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University of Nebraska Cooperative Extension MP 40
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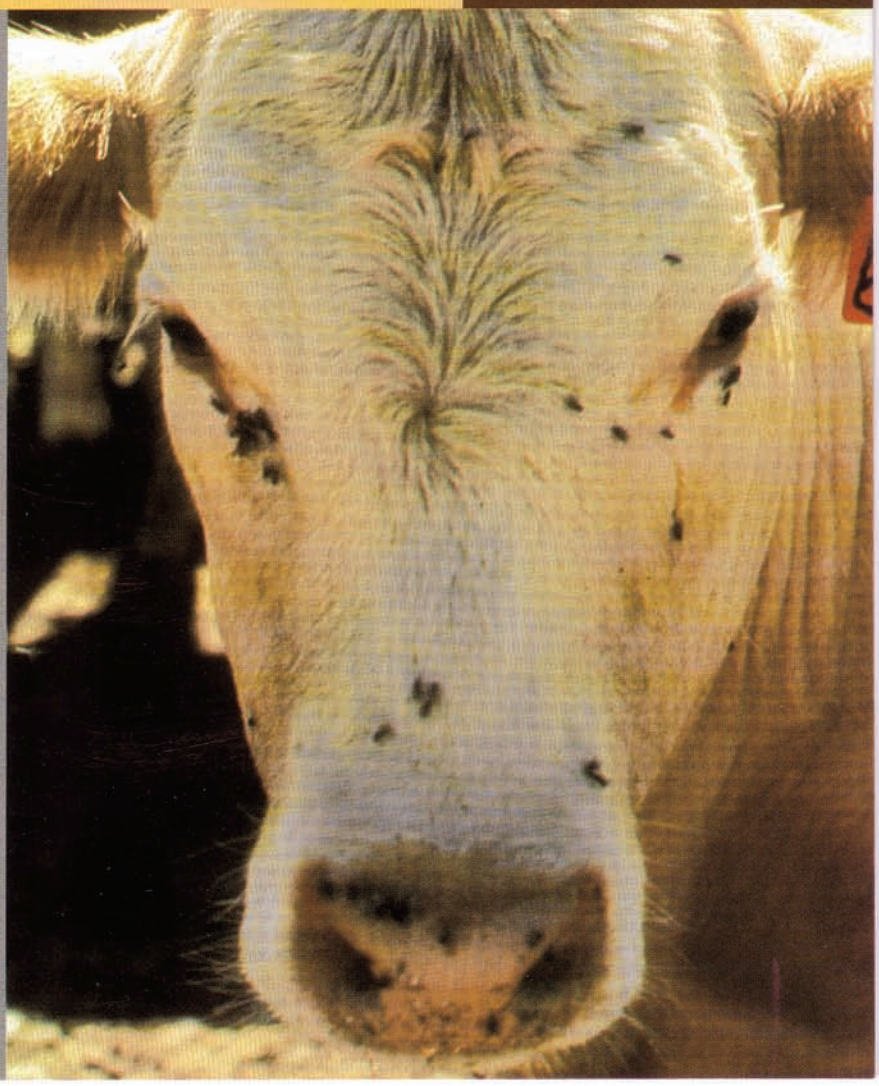
The Economics and Control of Insects Affecting BEEF CATTLE in Nebraska (Northern Great Plains)

J.B. Campbell and
G.D. Thomas



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The Economics and Control of Insects Affecting Beef Cattle in Nebraska (Northern Great Plains)

J.B. Campbell[1] and G.D. Thomas[2]

Introduction

The major insect parasites of range and pasture cattle in Nebraska and other states of the Northern Great Plains include the stable fly, *Stomoxys calcitrans* (L.); the horn fly, *Haematobia irritans* (L.); face fly, *Musca autumnalis* De Geer; heel flies, *Hypoderma lineatum* de Villers (common cattle grub) and *H. bovis* (L.) (northern cattle grub); and several species of cattle lice including *Haematopinus eurysternus* (Nitzsch) (short-nosed); *Solenopotes capillatus* Enderlein (little blue); *Linognathus vituli* (L.) (long-nosed); and *Bovicola bovis* (L.) (biting or chewing louse).

In years past, cattle scabies, *Psoroptes ovis* (Hering), a mite rather than an insect, would also be an important pest. It threatened the U.S. cattle industry in the late 1800s. In 1905, stringent federal control measures were instituted in an effort to stop its spread. By 1919, there were only a few cases annually, until a virulent outbreak in Oklahoma in 1971. The outbreak spread throughout the Great Plains until widespread use of the new bioinsecticide Ivermec® has practically eradicated this pest. In addition to these major insect pests of cattle, several species of deer or horse flies, Tabanidae; mosquitoes, primarily *Aedes vexans* (Meigen) and *Culex tarsalis* Coquillet; black flies, Simulidae; and gnats, *Culicoides*, can inflict heavy livestock losses under certain conditions or in certain regional areas by causing weight losses and/or transmitting diseases.

Drummond (1987) estimated annual losses from arthropod pests of livestock exceeded $2.25 billion. This figure didn't include cost of control or losses from diseases transmitted by arthropod vectors. This figure represents about 10 percent of the value of the livestock industry. The Great Plains states, because of the large concentration of cattle, incur most of these losses. This overview of losses to the range and pasture cow-calf industry may seem dramatic; however, the combination of high production costs and a narrow profit margin intensifies even small losses.

