

THE FACE FLY, *Musca autumnalis* . . .

A NEW LIVESTOCK FLY IS NOW MOVING TOWARD CALIFORNIA

THE FACE FLY, *Musca autumnalis*, was introduced into eastern North America from Europe, about 1950, and has since spread westward into 37 states and several Canadian provinces. It has become established as far west as Idaho, Utah, Washington and Oregon. Since it now occurs in all but two Oregon counties, it is expected to invade California in the near future. This pest has achieved high populations in many areas after invasion and has become of important economic significance to livestock growers and dairymen in several northeastern and midwestern states. Their pestiferous habit of clustering about the heads of animals reportedly causes severe annoyance and weight loss. These flies also have been associated with outbreaks of eye diseases in cattle, and they sometimes become pests of man when they enter dwellings to hibernate in the fall.

Although the adult face fly appears and acts very much like its close relative the house fly, the larvae of these two species

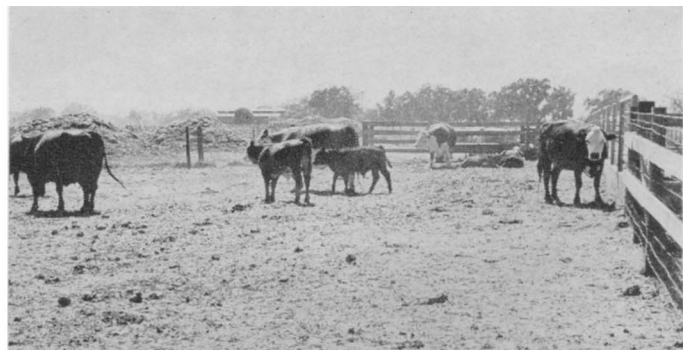
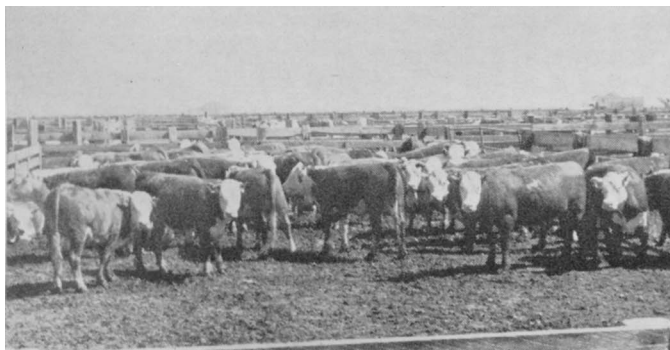
occur in separate habitats. Face fly larvae are found only in fresh cattle droppings (cowpats) in pasture and range situations. House fly larvae, on the other hand, are found in almost any kind of piled or accumulated dung (manure), such as cattle, pig, chicken, and human feces, as well as in decaying vegetable matter such as garbage, but they are not known to occur naturally in fresh, isolated, individual cattle droppings.

Cattle droppings in pasture or rangeland situations serve as a habitat for a large community of rather unique insects and other organisms. The species which comprise this community usually occur only in ruminant droppings, and they probably became adapted to such droppings long before the domestication of livestock by man. The insect community inhabiting cowpats in the vicinity of the San Francisco Bay area alone includes some 50 species of flies and 35 species of beetles. Although flies and beetles constitute the two major groups of insects

which inhabit individual droppings, a single pat also commonly contains several kinds of parasitic wasps, and many kinds of mites and worms.

The great majority of insects of the fresh cowpat community are truly "wild" insects and are rarely seen by man; they do not enter buildings and they are not pests of either man or livestock. These insects are beneficial and probably essential to pasture environments because they contribute to the breakdown of the droppings and the eventual return of valuable nutrients to the soil. In the United States, only two insect species of the cowpat community, the face fly and the horn fly, *Haematobia irritans*, are considered pests of man and animal. The horn fly, which remains on cattle and sucks blood, presently occurs in California. The face fly would not only add to the annoyance of livestock by flies, but it would also be the only member of the fresh-dropping community to annoy man by entering dwellings and other buildings.

