The Screwworm and Blowfly Problem

BY E. C. CUSHING AND D. C. PARMAN

AMONG ALL the insect pests that there are on this earth, those that raise their maggots in the living flesh of animals are peculiarly loathsome. Screwworms and blowflies have the doubtful honor of belonging to this group. Here is an account of their ways, the damage they do, and the steps that can be taken to outmaneuver them in their deadly business.

As enemies of livestock, screwworms and blowflies are in the forefront of many insect parasites. The primary screwworm is a native of the Americas, and few if any of the related species have been introduced into the United States from foreign lands. They have adapted themselves to conditions ranging from those of the hot dry sands of the desert to those of the frigid Arctic wastes. Fortunately, only a relatively small number of these flies are of great economic importance. Some are actually beneficial as parasites on other noxious insects and as scavengers.

The screwworm and blowfly problem in the United States today involves chiefly four groups or genera of flies, including about six species. All these different flies have one habit in common—they breed in animal flesh. One, however, the primary screwworm (scientific name, Cochliomyia americana), can breed only in the tissues of living warm-blooded animals, and it must depend upon finding a wounded or diseased part of the host's body in which its young can begin development. The other species of flies commonly

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2 The secondary screwworm fly (Cochliomyia macellaria); the black blowfly, fleseworm fly, or wool-maggot fly (Phormia regina); green-bottle flies (Lucilla spp.); and gray flesh flies (Sarcophaga spp.).
breed in carcasses but sometimes infest wounds or unhealthy tissues of live animals. They also contaminate and infest cooked and fresh meat of all kinds and for this reason are a problem of major importance around such places as slaughtering pens, packing houses, and farm homes.

**THE PRIMARY SCREWWORM FLY**

The primary screwworm fly is limited in its normal range to the Southern and Southwestern States, including Arizona and the southern half of California. Occasionally, under exceptionally favorable weather conditions or through the shipping of infested animals from farther south, destructive outbreaks of the pest have occurred in Iowa, Illinois, and Indiana.

In the areas where it normally occurs, this fly is undoubtedly the greatest enemy of all the insect species with which the livestock owner must contend. In the Southwest, where it inflicts the most injury, ranchmen report that 85 percent of their usual annual losses of livestock are caused by this parasite. Under the present system of livestock production in the screwworm-infested regions, man-made wounds occasioned by marking, branding, castrating, dehorning, and docking afford ample and fertile breeding grounds for screwworms, as do injuries resulting from such plants as cacti and needlegrass, from fighting, from diseased tissues, and from the attacks of blood-sucking insects. Newborn animals are particularly susceptible to infestation of the navel cord.

The primary screwworm fly is bluish green in color and has three dark stripes on its back. The space between and below the eyes is a reddish or orange color. It is often mistaken for one of the two common carcass-breeding species of blowflies which have almost identical color markings, although as seen in nature it is more robust and has a darker color. Only rarely is it observed on dead animals, but it is frequently seen feeding and laying eggs in the wounds of live animals.

The fly generally seeks the edges or a dry portion of the wound on which to deposit its eggs. From 50 to 300 eggs are laid at one time, fastened tightly to the tissue surface in compact shinglelike masses. A single female is capable of laying 3,000 eggs, which are deposited in masses of about 300 at 4-day intervals.

Hatching of the eggs occurs in 11 hours, and the young whitish worms immediately burrow into the flesh, where they feed and grow for a period of 4 to 7 days. During the larval, or maggot, stage the worms shed their skins twice. When the worms have reached their full growth they assume a pinkish color, leave the wound, and drop to the ground, where they dig beneath the surface and undergo a change to the hard-skinned, dark-brown, motionless pupa. It is during the pupal stage that the transformation from the maggot to the adult fly takes place. After the pupa has been in the soil from 7 to 60 days the fly emerges from it, works its way to the surface, and crawls up on some nearby bush, weed, or other object to allow its wings to unfold and its outer body coverings to harden. When it
first comes from the pupa, the fly is a grayish color without distinct markings, but as its body hardens it assumes its characteristic coloration. Under favorable conditions about 5 days are required before the newly emerged female fly becomes sexually mature and ready to lay eggs. During warm weather the life cycle is usually completed in 21 days, but under cold, unfavorable conditions the cycle takes as many as 80 days.

The injury this parasite does to animals is inflicted by the worms or maggots. The debilitating effect and the destruction of tissue kill the infested animal in a few days. The screwworm destroys untold numbers of domestic and wild animals from South Carolina to California, and this loss, together with the amount of labor required to prevent and treat infestations, costs North American livestock owners many millions of dollars annually.