Livestock insect control should be considered an integral part of an efficient beef herd health program. Livestock insect control-gain investment ratios of 1:2 to 1:8 are the norm rather than the exception (Steelman et al. 1972).

Stable Fly

Stable flies have only recently been considered pests of range cattle, except where rainfall is 30 inches or more, or where small herds are fed during the winter in farmstead corrals and in the summer are pastured close to the farmstead where the cattle return for water, salt, or shelter. Stable flies breed in decaying organic matter mixed with manure, dirt and moisture. If the winter feeding area is not cleaned thoroughly in the spring, it may provide an excellent stable fly breeding area. Stable flies feed on cattle as they come to water and may follow or seek out cattle in pastures. Under these conditions, flies must return to the breeding areas for egg deposition.

Description and Behavior

The stable fly is about the size of a house fly, but darker *(Figure 1)*. The abdomen has dark irregular spots. The proboscis (mouthpart) protrudes bayonet-like in front of the head. The larvae are typical, whitish fly maggots. The pupae are chestnut colored.

Figure 1. Stable fly.

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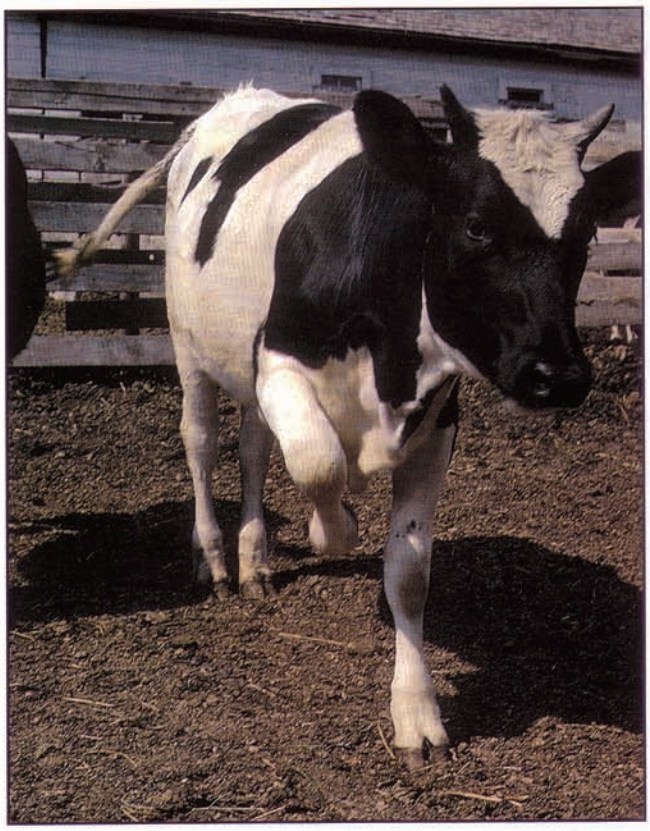

Figure 2. Cow stamping foot to dislodge stable fly.

The stable fly is most often found feeding on the lower legs of cattle *(Figure 2)* and rests in sheltered, shady areas to digest the blood meal. They may feed two or more times per day with feeding peaks at mid-morning and late afternoon.

Life History

The stable fly can complete its life cycle from egg to adult in 24-25 days during warm weather *(Figure 3)*. It overwinters in a fly breeding area (silage pit, feedlot mound, or feed around bunks) below the frost line as a slowly developing larva. As it warms in the spring, larval development is completed, the pupal form occurs, and first generation adults emerge (Berry et al. 1978).

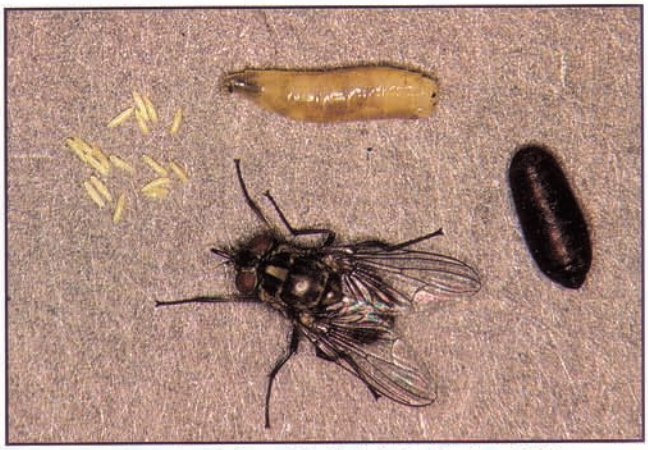

Figure 3. Life cycle of the stable fly (*clockwise from left*): egg, larva, pupa and adult.

Economics

The effects of stable flies on pasture cattle have been unknown until recently. Studies by Cutkomp and Harvey (1958) and Cheng (1958) do not differentiate between biting flies, while studies by Campbell et al. (1977, 1987) dealt only with feedlot cattle. Our observations are that range or pasture cattle bothered by stable flies will bunch, expend energy fighting flies and fail to graze normally.

