable number of animals on a fixed area of land during the time when grazing is allowed.*

Weed. (1) Any plant growing where unwanted. (2) A plant having a negative value within a given management system.*

Working. "Working" cattle refers to rounding them up and conducting necessary activities including branding, castration, vaccination, and pest management. Cattle are usually worked in the fall for weaning, culling, and vaccination. They may also be worked in early winter for lice treatment and scours vaccine. Most are worked again in the spring when they are moved to summer pastures; branding, vaccination, worming, and culling usually occurs at this time.

* Adapted from "Glossary of Terms" in *Range Management*, 4th Ed., Society for Range Management, 1839 York St, Denver, CO 80206.

ACTIVITY TABLES FOR RANGELAND BEEF

Cultural Practices, Northern Sub-region

	J	F	M	A	M	J	J	A	S	O	N	D	
Branding					xxx	xxx							
Calving	x	xxx	xxx	xx				x	xxx				85% Spring
Castration					xxx	xxx							
Culling									xxx	xxx	xxx		
De-Horning				xxx	xxx	xxx							
I.D. Tags	x	xxx	xxx	xx				x	xxx	xxx	xxx		85% Spring
Pregnancy Test	xxx								xxx	xxx	xxx		
Weaning			xxx						xxx	xxx	xxx		
Winter Quarters to Summer Pasture					xxx	xxx							

Pest Management Activities, Northern Sub-region

	J	F	M	A	M	J	J	A	S	O	N	D	
Blood Test for Blue Tongue (export)													Not routine
De-Worming				x	xxx				xxx	xxx		xxx	
Ear Tags				x	xxx								
Systemic Insecticides Application									xxx	xxx			
Non-systemic Insecticide Application				x	xxx				xxx	xxx			
Self-insecticide Treatment (back rubber, dust bags, oilers)					xxx	xxx	xxx	xxx	xxx				
Vaccination					xxx	xxx			xxx	xxx			

Seasonal Pest Occurrence[1], Northern Sub-region													
Insects		**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Black Flies	Present					xxx	xxx	xxx	xxx	xxx			
	Treated	research needed											
Cattle Grubs	Present	xxx	xxx	xxx		xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
	Treated									xxx	xxx	x	
		depends on cutoff date											
Cattle Lice	Present	xx	xxx	xxx	xxx	x	x	x	x	x	x	x	x
	Treated	xxx	xxx	xxx	xx					xxx	xxx	x	
Culicoides	Present					xxx	xxx	xxx	xxx	x			
	Treated	not treated											
Face Fly	Present					xxx	xxx	xxx	xxx	x			
	Treated					xxx	xxx	xxx	xxx	x			
Flukes	Present	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
	Treated (as needed)	xx											xx
Horn Flies	Present					xxx	xxx	xxx	xxx	x			
	Treated					xxx	xxx	xxx	xxx	x			
Mites	Present	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
	Treated	as needed											
Mosquito	Present				xxx	xxx	xxx	xxx	xxx	xxx	xxx		
	Treated	not treated											
Nematode	Present	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
	Treated			xxx						xxx	xx		xx
Stable Fly	Present						xxx	xxx	xxx	xxx	xxx		
	Treated						xxx	xxx	xxx	xxx	xxx		
Tabanids	Present						xxx	xxx	xxx	xxx	xxx		
	Treated	not treated											
Ticks	Present					xxx	xxx						
	Treated					xxx	xxx						
Disease		**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Anaplas-mosis	Present												
	Treated	as needed; transmitted by Tabanids and ticks											
Blue Tongue	Present						xx	xxx					
	Treated	no treatment, viral disease transmitted by *Culicoides*											

ACTIVITY TABLES FOR RANGELAND BEEF

Cultural Practices, Southern Sub-region

	J	F	M	A	M	J	J	A	S	O	N	D
Branding				xxx	xxx	xx						
Breeding Season				xx	xxx	xxx	xxx	xxx	x			
Calving	x	xxx	xxx	xxx	xxx	xx	x					
Castration				xxx	xxx	xx						
Culling										xxx	xxx	
De-Horning				xxx	xxx	xx						
I.D. Tags				xxx	xxx	xx						
Pregnancy Test										xxx	xxx	
Supplemental Feeding	xxx	xxx	xxx	xxx							xxx	xxx
Vaccination				xxx	xxx	xx				xxx	xxx	
Weaning										xxx	xxx	
Winter Quarters to Summer Pasture			xxx	xxx	xxx	xxx						

Pest Management Activities, Southern Sub-region

	J	F	M	A	M	J	J	A	S	O	N	D
Blood Test for Blue Tongue (export) [1]	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
De-Worming				xxx	xxx	xxx				xxx	xxx	
Ear Tags				xxx	xxx	xxx						
Pour-on Insecticide Application										xxx	xxx	
Self-insecticide Treatment (back rubber,dust bags, oilers)				xxx	xxx	xxx	xxx	xxx	xxx	xxx		