**BLOWFLIES**

The blowflies of economic importance, the primary screwworm excepted, find their principal breeding ground in carrion. With the exception of the group known as gray flesh flies, which deposit tiny living maggots instead of eggs, the blowflies have a life history similar to that of the related screwworm fly, although each stage of the cycle is generally completed in about half the time.

In general the more harmful carrion-breeding species of flies are widespread over the continent, but various factors determine their relative numbers in different localities. They are most injurious in the Pacific Northwest and in the areas inhabited by the screwworm fly. Because of their prolific breeding habits they occur in large numbers, and when weather conditions are favorable, they cause their greatest damage by grossly infesting wounds and the soiled hair or fleece of animals. Some of the species, especially the black blowfly, or wool-maggot fly, produce injuries similar to those caused by screwworms. Sheep are especially susceptible to the attacks of blowflies, as their wool frequently becomes soiled or moistened by rain and accumulations of feces and urine. The maggots spread extensively over the body, feeding on the skin surface, exciting severe irritation, causing the production of a serous exudate, and destroying the ability of the skin to function. Infested animals rapidly become fevered and debilitated, and although they may recover, they may remain in an unthrifty condition for a long period.

All the important species of blowflies except the flesh flies, which are grayish and have three dark stripes on their backs, have a more or less metallic luster. The coloration varies from almost black in the case of the wool-maggot fly to a light green in some of the greenbottle species. One of the carrion-breeding species greatly resembles the primary screwworm fly and for a number of years was thought to be the principal cause of wound infestations by fly maggots.

**ORIGIN OF THE PROBLEM**

During the known history of the screwworm and blowfly, there is no evidence that the flies have spread from their present normal range
to new areas, although they have occasionally temporarily invaded sections of the country where they are not usually found. The appearance of the screwworm in the Southeastern States in 1934 may prove to be an exception. While the information is meager, it seems certain that the early colonists of the South and Southwest encountered cases of screwworm and blowfly infestations in buffalo, coyotes, and other wild animals native to America. Spanish explorers brought horses to the region, and later cattle, hogs, sheep, and goats were introduced.

With the increase of the population in the East, the wild herds of cattle became of high value as a source of food, and a mad scramble for the ownership of these animals began. Since the land was free and the animals roamed at will, the only way ownership could be designated was by permanently marking individual animals. Thus was introduced one of the principal causes of screwworm infestation—the fire brand. Later, barbed-wire fencing was another important factor contributing to the increasing depredations of screwworms through causing injuries to animals.

The increasing demand for more and better meat led in rapid succession to indiscriminate practices of knife castration, earmarking, docking, uncontrolled breeding, and overstocking of ranges, all of which enlarged the opportunity for screwworms to multiply. With the greatly increased number of animals on a given area, diseases and famine began to appear in the herds, and the screwworm and blowfly problem was accentuated.

By the early part of the twentieth century the problem had become so acute that the raising of cattle in certain parts of the Southwest was practically impossible. Ranchmen began to realize that if they were to continue to produce livestock profitably, something must be done to control these flies.

**CONTROL OF SCREWWORMS AND BLOWFLIES**

Many factors determine whether screwworms and blowflies can become economic pests in any area. Farmers and ranchers must learn to use the factors that tend to destroy these enemies and to avoid or nullify those that favor their propagation.

Climate and weather are the dominant factors governing the relative abundance of screwworms and blowflies in an area. Weather conditions during certain seasons of the year favor the propagation of these pests, while the opposite is true at other seasons. The screwworm fly cannot survive the year around in localities where the average temperature is 50° F. or lower for a continuous period of approximately 80 days. In the United States the fly is limited in its normal range to sections with 45 inches or less of rainfall annually. Unlike many of its relatives, the screwworm fly does not have a true hibernating or dormant stage in its life cycle.

The blowflies in general have adapted themselves to broader climatic extremes. Some species are able to withstand the rigors of the Arctic and occur in areas as far separated as Texas and Alaska.
Other survive in the hot, dry desert regions. Certain ones are able to pass through periods of a year or more in a dormant state. Although neither the screwworm fly nor the blowflies apparently have definite migratory tendencies, some of them often drift as far as 1,200 to 1,500 miles each year from winter survival areas to reinfect regions in which they were previously exterminated by weather conditions. The screwworm fly is known to spread in this way at the rate of as much as 35 miles a week.

Topography plays an important role in determining the establishment and building up of fly populations. In no case have the largest populations been found on open, wind-swept plains or in the high mountain regions. Some species find conditions most favorable for propagation on highly developed, intensively cultivated, and thickly settled agricultural lands; while others, particularly the primary screwworm fly and some of the species of blowflies most destructive to livestock, breed in the greatest numbers on sparsely settled grazing land covered with a heavy low growth of brush and timber.