Stable flies have long been known as a serious pest of confined cattle at dairies (Bruce and Decker 1958) and feedlots (Campbell et al. 1987), however, in the past decade, the stable fly has also become a notable pest of pasture and range cattle. Hall et al. (1982) noted high numbers of stable flies attacking pasture cattle in Missouri. They had not observed this in previous years. Entomologists also have reported stable fly problems on grazing cattle in North and South Dakota, Wyoming, Colorado, Nebraska and Kansas.

Cattle react to stable fly attack by bunching, with each animal attempting to protect its front legs (the favorite feeding site of stable flies). Foot stomping, tail switching, heads thrown down toward the front legs and standing in any available water are all behavioral changes exhibited by cattle under stable fly attack. Nebraska ranchers indicate the bunching behavior results in tramping out forage which on fragile soils may create blow outs. They also indicated bunching of the cows injures calves that get stepped on and causes a higher incidence of footrot. In addition, heat stress increases because bunched cattle can't dissipate the heat. The response of feedlot cattle under heat stress is to reduce feed intake. This also may be true for range and pasture cattle which would fail to graze properly. Nebraska studies with grazing steers, where sprays protected some from stable flies, indicated stable flies reduced average daily gains by an average of 1/2 lb per day in 84-day trials. Nebraska ranchers estimated yearling weight gain losses were 40-50 lbs per animal and weaning weights 20-25 pounds per calf, which is close to the losses experienced in the research trials.

Control

Control of stable flies on pasture or range cattle is difficult. Research is needed to find the source of stable flies infesting range and pasture cattle. Hall et al. (1982) found considerable stable fly breeding at the edge of big bales if the hay was wet and had remained in the field for any length of time; however, in western Nebraska hay bales have not been found to be a

breeding source of stable flies, probably because of drier conditions. It doesn't seem likely that all of the flies are coming from feedlots and dairies because these units generally practice good sanitation and manure management practices and generally use insecticides if stable flies are numerous enough to affect confined cattle.

Numerous stable fly breeding sites may have previously gone unnoticed, such as winter feeding grounds where forage is fed on the ground and some residue remains. Some forage may be spread on trails when it is difficult to get vehicles through. Some cattle are fed from portable racks and hay gets trampled and remains uneaten which may create a fly breeding area if wet. Often hay is stored in stack yards near the winter quarters for the cattle. Spilled hay, parts of stacks and bales may not be fed in the winter and remain during the spring and summer where, if wet, the residue may be ideal for stable fly feeding. Wet vegetative areas around ponds, streams or areas where tanks have overflowed may also be fly-breeding sources. The areas listed as possible fly-breeding sites are only speculative. An intense research effort is needed to find the source of stable flies infesting range and pasture cattle. Wet sprays can provide cattle some relief, but these are washed off the legs of cattle by wet vegetation, and a spray is seldom effective for longer than a week (Campbell and Hermanussen 1971). Dust bags, oilers and ear tags are ineffective because they fail to treat the legs of cattle. Feed additives are also ineffective because the stable flies do not breed in fresh manure. The lack of control of stable flies with insecticides doesn't appear to be because of resistance, as is the case with horn flies. Bioassays of stable flies with three chemical groups used for control indicates the stable fly is still susceptible to all three types (Marcon et al. 1997).

Horn Fly

The horn fly, a native of Europe, was first reported in the United States in 1887. It has spread throughout the United States, into Canada and Mexico, and recently further south into Central and South America. The adults are blood-feeding, obligate parasites that spend most of their time resting or feeding on animals. They may feed as often as 30 times a day. Several thousand horn flies may be present on a single animal.

Description and Behavior

The horn fly is the same color and about half the size of a house fly *(Figure 4)*. A major difference is the piercing, sucking mouthparts of the horn fly. During the cool part of the day, it feeds on the back and shoulders of the animal, but tends to move to the shady side and belly when it becomes hot. On cool, cloudy days, it may be around the base of the horn or just above the hooves. Horn fly feeding attracts other flies that do not have piercing, sucking mouthparts such as the face fly and some blow flies. Heavy feeding may cause a scab-wound on the tender mid-line of the belly.

Figure 4. Horn fly.

Life History

The life cycle of flies consists of the egg, larva (maggot), pupa and adult. The female horn fly deposits eggs only in fresh cow manure. When the eggs hatch, larvae develop in the manure and change to the pupal stage and then the adult stage. In colder climates, the horn fly overwinters in the pupal stage. As temperatures increase (April and May), the adults emerge and seek a blood meal *(Figure 5)*. They generally move downwind to cattle. If cattle are not in the pastures where they emerge, they will move to feedlot cattle or other animals such as horses (Campbell and Thomas 1992).

Figure 5. Horn fly infestation.

Economics

Economic studies indicate weight gain losses from horn flies on yearling cattle ranging from 15-30 lbs. (Haufe 1971, Cutkomp and Harvey 1958, Duren and O'Keefe 1972, Kinzer et al. 1984, Kunz et al. 1984). Campbell (1976), Huston et al. (1979) and Quisenberry and Strohbehn (1984) showed calf weaning weight differences of 9.7 to 16.3 lbs. (4.4 kg - 7.4 kg) per calf, when comparing weaning weights of calves from treated and untreated cows.