Crowded feedlot in photo below, left, shows physical conditions preventing development of the natural fauna of cattle droppings (photo by H. T. Strong). Uncrowded feedlot, shown below, right, allows horn and face flies to develop in untrampled fresh pats, while other pests including house and stable flies proliferate in larger piles of accumulated droppings near feeders and fences.



The face fly, *Musca autumnalis*, now an important pest of livestock, and sometimes of man, throughout much of the United States, has spread as far west as Washington and Oregon; and its invasion of California now appears imminent. This fly differs from its close relative the house fly, *Musca domestica*, in that its immature stages develop only in fresh cattle droppings, rather than in manure piles, garbage, etc. Investigations of the unique insect community of which this fly is a member indicate that the face fly may soon become established throughout much of the state. This report details movement of the fly into western states, the insect's habits, and control possibilities.

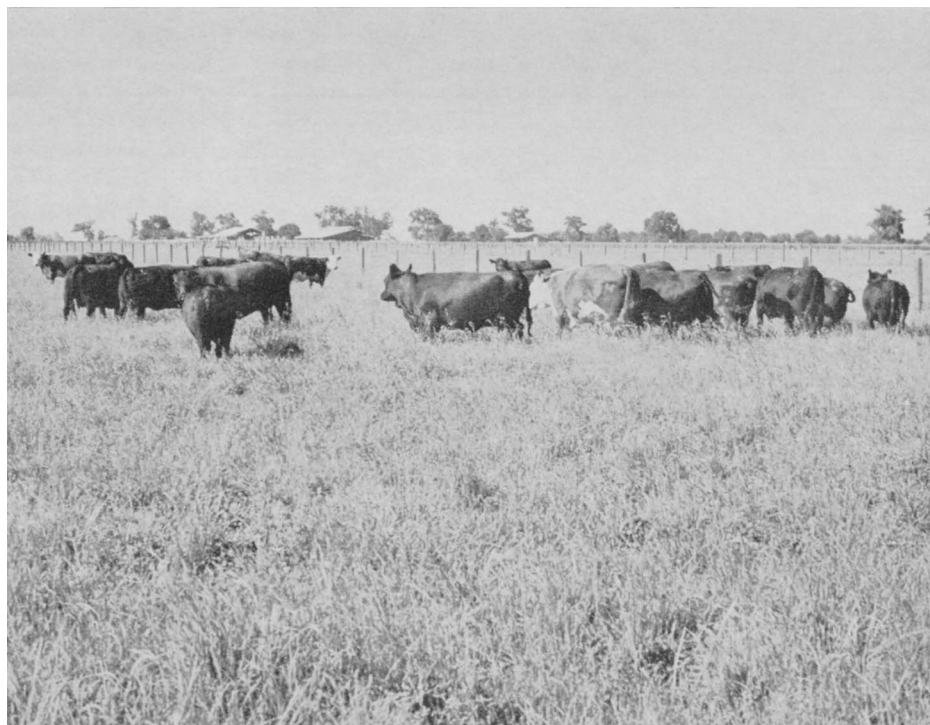
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When individual cattle droppings are heaped into manure piles, mixed with hay, straw or urine, concentrated and trampled in feedlots, or otherwise changed from the natural situation by various livestock management practices, the mixed dung becomes a habitat for entirely different insects. It is only such disturbed droppings that are utilized as breeding sites by many kinds of domestic pest flies, including the house fly and the biting stable fly, *Stomoxys calcitrans*. Both of these pest flies are sometimes common in various feedlot situations, but in over 300 droppings studied since 1964, we have not found the immature stages of either the house fly or the stable fly developing in undisturbed cowpats in pastures.