[1] Within 30 days before cattle is exported to regulated areas

Seasonal Pest Occurrence[1], Southern Sub-region													
Insects		**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Black Fly	Present				xxx	xxx	xxx	xxx	xxx	xxx			
	Treated	currently no treatments											
Cattle Grub	Present	xxx	xxx		xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
	Treated										xxx	xxx	
Cattle Lice	Present	xxx	xxx	xxx									xxx
	Treated										xxx	xxx	
Culicoides	Present				xxx	xxx	xxx	xxx	xxx	xxx			
	Treated	currently no treatments											
Face Fly	Present				xxx	xxx	xxx	xxx	xxx	xxx	xx		
	Treated				xxx	xxx	xxx						
Flukes[2]	Present	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
	Treated	xxx									xxx	xxx	xxx
Horn Fly	Present				xxx	xxx	xxx	xxx	xxx	xxx	xx		
	Treated				xxx	xxx	xxx						
Mites	Present	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
	Treated	treatment upon diagnosis											
Mosquito	Present				xxx	xxx	xxx	xxx	xxx	xxx	xx		
	Treated	no treatment directed at mosquitoes											
Nematode	Present	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
	Treated				xxx	xxx	xxx				xxx	xxx	
Stable Fly	Present				xxx	xxx	xxx	xxx	xxx	xxx	xx		
	Treated	no treatment directed at stable flies											
Tabanids	Present					xx	xxx	xxx	xxx				
	Treated	no treatment directed at tabanids											
Ticks	Present	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
	Treated	generally no treatment directed at ticks											
Disease		**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Anaplas-mosis	Present							xxx	xxx	xxx			
	Treated							xxx	xxx	xxx			
Blue Tongue	Present							x	xxx	xxx			
	Treated	no treatment											

[1] "Present" indicates periods when pests occur; population densities may or may not reach treatable levels. "Treated" indicates when field activities are likely, not pest occurrence (e.g., some insect pests may be found in all year, but management activities only occur as indicated in the table).

[2] Early treatment (October, November, early Dec) is sometimes employed, but is not effective.

EFFICACY OF PEST MANAGEMENT PRODUCTS IN RANGELAND BEEF

Registered Insecticides	**Applicaton Method**	**Black Flies** (*Simulium* spp.)	**Cattle grubs** (*Hypoderma lineatum, H. bovis*)	**Cattle lice**	**Face Fly** (*Musca autumnalis*)	**Flukes**	**Horn Flies** (*Haematobia irritans*)	**Mites (Cattle scabies)**	**Mosquitoes**	**Roundworms/ Nematodes**	**Ticks**
Amitraz (Taktic)	spray			G				F			E
B. Spharicus	granular								E		
	liquid								E		
Bti	granular								E		
	liquid	E							E		
Chlorpyrifos	ear tag										
Clorsulon (Curatrem)	oral					E					
Coumaphos (Co-Ral)	dust bag				G		G				G
Cyfluthrin, Beta-cyfluthrin (Cutter Gold, CyLence)	dust bag						G				
	ear tag						G				
	pour-on			G							
Diazinon (Cutter 1, Patriot, Warrior) 40%	ear tag			G	G		G				
Diazinon (Terminator, Optimizer) 20%	ear tag			F	F		F				
Diflubenzuron (Dimilin)	pour-on			E							
	spray			E							
Doramectin (Dectomax)	injection		E	E				E		E	
	pour-on		E	E				E		E	
Eprinomectin (Eprinex)	pour-on		E	E				E		E	
Ethion (Commando)	ear tag						F				
Ivermectin (Ivomec)	injection		E	P				E		E	
	pour-on		E	G				E		E	
Ivermectin + Clorsulon (Ivomec Plus)	injection		E	F		G		E		E	
Lambda-cyhalothrin (Saber)	ear tag				G		G				
	pour-on			G							

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E = Excellent (90-100% control); G = Good (80-90% control);
F = Fair (70-80% control); P = Poor (<70% control).

EFFICACY OF PEST MANAGEMENT PRODUCTS IN RANGELAND BEEF

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Registered Insecticides	**App Method**	**Black Flies** (*Simulium* spp.)	**Cattle grubs** (*Hypoderma lineatum, H. bovis*)	**Cattle lice**	**Face Fly** (*Musca autumnalis*)	**Flukes**	**Horn Flies** (*Haematobia irritans*)	**Mites (Cattle scabies)**	**Mosquitoes**	**Roundworms/ Nematodes**	**Ticks**
Mosquito larvicide oils									E		
Moxidectin (Cydectin)	pour-on		E	E							
Permethrin (Atroban, others)	pour-on	G		F			F		G		
	spray	G		F			F		G		
Pirimiphos-methyl (Dominator)	ear tag				G		F				
Spinosad	pour-on			G			F				
Stirofos (Rabon)	dust bag				G		F - G				
Zeta-cypermethrin (Python)	dust bag				G		G		G		
	ear tag				G		G		G		

E = Excellent (90-100% control); G = Good (80-90% control);
F = Fair (70-80% control); P = Poor (<70% control).