In general, when horn fly populations exceed 200 per animal, decreases in weight gains to either

yearlings or weaning calves range from 10 to 15 lbs. per animal. If average price for feeder calves was $75 per hundred wt. (1987-1993), the value of the decreased weight would be $7.50-$11.25 per head (avg. $9.375). Cost of control during that time period wouldn't exceed $2.50 per head, leaving a profit margin of $5.00-$8.75 (avg. $6.875) per head as the profit realized for horn fly treatment. In Nebraska this would equate to added value in excess of $5 million annually. In the rangeland of Alberta, Canada, horn fly numbers of less than 230 per animal on yearling steers or in the Nebraska Sandhills 197 per cow did not affect yearling or weaning weights, respectively (Haufe 1982, Schreiber et al. 1987). It seems likely that the economic losses for horn flies is dependent on the nutritional quality and quantity of grass, genetics of the cattle, other stress factors such as heat and management of the cattle, in addition to the number of horn flies and length of the fly season. If left untreated, horn fly numbers on range cattle in the Great Plains will exceed 500 per animal during the peak fly season virtually every year.

Control

Currently the most feasible control for horn flies is the use of an insecticide. Non-insecticide control measures, such as sanitation at feedlots and dairies to reduce stable flies and house flies, is simply not practical for horn fly control. The same is true for biological control in the Northern Great Plains. Some success with dung beetles imported from Australia has been reported (Fincher 1986). The beetles disrupt the dung before the flies can complete their life cycle, but these beetles are incapable of surviving northern winters. Horn flies have natural enemies i.e., predators and pupal parasites, but the effort required for control with inundative releases would be cost prohibitive and probably not achievable because of the widespread fly distribution. There is a mechanical trap (Missouri fly trap) that is like a gate that contains baffles which cattle pass through and flies are dislodged and trapped, but this isn't very useful for range cattle.

Horn flies spend virtually all of their adult life on the animals; therefore, if a treatment can place insecticide on the animal periodically, it is fairly effective. Drummond (1987) and Campbell and Thomas (1992) reviewed the historical evolution of horn fly control. After World War II, chlorinated hydrocarbon insecticides that were effective and cheap became available to ranchers and farmers. Laake (1946) demonstrated the impact of horn flies on cattle performance by spraying range cattle with DDT. Phenomenal weight gain increases of 30-50 lbs. per animal resulted from these treatments compared to untreated cattle; however, rounding up cattle for treatment during the heat of the summer offset some of the gain. Spraying was generally replaced with "oilers" — "rubbers" which were self-treatment devices. These were, in turn, generally replaced with dust bags. All of these treatment methods are still effective and used to some degree. The oilers consisted of a chain or wire strung between two posts. The chain or wire was wrapped in burlap which was treated with an insecticide. Eventually, most of the chlorinated hydrocarbon insecticides were prohibited by the Environmental Protection Agency from use on cattle and were replaced with phosphate insecticides. These insecticides didn't last as long as the earlier ones and required more frequent replenishing. These self-treatment devices work best if cattle are forced to use them to obtain water or feed.

Ear tags impregnated with pyrethroid insecticides were extraordinary in their horn fly control efficacy for a short time. They could be applied early in the fly season and would provide control for the entire season. Because of the mobility of the insecticide after it was deposited on the hair coat, the migrating of the insecticide through the hair coat would treat both the cow and calf. In fact, horn fly control could be achieved if only half the animals in a herd were treated. Unfortunately, the factors that made the tags so effective (longevity and toxicity) also led to the development of resistance. Within two years of the first use, resistance occurred in Florida, and within five years was widespread throughout the United States and Canada. Part of the rapid spread of resistance was because of cattle market sources (southern cattle moved north carrying resistant flies with them) and the widespread use of the ear tags.

Veterinary entomologists (Federal, University, Extension and the animal health industry) worked together to address the resistance problem. At first Extension recommendations were to return to earlier horn fly control procedures. These recommendations were followed by resistance management guidelines which included:

- tag cattle only after the injury threshold of 200 or more flies per animal was reached;
- remove tags at the end of the fly season;
- tag animals only in the growth mode;
- supplement ear tags with other control methods;
- use tags that contain insecticides different from those to which resistance had developed, and
- rotate tags with different insecticides at least seasonally.

The insecticide ear tags with the newer insecticides do not provide the degree of control provided with the first ear tags. We have conducted studies with virtually all the ear tags on the market and have found that all of them, if applied around May 15 when cattle are being moved to summer grass, start to decline in efficacy around the first of August. This is when horn fly populations peak. Either the cattle

should be retagged or additional fly control methods, such as dust bags or oilers, should be added August 1. This management approach should serve to at least delay, if not inhibit, the development of resistance to the new products.

Feed additives have been available for some time. They are incorporated into feed or salt-mineral blocks. The insecticide passes through the digestive system of the animal with little absorption or disintegration and is available in the manure to destroy developing fly maggots. There is no question about the effectiveness of the products in the manure. With most of the registered products kill rates of 90 percent are not uncommon; however, several factors may render this method unsatisfactory. If the vegetation in the area is salty, consumption of the blocks may not be uniform. If the herds consist of cows and calves, calves will consume very little, leaving untreated manure. Flies will migrate from untreated pastures to the cattle being treated with a feed additive, making this method questionable (Bay and Schofield 1976). Generally, the feed additives work well for the first 8-10 weeks but as populations increase fly migration negates the control effort.