Ecological studies

With an invasion of the face fly probable, survey work and ecological studies on the insects associated with fresh cattle droppings in northern California were begun in 1963. The main study area chosen was a dairy in Marin County where intensive sampling and quantitative studies were conducted from June 1964 through June 1965. Insects and other organisms occur in cattle droppings throughout the year in this mild climate, with one main group of insects occurring in the rainy, winter season and another in the dry, summer season. The horn fly



Typical pasture photo, above, shows abundant vegetation and shaded sites favoring the proliferation of almost all arthropod members of the cowpat community. In this situation pest fly populations generally remain low, whereas the numerous other inhabitants of pasture droppings are responsible for the rapid breakdown and recycling of the nutrients in individual droppings.

and face fly (where it occurs) are both characteristic of the summer community.

A considerable variation was observed in the numbers and kinds of insects developing within, and emerging from, various cowpats lying in different locations about the pastures and feedlots. This was related to the fact that the females of various species were not evenly distributed about pastures and lots, apparently because they have different environmental preferences and tolerances. Pats lying in the shade, for example, were visited by different numbers and kinds of insects from those visiting pats dropped in the sun (a phenomenon readily observed on hot days). Pats dropped in or near lush vegetation tended to have a large, varied insect fauna, because the vegetation undoubtedly provided a variety of habitats suitable to females of many different species. However, pats dropped in barren, open fields usually attracted only the horn fly (which remains with the cattle) and a few other species capable of flying far and wide in search of fresh pats. The exact place where a cowpat is dropped therefore, has a deciding effect on the number and kinds of insects which complete their development in that cowpat.

Biological control

Insects which develop as larvae in fresh cattle droppings include: (a) those spe-

cies which feed on the dung material and associated bacteria (coprophags); and (b) their natural enemies, the predaceous and parasitic insects (entomophags) which feed on them. Group A contains by far the larger number of species. Horn fly and face fly larvae are coprophagous, and both are quite susceptible to predation by the larvae of other predaceous flies, and by predaceous adult and larval beetles.

In laboratory studies, using known numbers of insects, nearly all deaths of the dung-feeding larvae were caused by the predaceous larvae in each individual pat. Depending on the size and numbers of prey larvae present, each predator larva of the fly *Myospila mediatubunda* accounted for the death of 25 to 100 larvae about the size of house fly larvae. Predaceous beetle larvae in the genus *Sphaeridium* were responsible for similar rates of prey mortalities. The extreme result of predation in field studies was that (at times of peak predator densities) no adults of either prey or predator species emerged from pats containing more predators than could be supported by the numbers of coprophagous prey larvae. This condition almost always occurred in the pats exposed in shaded, vegetated areas.

Pats yielding no adult flies were found to contain many larvae. The pats were

examined by randomly separating them (in pie slice fashion) into two equal halves, and by immediately extracting, identifying and counting the larvae in one half while holding the other half in the laboratory for adult emergence. In the case of most pat samples from which no adult flies emerged, the halves from which larvae were extracted yielded large numbers of stunted predator larvae and almost no prey larvae. In other pats, with a higher ratio of prey to predator larvae, only a few stunted adults of the predator species emerged. Results of these studies showed that adults of most species having dung-feeding larvae emerged in far fewer numbers from pats in sheltered vegetated areas than from pats in sunny barren areas. This result was attributed to females of the "free-living" predaceous species usually remaining in, or close to, areas sheltered by trees or other vegetation and thus ovipositing only in pats dropped in or near these areas.

Barren areas

Since horn and face fly females may oviposit in all pats dropped during the day (because they remain almost constantly on cattle) large numbers of these pests can emerge from predator-free cowpats dropped in barren areas. In pastures and rangeland where vegetation is lush and many predaceous and parasitic species of insects inhabit droppings, horn and face fly populations are balanced along with many other coprophagous non-pest species and thus are naturally contained below levels of economic significance. However, in many areas of California there are pasture and rangeland environments where few natural enemies occur in the droppings, allowing the horn fly (and soon the face fly) to reproduce in great numbers. Extremely dry and hot summer seasons, and cleared, overgrazed pasture areas reduce the numbers of beneficial insects which can populate droppings by killing or excluding the free-living adult females of the predaceous species.