Both the screwworm fly and the blowflies have natural enemies that destroy them in large numbers. For example, there are at least 17 species of small wasplike insects in the United States that lay their eggs on or in the maggots of blowflies. These eggs develop into small worms inside the fly larvae, which are eventually killed by the parasites. Other species of these parasites attack and destroy the pupae of blowflies. Predatory ants and beetles prey on the larvae and pupae of blowflies and screwworms for food. No methods, however, have been found to increase greatly the degree of control effected by these beneficial insects.

The wound-producing operations customary in connection with livestock raising in areas where the primary screwworm fly usually occurs are among the major factors that permit this pest to continue its depredations and survive from year to year; although many stockmen have learned to use the utmost care in preventing screwworm infestations following such operations. In a study of the predisposing causes of screwworm infestations in domestic animals on several hundred thousand acres of ranch land in southwest Texas during the period 1929 to 1933, Laake shows that of 20,962 cases the causes of which were known, branding, castrating, dehorning, docking, marking, and shearing were responsible for about 31 percent.

Losses from screwworms and blowflies may be avoided by preventing the propagation or breeding of the pests—the first and most important step—and by decreasing the susceptibility of animals to infestation. Under most conditions of livestock raising the two methods must go hand in hand.

**The Control of Screwworms**

As previously stated, the primary screwworm fly must have living warm-blooded animals in which to breed. In the regions where it

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occurs it produces 90 percent or more of all the fly-maggot infestations of wounds in wild and domestic animals.

The best time to begin control of the screwworm fly is during the winter. Then climatic conditions have forced it to occupy relatively small areas and even in these areas make it extremely difficult for the fly to live and breed. It must produce at least one generation during a 4-month period, or it is exterminated. The fly is inactive when air temperatures are 55° F. or lower. Continuous average temperatures of 50° or lower for approximately 3 months will eradicate the fly from any area. The flies do not hide in places like caves or animal burrows to seek protection from the cold, and hard frosts kill many of the adults. During the winter season few wounds in wild and domestic animals are available for the fly to attack. Probably not more than 3 flies emerge in the spring for every 100 pupae subjected to winter conditions, and these 3 are able to survive only because they

Figure 1.—Seasonal abundance of the screwworm fly and its relation to recommended ranch management for control in southern Texas. (See zone 1, fig. 2.)
find animals with wounds in which they may produce a midwinter generation within a 4-month period. The pupae in the soil must transform into flies within 60 days or they die; only a few survive that do not produce flies within 40 days. It is evident therefore that any screwworms allowed to mature in wounds during the winter are responsible for all the trouble which develops the following spring and summer. From 3 flies emerging in the spring, 500 may result by the following May and June.

In figure 1 is shown the seasonal abundance of the screwworm fly in one of the principal parts of the overwintering area in Texas, where careful studies are being made by the United States Department of Agriculture on the control of this pest. The sharp increase

![Figure 2: Zones and dates recommended for screwworm prevention in Texas.](image)

**FIGURE 2.**—Zones and dates recommended for screwworm prevention in Texas. In zone 1, perform surgical operations between February 1 and April 30, and between August 1 and September 30, and avoid wounds October 1 to January 31 and May 1 to July 31. In zone 2, perform operations between December 1 and April 30, and avoid all wounds except those incidental to fall shearing May 1 to November 30. In zone 3, perform operations October 1 to April 30, and avoid wounds except in connection with fall shearing May 1 to September 30. In zone 4, October 1 to May 31 is the time for surgical operations, and wounds should be avoided between June 1 and September 30. The normal winter screwworm survival area is dotted.
in the abundance of flies during the warm periods that usually occur in the latter part of December or early in January is almost entirely responsible for producing the midwinter generation. Wounds in animals at that time become infested and this allows the insects to survive until warm weather.

The screwworm fly can be controlled by diligent care to prevent infestations of livestock during the cold months in the areas where it overwinters and by not allowing any screwworms to develop in wounds in the early spring. If ranch operations that necessarily produce wounds are timed to occur in the seasons when the flies are least abundant and least active, the animals are less exposed to attack. In figure 2 recommendations are given for ranch practices in Texas and some adjoining States, which, if followed, will minimize screwworm losses.

**Treatment of Wounded and Infested Animals**

Under present range conditions and with present ranch practices it is inevitable that many animals will be wounded and infested. It is folly, however, to allow any of these animals to go untreated.

First, it is highly desirable that a "hospital" pasture be provided where the injured livestock can be kept and examined easily and frequently until they are healed. Such pastures should be equipped with suitable corrals and chutes for handling animals. Some owners find it advisable to build screened, flyproof structures in which to house wounded or infested animals.