Sprays are used by some beef cattle operators, but the labor involved and harassment to the cattle may not be worth the effort since sprays have to be repeated at two to three week intervals to keep horn fly populations low. There are small mist sprayers and small dusters that can be electrically operated from a vehicle system. These can be efficient but may not be repeated enough to provide good fly control. Some ranchers use pour-on grub or lice control insecticides for fly control rather than sprays. These treatments may last only a few days, so this method is costly if retreatment is required often.

A new concept in fly control is the use of a bolus implanted into the rumen. The bolus slowly dissolves, releasing insecticide into the manure. In principle, this is similar to the feed additive concept but has the advantage of not requiring feed or mineral block intake by the animals for uniform fly control.

An advantage of the two standard boluses registered for horn fly control is their unique chemistry. The inhibitor bolus contains methoprene, a juvenile hormone analog. This product replaces the naturally occurring juvenile hormone which normally ceases when the insect should change from its juvenile to adult form. This disruption in development usually kills the insect. The other bolus, vigilante, contains dimilin, a chemical that inhibits the production of chitin which hardens the insect integument after molting. If the hardening doesn't occur, the insect dies from ruptures in the integument. The main disadvantage of the boluses is the application method (balling gun) which most livestock producers dislike. Another disadvantage is one already mentioned for feed additives. Migration of horn flies from untreated herds to the bolus treated herd often renders the treatment ineffective after several weeks. A third bolus containing Ivomec®, which mechanically releases the insecticide, has recently been registered for internal parasite control. While not labeled for horn fly control, the bolus will probably control flies for at least some of the season. This bolus is made from plastic and does not erode.

Face Fly

The face fly is also a native of Europe but was introduced into the United States in 1953 (Vockeroth 1953). It has spread across the northern states into Canada but has been slow to spread into the warmer areas of the southern United States. Face flies have declined in distribution in the last decade. They are no longer a pest in the intermountain states or in the western range areas of the Dakotas, Nebraska and Kansas. They are still quite numerous in the wetter eastern parts of these states. The face fly feeds on animal secretions such as tears, saliva, nasal mucus, blood exuding from wounds, perspiration, and filth adhering to the hair and manure.

Description and Behavior

Face flies resemble house flies, but are slightly larger and somewhat darker. The abdomen of the male face fly is orange, not white as with the house fly. The female face fly has an orange stripe on the abdomen while the female house fly's abdomen is light. Face fly larvae (maggots) are yellowish and the pupal cases are white, while other manure-inhibiting flies have whitish or transparent larvae, and the pupal cases are red or brown.

The behavior of face flies on animals is decidedly different than the behavior of horn flies. Generally, only female face flies are on cattle. They are not obligate parasites and do not have to feed on cattle. Although they are generally found around the face of an animal *(Figure 6)*, they may be anywhere on the

Figure 6. Pink eye, which developed as a result of face fly feeding.

animal that has a suitable feeding habitat (Ode and Matthysse 1967).

Life History

The female face fly, like the horn fly, deposits eggs in fresh cattle manure. The life cycle from egg to adult is completed in about three weeks during the summer. This may be why the face fly is not present in the more arid (rainfall less than 30 inches) open ranges, since manure may dry out before the fly has completed its life cycle (Teskey 1960). The face fly overwinters as an adult in sheltered areas such as house attics, barns, sheds, trees and other areas. Females from the overwintering population do not mate until they emerge from shelter in the spring.

Economics

No data are available in the literature concerning the effects of the face fly on cattle weight gain. There have been studies on the association of the face fly with *Moraxella bovis*, the pinkeye organism (Steve and Lilly 1965, Brown and Atkins 1972, Shugart et al. 1979). Research by Shugart et al. (1979) indicated that face fly feeding on the conjunctiva of the eyes of cattle causes lesions which allow invasion by eye pathogens. Several authors (Cobb et al. 1976, Thrift and Overfield 1974, Ward and Nielson 1979, Shugart et al. 1980) have reported the effects of pinkeye on weight gain performance of cattle. Research by Broce and Elzinga (1984) with an electron microscope indicated that the face fly mandibles are serrated and their feeding causes abrasions in the eye tissue which provides an avenue for eye diseases to become established.

Control

All control methods for horn flies can be used for the face fly; however, since horn flies are always present as well as face flies, we recommend not using ear tags containing insecticides to which horn flies are resistant. Face fly control is extremely difficult to obtain because of the fly's behavior. Self-treatment devices must be forced-use to be effective. Forcing cattle to use them to obtain water, feed or mineral provides the best results. Insecticide must be present when the flies are on cattle, which requires daily treatment. The flies' habit of congregating on an animal's face (an area difficult to treat by oilers or dust bags) requires better management of the devices and some modifications to improve effectiveness. For example, you may get improved efficiency by providing strips or flaps that brush the animal's face as it passes under the oiler and using dust bags with a nylon mesh under them. Some mineral feeders are adapted for placement of a dust bag or oiler strip which treats the animal's face while feeding. When face fly populations are high, more than one control method may be necessary. Forced-use of self-treatment devices and periodic spraying, or the use of a feed additive and ear tags in conjunction with a spray or a self-treatment system, may be necessary for face fly control. Two ear tags per animal (both calves and cows) are necessary to obtain good face fly control with ear tags.