Chemical control

When natural control of the horn fly and face fly is not sufficient to keep the pests below economic thresholds, insecticides may be applied in various ways to kill adult flies on the livestock or the larvae in the droppings. To kill adult flies, recommended insecticides have been applied by such means as backrubbers, sprays and dusts. Under most circumstances the insecticides must be applied repeatedly to be of significant benefit. To

kill fly larvae in droppings, trials have been conducted to determine the efficacy of incorporating systemic insecticides in feed or salt to kill the larvae developing in such "self-treated" droppings. The systemics have not proved very successful and also have the significant disadvantage of killing the beneficial as well as the harmful fauna in droppings. Without the many beneficial species to help in the breakdown of droppings and the recycling of nutrients, pastures might soon be covered with innumerable islands of dried dung instead of forage.

Management for natural control

With regard to today's problems of horn fly (and soon the face fly) production in cattle dung, livestock husbandry practices may be considered in three general categories: (1) the crowded feedlot where all dung pats are soon trampled and mixed with urine, bedding, and other materials; (2) the uncrowded lot situation where little or no vegetation exists, but individual pats remain undisturbed long enough for the insects which reach them to successfully complete larval development; and (3) the pasture situation where individual pats lie undisturbed until they disintegrate and the general "wild" fauna of the area lives in a more natural situation.

Crowded feedlot

In the crowded feedlot (see photos), few or none of the natural fauna of cattle droppings can develop, so horn and face flies are excluded. However, house flies, stable flies, and other pests may develop in large numbers in the accumulated manure. In the uncrowded lot shown in photos, horn and face flies could develop in most droppings before they were trampled, but, because such lots are usually barren and unvegetated, few, if any, natural enemies of these pests can reach the fresh droppings (except perhaps around the lot edges, if suitable vegetation exists outside the lot fence). In this situation not only may large numbers of horn and face flies be produced, but also, manure accumulations around feeders, water troughs, and fences can produce house flies and stable flies as well, thus compounding the problem. Fly control in feedlots of both types now appears more dependent upon architectural and engineering solutions than on entomological ones. Removal and composting, or similar treatment of accumulated dung at short intervals, can eliminate the breeding medium, leaving only those flies attracted from neighboring areas.

In the usual pasture situation shown in photos, removal or destruction of the individual droppings of cattle would be difficult or impractical—and undesirable, because the nutrients should be returned to the soil. Encouragement and conservation of hedgerows, trees, and other vegetation in and near cattle pastures and feedlots could increase the numbers of natural enemies reaching the majority of droppings, thereby helping to keep pest fly populations below economic thresholds. This also would promote rapid breakdown of droppings due to the potentially larger numbers of species able to reach and colonize the pats.

Fewer enemies

Another aspect of the horn and face fly problem in the United States in general is that there are far fewer species of predaceous and parasitic insects in the dung community here than in other areas of the world. In Europe (the source of horn and face flies introduced to this country), the fauna of droppings is much richer than here, and these flies are not important pests. In Denmark, up to six species of flies whose larvae are predaceous may be found in the same dropping, while only one such species, *Myospila mediatubunda*, occurs in the United States. The beneficial fauna of droppings is slowly increasing in California as new species are accidentally introduced from Europe to the East Coast and spread westward. In the last few decades several species of predaceous beetles have followed this pattern, just as the face fly is doing currently.

In the studies conducted thus far, the major fly species of the cowpat community in northern California have been identified. Studies have been made of dropping colonization, and natural control of dung fly populations by predators of fly larvae have been determined for the first time. With the techniques developed in these investigations the progress of the face fly into various areas of California can be followed, and the interactions of this species with the existent fauna can be studied and evaluated.

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