Many medicines and nostrums have been used by ranchmen for protecting wounded animals against screwworm attack and for killing the worms in infested animals. These remedies have included everything from such materials as dried horse manure, common salt, boiling water, and strong caustics, to complex chemical substances. After many years of careful experimentation and testing, the Department of Agriculture has found that benzol is the best material for killing larvae in wounds, and diphenylamine, a powdered chemical, is best for protecting wounds against infestation.

The use of these substances separately, however, has certain disadvantages, particularly the slow killing action of benzol in large bloody wounds, the fact that the maximum protection period of the diphenylamine is only 3 days, and the necessity of having to apply two remedies in treating infested animals.

Recent research by entomologists of the Department of Agriculture has developed a method of combining these excellent materials into a single remedy whereby their inferior qualities have been mostly removed and their insecticidal value increased. This new remedy is known as Formula MS 62 and is made by mixing diphenylamine and benzol with turkey-red oil and lampblack in the following proportions:

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<tr>
<th>Ingredient</th>
<th>Parts by weight</th>
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<tbody>
<tr>
<td>Diphenylamine (technical grade)</td>
<td>3.5</td>
</tr>
<tr>
<td>Benzol (90 percent commercial)</td>
<td>3.5</td>
</tr>
<tr>
<td>Turkey-red oil (sulfonated castor oil, pH 10 or neutral)</td>
<td>1.0</td>
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<tr>
<td>Lampblack (Germantown)</td>
<td>2.0</td>
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The resulting mixture has the consistency of thin paint. It kills screwworms or other fly maggots infesting a wound quickly and gives protection against reinfestation for several days. The remedy is best applied with a small paint brush to infested or uninfested wounds. Two applications each week until the injured tissues have healed are usually sufficient to protect wounds against infestation. In many cases one treatment will give complete protection.

The use of pincer-type emasculators whenever possible, the dehorning of animals when young and during the proper season, the eradication of plants that cause injuries, the breeding of animals so that the young are born during the seasons of least fly activity, and the avoidance of anything else that might produce wounds will aid greatly in screwworm control.

CONTROLLING BLOWFLIES

Since blowflies breed principally in dead animals, the first step in the elimination of these pests is the destruction of carcasses or waste meat products. Carcasses are most easily disposed of by burning, and the proper method of accomplishing this is described in Farmers' Bulletin 857. The method consists essentially in digging a small trench near the carcass, placing a quantity of wood in the trench, and rolling the dead animal over the wood, which is then ignited. Care should be taken to avoid starting a range fire and to see that every part of the carcass is destroyed. As some of the larvae infesting the carcass may have matured and burrowed into the ground, it is usually advisable, except in the case of animals that have died within 48 hours, to scatter the hot coals of the fire over an area within a radius of 3 yards of the place where the carcass lay.

Traps and poisoned baits are useful supplemental control measures for all the carrion-breeding species of blowflies. The trap that has proved the most practical for general use is the Government all-metal cone-type trap described on pages 6, 7, and 8 of Farmers' Bulletin 734. Around food-preparation plants, canneries, and such places, where the odors from meat-baited traps may be objectionable and where the source of flies cannot be controlled, some of the better commercially made electrified screens are efficient in reducing trouble from blowflies.

Poisoned baits, consisting of meat or the carcasses of small animals placed in shallow water containing one-half ounce of nicotine sulfate to the gallon in suitable containers exposed to the flies, will kill large numbers of them. The dead flies accumulate on the surface of the bait, and it is necessary to remove them occasionally to obtain the best results. Care should be taken to prevent chickens, hogs, and other animals from having access to the bait.

When the hair of goats, sheep, or other animals becomes infested with blowfly maggots, it should be sheared well around the affected

area, and the worms should be killed by applying a small but sufficient amount of the same remedy recommended for the treatment of screwworm cases. The crutch of a sheep is a favorable site for infestations of blowfly larvae, especially in the spring, when scouring soils the wool on this part of the body. Shearing the wool from this part, the practice called tagging or crutching, will largely prevent infestations of this kind.

Wounds infested with the maggots of blowflies should be treated, and the animals should receive the same attention as in the case of screwworm infestations.

At the time this book went to press, the drugs and other materials mentioned in various articles—chiefly as disinfectants, insecticides, and anthelmintics—were still available for veterinary and medical use. Under war conditions, however, it is possible that some of these materials may become scarce or unavailable. In that case, the reader should obtain professional advice from the Department of Agriculture, the State experiment station, a local veterinarian, or the county agent as to available substitutes.