Unlike horn flies, face flies are as attracted to calves as to cows and bulls, therefore, control efforts must include calves. It is difficult to position oilers or dusters low enough to treat calves and still allow easy passage by mature animals. This may have to be done gradually because cows resist passing under self-treatment devices if they cannot see under them.

Because face flies migrate between herds, feed additives are virtually useless unless fly control is considered an area problem with owners working together to achieve control. No large scale area effort has been attempted, but it could be effective in reducing the overall number of flies in a given area.

Cattle Grubs

Cattle grubs have been considered pests of cattle since the time of Aristotle (Graham 1962). There are two grub species present in most of the Great Plains States: the common or early cattle grub, *Hypoderma lineatum* (de Villers), which is distributed over most of the United States, and the northern or late grub, *H. bovis* (L.), which is restricted to about the northern half of the country. This latter species has declined in the past few years, perhaps because the common grub is gradually replacing it.

Life History

Life cycles of the two species are similar. The heel fly deposits eggs on the hairs of cattle. After hatching, the larvae bore into the skin at the site of a hair follicle and then migrate through the animal until they reach either the gullet (common cattle grub) or spinal canal (northern cattle grub). Grubs may remain in the gullet or spinal canal for several months before starting another migration which eventually ends in the loin area of the animal's back (USDA 1968, Hadwen 1919, Pfadt 1952, Scharff 1950, Breyev and Dyadechko 1964, 1965, Breyev 1967).

Economics

The economic losses to the packing and hide industries, as a result of grubs, are well documented (Scharff 1950, Rich 1970). From the standpoint of dockage for grubby cattle at the packing plant, the economic threshold is less than five grubs per animal. Losses to grazing cattle were estimated by Bishopp et

al. (1949). They stated that the "gadding" by cattle being annoyed by the heel fly attempting to deposit eggs on them reduced milk production 10-25 percent for grazing dairy cattle. Weight gain data for "gadding" range cattle is unknown but estimated to be similar to the reduced milk production. Steers treated for grubs at Nebraska ranches gained 0.22 lb. per day more than grub infested steers between October 31 and February 20; however, the weight gains from April 24 to May 4, after the grubs had emerged from the back, were only 0.09 pounds per day difference between treated and untreated steers (Campbell et al. 1974). It would be difficult to conduct a precise experiment to determine the effect of the heel fly and young grubs on cattle during the summer grazing season since the chance of having fly-free cattle in the same pasture with infested cattle is virtually impossible but necessary to make an adequate comparison. During the winter, however, feedlot calves gained about 12 lb. per calf (5.4 kg) more as a result of grub control during a 100-day feeding period (Campbell et al. 1973).

Control

Serious efforts to eradicate cattle grubs were started before World War I (Hadwen 1919) and have continued to this day. The advent of systemic insecticides makes eradication a possibility (Khan 1968, Thornberry 1965). Most systemic insecticides have kill rates of grubs in excess of 90 percent, if applied at the proper time and at the correct dosage (Loomis et al. 1972). New and promising systemic insecticides have been studied in an effort to find some that may give even better results (Drummond 1963, Drummond and Graham 1966, Drummond et al. 1972). The new fungal toxoids, Ivomec, Cydectin and Dectomax (doramectin), control grubs at very low rates.

Systemic insecticides are not without problems. If applied while the grubs are in the gullet or spinal canal, adverse reactions can occur (Scharff et al. 1962, Rich 1965, Radeleff and Bushland 1960, Nelson et al. 1967, Nelson and White 1968). The most common of these reactions is the host-parasite reaction. This occurs when dead or dying grubs release toxins. If the reaction is from the common grub, the animal will experience bloat, difficulty in breathing, excessive salivation (usually foamy) and will vomit partially chewed food. These symptoms occur because of the grub's location in the esophagus. The northern grub has a different migration pattern — the grubs pass through the anterior end of the spinal canal. Toxins released by dying northern grubs in the central nerve canal cause a noticeable stiffness in the hind quarters and possibly partial paralysis.

The other type of reaction that could occur in cattle after grub treatment is phosphate insecticide toxicity. This reaction is usually indicated by diarrhea, abdominal pains, excessive salivation (usually stringy) and weakness of the hind legs, accompanied by a staggering gait.

It is important that the type of reaction be correctly identified. Cattle suffering a host-parasite reaction will usually recover when forced to exercise. Cattle reacting to phosphate poisoning may need treatments with 2 PAM or atropine.

As a consequence of these reactions, many states have instituted cut-off dates for use of systemic insecticides for grub control. Hagen (1967) pointed out that cut-off application dates and livestock management practices may be incompatible. The same is true for feedlots that have cattle coming into the feedlot from anywhere in the United States or Canada. These managers are generally aware of the potential and know about remedial treatments.

Cattle Lice

Cattle lice may be the most underestimated livestock insects. All three bloodsucking species and the biting louse may be found on one animal. Heavily infested cattle are usually in poor condition with rough, patchy haircoats which have a greasy, dirty appearance. Calves, yearlings and older undernourished cattle usually have the heaviest infestations. The latter may be "chronics" or "carriers" and even repeated insecticide treatments may fail to completely free the animal of lice.

Life History

The life cycle of all lice species is similar. They are host-specific and spend their entire life on the animal *(Figure 7)*. Eggs are deposited on the hair of cattle. The feeding habits of the immature lice are the same as the bloodsucking or biting habits of the adults. The life cycle from egg to adult requires three to four weeks during cold weather. Reproduction slows during

Figure 7. Cattle lice.

warm weather, and lice populations decline drastically in the summer. Lice are transmitted from one animal to another by contact (Matthysse 1946).

Economics

Anemia, anemic abortion and death as a result of heavy populations of bloodsucking lice have been reported (Smith and Roberts 1956, Peterson et al. 1953, Collins and Dewhirst 1965). Cattle moderately or heavily infested with sucking lice populations are considerably lighter after winter grazing or backgrounding than cattle with lice control (Scharff 1962, Collins and Dewhirst 1965). Scharff (1962) and Gibney et al. (1985) indicated that moderate or heavy populations are required to affect cattle weight gain performance. Ely and Harvey (1969) and Gibney et al. (1985) found that animal nutrition impacts cattle lice populations. Cattle fed better nutritional rations generally have reduced louse populations.

Control

Control of lice is not difficult since they spend their entire life on cattle. All techniques and materials used for control of horn flies and cattle grubs can be used for lice control. The pour-on, spray, or dip-applied systemics used in the fall for grub control will reduce lice populations but may not provide control for the entire winter. Two applications may be necessary because most of the registered insecticides have little effect on the egg stage. The second application should be two or three weeks after the first to allow time for most of the eggs to hatch.

Application of pour-on-spot-on insecticides for lice control during the winter has certain advantages. They can be used in any kind of weather and are much easier to apply than sprays (White and Campbell 1972). Undesirable factors include the danger of grub (host-parasite) reactions if applied on northern cattle between November 1 and about February 1, and a higher cost when compared to sprays. Lice can be eliminated from the herd by removing "carriers", treating all other animals twice at the prescribed intervals and keeping the herd isolated from other cattle (Anthony et al. 1963).

Systemic pour-ons, sprays and dips have been used for control of lice for some time and are quite effective (De Foliart et al. 1958, Rich 1966, Matthysse et al. 1967, Knapp 1965, Campbell et al. 1978). Dust bags and oilers are relatively new methods of insecticide application for lice control. They probably should be used as preventive practices rather than treatment for control since it would take considerable time to reduce a high louse population with these methods (Lloyd 1971). In practice, many ranchers use dust bags or oilers for horn fly control during summer and continue to use them in the winter to prevent problems with lice.

Merck's Ivomec, Pfizer's Dectomax and Cydectin from Fort Dodge contain toxins derived from fungi. These bioparasiticides have a broader range of parasite control than the systemic insecticides because they control nematode worm parasites in addition to cattle grubs and lice. They will provide short-term control of any blood feeding parasite for approximately one week. The injectable application of Ivomec was not very effective for control of the chewing louse. Consequently, this species built up on many herds where Ivomec injectable was used. Recent concern about injection injury to animals and the build-up of chewing louse populations has hastened the development of pour-ons as the preferred means of product application.

Cattle Scabies

Cattle scabies, *Psoroptes ovis*, is a mite parasite that spreads rapidly and easily among cattle of all ages, classes and conditions. Its effect on cattle is so severe that it comes under Federal Animal Health Quarantine laws. Federal agencies and the cattle industry have tried to eradicate scabies. In the 1950s and 1960s, they seemed about to reach that goal; however, in 1971, a new outbreak occurred in Oklahoma and soon spread through most of the Great Plains. Between 1971 and 1980 millions of cattle were treated to reduce the incidence of scabies to a minor status (Campbell and Hudson 1978). The registration and use of Ivomec has practically eliminated scabies.

Abnormal animal behavior may indicate cattle scabies (nervous tail-switching, licking, rubbing and scratching infested skin areas). Sometimes cattle rub vigorously enough to cause bleeding and hair removal. Most of these cattle reactions are also indicative of cattle lice, but the reactions to lice are less severe.

Description and Behavior

The *Psoroptes* scabies mite is pearly white and barely visible to the naked eye (ca. 0.6 mm long). The immature forms are similar to the adults but have only three pair of legs while the adults have four pair. Eggs hatch in less than a week under favorable conditions. The newly hatched mites develop into egg-laying adults in 10-12 days. The entire life cycle of the mite is spent on cattle (USDA 1969).

Economics

Psoroptic scabies mites usually infest cattle where hair is thick (withers, back and tailhead). Serum oozes from the skin areas where the mites have burrowed and soon hardens into yellow and gray scabs which

may be blood stained. The scabs seem to provide an ideal environment for the mites. They multiply rapidly and move out from the scab to feed on healthy skin. The lesions at the interface between healthy and infested skin are swollen, moist and red. The hair gradually disappears from scabby areas, and the skin becomes thick, corrugated and dry. Untreated cattle lose weight and may die. Scabies outbreaks in feedlots cost an average of $50 per head considering feed efficiency, weight loss and treatment costs (USDA 1976). Range cattle losses are less but average $25 per head.

Control

Scabies control is conducted under the quarantine laws of Veterinary Services Division of the Animal and Plant Health Inspection Service, USDA. Quarantines are placed on scabies-infested ranches and feedlots to prevent movement of infested cattle. All infested and/or exposed cattle must be dipped in USDA-permitted insecticide (sulfur, prolate and Co-Ral) under supervision or treated with Ivomec. This latter method is by far the treatment of choice because of ease of application. Infested cattle must be dipped twice at 14-day intervals before the cattle can be moved. After scabies outbreaks occur within a state, other states may require all cattle coming from that state to be treated before entry. These measures may seem severe but have reduced scabies to only occasional occurrences.

Horse and Deer Flies

The tabanids (horse and deer flies) are restricted to pastures along waterways, and are of limited importance on range and pasture cattle. When present, they feed by cutting through skin and creating a free-flowing blood wound. The feeding causes agitation and bunching of the cattle which reduces weight gains (Tashiro and Schwardt 1949, Bruce and Decker 1951). These wounds attract other flies, such as the face fly, which hinders healing of the tabanid feeding wounds. In addition to irritation of animals, some tabanids are vectors of diseases such as anaplasmosis.

Life History

The various species of horse or deer flies *(Figure 8)* may have different life histories, but those present in Nebraska usually have one generation per year. Eggs are deposited in aquatic or muddy areas. Larvae of most species develop in wet soil (some in water), and some are predacious on other insects.

Figure 8. Horse fly.

Control

The tabanids are one of the most difficult groups of insects to control. Little can be done to control larvae in wet, muddy areas and control of adults is also difficult. Use of self-treatment devices such as oilers and dust bags are of some value. Sprays will also help but should be repeated at frequent intervals. Aerial sprays of ultra-low volume (ULV) insecticides (high concentrate insecticide applied at low rates) have been effective if timing of the spray is correct. Several sprays may be required if several species are present because of differences in emergence times.

Mosquitoes

Mosquitoes *(Figure 9)* are a major pest of cattle in the Southeast, but not usually in the Midwest; however, flood water species of *Aedes* can be a problem along waterways, primarily in the spring. Permanent water species of *Culex* and *Anopheles* may be a problem later in the summer. Only female mosquitoes feed on blood. Steelman et al. (1972) and Steelman and Schilling (1977) have shown losses of economic importance in Louisiana. Diseases such as anaplasmosis usually increase in incidence as mosquito numbers increase (USDA 1960).

Figure 9. Mosquito.

Life History

The biology of mosquitoes changes with the species. Most flood water species reach the adult stage four to five days after hatch, but the permanent water species usually take seven to ten days. The number of generations also varies with species. The flood water species are dependent on a suitable habitat.

Control

Drainage of breeding areas is the most desirable control method. This method may not be economically feasible in some situations. Steelman and Schilling (1977) have used integrated pest management for Louisiana cattlemen, organized like urban

mosquito abatement districts. Stockgrowers pay the cost of the program which uses satellite infrared photography to identify mosquito breeding populations. Sprays for animal protection are short-lived and have to be repeated frequently to be beneficial.

Black Fly

Black flies, *Simulidae*, are not of major importance on cattle in Nebraska, but they may be important along waterways for a two to three week period in late spring or early summer. Where they are present, they may bother horses and hay crews more than cattle because cattle are usually moved to pastures away from waterways before the black fly appears. In Canada and in the southeast states, they reach numbers that may kill cattle (Steelman 1976). Their bite may cause antigen reactions, and the toxin in the saliva may prevent blood clotting.

Description

Black flies are small blood-feeding, hump-backed flies. They are not all black but rather, vary in color depending on the species. Black flies may move some distance in search of a host.

Life History and Behavior

Black flies may swarm to mate if enough are present. The female deposits eggs while flying over water surfaces. The eggs hatch in three to seven days in the spring, but eggs laid in the fall diapause during the winter and hatch the next spring. Larvae attach to rocks or other objects in streams.

Control

Control of black flies is not generally feasible in Nebraska. Controlled insecticide-release in streams is practiced where this fly is a major problem. Animal protection by spraying is short-lived. Horses can be protected to some extent by using ear smears. (The ears of horses are a favorite black fly feeding site.) Aerial ultra-low volume or mist blower application of knockdown sprays along riverways may provide temporary help.

Biting Midges (Gnats)

There are several families of gnats, but the best known is the Ceratopogonidae of which *Culicoides* is the most common genus. Their biting habits are similar to black flies, and subsequently, attacks on cattle cause the same response by cattle. *Culicoides* can transmit blue tongue, a viral disease. Sheep and deer are the most susceptible to the disease. Although spread primarily by *Culicoides variipennis*, the virus is shed in bull semen. The disease causes only five percent morbidity in beef cattle, but serologically the incidence is much higher. Reproduction problems and calves with congenital anomalies can result from this disease (Williams 1979). Based on cattle serology, the Animal and Plant Inspection Service (APHIS) has indicated a high incidence of the disease south of the Platte River and a moderate incidence north of the Platte in Nebraska. *Culicoides* have been collected from light traps placed around feedlots in several areas of Nebraska.

Description and Behavior

These flies are somewhat hump-backed but smaller than black flies. Most species breed along waterways in wet soil adjacent to water. They may breed in wet run-off areas around feedlots or dairies. They are seasonal in Nebraska and are generally not a problem after midsummer.

Control

Control of the aquatic insect complex is difficult. Aerial or mist applications of the infested area may provide control if timed properly. Breeding areas are either too wide-spread or difficult to find to make larval control feasible. Animal sprays may provide temporary protection.

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